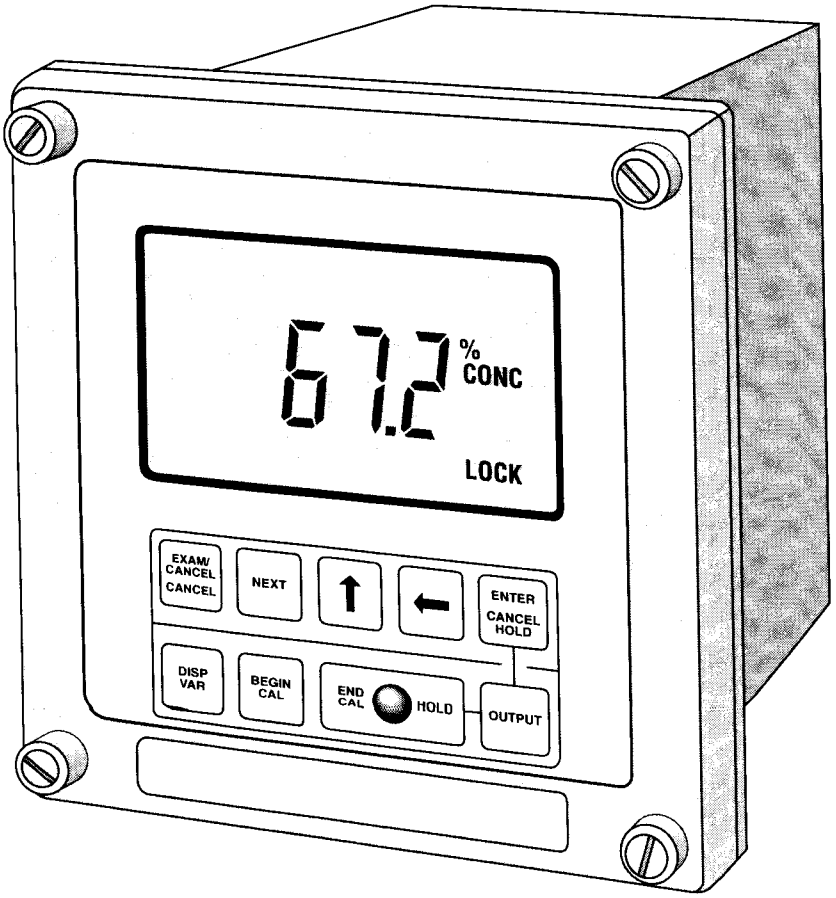
.1 YEAR
WARRANTY

MADE IN
USA

User's Guide



CDCN-672
Conductivity Analyzer

omega.com®
OMEGA®

OMEGAnet® Online Service www.omega.com	Internet e-mail info@omega.com

Servicing North America:

USA:
ISO 9001 Certified
One Omega Drive, P.O. Box 4047
Stamford CT 06907-0047
TEL: (203) 359-1660 FAX: (203) 359-7700
e-mail: info@omega.com

Canada:
976 Bergar
Laval (Quebec) H7L 5A1, Canada
TEL: (514) 856-6928 FAX: (514) 856-6886
e-mail: info@omega.ca

For immediate technical or application assistance:

USA and Canada: Sales Service: 1-800-826-6342 / 1-800-TC-OMEGA®
Customer Service: 1-800-622-2378 / 1-800-622-BEST®
Engineering Service: 1-800-872-9436 / 1-800-USA-WHEN®
TELEX: 996404 EASYLINK: 62968934 CABLE: OMEGA

Mexico: En Español: (001) 203-359-7803 e-mail: espanol@omega.com
FAX: (001) 203-359-7807 info@omega.com.mx

Servicing Europe:

Benelux:
Postbus 8034, 1180 LA Amstelveen, The Netherlands
TEL: +31 (0)20 3472121 FAX: +31 (0)20 6434643
Toll Free in Benelux: 0800 0993344
e-mail: sales@omegaeng.nl

Czech Republic:
Frystatska 184/46, 733 01 Karviná, Czech Republic
TEL: +420 (0)59 6311899 FAX: +420 (0)59 6311114
Toll Free: 0800-1-66342 e-mail: info@omegashop.cz

France:
11, rue Jacques Cartier, 78280 Guyancourt, France
TEL: +33 (0)1 61 37 29 00 FAX: +33 (0)1 30 57 54 27
Toll Free in France: 0800 466 342
e-mail: sales@omega.fr

Germany/Austria:
Daimlerstrasse 26, D-75392 Deckenpfronn, Germany
TEL: +49 (0)7056 9398-0 FAX: +49 (0)7056 9398-29
Toll Free in Germany: 0800 639 7678
e-mail: info@omega.de

United Kingdom:
ISO 9002 Certified
One Omega Drive, River Bend Technology Centre
Northbank, Irlam, Manchester
M44 5BD United Kingdom
TEL: +44 (0)161 777 6611 FAX: +44 (0)161 777 6622
Toll Free in United Kingdom: 0800-488-488
e-mail: sales@omega.co.uk

INSTRUMENT SETUP GUIDE

This manual contains detailed instructions for all operating aspects of this instrument. Read Part One for a general description of the Model CDCN-672. Part Two explains how to install and wire the instrument. To familiarize yourself with the basic operation of the CDCN-672, read Part Three, Sections 1, 2 and 3. The following guide shows which other sections of Part Three to use for setup as a conductivity or % concentration analyzer.

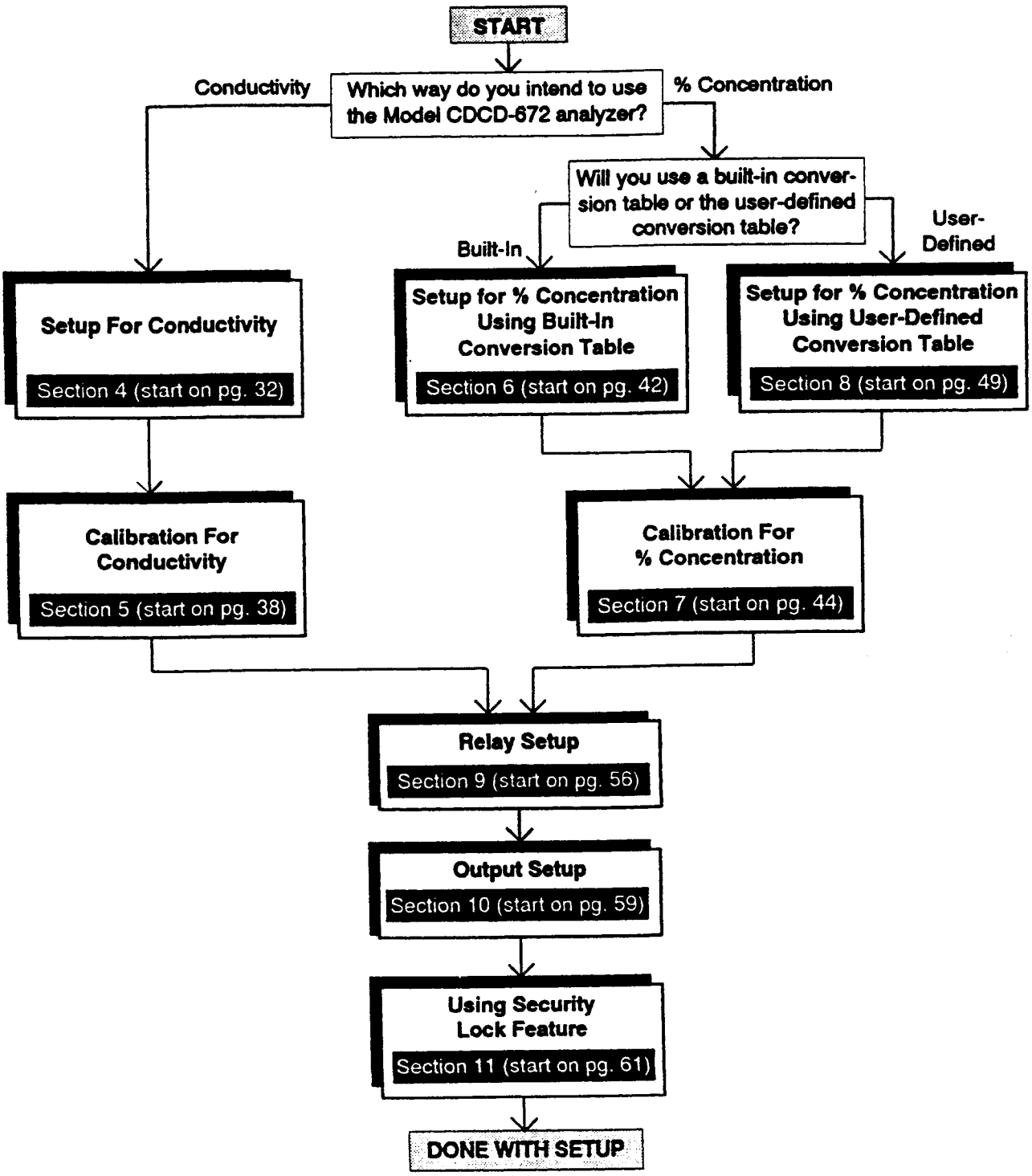


TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

NOTES:

PART ONE - INTRODUCTION

SECTION 1 - GENERAL INFORMATION

1.1 Instrument Capability

Two Analyzers In One

The CDCN-672 (110V, 60Hz) or CDCN-672 (230V, 50Hz) conductivity analyzer must be used with CDE-3600-series electrodeless conductivity sensor. The instrument can be set up to measure the conductivity or the % concentration of a solution. When measuring concentration, built-in conversion tables are provided for some of the more common solutions to conveniently convert measured conductivity values to % concentration. For other solutions, the operator can create a user-defined table to convert conductivity to % concentration. Up to 10 data points can be entered via the keypad to define the solution curve using conductivity and % concentration values.

Temperature Compensation

The electrodeless conductivity sensor used with the CDCN-672 analyzer has an integral 1000 ohm platinum RTD to sense the temperature of the solution being measured. This temperature data can be used in conjunction with one of the selectable temperature compensation methods available to provide accurate temperature-compensated conductivity or % concentration readings.

Display Readouts

The large liquid crystal display can alternately indicate four measured variables: conductivity, % concentration (only when a conversion table is used to convert measured conductivity), temperature (in °C or °F), or the 4-20 mA instrument output.

Operator Interface

Abbreviated identifiers are shown along with their related numerical values to provide understandable readouts for instrument setup, calibration and process monitoring. Procedure messages prompt the operator during instrument setup and calibration. System diagnostic error messages flash whenever the instrument detects an abnormal system operating condition.

Output Flexibility

Isolated instrument outputs which track the measured conductivity or % concentration include 0-5 VDC, 0-1 mA and 4-20 mA. An ouput hold feature can be used to maintain the latest output during calibration or instrument setup to suspend operation of the receiving device. A range expand feature allows the outputs to represent any segment of the measuring scale. Also, the outputs may be inverted so that they decrease instead of increase as the measured conductivity or % concentration increases.

The instrument has two SPDT relays to handle on/off control requirements. Relays A and B can be independently set up to operate in a control or alarm mode. In the control mode, the relay can be selected to operate in response to increasing or decreasing measured conductivity or % concentration and has a setpoint and deadband. When a relay is set up for the alarm mode, the relay operates as a "dual-alarm" relay with independent low and high alarm points. In this mode, the relay will transfer whenever the measured value decreases below the low alarm point or increases above the high alarm point. In either mode, both relays can be selected for "fail-safe" operation which reverses normal operation so that the relays will deenergize when a power interruption occurs. Lastly, Relay B can be alternately selected to operate as a "system diagnostic alarm" relay instead of its normal operation. This enables Relay B to transfer whenever a system diagnostic error or power failure is detected by the CDCN-672 to alert the operator.

Operator Safety

Modular construction simplifies field servicing and provides electrical safety for the operator. The LCD board assembly (Figure 3-1) contains voltages no greater than 24 VDC and is safe to handle. The display board is removable to access the terminal strips on the power-supply board. The relays are located on the backside of the power-supply board.

WARNING: REMOVE LINE POWER BEFORE HANDLING POWER-SUPPLY BOARD TO AVOID ELECTRICAL SHOCK.

1.2 Battery Back-up

A battery is provided to keep the volatile memory powered when there is a line power interruption. This ensures that all outputs and the CDCN-672's operating state are immediately restored. The rechargeable nickel-cadmium battery can provide power for up to 5 months (at 25°C). This 10-year battery is continually trickle-charged whenever line power is applied. A completely discharged battery recharges fully after 48 hours of instrument operation. A **BATTERY ON/OFF** jumper is located next to the battery's "+" lead (Figure 3-1) to disconnect the battery when the instrument is not used for an extended time.

NOTE: *All user-entered values are stored indefinitely in another memory which is non-volatile. These values will not be lost even if this battery is depleted or the jumper is either removed or in the **OFF** position.*

1.3 Product Identification

The serial # of your instrument is located on the backside of the display board (Figure 3-1).

SECTION 2 - SPECIFICATIONS

2.1 Operational

Display .....4-1/2 digit LCD with measurement unit and setup variable identifiers, 7/8" high digits

Measuring Ranges:

Conductivity.....0.0-200.0 µS/cm, 0-2000 µS/cm, 0.000-2.000 mS/cm, 0.00-20.00 mS/cm, 0.0-200.0 mS/cm, 0-2000 mS/cm or 0.00-8.00 S/cm, selectable with user-entered full scale value

Concentration 0.0-100.0%

Temperature.....(–)10.0 to (+)200.0°C (14 to 392°F)

Ambient Conditions....–20 to 60°C (–4 to 140°F), 0 to 95% relative humidity, non-condensing

Relay Function:

Operating Modes....Control: Setpoint with adjustable deadband. Selectable operation in response to increasing or decreasing measured conductivity or % concentration.

Alarm: Dual-alarm relay operation with low and high alarm points and fixed deadbands (1.0 % of full scale).

Fail-Safe: Reverses normal operation of Relays A and B (in control, alarm or system alarm mode) so that relays will deenergize if a power interruption occurs.

System Alarm: Relay B transfers whenever instrument detects a system diagnostic error. This mode overrides normal control or alarm operating mode.

Indicators.....Relay A and B annunciators flash to indicate respective relay status

Outputs.....Two SPDT contact outputs, U.L. rating: 5A 115/250 VAC, 5A @ 30 VDC resistive

Temperature Compensation.....None, user-entered linear % per °C slope, user-entered temperature curve, or automatic over –10 to +200°C when built-in solution concentration conversion table is used. Temperature sensor is 1000 ohm platinum RTD.

Sensor-to-Analyzer Distance .....Maximum cable length is a function of measuring range and allowable non-linearity. The following schedule is recommended:

Full Scale Range	Max. Length
200 to 2000 microSiemens/cm	200 feet
2000 to 2,000,000 microSiemens/cm	300 feet

Power Requirements.....100-137 VAC, 50/60 Hz (less than 6 VA), optional 200-275 VAC, 50/60 Hz

Remote Output Hold .....LSTTL-compatible (active low) or switch closure input

2.2 Analyzer Performance (Electrical, Analog Outputs)

Analog Outputs* .....Isolated 0-1 mA, 100 ohms maximum load
Isolated 0-5 VDC, 50K minimum load
Isolated 4-20 mA, 600 ohms maximum load

Range Expand – The analog outputs can be made to represent any segment of the measuring scale.

*Each output is isolated from the input, ground and line power, but not from each other.

Sensitivity .....0.3% of span

Stability.....0.1% of span per 24 hrs., non-cumulative

Non-linearity .....0.5% of span

Repeatability .....0.2% of span or better

Temperature Drift .....Zero: 0.025% of span per °C
Span: 0.025% of span per °C

Response Time .....0.1, 1, 10 or 30 seconds to 90% of value upon step change, selectable

2.3 Mechanical

Enclosure .....NEMA-4X, 1/2 DIN, polycarbonate with two 1/2-inch conduit holes and two stainless steel mounting brackets

Mounting Configurations .....Surface, panel and horizontal pipe mount. Vertical pipe mounting optional.

Net Weight .....3.5 lbs. (1.58 kg) approx.

Dimensions .....See Part Three, Section 2

PART TWO - INSTALLATION

SECTION 1 - UNPACKING

Remove the Packing List and verify that you have received all equipment. If you have any questions about the shipment, please call the OMEGA Customer Service Department at 1-800-622-2378 or (203) 359-1660.

When you receive the shipment, inspect the container and equipment for any signs of damage. Note any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE: The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material in event reshipment is necessary.

SECTION 2 - MECHANICAL REQUIREMENTS

2.1 Location

1. Locate the CDCN-672 within 200 ft. of where the conductivity sensor is to be installed (up to 300 ft. is permissible for full scale ranges between 2000 and 2,000,000 microSiemens/cm).
2. Mount the CDCN-672 in a location that is:
   - Clean and dry where little or no vibration exists.
   - Protected from falling corrosive fluids.
   - Within ambient temperature limits (–4 to +140°F, –20 to +60°C).

