GLI_ElectrodelessCondTransmitter_692E_om_D598

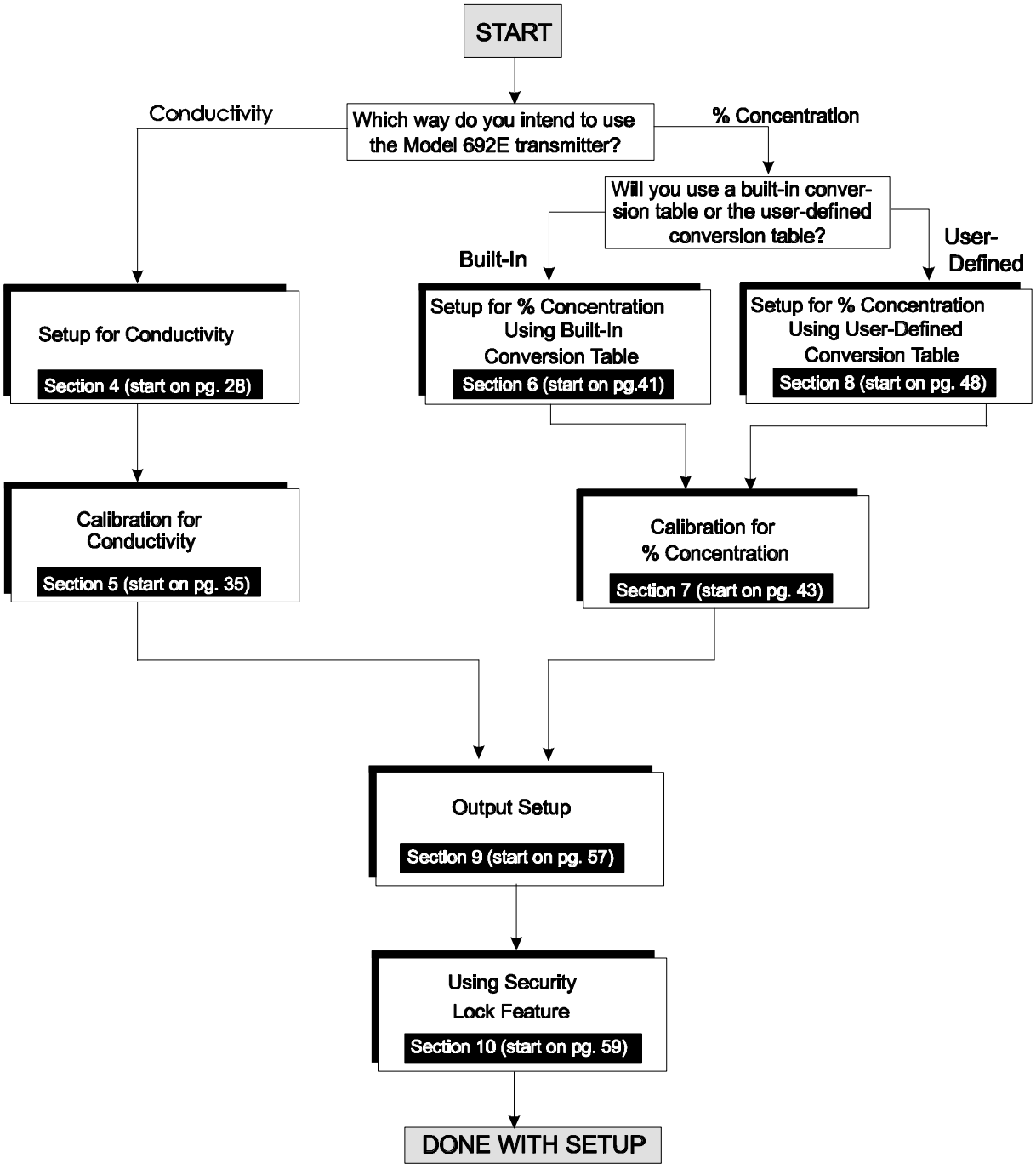
Manual No. 692E
Revision 5-598

MODEL 692E
TWO-WIRE ELECTRODELESS CONDUCTIVITY TRANSMITTER

(selectable for conductivity or % concentration measurement)

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 692E. Part Two explains how to install and wire the instrument. To familiarize you with the basic operation of the 692E, 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 transmitter.