CAUTION: MOUNTING IN DIRECT SUNLIGHT MAY INCREASE TEMPERATURE ABOVE MAX. LIMIT.

2.2 Mounting

Refer to Figure 2-1 for enclosure and mounting dimension details. Figure 2-2 illustrates various mounting configurations. Use the two stainless steel brackets provided to panel, surface or pipe-mount the instrument. The bracket attachment configuration determines the mounting method.

To panel mount the CDCN-672:

1. Place Tinnerman fasteners on each mounting bracket as shown in Figure 2-2.

2. Place instrument into square panel cutout (5.43 x 5.43", 138 x 138 mm) and fasten brackets to instrument case with No. 8-32 x 3/8" long screws.

   NOTE: *Use appropriate mounting bracket holes (depicted in Figure 2-2 with screw heads) to properly position brackets.*

3. Fasten No. 10-32 x 3/4" long screws into Tinnerman fasteners until ends of screws are snugged against panel.

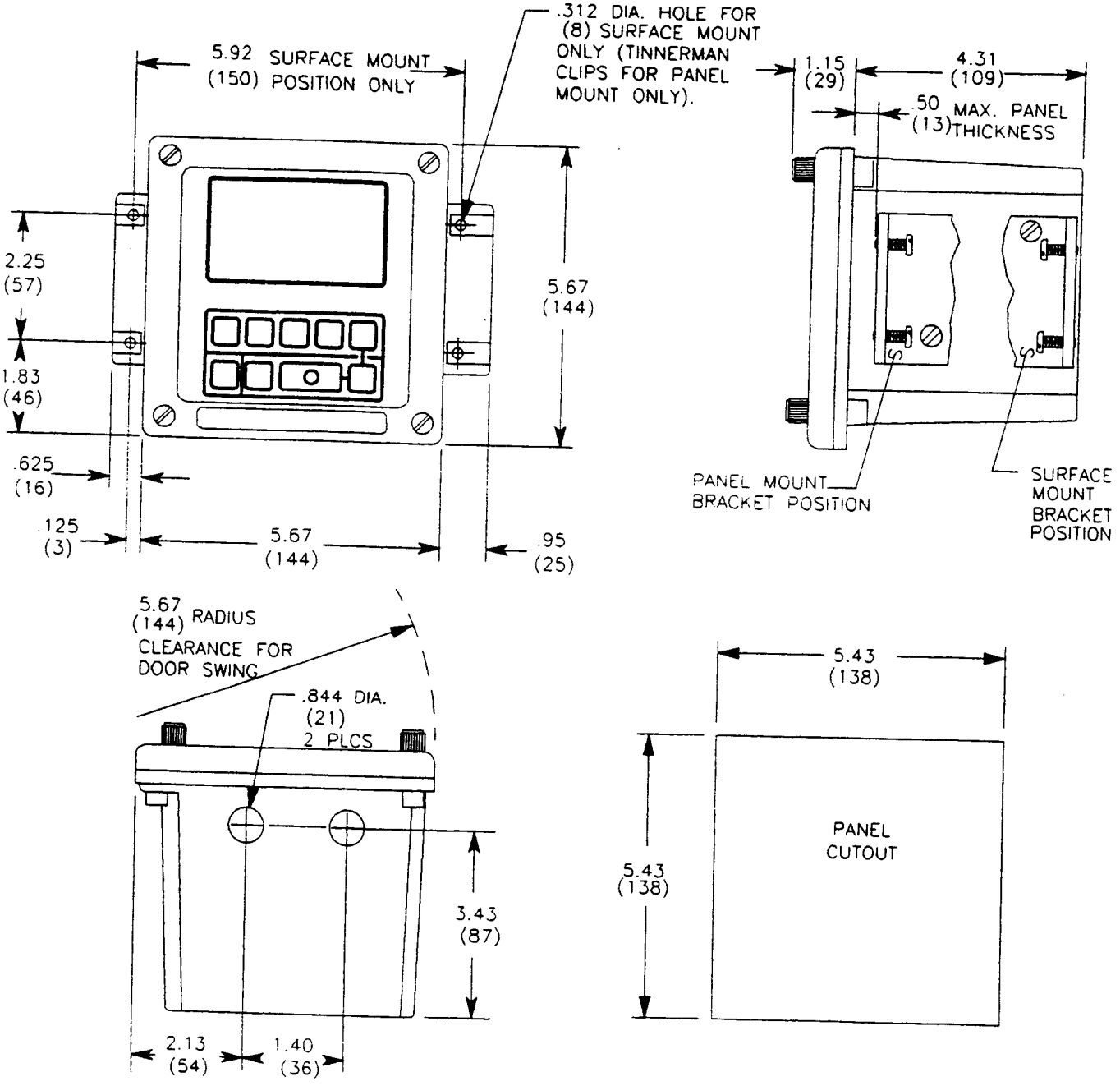


FIGURE 2-1 Enclosure Outline

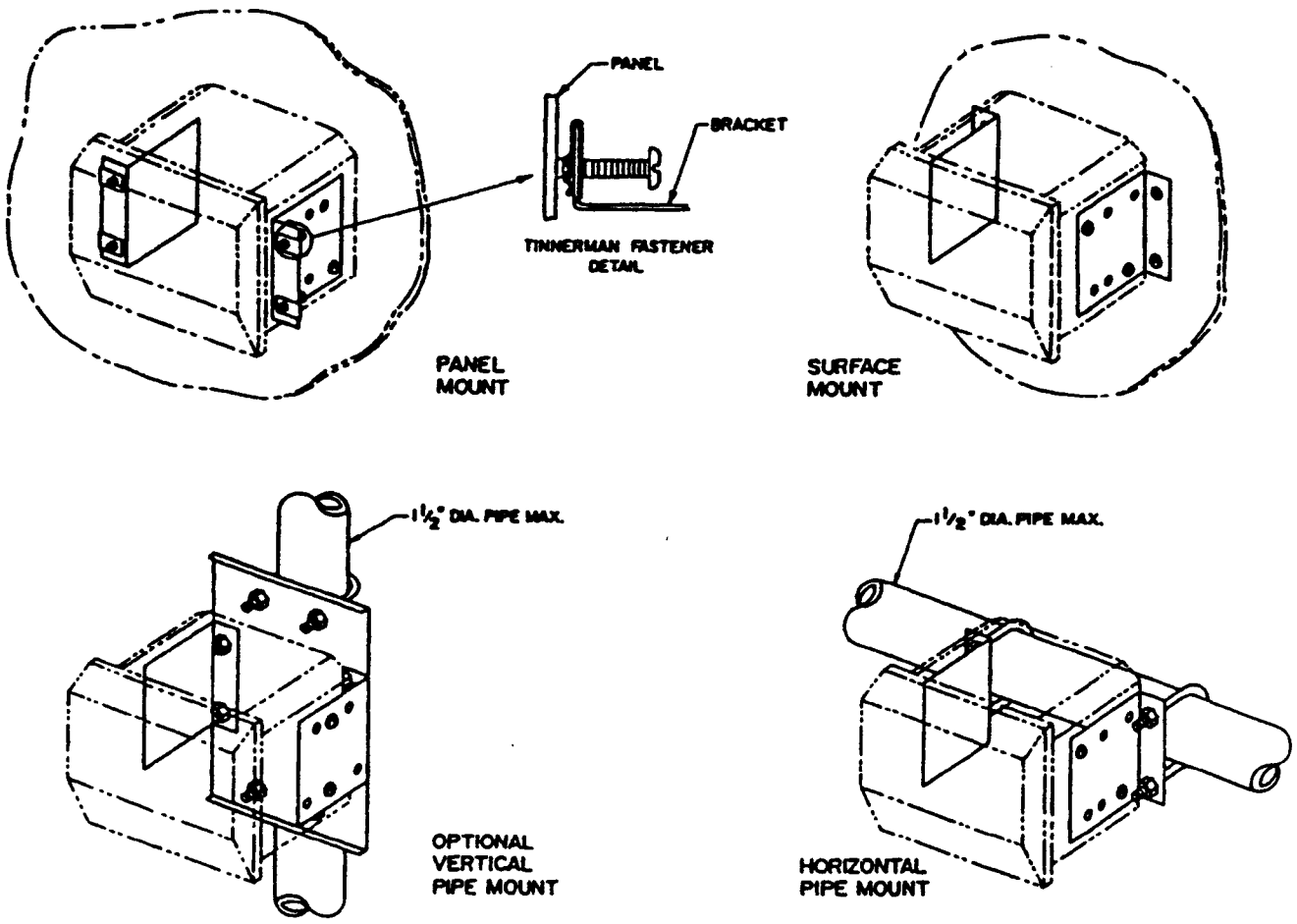


FIGURE 2-2 Mounting Configurations

2.3 Plugging Conduit Holes

Use conduit hubs or cable feed-thru fittings where cables enter the enclosure. Holes not used for cable entry should be sealed with plugs.

NOTE: *Use NEMA-4 rated fittings and plugs to maintain the watertight integrity of the NEMA-4 enclosure. The left conduit hole (viewed from front) is for power and relay wires; the right conduit hole is for sensor cable and instrument output wires.*

SECTION 3 - ELECTRICAL CONNECTIONS

To access terminal strips for electrical connections, loosen four thumbscrews and open enclosure door. Carefully remove LCD board assembly (Figure 3-1 on page 20) by loosening the two captive fasteners. Figure 2-3 on the next page shows terminal designations for instrument hook-up.

3.1 Sensor

It is recommended that sensor signal wires be run in 1/2" metal conduit for protection against moisture and mechanical damage. Do not run signal wires in same conduit with power or control wiring ("electrical noise" may interfere with sensor signal).

Connect sensor (or interconnect) cable wires to SENSOR Terminals 1 through 6 on TB2, matching colors as indicated.

3.2 Analog Outputs

The analog outputs track the measured conductivity or % concentration. The outputs can represent the entire measuring scale or any desired segment of it. To use the range expand feature, refer to Part Three, Section 10.2 for instructions.

Isolated 0-5 VDC

This output can drive a load of greater than 50,000 ohms. Connect load (+) to Terminal 8 and load (–) to LO Terminal 9 on TB2.

Isolated 0-1 mA

This output can drive a load of up to 100 ohms. Connect load (+) to Terminal 10 and load (–) to LO Terminal 11 on TB2.

Isolated 4-20 mA

This output can drive a load of up to 600 ohms. Connect load (+) to Terminal 12 and load (–) to Terminal 13 on TB2.

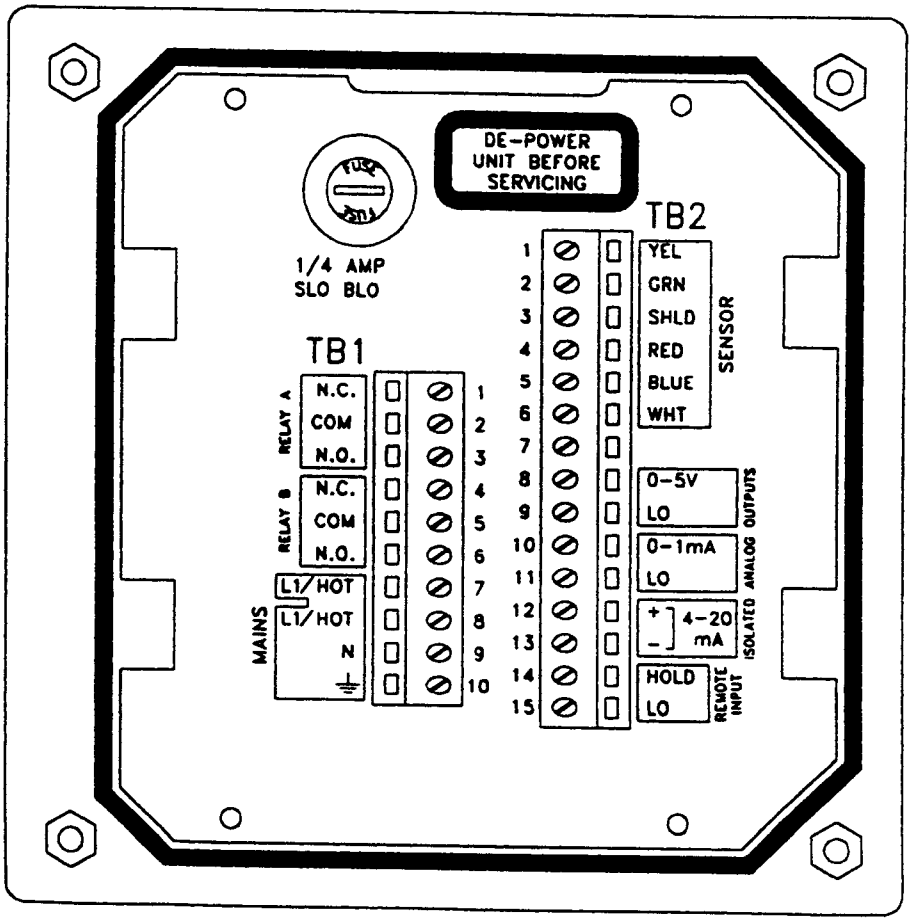


FIGURE 2-3 Electrical Hook-up Details

3.3 Remote Output Hold

The instrument will accept an LSTTL-compatible (active low) or switch closure input to hold the latest output during calibration or instrument setup to suspend operation of the receiving device. Refer to Part Three, Section 10.3 for complete details.

Connect switch closure wires to HOLD Terminal 14 and LO Terminal 15 on TB2. When an LSTTL input is used, connect signal "low" to LO Terminal 15.

3.4 Relay Outputs

Two sets of SPDT relay outputs are provided at Terminals 1 through 6 on TB1. **They are not powered.** However, the instrument's line power may be used to power control or alarm devices via these relay contacts. Refer to Figure 2-4 for wiring details. An extra, unfused L1/HOT power source (Terminal 7 on TB1) is provided to connect line power to the relay outputs. Always check control wiring to insure that line power will not be shorted by the switching action of the relay contacts. Refer to Part Three, Section 9 for relay setup instructions.

NOTE: Because of space limitations within the instrument enclosure, it is recommended that bulky wiring connections (resulting from combinations of multiple connections per terminal and large gauge wires) be terminated outside the instrument enclosure, preferably in an external junction box.

CAUTION: Do not exceed each relay's contact rating of 5A 115/250 VAC. If larger currents are to be switched, use of an auxiliary relay will extend relay life. When relay outputs are used, the instrument's line power wiring must be adequate to conduct the anticipated load(s).

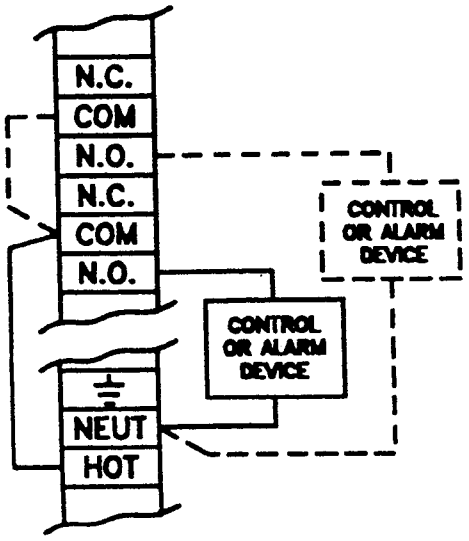


FIGURE 2-4 Connecting Control Or Alarm Device(s) To Relay Outputs

3.5 Line Power

Connect line power to MAINS (Power) Terminals 8, 9 and 10 on TB1. The L1 HOT Terminal 8 is fused (1/4 amp. slow-blow) to protect instrument circuits. (NEUT Terminal 9 is also fused on instruments equipped with the 230 VAC dual-fused option). Use wiring practices which conform to local codes. Use only the standard three-wire connection. The ground symbol Terminal 10 grounds the instrument which is mandatory for safe operation. Refer to Figure 2-3.

CAUTION: Any other wiring method may be unsafe or cause improper operation of the instrument.

It is recommended not to run line power or relay outputs powered off the line in the same conduit with sensor signal wires ("electrical noise" may interfere with sensor signal).

PART THREE - OPERATION

SECTION 1 - OPERATING CONTROLS

Two eight-position DIP switches, used for selecting relay operating modes, solution concentration tables, temperature compensation method, etc., are located at the right edge of the LCD board assembly (Figure 3-1). These switches are accessed by opening the enclosure door which can be easily removed by unsnapping it from its hinge.

The keypad, all switches and status indicators used for instrument operation are described in this section. Familiarize yourself with each item before operating the instrument.

1.1 Keypad Switches

1. **EXAM/CANCEL** key (Figure 3-1)

   Selects the normal "measurement" display mode or an "examination" display mode. Successive key presses alternate the display between these two modes.

   - In measurement mode:

     Display shows measured variable selected with **DISP VAR** key: conductivity, % concentration – if one of the solution concentration conversion tables is used, temperature, or the 4-20 mA instrument output.

   - In "examination" mode:

     Display shows setup variables and their stored values. Setup data such as calibration values, relay setpoints, etc. are called up in the sequence shown in Figure 3-2 by pressing the **NEXT** key (item 2). Values can be changed by using the ⬆ and ⬅ keys (items 3 and 4) and are entered by pressing the **ENTER/CANCEL HOLD** key (item 5). Any entry routine may be cancelled by pressing the **EXAM/CANCEL** key which also returns display to normal measurement mode.