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PART ONE - INTRODUCTION

SECTION 1 - GENERAL INFORMATION

1.1 Instrument Capability

Two Transmitters in One

The Model 692E can be used with a GLI Model 3600E or 3700E-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 common industrial solutions to conveniently convert measured conductivity values to % concentration. For solutions that do not have a built-in table, 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 692E transmitter 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 loop current.

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

The 4-20 mA instrument output, which tracks the measured conductivity or % concentration, is isolated to eliminate problems caused by ground loops. An output hold feature can be used to maintain the latest output during calibration or instrument setup to suspend operation of a receiving de-

vice. A range expand feature allows the 4-20 mA output to represent any segment of the measuring scale.

Operator Safety

Modular construction simplifies field servicing and provides electrical safety for the operator. The printed circuit module assemblies contain voltages no greater than 24 VDC and are safe to handle. A terminal strip compartment, with separate access and weatherproof seals, permits electrical hookup without exposing the instrument circuitry to the environment.

Non-volatile Backup Memory

A non-volatile memory in the 692E stores all user-entered values (calibration data, range expand endpoints, etc.) indefinitely, even if power is lost or turned off. A back-up battery is not required.

1.2 Product Identification

The serial # of your instrument is located at the top of the backside of the display module assembly (Figure 3-2). Write the serial # in the space provided below for convenient identification should technical assistance be required.

Serial #_____

SECTION 2 - SPECIFICATIONS

2.1 Operational

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

Measuring Ranges:

- Conductivity..... 0-500.0 µS/cm, 0-2000 µS/cm, 0-2.000 mS/cm, 0-20.00 mS/cm, 0-200.0 mS/cm, 0-2000 mS/cm or 0-8.00 S/cm; selectable with user-entered full-scale value
- Concentration 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

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

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

Full Scale Range	Max. Length
500 to 49,999 µS/cm	100 ft.
50,000 to 2,000,000 µS/cm.....	200 ft.

Power Requirements..... 16 to 36 volts DC

Analog Output..... Isolated 4-20 mA with output hold feature

Range Expand - The 4-20 mA output can be made to represent any segment of the measuring scale.

Hazardous Area Classification:

Intrinsic Safety..... FM and CSA: Class I, Div. 1 Groups A,B,C and D
Class II, Div. 1 Groups E,F and G

♦ Maximum Loop Load (in series with 692E and power supply)..... With 24 VDC supply: 400 ohms
With 32 VDC supply: 800 ohms
With 40 VDC supply: 1000 ohms

NOTE - For long cable runs, the resistance of the wire must be considered and may decrease maximum load capability.

♦Not applicable when using barrier for intrinsic safety.

2.2 Analyzer Performance (Electrical, Analog Output)

Sensitivity ..... 0.3% of span

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

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

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

Temperature Drift..... Zero: 0.050% of span per °C
Span: 0.025% of span per °C

Response Time..... Selectable 1, 3, 10 or 30 seconds to 90% of value upon step change

2.3 Mechanical

Enclosure..... General purpose -- safe for Div. 2; NEMA 4X, polycarbonate with two 1/2-inch conduit holes and four stainless steel mounting tabs

Mounting Configurations..... Surface or optional pipe mount (vertical or horizontal)

Net Weight..... 3 lbs. (1.36 kg) approx.

PART TWO - INSTALLATION

SECTION 1 - UNPACKING

After unpacking, it is recommended to save the shipping carton and packing materials in case the instrument is stored or re-shipped. Inspect the equipment and carton for damage. If there is evidence of shipping damage, notify the carrier immediately.

SECTION 2 - MECHANICAL REQUIREMENTS

2.1 Location

An agency-approved Model 692 is designed intrinsically safe. That is, an explosionproof enclosure is not required when the transmitter, powered through an approved barrier, is located in Division 1 hazardous areas.

WARNING: THE POWER SUPPLY AND INTRINSIC SAFETY BARRIER MUST ALWAYS BE LOCATED IN A SAFE AREA.