2. **NEXT** key (Figure 3-1)

   - With display in measurement mode:

     This key has no effect.

   - With display in "examination" mode:

     Scrolls display to show next menu of setup variables with each press. After pressing **ENTER/CANCEL**

HOLD key (item 5) to enter a specific menu, each press of the NEXT key displays the setup variables in sequence for that menu. The setup variables "wrap around" from last to first within the menu. Refer to Table A in Section 3.3 for a complete listing of all setup variables.

3. ⬆ key (Figure 3-1)

   - With display in measurement mode:

     This key has no effect.

   - With display in "examination" mode:

     Increases flashing digit value by one with each key press or continually advances digit value from 0 thru 9 by holding key down. This key is used with ⬅ key (item 4) to change displayed value to a new value.

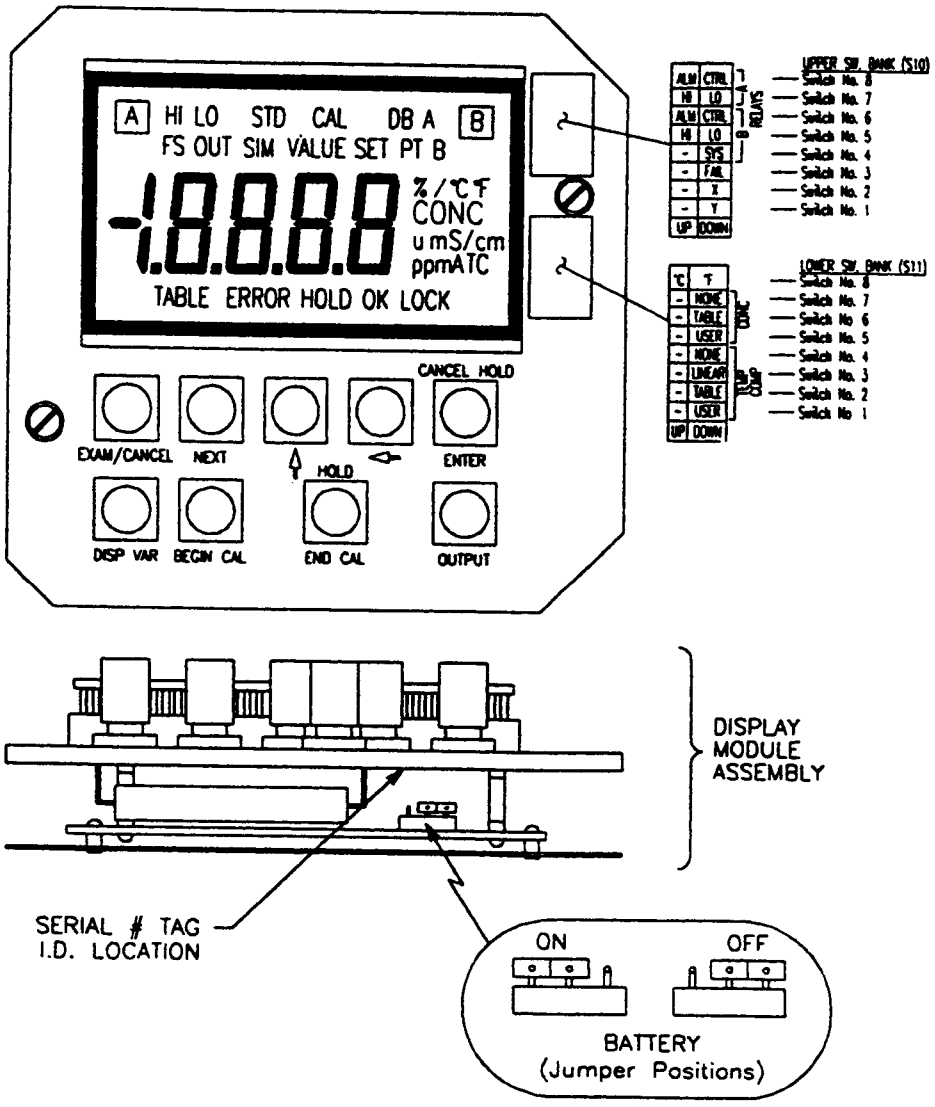


FIGURE 3-1 CDCN-672 LCD Board Assembly – Operating And Setup Controls

4. ⬅ key (Figure 3-1)

   ■ With display in measurement mode:

   This key has no effect.

   ■ With display in "examination" mode.

   Progressively selects the next digit to the left to flash with each press-and-release so that its value can be changed with the ⬆ key (item 3). The flashing digit "wraps around" from far left to far right.

5. **ENTER/CANCEL HOLD** key (Figure 3-1)

   ■ With display in measurement mode:

   Cancels output hold feature when pressed together with **OUTPUT** key (item 9).

   ■ With display in "examination" mode:

   A. Enters displayed value into memory (if within acceptable range) for the indicated setup variable. Display flashes "OK" for approximately 5 seconds to confirm entry.

   B. Cancels output hold feature when pressed together with **OUTPUT** key (item 9).

6. **DISP VAR** key (Figure 3-1)

   ■ With display in measurement mode:

   Scrolls display with each key press to show the following measured variables:

   A. Conductivity in µS/cm, mS/cm or S/cm.

   B. % Concentration – only when one of the solution concentration conversion tables is used to convert the measured conductivity.

   C. Temperature in °C or °F.

   D. The 4-20 mA instrument analog output.

   NOTE: *As a display check, all indicators light up (as shown in Figure 3-1) when 4-20 mA output variable is displayed and ⬅ key is pressed.*

   ■ With display in "examination" mode:

   This key has no effect.

7. **BEGIN CAL** key (Figure 3-1)

   - With display in measurement mode:

     A. Displays stored value for LO or HI CAL VALUE setup variable used in "two-key" calibration method. Each key press alternately displays both stored values. **EXAM/CANCEL** key must be pressed to return display to normal indication.

     B. Initiates calibration of a point used in "two-key" calibration method. Specific conductivity (or % concentration) reference solution values should be stored in memory before using this key to initiate calibration. See Part Three, Section 5.4 (or Section 7.4 for % concentration) for details.

   - With display in "examination" mode:

     This key has no effect.

8. **END CAL/HOLD** recessed button (Figure 3-1)

   - With display in measurement mode:

     Activates output hold feature when pressed together with **OUTPUT** key (item 9).

   - With display in "examination" mode:

     A. Completes calibration of a point used in "two-key" calibration method.

     B. Activates output hold feature when pressed together with **OUTPUT** key (item 9).

9. **OUTPUT** key (Figure 3-1)

   With display in measurement or "examination" mode:

   A. Activates output hold feature when pressed together with recessed **END CAL/HOLD** button.

   B. Cancels output hold feature when pressed together with **ENTER/CANCEL HOLD** key.

1.2 DIP Switches

Upper Switch Bank (S10)

10. **RELAY A ALM/CTRL** switch (No. 8, Figure 3-1)

    ALM POSITION (up) – Selects alarm mode of operation for Relay A (dual-alarm points).

    CTRL POSITION (down) – Selects control mode of operation for Relay A (setpoint and deadband).

11. **RELAY A HI/LO** switch (No. 7, Figure 3-1)

    HI POSITION (up) – Selects Relay A to operate in response to increasing measured conductivity or % concentration.

    LO POSITION (down) – Selects Relay A to operate in response to decreasing measured conductivity or % concentration.

12. **RELAY B ALM/CTRL** switch (No. 6, Figure 3-1)

    ALM POSITION (up) – Selects alarm mode of operation for Relay B (dual-alarm points).

    CTRL POSITION (down) – Selects control mode of operation for Relay B (setpoint and deadband).

13. **RELAY B HI/LO** switch (No. 5, Figure 3-1)

    HI POSITION (up) – Selects Relay B to operate in response to increasing measured conductivity or % concentration.

    LO POSITION (down) – Selects Relay B to operate in response to decreasing measured conductivity or % concentration.

14. **RELAY B SYS** mode switch (No. 4, Figure 3-1)

    In the **DOWN** position, this switch selects Relay B to operate as a "system alarm" relay which overrides the control or alarm mode selected with **RELAY B** mode switch (item 12). This **SYS** mode switch has no effect in the **UP** position.

15. **FAIL SAFE** switch (No. 3, Figure 3-1)

    In the **DOWN** position, this switch selects fail-safe operation for Relays A and B which reverses normal operation so that the relays will deenergize when a power interruption occurs. This switch has no effect in the **UP** position.

16. **X** and **Y** switches (No. 2 and No. 1 respectively, Figure 3-1)

    These two response time switches configure the CDCN-672 for:

    A. The time it takes for the display and analog outputs to respond to a change in the measured conductivity input.

    B. The rate of change that is acceptable for the conductivity input during calibration when using the "two-key" method.

    C. The rate of change that is acceptable for the temperature input during calibration when using the "two-key" method.

To select one of the four response times, place **X** and **Y** switches in the positions shown in the following matrix:

Display/Output ResponseTime	Rate Of Change		Switch Pos.	
	For Cond. Input	For Temp. Input	X	Y
0.1 sec.	10% F.S./6 sec.	1°C/30 sec.	UP	UP
1 sec.	0.1% F.S./2 sec.	1°C/ 2 min.	UP	DOWN
10 sec.	0.1% F.S./3 sec.	1°C/ 3 min.	DOWN	UP
30 sec.	0.1% F.S./5 sec.	1°C/5 min.	DOWN	DOWN

Lower Switch Bank (S11)

17. **°C/°F** switch (No. 8, Figure 3-1)

    In the **UP** position, this switch selects measured temperature to be displayed in °C. In the **DOWN** position, the measured temperature is displayed in °F.

18. **CONC NONE** switch (No. 7, Figure 3-1)

    In the **DOWN** position, this switch selects the CDCN-672 to be used as a conductivity instrument — not a % concentration monitor. This switch has no effect in the **UP** position.

19. **CONC TABLE** switch (No. 6, Figure 3-1)

    In the **DOWN** position, this switch enables one of the built-in solution concentration conversion tables to be selected to convert measured conductivity to % concentration. This switch has no effect in the **UP** position.

20. **CONC USER** switch (No. 5, Figure 3-1)

    In the **DOWN** position, this switch selects the user-defined solution concentration conversion table to be used to convert measured conductivity to % concentration. This switch has no effect in the **UP** position.

21. **TEMP COMP NONE** switch (No. 4, Figure 3-1)

    In the **DOWN** position, this switch selects that there will <u>not</u> be any temperature compensation applied to the measured conductivity. Raw, uncompensated conductivity or % concentration values will then be displayed. This switch has no effect in the **UP** position.

22. **TEMP COMP LINEAR** switch (No. 3, Figure 3-1)

    In the **DOWN** position, this switch selects the user-entered linear compensation slope value (in % per °C) to be applied to the measured conductivity. This switch has no effect in the **UP** position.

23. **TEMP COMP TABLE** switch (No. 2, Figure 3-1)

In the **DOWN** position, this switch selects the temperature compensation curve in the selected built-in solution concentration conversion table to be applied to the measured conductivity. This switch has no effect in the **UP** position.

NOTE: *If no conversion table or the user-defined conversion table is selected with the* ***CONC NONE*** *or* ***CONC USER*** *switch respectively, the* ***TEMP COMP TABLE*** *switch must be in the* ***UP*** *position.*

24. **TEMP COMP USER** switch (No. 1, Figure 3-1)

In the **DOWN** position, this switch selects the user-defined temperature table curve (up to 10 user-entered data points) to be applied to the measured conductivity. This switch has no effect in the **UP** position.

1.3 BATTERY Jumper

25. **BATTERY** jumper (Figure 3-2)

ON – Connects battery to keep the volatile memory powered when there is a line power interruption. This ensures that all outputs and the CDCN-672's operating state are immediately restored to their original status when line power is returned.

OFF – Disconnects battery when instrument is not to be used for an extended time.

NOTE: *All user-entered values are stored indefinitely in another memory which is non-volatile. These values will not be lost even if this battery is depleted or the jumper is removed or in the* ***OFF*** *position.*

1.4 Status Indicators

26. **A** and **B** relay indicators (LCD display)

Respective indicators flash on and off to indicate that the instrument control state has initiated relay action (for normal or fail-safe relay operation).

27. **HOLD** indicator (LCD display)

Indicates that the output hold feature is in use (instrument output values are maintained and relays configured for control mode are suspended in "off" state).

NOTE: *After 30 minutes,* ***HOLD*** *indicator flashes to indicate that output hold feature will be automatically cancelled in 30 seconds. Pressing any key extends hold feature for another 30 minutes.*

28. **OK** indicator (LCD display)

    Flashes for approximately 5 seconds to confirm successful entry of a setup variable value.

29. **LOCK** indicator (LCD display)

    Indicates that instrument keypad entry is "locked" to prevent unauthorized tampering of stored setup variable values. Refer to Section 11 for security lock feature instructions.

    NOTE: Calibration values can be entered and all stored setup variable values can be displayed when instrument is "locked".

30. **ERROR** indicator (LCD display)

    Flashes to indicate an incorrect entry or alternately flashes with "Er 1", "Er 2 ", etc. to up to "Er 12" to indicate a system diagnostic error causing improper system operation.

SECTION 2 - MEASURED VARIABLES

The CDCN-672 can display four measured variables. With the display in the measurement mode, each press of the **DISP VAR** key sequentially displays:

- Conductivity in µS/cm, mS/cm or S/cm.
- % Concentration – only when one of the solution concentration conversion tables is used to convert the measured conductivity.
- Temperature in °C or °F.
- The 4-20 mA instrument analog output.

SECTION 3 - SETUP VARIABLES

3.1 Calling Up Setup Variables

1. Pressing the **EXAM/CANCEL** key while the display is in the measurement mode changes the readout to an "examination" mode to show the first of five menu identifiers. Each menu contains different setup variables to configure the instrument.
2. Each press of the **NEXT** key scrolls the display to show the identifier for the next menu of setup variables.
3. With the display indicating the identifier for the desired menu, press the **ENTER** key to access the first setup variable within that menu.
4. Each press of the **NEXT** key displays the next setup variable, in sequence, for that menu. The setup variables "wrap around" from last to first within each menu.

The **EXAM/CANCEL** key may be pressed anytime to return the display to the measuring mode.

3.2 Entering Values

The ⬆ and ⬅ keys are used to change displayed setup values. Each press of the ⬆ key increases the flashing digit value by one. When held down, the ⬆ key continually advances the value. Pressing and releasing the ⬅ key selects the next digit to the left to flash, indicating that it can now be changed with the ⬆ key. After establishing the desired value, press the **ENTER** key to store it in memory. Thereafter, "OK" flashes for approximately 5 seconds to confirm that the entry was accepted or "ERROR" flashes if the entry was invalid.

3.3 Setup Variables Call-up Chart And Table Of Descriptions

Figure 3-2 on the following page shows the four measured variable display modes (shaded boxes at top left of chart), the five menus of setup variables (across top of chart), and the call-up order of the setup variables within each menu. Depending on selected DIP switch settings, specific setup variables are not displayed and do not apply (see footnotes at bottom of chart).

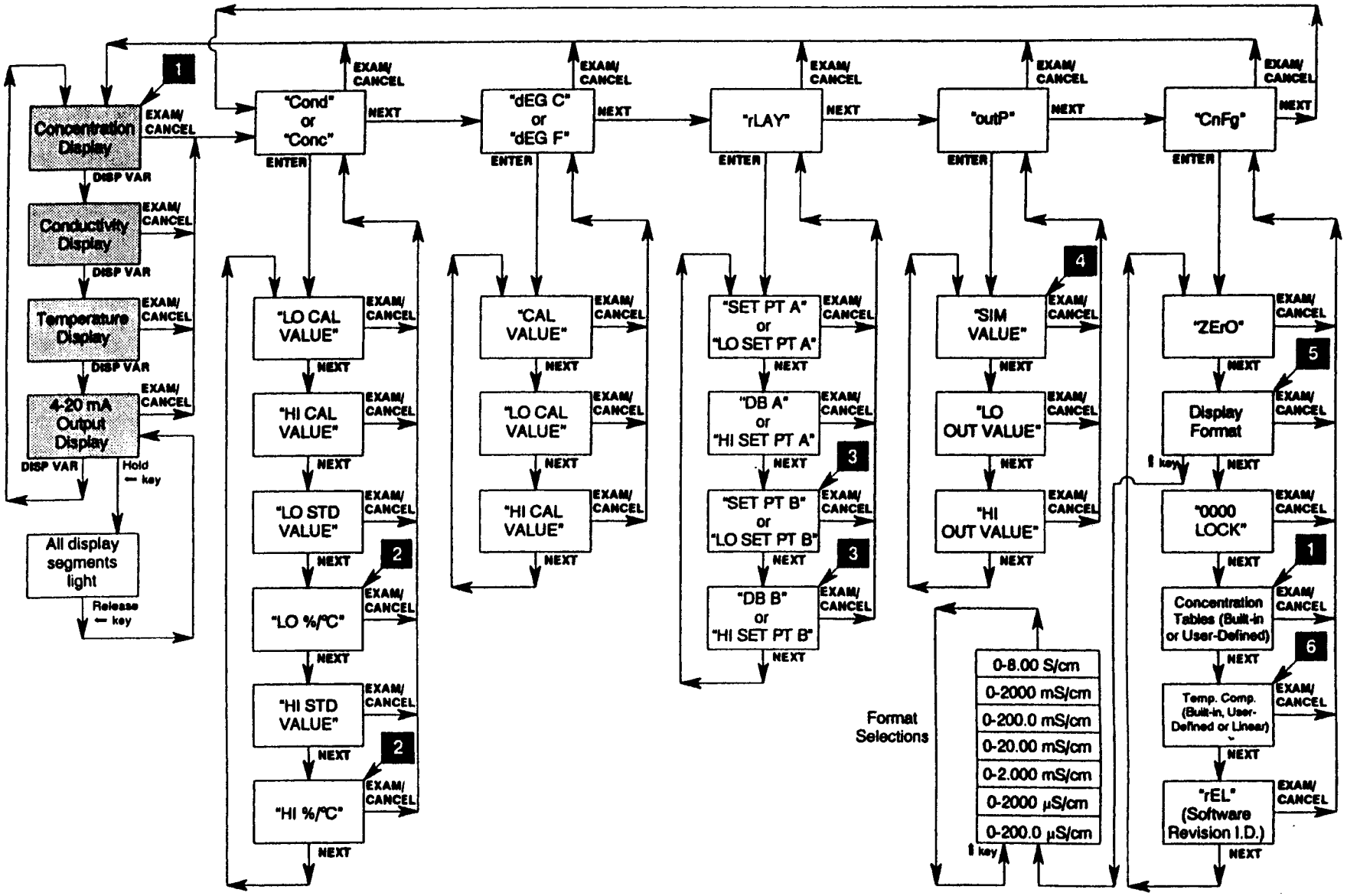


FIGURE 3-2 Display Modes And Call-up Chart Of Setup Variables

1. Displayed only when one of the conversion tables is used to convert conductivity to % concentration.
2. Displayed only when the linear %/°C temperature compensation method is selected and the CDCN-672 is in the conductivity measuring mode.
3. Displayed only when Relay B is in normal control or alarm operating mode, not "system diagnostic alarm" mode.
4. Displayed only when the output hold feature is not in use.
5. Displayed only when no conversion table or the user-defined % concentration conversion table is selected. When a built-in conversion table is selected, the correct display format for that table is automatically established.
6. Not displayed when a built-in concentration conversion table is selected.

The following table lists each of the five setup variable menus, the setup variables within each menu in exact order of call-up, and describes their use and entry value range. The far right column can be used to write in entered setup values for convenient referral.

Table A — DESCRIPTION OF SETUP VARIABLES

Displayed Identifier	Use		Entry Value Range Min.	Entry Value Range Max.	Record Your Entry
"Cond" or "Conc" Menu					
"LO CAL VALUE"	Establishes low calibration point for two-point conventional calibration method.	Cond.	0.0	40.0%F.S.	
		Conc.	0.0%	100.0%	
"HI CAL VALUE"	Establishes high calibration point for two-point conventional calibration method.	Cond.	20.0%F.S.	1000.0%F.S.	
		Conc.	0.0%	100.0%	
"LO STD VALUE"	Sets the value of lower conductivity or % concentration reference solution used for "two-key" calibration method.	Cond.	0.0	90.0%F.S.	
		Conc.	0.0%	97.0%	
"LO %/°C"[1]	Sets the temperature compensation value for the lower calibration solution used for "two-key" method.		0.00%	5.00%	
"HI STD VALUE"	Sets the value of higher conductivity or % concentration reference solution used for "two-key" calibration method.	Cond.	10.0%F.S.	1000.0%F.S.	
		Conc.	1.0%	100.0%	
"HI %/°C"[1]	Sets the temperature compensation value for the higher calibration solution used for "two-key" method.		0.00%	5.00%	
"dEG C" or "dEG F" Menu					
"CAL VALUE"	Sets calibration point for single-point temperature calibration.	°C	0.0	200.0	
		°F	32.0	392.0	
"LO CAL VALUE"	Sets low calibration point for two-point temperature calibration.	°C	0.0	30.0	
		°F	32.0	86.0	
"HI CAL VALUE"	Sets high calibration point for two-point temperature calibration.	°C	40.0	200.0	
		°F	104.0	392.0	
"rLAY" (Relay) Menu					
"SET PT A"[2]	Sets setpoint at which Relay A transfers.	Cond.	0.0	100.0%F.S.	
		Conc.	0.0%	100.0%	
"DB A"[2]	Sets deadband for Relay A.	Cond.	0.0	50.0%F.S.	
		Conc.	0.0%	50.0%	
"LO SET PT A"[3]	Sets low alarm point at which Relay A transfers.	Cond.	0.0	100.0%F.S.	
		Conc.	0.0%	100.0%	
"HI SET PT A"[3]	Sets high alarm point at which Relay A transfers.	Cond.	0.0	100.0%F.S.	
		Conc.	0.0%	100.0%	
"SET PT B"[2]	Sets setpoint at which Relay B transfers.	Cond.	0.0	100.0%F.S.	
		Conc.	0.0%	100.0%	
"DB B"[2]	Sets deadband for Relay B.	Cond.	0.0	50.0%F.S.	
		Conc.	0.0%	50.0%	
"LO SE PT B"[3]	Sets low alarm point at which Relay B transfers.	Cond.	0.0	100.0%F.S.	
		Conc.	0.0%	100.0%	
"HI SET PT B"[3]	Sets high alarm point at which Relay B transfers.	Cond.	0.0	100.0%F.S.	
		Conc.	0.0%	100.0%	

[1] Only provided and displayed when the linear %/°C temperature compensation method is selected and the CDCN-672 is in the conductivity measuring mode.

[2] Only provided and displayed when relay is configured for control mode of operation.

[3] Only provided and displayed when relay is configured for alarm mode of operation.

Table A — DESCRIPTION OF SETUP VARIABLES (Continued)

Displayed Identifier	Use		Entry Value Range Min.	Entry Value Range Max.	Record Your Entry
"outP" (Output) Menu					
"SIM VALUE"[4]	Sets simulated conductivity or % concentration value for diagnostic purposes. The analog and relay outputs respond to the displayed value.	Cond.	0.0	100.0%F.S.	
		Conc.	0.0%	100.0%	
"LO OUT VALUE"	Sets low endpoint at which minimum outputs (0 VDC, 0 mA and 4 mA) are provided.	Cond.	0.0	100.0%F.S.	
		Conc.	0.0%	100.0%	
"HI OUT VALUE"	Sets high endpoint at which maximum outputs (5 VDC, 1 mA and 20 mA) are provided.	Cond.	0.0	100.0%F.S.	
		Conc.	0.0%	100.0%	
"CnFg" (Configuration) Menu					
"ZErO"	Zeros the instrument during startup procedure.		No value is entered.		
"200.0µS/cm", "2000 µS/cm", "2.000 mS/cm", "20.00 mS/cm", "200.0 mS/cm", "2000 mS/cm", –or– "8.00 S/cm"[5]	Selects display format (measurement units and decimal point position) during initial instrument setup.		↑ key is used to select display format.		
"0000" and "LOCK"	Activates the security lock feature.		0000	9999	———
"tb 1%", "tb 2%", "tb 3%", "tb 4%", "tb 5%", "tb 6%", "tb 7%", "tb 8%", "tb 9%", –or– "TABLE Pt 1CONC"[6]	Selects one of the built-in conversion tables or the user-defined conversion table to convert conductivity values to % concentration.		Built-in or user-defined table is selected by DIP switch settings. ↑ or ← keys further select the desired built-in table (if selected).		
"%/°C", "TABLE tb 1%/°C", "TABLE tb 2%/°C", "TABLE tb 3%/°C", "TABLE tb 4%/°C", "TABLE tb 5%/°C", "TABLE tb 6%/°C", "TABLE tb 7%/°C", "TABLE tb 8%/°C", "TABLE tb 9%/°C", –or– "TABLE Pt 1 TC"[7]	Selects a temperature compensation method to be applied to the measured conductivity.		T.C. method is selected by DIP switch settings.		

[4] Only provided and displayed when the output hold feature is not in use.

[5] One of these values is displayed only when no conversion table or the user-defined % concentration conversion table is selected. When a built-in conversion table is selected, the correct display format for that table is automatically established.

[6] One of these identifiers is displayed only when the corresponding built-in conversion table or user-defined conversion table is selected.

[7] One of these identifiers is displayed only when the user-defined conversion table is selected and the linear %/°C or user-defined temperature table compensation method is used.

SECTION 4 - SETUP FOR CONDUCTIVITY

When the CDCN-672 is used for measuring the conductivity of a solution, use the setup instructions in this section. If the CDCN-672 is to be used to display solution concentration in %, disregard this section and, depending on whether you're using a built-in or the user-defined conversion table, use the setup instructions in Section 6 or Section 8 respectively.

4.1 Checking Battery Backup Jumper

An internal battery powers the volatile memory in the event that line power is lost. This ensures that all outputs and the CDCN-672's operating state are immediately restored to their original status when line power is returned. The CDCN-672 is supplied with its **BATTERY** jumper (Figure 3-1) in the **ON** position. Make sure this jumper is set to **ON** before proceeding.

4.2 Selecting Conductivity Measurement Mode

Locate the lower bank of eight switches at right edge of LCD readout (Figure 3-1) and place **CONC NONE** switch in **DOWN** position.

*NOTE: The **CONC TABLE** and **CONC USER** switches must be set to their **UP** positions.*

4.3 Selecting Display Format

1. With display in conductivity measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond").
2. Press **NEXT** key until display indicates "CnFg". Then press **ENTER** to access this menu of setup variables (display indicates "ZErO").
3. Press **NEXT** key once to access the display format setup variable (display indicates one of the format selections shown in Figure 3-2).

Establishing Measurement Units And Decimal Pt. Position

4. Press ⬆ key until display indicates the measurement units and decimal point position you want for your measuring scale.
5. Press **ENTER** key to enter your format selection (display indicates "FS VALUE" to confirm entry and flashes far right "0" to indicate that the full-scale value can now be established and entered).

Establishing Full-Scale Value

6. Use ⬆ and ⬅ keys to make display indicate desired full-scale value which must be less than or equal to the format value selected in step 5.
7. Press **ENTER** key to enter full-scale value ("FS VALUE" disappears and "OK" flashes to confirm entry). Then press **EXAM/CANCEL** key twice to return display to measuring mode.

Establishing Temperature Units (°C or °F)

8. Locate the lower bank of eight switches at right edge of LCD readout (Figure 3-1) and place °C/°F switch in the **DOWN** position for temperature values to be displayed in °F. Place in the **UP** position for °C readout.

4.4 Selecting Temperature Compensation Method

One of four methods of temperature compensation can be selected when the CDCN-672 is used as a conductivity analyzer.

No Compensation

Temperature compensation may be purposely bypassed to provide raw, uncompensated conductivity readings. No compensation is typically used when the solution temperature remains constant and/or when uncompensated readings are desired. Locate the lower bank of eight switches at right edge of LCD readout (Figure 3-1) and place **TEMP COMP NONE** switch in **DOWN** position.

NOTE: *The other three **TEMP COMP** switches (**LINEAR, TABLE** and **USER**) must be set to their **UP** positions.*

Linear Compensation

The user enters a desired temperature compensation slope value in % per °C to be applied to the raw, measured conductivity. Linear compensation is the most frequently used method, since it is sufficient for most applications and is simple to implement. This method provides temperature-compensated conductivity readings referenced to 25°C.

1. Locate the lower bank of eight switches at right edge of LCD readout (Figure 3-1) and place **TEMP COMP LINEAR** switch in **DOWN** position.

   NOTE: *The other three **TEMP COMP** switches (**NONE, TABLE** and **USER**) must be set to their **UP** positions.*

2. With display in conductivity measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond").

3. Press **NEXT** key until display indicates "CnFg". Then press **ENTER** to access this menu of setup variables (display indicates "ZErO").

4. Press **NEXT** key until display indicates "%/°C" and a value with its far right digit flashing. This indicates that the temp. comp. slope value can now be established/changed if desired.

5. Determine the desired slope value to enter for the solution being measured, based on raw conductivity versus temperature values. For most aqueous solutions, the slope value is approximately 2.00%/°C.

6. Use ⬆ and ⬅ keys to make display indicate desired temp. comp. slope value.

7. Press **ENTER** key to enter temp. comp. slope value ("OK" flashes to confirm entry.

Built-in Solution Table Compensation

The user selects one of nine built-in temperature data tables that corresponds with the measured solution. The data in the selected table is then applied to the raw, measured conductivity. This method provides extremely accurate temperature-compensated readings referenced to the °C temperature of the selected table (typically 25°C).

Setting DIP Switches

1. Locate the lower bank of eight switches at right edge of LCD readout (Figure 3-1) and place **TEMP COMP TABLE** switch in **DOWN** position.

   ***NOTE:** The other three **TEMP COMP** switches (**NONE, LINEAR** and **USER**) must be set to their **UP** positions.*

Finding Tables

2. With display in conductivity measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond").

3. Press **NEXT** key until display indicates "CnFg". Then press **ENTER** to access this menu of setup variables (display indicates "ZErO").

4. Press **NEXT** key until display indicates "TABLE tb 1 (2, 3, etc.) %/°C".

Selecting A Table

5. The following table lists the selection of temperature data tables (by their displayed identifying numbers), the type of solution each represents and their °C reference temperatures.

Table B – BUILT-IN TEMP. COMP. TABLES			
Displayed Identifier	Solution	Concentration	Reference Temp.
"TABLE tb 1 %/°C"	NaCl	0-5%	25°C
"TABLE tb 2 %/°C"	HCl	0-15%	25°C
"TABLE tb 3 %/°C"	HNO_3	0-10%	25°C
"TABLE tb 4 %/°C"	H_2SO_4	0-25%	25°C
"TABLE tb 5 %/°C"	H_2SO_4	96-99.5%	50°C
"TABLE tb 6 %/°C"	NaOH	0-15%	25°C
"TABLE tb 7 %/°C"	NaOH	0-20%	100°C
"TABLE tb 8 %/°C"	$CaCl_2$	0-15%	25°C
"TABLE tb 9 %/°C"	H_3PO_4	0-40%	25°C

Use the ⬆ and ⬅ keys to make display indicate desired table (1, 2, 3, etc.).

6. Press **ENTER** key to enter selected temp. comp. table ("OK" flashes to confirm entry).

User-Defined Temperature Table Compensation

The user may enter up to 10 data points to define a temperature curve for the measured solution. Each data point on the curve consists of a temperature value and a corresponding calculated compensation factor. This curve is then applied to the raw, measured conductivity to provide extremely accurate temperature-compensated readings.

NOTE: *It is recommended that the operator plan ahead and determine the temperature and compensation factor for each point in the table before beginning data entry. The table need not contain all 10 points, but at least the first two points (Pt. and Pt. 2) must be entered.*

Determining Data For Entry

A temperature curve for the solution being measured must be created by measuring and noting the raw, uncompensated conductivity of the solution at various temperatures, including a reference temperature. The CDCN-672 can be used to do this under the following provisions:

- The **CONC NONE** switch must be set in **DOWN** position and the other two **CONC** switches (**TABLE** and **USER**) must be set to their **UP** positions.
- The **TEMP COMP NONE** switch must be set in **DOWN** position and the other three **TEMP COMP** switches (**LINEAR, TABLE** and **USER**) must be set to their **UP** positions.
- The CDCN-672 must be calibrated (refer to Part Three, Section 5 for instructions).

Compensation factors for each noted temperature are determined by calculation, using the noted conductivity values and the following equation:

$$\text{Compensation Factor For Each Noted Temp.} = \frac{\text{Cond. Value at Ref. Temp.}}{\text{Cond. Value at Noted Temp.}}$$

Example: Suppose the raw conductivity values were 10 mS/cm at a 25°C ref. temp., 12 mS/cm at 50°C and 7 mS/cm at 15°C. Using the above equation, the compensation factors for each of the temperatures would be 10 ÷ 10 or 1.00 for 25°C, 10 ÷ 12 or 0.83 for 50°C, and 10 ÷ 7 or 1.43 for 15°C.

The following table shows the data for this example, organized for temperature table entry:

EXAMPLE VALUES FOR USER-DEFINED TEMPERATURE TABLE							
Data Point	Temp. (in °C)	Raw Cond. Value	Compen-sation Factor	Data Point	Temp. (in °C)	Raw Cond. Value	Compen-sation Factor
Pt 1	15°C	7 mS/cm	1.43	Pt 6	0.0°C	—	0.00
Pt 2	25°C	10 mS/cm	1.00	Pt 7	0.0°C	—	0.00
Pt 3	50°C	12 mS/cm	0.83	Pt 8	0.0°C	—	0.00
Pt 4	0.0°C	—	0.00	Pt 9	0.0°C	—	0.00
Pt 5	0.0°C	—	0.00	Pt 10	0.0°C	—	0.00

Use the following convenient table to write in and organize the entry values for your user-defined temperature table.