1. Locate the transmitter as close as possible to where the sensor is to be installed. The maximum distance between the sensor and transmitter depends upon the full-scale value of the transmitter.

   - **500-49,999 µS/cm Full-scale Value:** The transmitter may be located up to 100 ft. (30 m) from the installed sensor.
   - **50,000-2,000,000 µS/cm Full-scale Value:** The transmitter may be located up to 200 ft. (61 m) from the installed sensor.

2. Mount the transmitter 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 the various ways that the the transmitter can be mounted. To surface mount, use the supplied stainless steel tabs. To pipe mount, use the optional GLI hardware kit. The way you attach the optional bracket determines vertical or horizontal pipe mounting.

To surface mount the 692:

1. Place tabs in appropriate locations on back of enclosure and fasten with screws provided.
2. Position the instrument on a flat surface and use appropriate fasteners to secure it in place.

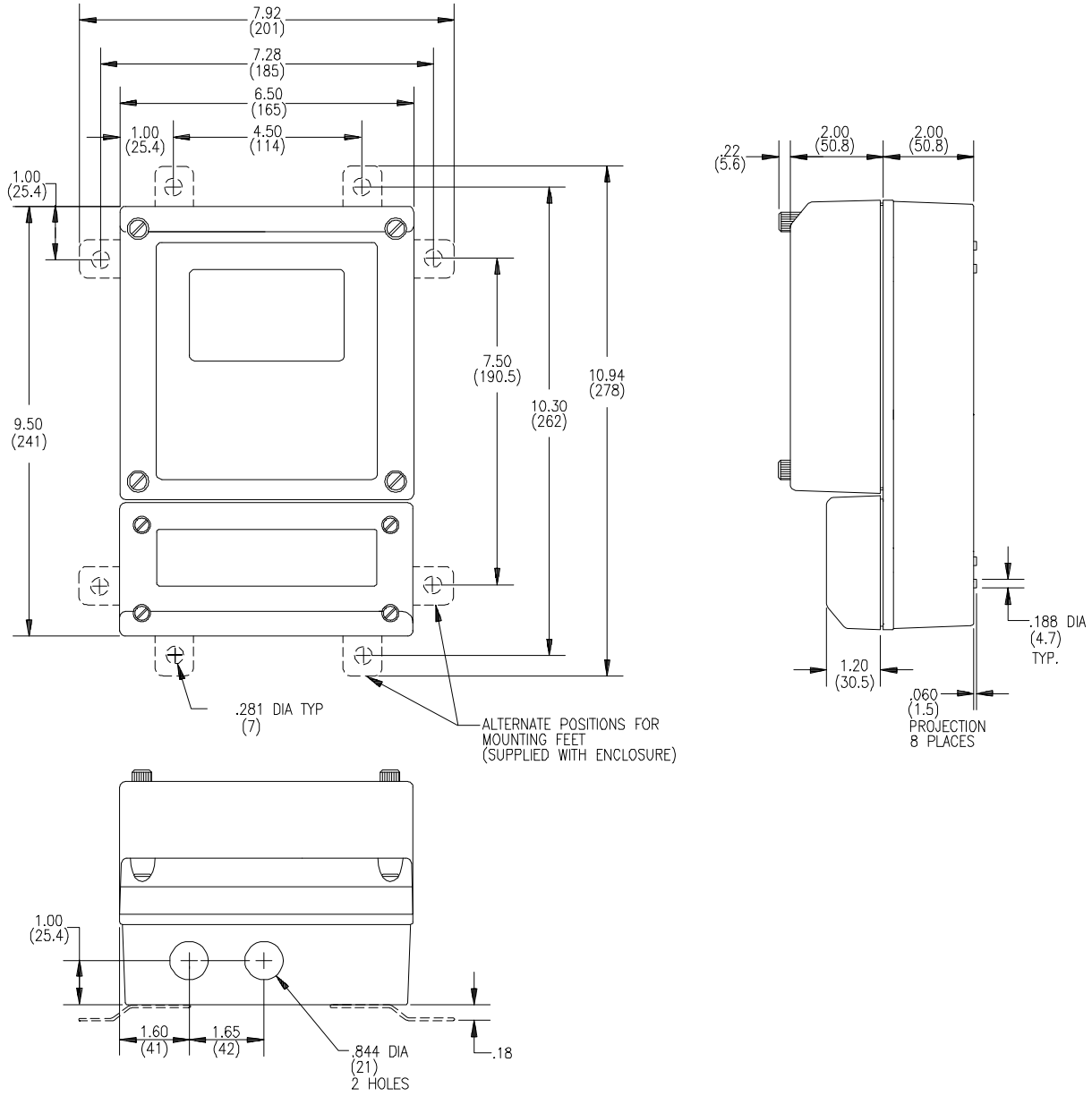


FIGURE 2-1 Enclosure Outline

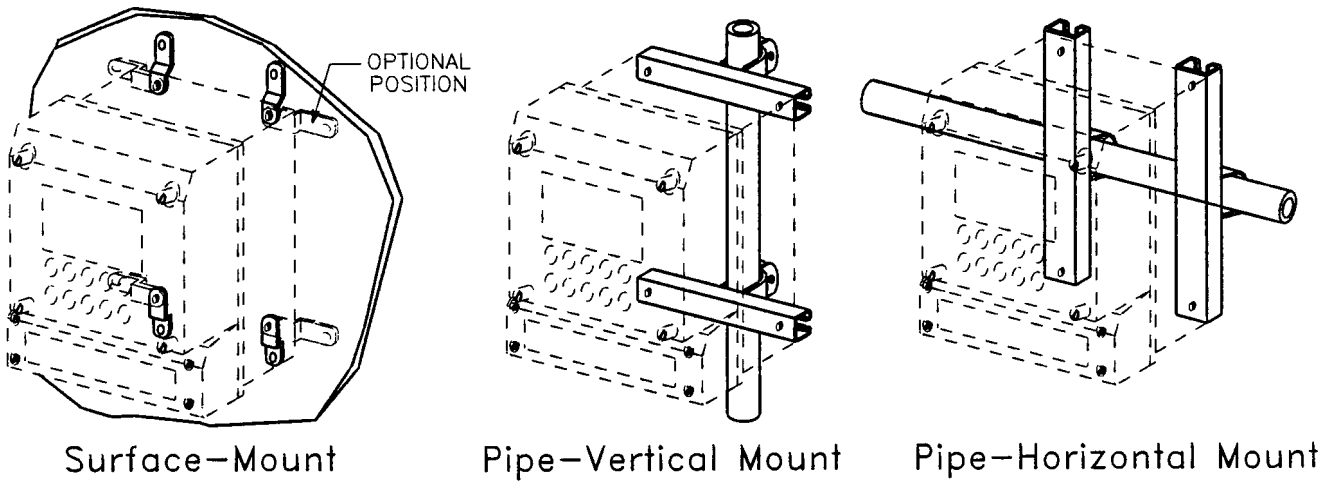


FIGURE 2-2 Mounting Configurations

2.3 Conduit Hole Requirements

Recommendation: Run all wiring to the transmitter in 1/2-inch, grounded metal conduits. If using only shielded cables, appropriate strain reliefs or cable grips are required. Use cable grips (GLI part number 3H1091) and watertight locknuts (GLI part number 3H1230) for cable entries. Seal unused cable entry holes with appropriate plugs.

NOTE: *Use NEMA 4 rated fittings and plugs to maintain the watertight integrity of the NEMA 4 enclosure.*

SECTION 3 - ELECTRICAL CONNECTIONS

To access terminal strips for electrical connections, loosen bottom four captive fasteners and remove terminal compartment cover. Figure 3-2 shows terminal designations for instrument hookup. If the transmitter is located in a hazardous area, refer to Section 3.4 for wiring details.

3.1 Conductivity Sensor

Installation Tip! When indirectly connecting the sensor to the transmitter using a junction box and interconnect cable, route the cable in 1/2-inch, grounded metal conduit to protect it from moisture, electrical noise, and mechanical damage.