NOTE: *Temperature values for the curve must be entered in ascending order for each data point; they must be between 0.0 and 200.0°C; and they cannot be alike. Entered compensation factors must be between 0.00 and 99.99. Also, all unused data points in the table must have entered temperature values of 0.0°C and compensation factors of 0.00.*

Table C – VALUES FOR USER-DEFINED TEMPERATURE TABLE							
Data Point	Temp. (in °C)	Raw Cond. Value	Compen-sation Factor	Data Point	Temp. (in °C)	Raw Cond. Value	Compen-sation Factor
Pt 1				Pt 6			
Pt 2				Pt 7			
Pt 3				Pt 8			
Pt 4				Pt 9			
Pt 5				Pt 10			

Setting DIP Switches

1. Locate the lower bank of eight switches at right edge of LCD readout (Figure 3-1) and place **TEMP COMP USER** switch in **DOWN** position.

   NOTE: *The other three **TEMP COMP** switches (**NONE, LINEAR** and **TABLE**) must be set to their **UP** positions.*

Finding The Table

2. With display in conductivity measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond").

3. Press **NEXT** key until display indicates "CnFg". Then press **ENTER** to access this menu of setup variables (display indicates "ZErO").

4. Press **NEXT** key until display indicates "TABLE Pt 1 (2, 3, etc.) TC". If necessary, use ⬆ key to make display indicate "Pt 1".

Entering Temperature And Compensation Factor Values

5. Press **ENTER** key to access the temperature value for Data Point 1 entry (display indicates "TABLE °C TC" and flashes far right digit).

   A. Use ↑ and ← keys to make display indicate desired temperature value for Data Point 1.

   B. Press **ENTER** key to enter °C value ("OK" flashes to confirm entry, "°C" disappears and far right digit flashes to indicate that compensation factor can now be established/changed).

   C. Use ↑ and ← keys to make display indicate corresponding compensation factor for Data Point 1.

   D. Press **ENTER** key to enter factor ("OK" flashes to confirm entry and "Pt 2" appears).

6. Press **ENTER** key to access the temperature value for Data Point 2 entry (display indicates "TABLE °C TC" and flashes far right digit).

7. Repeat steps 5A, 5B, 5C and 5D for each remaining data point in the table to enter the temperature and corresponding compensation factor.

8. Any remaining, unused data points in the table must have temperature values of 0.0 °C and compensation factors of 0.00 entered to define the end of the table.

   NOTE: If this step is not done, the user-defined temperature table is not complete and is recognized as being improper (display flashes "Er 8" when in conductivity measuring mode).

   Should any new, additional data points be entered at a later time, the table entries must comply with all of the conditions previously described.

4.5 Zeroing The System

The instrument must be zeroed to compensate for any sensor offset. This zeroing procedure, which takes approximately 90 seconds to execute, only needs to be done at instrument startup or whenever the sensor or interconnect cable is replaced. For best accuracy, zeroing should be performed with the interconnect cable, if used, installed in place.

1. With display in conductivity measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond").

2. Press **NEXT** key until display indicates "CnFg". Then press **ENTER** key to access this menu of setup variables (display indicates "ZErO").

3. Holding the sensor in air, press **ENTER** key to initiate zeroing (display indicates "buSy" and "HOLD", then returns to "ZErO" when routine is completed).

   NOTE: During zeroing, the analog outputs are held at their minimum values and relay operation is suspended.

4.6 Initial Calibration

Before initially calibrating the instrument, read Part Three, Section 5.1 "Summary of Methods To Use". Then calibrate the instrument using the desired method.

SECTION 5 - CALIBRATION FOR CONDUCTIVITY

The instrument must be calibrated periodically with conductivity reference solution(s) to maintain measurement accuracy. It is highly recommended to establish a maintenance program to keep the sensor clean and the instrument calibrated. The time period between performing maintenance (days, weeks, etc.) is affected by the characteristics of the process solution and can only be determined by operating experience.

5.1 Summary Of Methods To Use

The instrument can be calibrated in two different ways. The conventional method (Section 5.3) can be used where the operator enters the solution values into memory.

NOTE: The conventional method should be used for initial calibration or when the sensor has been replaced.

An alternate "two-key" calibration method is also possible which is especially convenient for the novice operator because it eliminates the need for that person to enter solution values. When the "two-key" calibration method (Section 5.4) is used, two reference solution values are first entered by a qualified person. Anytime thereafter, a novice operator can accurately calibrate the instrument for each point by simply pressing two keys. The only operator requirement is that the sensor must be in the appropriate reference solution for each calibration point.

Calibration requires a clean sensor and one (or two) fresh, accurate conductivity reference solutions. Normally, the "low" calibration point is entered as zero conductivity with the sensor in air. In this case only one reference solution need be made. It is recommended that this "high" reference solution have a conductivity value close to the normal value of the process solution or between 80% and 100% of the CDCN-672's full-scale value.

NOTE: For applications requiring high measurement accuracy within a segment of the measuring scale, the

CDCN-672 should be calibrated with two reference solutions. These "low" and "high" reference solutions should have values approximately equal to the segment's low and high endpoints respectively.

5.2 Preparing Conductivity Reference Solutions

Prepare conductivity reference solutions using Table D. The listed grams of salt should be added to one liter of distilled water to obtain the listed conductivity. Solutions of lower conducitivity can be made by dilution with distilled water. Solution temperatures should be as near as possible to 25°C.

Table D – CONDUCTIVITY REFERENCE SOLUTIONS

Desired Solution Value		Grams NaCl To Be Added
µS/cm	mS/cm	
100 200	0.10 0.20	0.05 0.10
500 1000	0.50 1.00	0.25 0.50
2000 5000	2.00 5.00	1.01 2.61
10,000 20,000	10.00 20.00	5.56 11.59
50,000 100,000	50.00 100.00	31.95 72.71

***NOTE:** Consult factory for details on preparing reference solutions with a value greater than 100,000 µS/cm.*

5.3 Conventional Method

1. With display in conductivity measuring mode, hold clean sensor in air or, if using two reference solutions, place sensor in the lower value solution. (In this latter case, allow display reading to stabilize. The sensor may take several minutes to attain temperature equilibrium with the solution.)
2. Press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond").
3. Press **ENTER** key to access the "Cond" menu of setup variables (display indicates "LO CAL VALUE").
4. Use ⬆ and ⬅ keys to make display indicate:
   A. Zero conductivity if sensor is held in air.
   B. The known value of the lower conductivity reference solution if two solutions are used for calibration.
5. Press **ENTER** key to enter value (display indicates "buSy" for approx. 10 seconds, then flashes "OK" to confirm entry and returns to the conductivity measuring mode).
6. If a "low" value solution was used, remove sensor from it and rinse sensor in clean water.

7. Place sensor in "high" value reference solution. Allow sensor to attain temperature equilibrium with the solution.
8. Press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond").
9. Press **ENTER** key to access the "Cond" menu of setup variables (display indicates "LO CAL VALUE").
10. Press **NEXT** key once to make display indicate "HI CAL VALUE".
11. Use ↑ and ← keys to make display indicate the known value of the "high" conductivity reference solution.
12. Press **ENTER** key to enter value (display indicates "buSy" for approx. 10 seconds, then flashes "OK" to confirm entry and returns to the conductivity measuring mode).

This completes the conventional conductivity calibration method.

5.4 "Two-Key" Method

For initial calibration, or if the sensor has been replaced, the instrument should first be calibrated using the conventional method (Section 5.3). Thereafter, the "two-key" method may be used. For routine "two-key" calibrations, a qualified person must first enter the conductivity reference solution value(s) to be used as the calibration points and then select an acceptable response time for the application. Thereafter, the instrument can be periodically calibrated using the procedure described under the "Performing Calibration" subheading.

Entering Calibration Points (By Qualified Person)

1. With the display in conductivity measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond").
2. Press **ENTER** key to access the "Cond" menu of setup variables (display indicates "LO CAL VALUE").
3. Press **NEXT** key until display indicates "LO STD VALUE".
4. Use ↑ and ← keys to make display indicate:
   A. Zero conductivity if sensor is to be held in air for the lower calibration point.
   B. The desired value for the lower calibration point.
5. Press **ENTER** key to enter value ("OK" flashes to confirm entry).
6. Press **NEXT** key until display indicates "HI STD VALUE".
7. Use ↑ and ← keys to make display indicate the desired value for the higher calibration point.

8. Press **ENTER** key to enter value ("OK" flashes to confirm entry).

9. Press **EXAM/CANCEL** key twice to return display to conductivity measuring mode.

Selecting Response Time

Refer to Part Three, Section 1.2 – item 16 for details on the response time **X** and **Y** switches and their settings. For fastest display/output response time, place **X** and **Y** switches in their **UP** positions. However, when the "two-key" method is used for calibration, the 30 second response time (**X** and **Y** switches in their **DOWN** positions) selects the slowest conductivity and temperature rates of change for best calibration accuracy. The only consequence of this is that more time is required to calibrate the CDCN-672 and display/output response time is the slowest. The intermediate choices are compromises between display/output response time and the time it takes to perform a "two-key" calibration. If the "two-key" method is not used, the selection can be based solely on desired display/output response time.

Performing Calibration

Use this "two-key" method to calibrate the instrument after both calibration points have been entered. This calibration procedure requires a clean sensor and one (or two) fresh, accurate conductivity reference solutions that have the same values as the two preselected calibration points.

1. With display in conductivity measuring mode, press **BEGIN CAL** key (display indicates one of the preselected values — "LO CAL VALUE" or "HI CAL VALUE"). If display indicates the higher value, press **BEGIN CAL** key again to display the lower value.

   When **BEGIN CAL** is pressed, the operator has 30 minutes to complete the calibration of this point. During the routine, pressing any key except **END CAL** provides another 30 minutes if needed.

2. Hold *clean* sensor in air or, if using two reference solutions for calibration, place sensor in the "low" value reference solution (display indicates its value). (In this latter case, allow display reading to stabilize. The sensor may take several minutes to attain temperature equilibrium with the solution.)

   The instrument checks the stability of the conductivity and temperature inputs. As each input changes, the respective conductivity measurement unit and °C (or °F) indicator flashes. When each input is stable (changing less than rate selected with **X** and **Y** switches), the respective indicator stops flashing and remains on.

3. When the conductivity measurement unit and °C (or °F) indicators are both on (not flashing), press recessed **END CAL** button using a slender tool. The display flashes "OK" to confirm successful calibration of the low calibration point and returns to the conductivity measuring mode.

   NOTE: If display flashes "ERROR" and "Er 9", an incorrect solution value may have been used or the sensor may be dirty or defective.

4. If a "low" value solution was used, remove sensor from it and rinse sensor in clean water.

5. Press **BEGIN CAL** key to initiate calibration of the second calibration point.

6. Place sensor in the "high" value reference solution (display indicates its value). Allow sensor to attain temperature equilibrium with the solution.

   The instrument checks the stability of the conductivity and temperature inputs. As each input changes, the respective conductivity measurement unit and °C (or °F) indicator flashes. When each input is stable (changing less than rate selected with **X** and **Y** switches), the respective indicator stops flashing and remains on.

7. When the conductivity measurement unit and °C (or °F) indicators are both on (not flashing), press recessed **END CAL** button using slender tool. The display flashes "OK" to confirm successful calibration of the high calibration point and returns to the conductivity measuring mode.

   NOTE: If display flashes "ERROR" and "Er 9", an incorrect solution value may have been used.

This completes the "two-key" conductivity calibration method.

SECTION 6 - SETUP FOR % CONCENTRATION USING BUILT-IN CONVERSION TABLE

When the CDCN-672 is used for monitoring the % concentration of a solution and that solution is represented by one of the built-in conversion tables listed in Section 6.2 – step 6, use the setup instructions in this section. For other solutions not covered by the built-in tables, the user-defined table must be used to convert conductivity into % concentration. In this case, refer to Section 8. If the CDCN-672 is to be used for measuring conductivity, disregard Sections 6 through 8 and use the setup instructions in Section 4.

6.1 Checking Battery Backup Jumper

An internal battery powers the volatile memory in the event line power is lost. This ensures that all outputs and the CDCN-672's operating state are immediately restored to their original status when line power is returned. The CDCN-672 is supplied with its **BATTERY** jumper (Figure 3-1) in the **ON** position. Make sure this jumper is set to **ON** before proceeding.

6.2 Reviewing Built-in Concentration Tables

Setting DIP Switches

1. Locate the lower bank of eight switches at right edge of LCD readout (Figure 3-1) and place **CONC TABLE** switch in **DOWN** position.

   *NOTE: The **CONC NONE** and **CONC USER** switches must be set to their **UP** positions.*

2. Place **TEMP COMP TABLE** switch in **DOWN** position.

   *NOTE: The other three **TEMP COMP** switches (**NONE, LINEAR** and **USER**) must be set to their **UP** positions.*

Finding Tables

3. With display in % concentration measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Conc").

4. Press **NEXT** key until display indicates "CnFg". Then press **ENTER** to access this menu of setup variables (display indicates "ZErO").

5. Press **NEXT** key until display indicates "tb 1 (2, 3, etc.) %".

Selecting A Table

6. The following table lists the selection of concentration tables (by their displayed identifying numbers), the type of solution each represents and their °C reference temperatures.

Table E – BUILT-IN CONCENTRATION CONVERSION TABLES

Displayed Identifier	Solution	Concentration	Reference Temp.
"tb 1 %"	NaCl	0-5%	25°C
"tb 2 %"	HCl	0-15%	25°C
"tb 3 %"	HNO_3	0-10%	25°C
"tb 4 %"	H_2SO_4	0-25%	25°C
"tb 5 %"	H_2SO_4	96-99.5%	50°C
"tb 6 %"	NaOH	0-15%	25°C
"tb 7 %"	NaOH	0-20%	100°C
"tb 8 %"	$CaCl_2$	0-15%	25°C
"tb 9 %"	H_3PO_4	0-40%	25°C

Use the ⬆ and ⬅ keys to make display indicate desired table (1, 2, 3, etc).

7. Press **ENTER** key to enter selected concentration conversion table ("OK" flashes to confirm entry).

6.3 Selecting Temperature Display Units (°C or °F)

Locate the lower bank of eight switches at right edge of LCD readout (Figure 3-1) and place °C/°F switch in the **DOWN** position for temperature values to be displayed in °F. Place in the **UP** position for °C readout.

6.4 Zeroing The System

The instrument must be zeroed to compensate for any sensor offset. This zeroing procedure , which takes approximately 90 seconds to execute, only needs to be done at instrument startup or whenever the sensor or interconnect cable is replaced. For best accuracy, zeroing should be performed with the interconnect cable, if used, installed in place.

1. With display in % concentration measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Conc").
2. Press **NEXT** key until display indicates "CnFg". Then press **ENTER** key to access this menu of setup variables (display indicates ZErO").
3. Holding the sensor in air, press **ENTER** key to initiate zeroing (display indicates "buSy" and "HOLD", then returns to "ZErO" when routine is completed).

NOTE: During zeroing, the analog outputs are held at their minimum values and relay operation is suspended.

6.5 Initial Calibration

Before initially calibrating the instrument, read Part Three, Section 7.1 "Summary Of Methods To Use". Then calibrate the instrument using the desired method.

SECTION 7 - CALIBRATION FOR % CONCENTRATION

The instrument must be calibrated periodically with % concentration reference solution(s) to maintain measurement accuracy. It is highly recommended to establish a maintenance program to keep the sensor clean and the instrument calibrated. The time period between performing maintenance (days, weeks, etc.) is affected by the characteristics of the process solution and can only be determined by operating experience.

7.1 Summary Of Methods To Use

The instrument can be calibrated in two different ways. The conventional method (Section 7.3) can be used where the operator enters the solution values into memory.

NOTE: *The conventional method should be used for initial calibration or when the sensor has been replaced.*

An alternate "two-key" calibration method is also possible which is convenient for the novice operator because it eliminates the need for that person to enter solution values. When the "two-key" calibration method (Section 7.4) is used, two reference solution values are first entered by a qualified person. Anytime thereafter, a novice operator can accurately calibrate the instrument for each point by simply pressing two keys. The only operator requirement is that the sensor must be in the appropriate reference solution for each calibration point.

Calibration requires a clean sensor and one (or two) fresh, accurate % concentration reference solutions. Normally, the "low" calibration point is entered as zero % concentration with the sensor in air. In this case, only one reference solution need be made. It is recommended that this "high" reference solution have a % concentration value close to the normal value of the process solution or between 80% and 100% of the CDCN-672's full-scale value.

NOTE: *For 96-99.5% H_2SO_4 and applications that require high measurement accuracy within a segment of the measuring scale, the CDCN-672 should be calibrated with two reference solutions. These "low" and "high" reference solutions should have values approximately equal to the segment's low and high endpoints respectively.*

7.2 % Concentration Reference Solutions

Either make reference solution(s) of known % concentration using chemicals and handbooks, etc. or use a sample of process solution whose % concentration is known. Also, make sure that the reference solution(s) being used corresponds to the selected concentration conversion table.

7.3 Conventional Method

1. With the display in % concentration measuring mode, hold clean sensor in air or, if using two reference solutions, place sensor in the lower value solution. (In this latter case, allow display reading to stabilize. The sensor may take several minutes to attain temperature equilibrium with the solution).
2. Press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Conc").
3. Press **ENTER** key to access the "Conc" menu of setup variables (display indicates "LO CAL VALUE").

4. Use ↑ and ← keys to make display indicate:
   A. Zero % concentration if sensor is held in air.
   B. The known value of the lower % concentration reference solution if two solutions are used for calibration.
5. Press **ENTER** key to enter value (display indicates ObuSy" for approx. 10 seconds, then flashes "OK" to confirm entry and returns to the % concentration measuring mode).
6. If a "low" value solution was used, remove sensor from it and rinse sensor in clean water.
7. Place sensor in "high" value reference solution. Allow sensor to attain temperature equilibrium with the solution.
8. Press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Conc").
9. Press **ENTER** key to access the "Conc" menu of setup variables (display indicates "LO CAL VALUE").
10. Press **NEXT** key <u>once</u> to make display indicate "HI CAL VALUE".
11. Use ↑ and ← keys to make display indicate the known value of the Qhigh" % concentration reference solution.
12. Press **ENTER** key to enter value (display indicates "buSy" for approx. 10 seconds, then flashes "OK" to confirm entry and returns to the % concentration measuring mode).

This completes the conventional % concentration calibration method.

7.4 "Two-Key" Method

For initial calibration, or if the sensor has been replaced, the instrument should first be calibrated using the conventional method (Section 7.3). Thereafter, the "two-key" method may be used. For routine "two-key" calibrations, a qualified person must first enter the % concentration reference solution value(s) to be used as the calibration points and then select an acceptable response time for the application. Thereafter, the instrument can be periodically calibrated using the procedure described under the "Performing Calibration" subheading.

Entering Calibration Points (By Qualified Person)

1. With the display in % concentration measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Conc").
2. Press **ENTER** key to access the "Conc" menu of setup variables (display indicates "LO CAL VALUE").
3. Press **NEXT** key until display indicates "LO STD VALUE".

4. Use ⬆ and ⬅ keys to make display indicate:
   A. Zero % concentration if sensor is to be held in air for the lower calibration point.
   B. The desired value for the lower calibration point.
5. Press **ENTER** key to enter value ("OK" flashes to confirm entry).
6. Press **NEXT** key until display indicates "HI STD VALUE".
7. Use ⬆ and ⬅ keys to make display indicate the desired value for the higher calibration point.
8. Press **ENTER** key to enter value ("OK" flashes to confirm entry).
9. Press **EXAM/CANCEL** key twice to return display to % concentration measuring mode.

Selecting Response Time

Refer to Section 1.2 – item 16 for details on the response time **X** and **Y** switches and their settings. For fastest display/output response time, place **X** and **Y** switches in their **UP** positions. However, when the "two-key" method is used for calibration, the 30 second response time (**X** and **Y** switches in their **DOWN** positions) selects the slowest conductivity and temperature rates of change for best calibration accuracy. The only consequence of this is that more time is required to calibrate the CDCN-672 and display/output response time is the slowest. The intermediate choices are compromises between display/output response time and the time it takes to perform a "two-key" calibration. If the "two-key" method is not used, the selection can be based solely on desired display/output response time.

Performing Calibration

Use this "two-key" method to calibrate the instrument after both calibration points have been entered. This calibration procedure requires a clean sensor and one (or two) fresh, accurate % concentration reference solutions that have the same values as the two preselected calibration points.

1. With display in % concentration measuring mode, press **BEGIN CAL** key (display indicates one of the preselected values — "LO CAL VALUE" or "HI CAL VALUE"). If display indicates the higher value, press **BEGIN CAL** key again to display the lower value.

   When **BEGIN CAL** is pressed, the operator has 30 minutes to complete the calibration of this point. During the routine, pressing any key except **END CAL** provides another 30 minutes if needed.

2. Hold *clean* sensor in air or, if using two reference solutions for calibration, place sensor in the "low" value reference solution (display indicates its value). (In this latter case, allow display reading to stabilize. The sensor may take several minutes to attain temperature equilibrium with the solution.)

   The instrument checks the stability of the % concentration and temperature inputs. As each input changes, the respective % and °C (or °F) indicator flashes. When each input is stable (changing less than rate selected with **X** and **Y** switches), the respective indicator stops flashing and remains on.

3. When the % and °C (or °F) indicators are both on (not flashing), press recessed **END CAL** button using a slender tool. The display flashes [OK" to confirm successful calibration of the low calibration point and returns to the % concentration measuring mode.

   NOTE: If display flashes "ERROR" and "Er 9", an incorrect solution value may have been used or the sensor may be dirty or defective.

4. If a "low" value solution was used, remove sensor from it and rinse sensor in clean water.

5. Press **BEGIN CAL** key to initiate calibration of the second calibration point.

6. Place sensor in the "high" value reference solution (display indicates its value). Allow sensor to attain temperature equilibrium with the solution.

   The instrument checks the stability of the % concentration and temperature inputs. As each input changes, the respective % and °C or (°F) indicator flashes. When each input is stable (changing less than rate selected with **X** and **Y** switches), the respective indicator stops flashing and remains on.

7. When the % and °C (or °F) indicators are both on (not flashing), press recessed **END CAL** button using slender tool. The display flashes "OK" to confirm successful calibration of the high calibration point and returns to the % concentration measuring mode.

   NOTE: If display flashes "ERROR" and "ER 9", an incorrect solution value may have been used.

This completes the "two-key" % concentration calibration method.

SECTION 8 - SETUP FOR % CONCENTRATION USING USER-DEFINED CONVERSION TABLE

When the CDCN-672 is used for measuring the % concentration of a solution and that solution is not represented by one of the built-in conversion tables listed in Section 6.2 – step 6, use the setup instructions in this section. If the solution is covered by a built-in table, use the setup instructions in Section 6. If the CDCN-672 is to be used for measuring conductivity, disregard Sections 6 through 8 and use the setup instructions in Section 4.

8.1 Checking Battery Backup Jumper

An internal battery powers the volatile memory in the event line power is lost. This ensures that all outputs and the CDCN-672's operating state are immediately restored to their original status when line power is returned. The CDCN-672 is supplied with its **BATTERY** jumper (Figure 3-1) in the **ON** position. Make sure this jumper is set to **ON** before proceeding.

8.2 Setting DIP Switches

Locate the lower bank of eight switches at right edge of LCD readout (Figure 3-1) and place **CONC USER** switch in **DOWN** position.

NOTE: *The **CONC NONE** and **CONC TABLE** switches must be set to their **UP** positions.*

8.3 Determining Concentration Versus Conductivity Values

The user may enter up to 10 data points to convert conductivity to % concentration for the solution being measured. Each data point consists of a % concentration value and a corresponding conductivity value.

NOTE: *It is recommended that the operator plan ahead and determine the % concentration and conductivity values for each point in the table before beginning data entry. The table need not contain all 10 points, but at least the first two points (Pt. 1 and Pt. 2) must be entered.*

Obtain the appropriate % concentration and conductivity values from chemical handbooks, journals, etc. or from laboratory analysis. (The CDCN-672 may be used to obtain conductivity values of known % concentration samples.)

Example: Suppose the solution to be measured is sodium chloride (NaCl) and that the % concentration and corresponding conductivity values for this solution are:

% Concentration	Corresponding Conductivity Value
1.0%	18.0 mS/cm
7.0%	100.0 mS/cm
14.6%	175.0 mS/cm

(For these conductivity values, the 0-200.0 mS/cm display format is recommended when establishing the CDCN-672 measuring scale described in Section 8.4.)

The following table shows the data for this example, organized for concentration conversion table entry:

EXAMPLE VALUES FOR USER-DEFINED CONCENTRATION CONVERSION TABLE					
Data Point	% Concentration Value	Conductivity Value	Data Point	% Concentration Value	Conductivity Value
Pt 1	1.0%	18.0 mS/cm	Pt 6	0.0%	0.0 mS/cm
Pt 2	7.0%	100.0 mS/cm	Pt 7	0.0%	0.0 mS/cm
Pt 3	14.6%	175.0 mS/cm	Pt 8	0.0%	0.0 mS/cm
Pt 4	0.0%	0.0 mS/cm	Pt 9	0.0%	0.0 mS/cm
Pt 5	0.0%	0.0 mS/cm	Pt 10	0.0%	0.0 mS/cm

Use the following convenient table to write in and organize the entry values for your user-defined concentration conversion table.

NOTE: *The % concentration values must be entered in <u>ascending order</u> for each data point; they must be between 0.0 and 100.0%; and they cannot be alike. The corresponding conductivity values for each data point must be entered in <u>consecutive</u> ascending or descending order. Also, all unused data points in the table must have entered concentration values of 0.0% and conductivity values of zero (display resolution being determined by selected display format).*

Table F – VALUES FOR USER-DEFINED CONCENTRATION CONVERSION TABLE					
Data Point	% Concentration Value	Conductivity Value	Data Point	% Concentration Value	Conductivity Value
Pt 1			Pt 6		
Pt 2			Pt 7		
Pt 3			Pt 8		
Pt 4			Pt 9		
Pt 5			Pt 10		

8.4 Selecting Display Format

1. With display in % concentration measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Conc").
2. Press **NEXT** key until display indicates "CnFg". Then press **ENTER** to access this menu of setup variables (display indicates "ZErO").
3. Press **NEXT** key <u>once</u> to access the display format setup variable (display indicates one of the format selections shown in Figure 3-2).

Establishing Measurement Units And Decimal Pt. Position

4. Press ⬆ key until display indicates the measurement units and decimal point position which are appropriate for the conductivity values determined in Section 8.3 for conversion table entry (0-200.0 mS/cm is recommended for this example).

5. Press **ENTER** key to enter your format selection (display indicates "FS VALUE" to confirm entry and flashes far right "0" to indicate that the full-scale value can now be established and entered).

Establishing Full-Scale Value

6. Use ⬆ and ⬅ keys to make display indicate desired full-scale value which must be less than or equal to the format value selected in step 5. (For this example, "200.0 mS/cm" is acceptable since it is reasonably close to the anticipated maximum measured conductivity of 175.0 mS/cm. If the display format value is significantly higher, it is recommended to enter the anticipated maximum measured conductivity or a slightly higher value to accommodate unexpected higher process conductivities.)

7. Press **ENTER** key to enter full-scale value ("FS VALUE" disappears and "OK" flashes to confirm entry). Then press **EXAM/CANCEL** key twice to return display to measuring mode.

Establishing Temperature Units (°C or °F)

8. Locate the lower bank of eight switches at right edge of LCD readout (Figure 3-1) and place °C/°F switch in the **DOWN** position for temperature values to be displayed in °F. Place in the **UP** position for °C readout.

8.5 Entering Conversion Table Data

1. With display in % concentration measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Conc").

2. Press **NEXT** key until display indicates "CnFg". Then press **ENTER** to access this menu of setup variables (display indicates "ZErO").

3. Press **NEXT** key until display indicates "TABLE Pt 1 (2, 3, etc.) CONC". If necessary, use ⬆ key to make display indicate "Pt 1".

4. Press **ENTER** key to access the % concentration value for Data Point 1 entry (display indicates "TABLE % CONC" and flashes far right digit).

   A. Use ⬆ and ⬅ keys to make display indicate desired % concentration value for Data Point 1.

   B. Press **ENTER** key to enter % concentration value ("OK" flashes to confirm entry, % disappears as units appear with far right digit flashing to indicate that the corresponding conductivity value can now be established).

   C. Use ⬆ and ⬅ keys to make display indicate corresponding conductivity value for Data Point 1.

D. Press **ENTER** key to enter conductivity value ("OK" flashes to confirm entry and "Pt 2" appears).

5. Press **ENTER** key to access the % concentration value for Data Point 2 entry (display indicates "TABLE % CONC" and flashes far right digit).

6. Repeat steps 4A, 4B, 4C and 4D for each remaining data point in the table to enter the % concentration and corresponding conductivity values.

7. Any remaining, unused data points in the table must have concentration values of 0.0% and conductivity values of zero (display resolution being determined by selected display format) entered to define the end of the table.

   NOTE: *If this step is not done, the user-defined concentration conversion table is not complete and is recognized as being improper (display flashes "Er 7" when in % concentration measuring mode).*

   Should any new, additional data points be entered at a later time, the table entries must comply with all of the conditions previously described.

8.6 Selecting Temperature Compensation Method

One of three methods of temperature compensation can be selected when the user-defined concentration conversion table is used.

No Compensation

Temperature compensation may be purposely bypassed to provide raw, uncompensated % concentration readings. No compensation is typically used when the solution temperature remains constant and/or when uncompensated readings are desired. Locate the lower bank of eight switches at right edge of LCD readout (Figure 3-1) and place **TEMP COMP NONE** switch in **DOWN** position.

NOTE: *The other three **TEMP COMP** switches (**LINEAR, TABLE** and **USER**) must be set to their **UP** positions.*

Linear Compensation

The user enters a desired temperature compensation slope value in % per °C to be applied to the raw, measured unconverted conductivity. Linear compensation is the most frequently used method, since it is sufficient for most applications and is simple to implement. This method provides temperature-compensated % concentration readings referenced to 25°C.

1. Locate the lower bank of eight switches at right edge of LCD readout (Figure 3-1) and place **TEMP COMP LINEAR** switch in **DOWN** position.

   NOTE: *The other three **TEMP COMP** switches (**NONE, TABLE** and **USER**) must be set to their **UP** positions.*

2 With display in concentration measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Conc").

3 Press **NEXT** key until display indicates "CnFg". Then press **ENTER** to access this menu of setup variables (display indicates "ZErO").

4. Press **NEXT** key until display indicates "%/°C" and a value with its far right digit flashing. This indicates that the temp comp. slope value can now be established/changed if desired.

5. Determine the desired slope value to enter for the solution being measured, based on raw conductivity versus temperature values. For most aqueous solutions, the slope value is approximately 2.00%/°C.

6 Use ⬆ and ⬅ keys to make display indicate desired temp comp slope value.

7 Press **ENTER** key to enter temp comp slope value ("OK" flashes to confirm entry).

User-Defined Temperature Table Compensation

The user may enter up to 10 data points to define a temperature curve for the measured solution Each data point on the curve consists of a temperature value and a corresponding calculated compensation factor This curve is then applied to the raw, measured unconverted conductivity to provide extremely accurate temperature-compensated readings.

NOTE: *It is recommended that the operator plan ahead and determine the temperature and compensation factor for each point in the table before beginning data entry The table need not contain all 10 points, but at least the first two points (Pt 1 and Pt 2) must be entered.*

Determining Data For Entry

A temperature curve for the solution being measured must be created by measuring and noting the raw, uncompensated conductivity of the solution at various temperatures, including a reference temperature. The CDCN-672 can be used to do this under the following provisions:

- The **CONC NONE** switch must be set in **DOWN** position and the other two **CONC** switches (**TABLE** and **USER**) must be set to their **UP** positions.
- The **TEMP COMP NONE** switch must be set in **DOWN** position and the other three **TEMP COMP** switches (**LINEAR, TABLE** and **USER**) must be set to their **UP** positions.

- The CDCN-672 must be calibrated for conductivity (refer to Part Three, Section 5) for instructions.

Compensation factors for each noted temperature are determined by calculation using the noted conductivity values and the following equation:

$$\text{Compensation Factor For Each Noted Temp.} = \frac{\text{Cond. Value at Ref. Temp.}}{\text{Cond. Value at Noted Temp.}}$$

Example: Suppose the raw conductivity values were 10 mS/cm at a 25°C ref. temp., 12 mS/cm at 50°C and 7 mS/cm at 15°C. Using the above equation, the compensation factors for each of the temperatures would be 10 ÷ 10 or 1.00 for 25°C, 10 ÷ 12 or 0.83 for 50°C, and 10 ÷ 7 or 1.43 for 15°C.

The following table shows the data for this example, organized for temperature table entry:

EXAMPLE VALUES FOR USER-DEFINED TEMPERATURE TABLE

Data Point	Temp. (in °C)	Raw Cond. Value	Compen-sation Factor	Data Point	Temp. (in °C)	Raw Cond. Value	Compen-sation Factor
Pt 1	15°C	7 mS/cm	1.43	Pt 6	0.0°C	—	0.00
Pt 2	25°C	10 mS/cm	1.00	Pt 7	0.0°C	—	0.00
Pt 3	50°C	12 mS/cm	0.83	Pt 8	0.0°C	—	0.00
Pt 4	0.0°C	—	0.00	Pt 9	0.0°C	—	0.00
Pt 5	0.0°C	—	0.00	Pt 10	0.0°C	—	0.00

Use the following convenient table to write in and organize the entry values for your user-defined temperature table.