NOTE: *Do not route the sensor or interconnect cable in any conduit containing AC power wiring ("electrical noise" may interfere with the sensor signal).*

CAUTION: USE THE STANDARD TERMINATION PROCEDURE DESCRIBED IN THE SENSOR INSTRUCTION MANUAL TO TERMINATE THE SENSOR OR INTERCONNECT CABLE -- UNLESS THE TRANSMITTER HAS THE EUROPEAN COMMUNITY "CE" LABEL. IN THIS CASE, USE THE CE TERMINATION PROCEDURE.

Direct Wiring

Standard Sensor: Refer to Figure 3-2 and connect sensor cable wires to "CONDUCTIVITY SENSOR" terminals on TB2, matching colors as indicated. Always connect the shield wire to the "SHLD" terminal.

Special "CE-terminated" Sensor: Connect sensor cable wires to "CONDUCTIVITY SENSOR" terminals on TB2, matching colors as indicated -- and connecting its signal shield wire (identified by clear insulation) to the "SHLD" terminal. Capture the bare bent-back cable shield wire under the cord grip nut as shown in Figure 2-3.

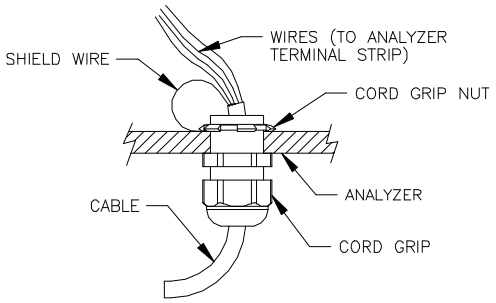


FIGURE 2-3 Sensor or Interconnect Cable Bare Shield Wire Connection

Indirect Wiring (with interconnect cable and junction box)

Standard Sensor: In the junction box, connect the sensor cable and interconnect cable wires, matching colors and connecting their shields together. Do not connect these shield wires to earth ground. In the transmitter, connect interconnect cable wires to "CONDUCTIVITY SENSOR" terminals on TB2, matching colors as indicated. Always connect the shield wire to the "SHLD" terminal.

Special "CE-terminated" Sensor: In the junction box, connect the sensor and interconnect cable wires, matching colors -- and connecting their signal shield wires (identified by clear insulation) together. Do not connect any shield wires to earth ground. In the transmitter, connect interconnect cable wires to "CONDUCTIVITY SENSOR" terminals on TB2, matching colors as indicated -- and connecting its shrink wrapped or taped signal shield wire to the "SHLD" terminal. Capture the bare bent-back cable shield wire under the cord grip nut as shown in Figure 2-3.

3.2 Power Supply

Connect the DC voltage power supply to "4-20 mA" terminals on TB1, matching polarity as indicated.

NOTE: *If the 692 is used in an intrinsically safe application, it may be located in a Class I or II, Division 1 hazardous area without an explosionproof enclosure when powered through an approved barrier. Refer to Section 3.4 for details on hazardous area wiring requirements.*

3.3 Analog Output

The isolated 4-20 mA output can represent either the measuring scale or a selected segment of it. To use the range expand feature, refer to Part Three, Section 9.2 for details.

The isolated 4-20 mA output can drive auxiliary devices (resistive loads) such as displays, recorders and computers, provided that the voltage supplied by the power supply is adequate. Devices must be wired in series with the transmitter and power supply. The voltage drop across the load(s) and the 16 volts DC minimum needed to drive the transmitter determines the minimum voltage required from the power supply.

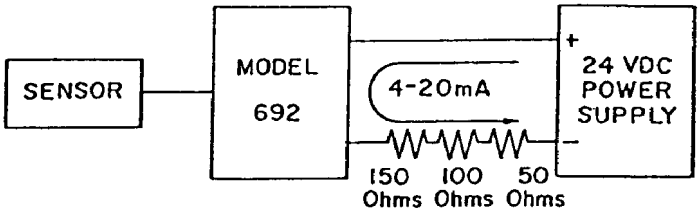
1. Determine the necessary voltage required to adequately drive the Model 692 and auxiliary device(s).