NOTE: *Temperature values for the curve must be entered in <u>ascending order</u> for each data point; they must be between 0.0 and 200.0°C; and they cannot be alike. Entered compensation factors must be between 0.00 and 99.99. Also, all unused data points in the table must have entered temperature values of 0.0°C and compensation factors of 0.00.*

Table C – VALUES FOR USER-DEFINED TEMPERATURE TABLE

Data Point	Temp. (in °C)	Raw Cond. Value	Compen-sation Factor	Data Point	Temp. (in °C)	Raw Cond. Value	Compen-sation Factor
Pt 1				Pt 6			
Pt 2				Pt 7			
Pt 3				Pt 8			
Pt 4				Pt 9			
Pt 5				Pt 10			

Setting DIP Switches

1 Locate the lower bank of eight switches at right edge of LCD readout (Figure 3-1) and place **TEMP COMP USER** switch in **DOWN** position.

*NOTE: The other three **TEMP COMP** switches (**NONE, LINEAR** and **TABLE**) must be set to their **UP** positions.*

Finding The Table

2 With display in concentration measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Conc").

3 Press **NEXT** key until display indicates "CnFg". Then press **ENTER** to access this menu of setup variables (display indicates "ZErO").

4. Press **NEXT** key until display indicates "TABLE Pt 1 (2, 3, etc) TC". If necessary, use ⬆ key to make display indicate "Pt 1".

Entering Temperature And Compensation Factor Values

5 Press **ENTER** key to access the temperature value for Data Point 1 entry (display indicates "TABLE °C TC" and flashes far right digit).

A Use ⬆ and ⬅ keys to make display indicate desired temperature value for Data Point 1.

B Press **ENTER** key to enter °C value ("OK" flashes to confirm entry, "°C" disappears and far right digit flashes to indicate that compensation factor can now be established/changed.

C Use ⬆ and ⬅ keys to make display indicate corresponding compensation factor for Data Point 1.

D. Press **ENTER** key to enter factor ("OK" flashes to confirm entry and "Pt 2" appears).

6 Press **ENTER** key to access the temperature value for Data Point 2 entry (display indicates "TABLE °C TC" and flashes far right digit).

7. Repeat steps 5A, 5B, 5C and 5D for each remaining data point in the table to enter the temperature and corresponding compensation factor.

8 Any remaining, unused data points in the table must have temperature values of 0 0°C and compensation factors of 0 00 entered to define the end of the table.

NOTE: If this step is not done, the user-defined temperature table is not complete and is recognized as being improper (display flashes "Er 8" when in % concentration measuring mode).

Should any new, additional data points be entered at a later time, the table entries must comply with all of the conditions previously described.

8.7 Zeroing The System

The instrument must be zeroed to compensate for any sensor offset. This zeroing procedure, which takes approximately 90 seconds to execute, only needs to be done at instrument startup or whenever the sensor or interconnect cable is replaced. For best accuracy, zeroing should be performed with the interconnect cable, if used, installed in place.

1. With display in % concentration measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Conc").
2. Press **NEXT** key until display indicates "CnFg". Then press **ENTER** key to access this menu of setup variables (display indicates "ZErO").
3. Holding the sensor in air, press **ENTER** key to initiate zeroing (display indicates "buSy" and "HOLD", then returns to "ZErO" when routine is completed).

   NOTE: During zeroing, the analog outputs are held at their minimum values and relay operation is suspended.

8.8 Initial Calibration

Before initially calibrating the instrument, read Part Three, Section 7.1 "Summary Of Methods To Use." Then calibrate the instrument using the desired method.

SECTION 9 - RELAY SETUP

The instrument has two SPDT relays. Relay A and B can be independently set up to operate in a control mode or an alarm mode.

- In the control mode, the relay can be selected to operate in response to increasing or decreasing measured conductivity or % concentration and has a setpoint and deadband.
- In the alarm mode, the relay operates as a "dual-alarm" relay with independent low and high alarm points. The relay will transfer whenever the measured conductivity or % concentration decreases below the low alarm point or increases above the high alarm point.

In either mode, both relays can be selected for "fail-safe" operation which reverses normal operation so that the relays will deenergize when a power interruption occurs.

Lastly, Relay B can be programmed to function as a "system alarm"relay This configuration will transfer Relay B whenever a system diagnostic error is detected by the instrument to alert the operator.

9.1 Control Mode Of Operation

The procedure to setup a relay for control mode of operation is described with the following example:

> CONTROL MODE RELAY SETUP EXAMPLE
>
> Suppose the control requirements for Relay A are:
>
> Relay A turns on at 150 0 mS/cm as the conductivity increases.
> Relay A turns off at 145 0 mS/cm as the conductivity decreases.

Selecting Ccntrol Mode

Locate the upper bank of eight switches at right edge of LCD readout (Figure 3-1) and place **RELAY A ALM/CTRL** switch in **CTRL** (down) position to operate Relay A in the control mode Use **RELAY B ALM/CTRL** switch to select Relay B mode.

Selecting Relay Response Action

Place **RELAY A HI/LO** switch in **HI** (up) position to make Relay A respond to increasing value for this example For applications that require the relay to transfer in response to decreasing value, place switch in **LO** (down) position Use **RELAY B HI/LO** switch to select Relay B response action.

Entering Relay Setpoints

1 With display in conductivity or % concentration measuring mode (conductivity for this example), press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond" or "Conc").

2 Press **NEXT** key until display indicates "rLAY" Then press **ENTER** key to access the "rLAY" menu of setup variables (display indicates "SET PT A"). To set Relay B setpoint, press **NEXT** key until display indicates "SET PT B".

3 Use ⬆ and ⬅ keys to make display indicate desired setpoint value (150 0 mS/cm for this example).

4 Press **ENTER** key to enter value ("OK" flashes to confirm entry).

Entering Relay Deadbands

1 Press **NEXT** key until display indicates "DB A" for this example ("DB B" for Relay B).

2 Use ⬆ and ⬅ keys to make display indicate desired deadband (150 0 minus 145 0 or 5 0 mS/cm for this example).

3. Press **ENTER** key to enter value ("OK" flashes to confirm entry).

9.2 Alarm Mode Of Operation

The procedure to set up a relay for alarm mode of operation is described with the following example:

> ALARM MODE RELAY SETUP EXAMPLE
>
> Suppose the alarm requirements for Relay B are:
>
> Relay B turns on at 170.0 mS/cm in response to increasing conductivity and turns on at 120.0 mS/cm in response to decreasing conductivity.

Selecting Alarm Mode

Locate the upper bank of eight switches at right edge of LCD readout (Figure 3-1) and place **RELAY B ALM/CTRL** switch in **ALM** (up) position to operate Relay B in the alarm mode. Use **RELAY A ALM/CTRL** switch to select Relay A mode.

NOTE: *A relay configured in the alarm mode has fixed (non-selectable HI and LO response action regardless of the position of **RELAY B HI/LO** switch (or **RELAY A HI/LO** switch for Relay A). Also, each alarm point has a fixed deadband of 1.0% of full scale.*

Entering Relay Dual-Alarm Points

1. With display in conductivity or % concentration measuring mode (conductivity for this example), press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond" or "Conc").
2. Press **NEXT** key until display indicates "rLAY". Then press **ENTER** key to access the "rLAY" menu of setup variables (display indicates "ST PT A").
3. Press **NEXT** key until display indicates "LO SET PT B" for this example ("LO SET PT A" for Relay A).
4. Use ⬆ and ⬅ keys to make display indicate desired low alarm point value (120.0 mS/cm for this example).
5. Press **ENTER** key to enter value ("OK" flashes to confirm entry).
6. Press **NEXT** key once to make display indicate "HI SET PT B" for this example ("HI SET PT A" for Relay A).
7. Use ⬆ and ⬅ keys to make display indicate desired high alarm point value (170.0 mS/cm for this example).
8. Press **ENTER** key to enter value ("OK" flashes to confirm entry).

9.3 Fail-Safe Operation

Whether set up for a control, alarm or system alarm mode, Relays A and B can be selected for fail-safe operation. This reverses the normal operation of both relays so that the relays will deenergize when a power interruption occurs.

To program Relays A and B for fail-safe operation, locate the upper bank of eight switches at right edge of LCD readout (Figure 3-1) and place **FAIL SAFE** switch in **DOWN** position. For normal relay operation, place this switch in the **UP** position.

9.4 Relay B System Alarm Operation

Relay B can be used to alert the operator if the CDCN-672 detects a system diagnostic error or power failure. When any of these conditions occurs, Relay B will transfer. When Relay B is configured to operate as a "system alarm" relay, all other Relay B DIP switch settings are ignored including all entered Relay B setup variable values (setpoint, deadband or alarm points). Also, if fail-safe operation is selected, Relay B system alarm operation is reversed.

To set up Relay B to operate as a "system alarm" relay, locate the upper bank of eight switches at right edge of LCD readout (Figure 3-1) and place **SYS ALM** switch in **DOWN** position. To disable the "system alarm" operation and return Relay B to its normal operation, place this switch in the **UP** position.

SECTION 10 - OUTPUT SETUP

The CDCN-672 provides 0-5 VDC, 0-1 mA and 4-20 mA analog output signals which track the measured conductivity or % concentration.

NOTE: *The output display mode indicates the 4-20 mA signal only, regardless of which output signals are actually being used.*

10.1 Selecting Response Time

Refer to Section 1.2 – item 16 for details on the response time **X** and **Y** switches and their settings. For fastest display/output response time, place **X** and **Y** switches in their **UP** positions. However, if the "two-key" method is used for calibration, the 30 second response time (**X** and **Y** switches in their **DOWN** positions) selects the slowest conductivity and temperature rates of change for best calibration accuracy. The only consequence of this is that more time is required to calibrate the CDCN-672 and display/output response time is the slowest. The intermediate choices are compromises between display/output response time and the time it takes to perform a "two-key" calibration. If the "two-key" method is not used, the selection can be based solely on desired display/output response time.

10.2 Using Range Expand Feature

The 0-5 VDC, 0-1 mA and 4-20 mA outputs can represent the entire measuring scale or a desired segment of it. The LO OUT VALUE and HI OUT VALUE setup variables are used to enter the low and high endpoints of the segment at which the minimum and maximum values of these outputs are desired. Note these important points:

- The desired segment, represented by each output, cannot be smaller than 10.0% of the measuring scale.
- The outputs can be inverted (outputs decrease as measured conductivity or % concentration increases) by entering the higher value with LO OUT VALUE and the lower value with HI OUT VALUE.
- When the measured conductivity (or % concentration) is below or above the desired segment, the outputs are limited to their designated minimum and maximum values respectively.

NOTE: *When one of the conversion tables is used to convert measured conductivity to % concentration, the LO and HI OUT VALUE setup variables are displayed in % concentration.*

The procedure to use the range expand feature is described with the following example:

> RANGE EXPAND SETUP EXAMPLE
>
> Suppose the 4-20 mA output is desired between 30.0 and 70.0 mS/cm and that it is to increase as the measured conductivity increases (non-inverted output).

Setting The Low Endpoint

The low endpoint, entered with the LO OUT VALUE setup variable, is the point at which the minimum outputs (0 VDC, 0 mA and 4 mA) are provided.

1. With display in conductivity or % concentration measuring mode (conductivity for this example), press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Condí or "Conc").
2. Press **NEXT** key until display indicates "outP". Then press **ENTER** key to access the "outP" menu of setup variables (display indicates "SIM VALUE").
3. Press **NEXT** key <u>once</u> to make display indicate "LO OUT VALUE".

4. Use ↑ and ← keys to make display indicate the low endpoint at which the minimum outputs are to be provided (30.0 mS/cm for 4 mA for this example).
5. Press **ENTER** key to enter value ("OK" flashes to confirm entry.

Setting The High Endpoint

The high endpoint, entered with the HI OUT VALUE setup variable, is the point at which the maximum outputs (5 VDC, 1 mA and 20 mA) are provided.

1. With the display still in the "examination" mode, press **NEXT** key once to make display indicate "HI OUT VALUE".
2. Use ↑ and ← keys to make display indicate the high endpoint at which the maximum outputs are to be provided (70.0 mS/cm for 20 mA for this example).
3. Press **ENTER** key to enter value ("OK" flashes to confirm entry.

10.3 Using Output Hold Feature

The 0-5 VDC, 0-1 mA and 4-20 mA analog outputs can be held during calibration or while setting up the instrument to suspend operation of a receiving device.

Keypad Activation

When pressed together, the **OUTPUT** key and recessed **END CAL/HOLD** button activate the hold mode feature. At this time, the **HOLD** status indicator lights and output values are held for 30 minutes unless the hold feature is extended or cancelled. Also, relays set up for the control mode are suspended in the "off" state (as if their setpoints are satisfied). Relays set up for the alarm mode are unaffected and remain in whatever state they are in when the hold feature is activated. Thirty seconds before the 30-minute hold period expires, the **HOLD** indicator begins flashing to warn of impending automatic cancellation. Another press of the **OUTPUT** key extends the hold period for another 30 minutes. The output hold feature may be cancelled at any time by simultaneously pressing the **CANCEL HOLD** and **OUTPUT** keys.

Remote Activation

The output hold feature can also be activated from a remote location by an LSTTL-compatible (active low) or switch closure input connected to Terminals 14 and 15 on TB2. When the switch is closed, the outputs are held and the relays are affected in the same way as described in the "Keypad Activation" subsection. Remote activation of the hold feature also causes the **HOLD** status indicator to flash continuously during the entire time "hold" is in effect. When the remote switch is opened, the outputs and control relays resume their normal operation.

SECTION 11 - USING SECURITY LOCK FEATURE

A security lock feature is provided to prevent unauthorized alteration of stored values. When the CDCN-672 is locked (identified with lit "LOCK" status indicator), stored setup variable values—including preset calibration points for the "two-key" method—cannot be changed. However, calibration can be performed using any method and all stored values can be displayed.

11.1 Locking Stored Values

1. With display in conductivity or % concentration measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond" or "Conc").
2. Press **NEXT** key until display indicates "CnFg". Then press **ENTER** key to access the "CnFg" menu of setup variables (display indicates "ZErO").
3. Press **NEXT** key until display indicates "0000" and "LOCK" (identifiers for security lock feature).
4. Use ⬆ key to make display indicate the lock code "0001."
5. Press **ENTER** key to enter lock code ("OK" flashes to confirm entry and **LOCK** status indicator remains lit).
6. Press **EXAM/CANCEL** key to return display to measuring mode.

11.2 Unlocking Stored Values

1. With display in conductivity or % concentration measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond" or "Conc" with **LOCK** status indicator lit).
2. Press **NEXT** key until display indicates "CnFg" and "LOCK". Then press **ENTER** key to access the "CnFg" menu of setup variables (display indicates "ZErO" and "LOCK").
3. Press **NEXT** key until display indicates "0000" and "LOCK" (identifiers for security lock feature).
4. Use ⬆ and ⬅ keys to make display indicate the unlock code "1234".
5. Press **ENTER** key to enter unlock code ("OK" flashes to confirm entry and **LOCK** status indicator remains lit).
6. Press **EXAM/CANCEL** key to return display to measuring mode (**LOCK** status indicator disappears from display).

PART FOUR - OPERATING AIDS

SECTION 1 - PRESERVING MEASUREMENT ACCURACY

1.1 Keeping Sensor Clean

Clean the sensor as required using the recommended procedure described in the sensor operating instruction manual.

1.2 Keeping Instrument Calibrated

Calibrate the instrument as experience dictates, using one of the methods described in Part Three, Section 5 (or Section 7 for % concentration). Errors in readings may be caused by using a diluted or contaminated reference solution when calibrating the instrument. For best accuracy, do not reuse reference solutions. The system can never be more accurate than the solutions used to calibrate it. Note that reference solutions may change in value with ambient temperature. Therefore, the sensor and reference solution should be allowed to come to the same temperature.

1.3 Avoiding Ground Loop Errors

The instrument may be affected by a "ground loop" electrical problem when there is moisture in a junction box. This condition provides a conductive pathway from the sensor connections to earth ground. To prevent a ground loop from occurring, keep terminal connections dry and corrosion-free.

1.4 Avoiding Electrical Interferences

Do not run sensor wires in the same conduit with line power. Excess wire should not be coiled near motors or other equipment that may generate electric or magnetic fields. Cut wires to proper length during installation to avoid unnecessary inductive pick-up ("electrical noise" may interfere with sensor signal).

SECTION 2 - TEMPERATURE CALIBRATION

The instrument is typically selected to automatically compensate the conductivity (or % concentration) reading for changes in temperature. The CDCN-672 is factory-calibrated for temperature to provide very accurate temperature measurement. However, the CDCN-672 has temperature calibration capabilities to tailor the calibration for specific, unusual application conditions to provide the highest possible temperature measurement accuracy. A single or two-point method for temperature calibration may be performed.

2.1 Single-Point Method

This method requires a container of water (or process solution) that has a known temperature value approximately equal to the normal operating temperature of the process.

1. Place conductivity sensor in water (or process solution) of known temperature value.
2. Press **DISP VAR** key as needed to display temperature and allow display reading to stabilize. The sensor may take several minutes to attain temperature equilibrium with the solution.
3. Press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond" or "Conc").
4. Press **NEXT** key once to make display indicate "dEG C" or "dEG F". Then press **ENTER** key to access this menu of setup variables (display indicates "CAL VALUE").
5. Use ⬆ and ⬅ keys to make display indicate the known temperature value of the solution.
6. Press **ENTER** key to enter value (display indicates "buSY" for approx. 10 seconds, then flashes "OK" to confirm entry and returns to temperature measuring mode). HI/LO ERROR flashes if the difference between the entry value and actual solution temperature is greater than 5.0°C.

This completes the single-point temperature calibration.

2.2 Two-Point Method

This method requires a container of ice water and a container of boiling water.

1. Place conductivity sensor in the ice water.
2. Press **DISP VAR** key as needed to display temperature and allow display reading to stabilize. The sensor may take several minutes to attain temperature equilibrium with the water.
3. Press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond" or "Conc").
4. Press **NEXT** key once to make display indicate "dEG C" or "dEG F". Then press **ENTER** key to access this menu of setup variables (display indicates "CAL VALUE").
5. Press **NEXT** key once to make display indicate "LO CAL VALUE".
6. Use ⬆ and ⬅ keys to make display indicate "0.0°C" or "32.0°F".

7. Press **ENTER** key to enter value (display indicates "buSY" for approx. 10 seconds, then flashes OK" to confirm entry and returns to temperature measuring mode). If HI/LO ERROR flashes, the difference between the entry value and actual solution temperature is greater than 10.0°C.
8. Place conductivity sensor in the boiling water. Allow sensor to attain temperature equilibrium with the water.
9. Press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond" or "Conc").
10. Press **NEXT** key once to make display indicate "dEG C" or dEG F". Then press **ENTER** key to access this menu of setup variables (display indicates "CAL VALUE").
11. Press **NEXT** key twice to make display indicate "HI CAL VALUE".
12. Use ⬆ and ⬅ keys to make display indicate "100.0°C" or "212.0°F".
13. Press **ENTER** key to enter value (display indicates "buSY" for approx. 10 seconds, then flashes "OK" to confirm entry and returns to temperature measuring mode). If HI/LO ERROR flashes, the difference between the entry value and actual water temperature is greater than 10.0°C.

This completes the two-point temperature calibration.

SECTION 3 - SIMULATING MEASURED VALUES

To aid in setting up external devices (recorders, controllers, etc.) connected to the analog outputs and to verify relay operation, conductivity or % concentration values may be simulated. This can only be accomplished when the security lock feature is in the unlock mode (Part Three, Section 11.2). Accessing the "SIM VALUE" setup variable displays a conductivity or % concentration value. After entering a simulation value, analog output values corresponding to the displayed value are provided. Changing the simulation value also changes the output values respectively. Exiting the "SIM VALUE" setup variable returns outputs to tracking the measured conductivity or % concentration. The output hold feature (Part Three, Section 10.3) may be used in conjunction with an entered simulation value. This allows a simulation value to be entered and the outputs corresponding to that value to be held, for example, while calibrating the CDCN-672.

To simulate a desired value:

1. With display in conductivity or % concentration mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicates "Cond" or "Conc").
2. Press **NEXT** key until display indicates "outP". Then press **ENTER** to access this menu of setup variables (display indicates "SIM VALUE").
3. Use ⬆ and ⬅ keys to make display indicate the desired simulation value.
4. Press **ENTER** key to enter value ("OK" flashes to confirm entry). Output values change from tracking measured conductivity or % concentration to those which correspond to the entered simulation value.
5. To cancel the simulation value, press **EXAM/CANCEL** key.

PART FIVE - PRINCIPLE OF OPERATION

See Figure 5-1 for functional diagram pertaining to these descriptions:

1. The power-supply section converts line power to appropriate voltages for circuit operation.

2. The scaling and analog-to-digital converter sections accept signals from the conductivity sensor. This section converts these analog conductivity and temperature signals to digital signals for use by the microprocessor.

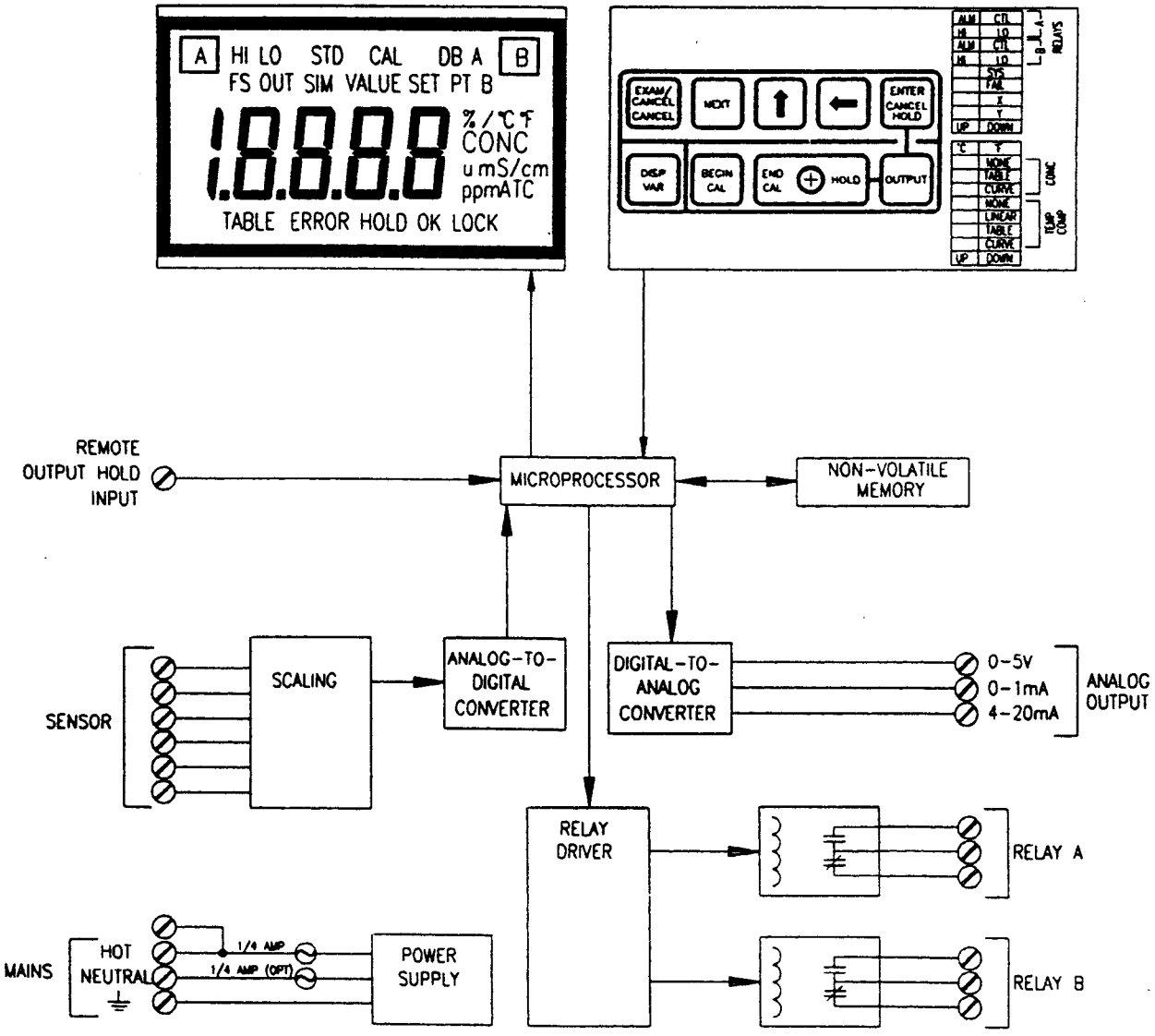


FIGURE 5-1 Instrument Operations Block Diagram

3. Using the conductivity and temperature signals, the microprocessor computes the temperature compensated conductivity or % concentration value. The microprocessor also performs the various control algorithms, updates the liquid crystal display, monitors the keypad and other configuration switches and controls the relay status and the analog outputs. The user-entered calibration and configuration values are retained in a non-volatile memory.

4. The liquid crystal display indicates the process-related values (conductivity, % concentration, temperature and 4-20 mA output value) along with a variety of annunciators to indicate the status of the analyzer. The display also indicates configuration constant values, error messages, diagnostic information and relay status.

5 The keypad and configuration switches and the remote "hold" input are continuously monitored by the microprocessor Based on the status of these inputs, the microprocessor immediately initiates the appropriate action.

6 The analog outputs (0-1 mA, 0-5 VDC and 4-20 mA) are controlled by the microprocessor The digital output values are sent to the digital-to-analog converter section.

7 The microprocessor controls the relay driver circuitry, based on each relay's configured mode (control or alarm) and fail-safe or system alarm operation selection The relay driver section operates relays A and B.

PART SIX - SERVICE AND MAINTENANCE

SECTION 1 - GENERAL

1.1 Inspecting Sensor Cable

If a measurement problem exists and the sensor cable is suspected, inspect it for physical damage. If interconnect cable is used, disconnect cable at the sensor and instrument, and check wires for internal shorts with an ohmmeter.

1.2 Checking System Periodically

Depending on the application, system calibration should be performed periodically to maintain measurement accuracy. Frequent checks are suggested until operating experience can determine the optimum time between checks that provides acceptable measurement results.

1.3 Replacing Relays

1. *Disconnect line power.* Remove display module assembly by loosening two captive fasteners and disconnecting ribbon-cable connector.
2. Unfasten four screws that hold power-supply board to bottom of instrument case. Remove power-supply board.
3. Remove black insulator (with terminal designations) to access relay pins.
4. Unsolder relay from backside of power-supply board (side opposite terminal strips).
5. Replace relay with equivalent relay (p/n 99X2T1016). Solder relay pins into board and replace black insulator.
6. Mount power-supply board, connect ribbon cable connector and install display module assembly with captive fasteners.

SECTION 2 - TROUBLESHOOTING

2.1 System Diagnostic Error Messages

Improper operation is signaled by a flashing **ERROR** indicator while the display alternates between a measured value and one of the following error messages:

Table G – SYSTEM DIAGNOSTIC ERROR MESSAGES — MEANINGS/CORRECTIVE ACTIONS		
Error Message	Meaning	Action To Take
"Er 1"	Faulty conductivity and temperature inputs (open or shorted cable, defective sensor, etc.).	Check wiring and calibrate system.
"Er 2"	Faulty conductivity input ("S" flashes).	Check wiring and calibrate system.
"Er 3"	Faulty temperature input ("°C" or "°F" flashes).	Check wiring and calibrate system.
"Er 4"	Incorrectly set lower bank DIP switches (wrong combinations).	Depending on whether the CDCN-672 is used to measure conductivity or % concentration, refer to Part Three, Section 4, 6 or 8 and reset switches as described.
"Er 5"	Entry values are not accepted by non-volatile memory (but CDCN-672 will still operate).	Call OMEGA for assistance.
"Er 6"	The system has not been "zeroed" during instrument setup.	Depending on whether the CDCN-672 is used to measure conductivity or % concentration, refer to Part Three, Section 4.5, 6.4 or 8.7 for zeroing instructions.
"Er 7"	Improper user-defined concentration conversion table.	Refer to Part Three, Sections 8.3 and 8.5 and review instructions to ensure proper table setup.
"Er 8"	Improper user-defined temperature compensation table.	Depending on whether the CDCN-672 is used to measure conductivity or % concentration, refer to Part Three, Section 4.4 or 8.6 under "User-Defined Temperature Table Compensation" subheading for table setup instructions.
"Er 9"	Improper calibration (sensor in wrong conductivity reference solution).	Recalibrate with sensor in correct value reference solution.
"Er 10"	Defective non-volatile memory (CDCN-672 is inoperable).	Call OMEGA for assistance.
"Er 11"	Volatile memory failure (battery backup not in effect).	Make sure BATTERY jumper (Figure 3-1) is in ON position and recharge battery by operating the CDCN-672 for 48 hrs.
"Er 12"	Warning — the full-scale value has been changed.	Since this affects the instrument setup, refer to Part Three, Section 4, 6, or 8 and review instructions to ensure proper setup.

NOTE: "Er 10", "Er 11" and "Er 12" error message indications are not cleared automatically after corrective action is taken. These messages may be cleared anytime by pressing the ENTER key. However, if the error condition remains, the error message will reappear.

All error messages are only displayed in the measurement mode. During a configuration or calibration procedure, an error message will not be displayed. Upon completing the procedure, an error message will be displayed if the condition has not been corrected. If more than one problem condition occurs at the same time, the most serious error message takes precedence and will be displayed. If that condition is corrected and others still exist, the error message for the most serious remaining condition will be displayed.

2.2 Common Problems

The following table lists symptoms and their typical causes to aid in correcting common problems.

Table H – TROUBLESHOOTING COMMON PROBLEMS	
Symptom	Typical Causes
Display is completely blank.	1. Line power is not present or connected. 2. Line fuse(s) open. 3. Ribbon cable plug from display module assembly is not properly connected into power-supply board assembly.
Output values remain fixed when process value is known to be changing.	Output hold feature is temporarily holding outputs. Simultaneously press **CANCEL HOLD** and **OUTPUT** keys to cancel hold feature or open external switch if held from remote location (Part Three, Section 10.3).
Relay remains deenergized even though setpoint has been exceeded.	Output hold feature is temporarily suspending relay operation. Simultaneously press **CANCEL HOLD** and **OUTPUT** keys to cancel hold feature or open external switch if held from remote location (Part Three, Section 10.3).
Valid setup variable value cannot be entered.	Instrument is in "lock" mode. Enter unlock code to unlock instrument (Part Three, Section 11.2).

MANUAL # M-1728 ****ADDENDUM****

****NOTE****

IF ON INITIAL POWER UP OF THE CDCN-672 YOU OBTAIN AN "E-12" ERROR, WHICH IS AN EPROM ERROR, PLEASE POWER UP THE CDCN-672 UNIT FOR 24 HOURS. IF THIS ERROR DOESN'T CLEAR AFTER 24 HOURS, NEXT HIT THE "ENTER" KEY AND THIS ERROR SHOULD CLEAR.

THE CDCN-672 HAS A RECHARGEABLE BATTERY TO TEMPORARILY BACKUP THE EPROM MEMORY. THIS BATTERY WILL ONLY BACK UP THE EPROM FOR ABOUT 4 HOURS CONTINUOUSLY WITH THE AC POWER OFF. WHENEVER AC POWER IS ON, THE BATTERY IS GETTING RECHARGED.

PART SEVEN - SPARE PARTS AND ACCESSORIES

CDCN-672 Analyzer

Description	Part Number
BATTERY Jumpers (7 per package)	670X4A1140
Relay, 5A Contacts, 24 VDC Coil	99X2T1016
Complete Circuit Board Set* (115 V, 50/60 Hz – 1 fuse)	672M4G5020-101
Complete Circuit Board Set* (230 V, 50/60 Hz – 1 fuse)	672M4G5020-201
Complete Circuit Board Set* (230 V, 50/60 Hz – 2 fuses)	672M4G5020-202
Liquid Crystal Display	9X6Q1124
Optional Vertical Pipe-mount Kit	1000A4A1077
1/4 Amp. Slo-blow Fuse (5 mm dia. x 20 mm long)	99X1F1048
Door Assembly	1000M4G1189-103

*Individual boards cannot be separately ordered because they are calibrated as a set. However, the boards may be repaired and recalibrated at the factory.

Sensors And Accessories

Polypropylene Sensor with 304 SS Sanitary Fittings	CDE-3605P
PVDF Sensor with 304 SS Sanitary Flange	CDE-3606K
Polypropylene Convertible Sensor	CDE-3625P
PVDF Convertible Sensor	CDE-3626K
Polypropylene Flange Mount Style Sensor*	CDE-3635P
PVDF Flange Mount Style Sensor*	CDE-3636K
Polypropylene Perlick Mount Sensor	CDE-3665C
Sensor Extension Cable (need user-provided junction box - order by the foot lengths)	CDE-36103
Sanitary Clamp	CDE-36132
Spare Sanitary Cap	CDE-36037
Sanitary Gasket	CDE-36327
Sanitary (Flow-Through) Tee	CDE-36048

*The flange mount style sensor features metal 5/8-11 UNC threads for fastening into any metal flange. A Viton O-ring provides a leak-proof seal.

NOTE: Sensors' standard cable length is 4-1/2 ft. Optional cable lengths are 10 ft. and 20 ft. For longer lengths, use sensor extension cable and junction box.

NOTES

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 which wear are not warranted, including but 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 it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESS 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.

OMEGA is a registered trademark of OMEGA ENGINEERING, INC.

Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

Shop online at www.omega.com

TEMPERATURE

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

PRESSURE, STRAIN AND FORCE

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

FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION

- Data Acquisition & Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
- Recorders, Printers & Plotters

HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL

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

M1728/0303