   A. The Model 692 acts as a current controlling device. Thus, the current output remains the same even if the power supply voltage fluctuates or the load resistance changes. Current varies only with respect to the sensor signal, as long as the voltage drop across the transmitter is at least 16 VDC, but not more than 36 VDC.

   B. The load(s) in the circuit will generally have some electrical resistance, 100 ohms for example. The 4-20 mA loop current will produce a voltage drop across each load. The maximum voltage drop will exist when the loop current is 20 mA. The power supply must provide enough voltage for this drop plus the 16 VDC minimum required for the Model 692. Two examples illustrate this point:

EXAMPLE 1

Sufficient Power Supply Voltage

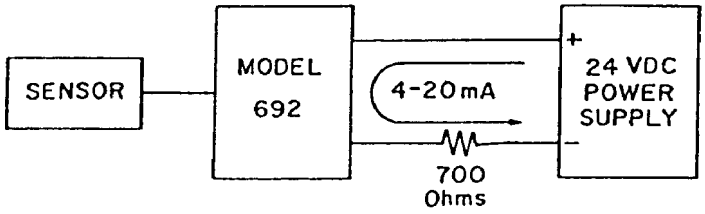


Total Load Resistance = 300 ohms
At 20 mA loop current, the voltage drop across the load(s) is 6 volts:
300 ohms x 20 mA = 6,000 mV or 6 volts

Subtract 6 volts from the 24 volt source to determine that 18 volts is available to power the Model 692. The 18 volts is within the specified 16 to 36 volt range and is sufficient to power the transmitter.

EXAMPLE 2

Insufficient Power Supply Voltage



Total Load Resistance = 700 ohms
At 20 mA loop current, the voltage drop across the load is 14 volts:
700 ohms x 20 mA = 14,000 mV or 14 volts

Subtract 14 volts from the 24 volt source to determine that 10 volts is available to power the Model 692. The 10 volts is below the specified 16 to 36 volt range and is not adequate to power the transmitter. If, for example, the power supply voltage was 40 volts instead of 24 volts, the voltage available to power the Model 692 would be 26 volts, well within the specified range.

2. Connect load(s) in series with transmitter and power supply.

NOTE: *Connecting the transmitter output to some types of computers may cause the computer display reading to fluctuate. This is caused by "electrical noise" in the signal line. To correct this condition, connect a 4.7 microfarad/80 volt, metal foil capacitor across the computer input.*

3.4 Hazardous Area Wiring (Intrinsically Safe -- Division 1)

All Model 692E regulatory agency certifications for installation of the Model 692E in a hazardous area require that the transmitter must be:

- Powered by a power supply that provides no more than 28 volts DC.
- Powered through a Pepperl & Fuchs KHD3-ICR/Ex130 200 transformer isolated barrier (GLI part number 1F1054).

Furthermore, each respective regulatory agency requires that you meet additional specific conditions. Refer to the appropriate agency subheading for details.

FM-approved System

The 692E, in a Class I or II, Div. 1 (Groups A through G) hazardous area, is UL Classified as intrinsically safe only when:

1. Using a GLI conductivity sensor with a model number listed on GLI control drawing 1001X4N1263.
2. Wiring the system in accordance with GLI control drawing 1001X4N1263.

CSA-certified System

The 692E, in a Class I or II, Div. 1 (Groups A through G) hazardous area, is CSA Certified as intrinsically safe only when:

1. Using a GLI conductivity sensor with a model number listed GLI control drawing 1001X4N1250.
2. Wiring the system in accordance with GLI control drawing 1001X4N1250.

PART THREE - OPERATION

SECTION 1 - OPERATING CONTROLS

The frequently used keypad switches (Figure 3-1) can be used without opening the instrument enclosure. One ten-position slide switch, used for selecting instrument response time, solution concentration tables and temperature compensation method is located on the backside of the display module assembly in the upper left corner (Figure 3-2). Access this switch by loosening the upper four screw-type fasteners and opening the enclosure door. The complete door/display module assembly can be easily removed from the enclosure by unsnapping it from its hinge and disconnecting the ribbon-cable connector.

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, temperature, or the 4-20 mA instrument output. The % concentration is only shown when one of the solution concentration conversion tables (built-in or user-defined) is used.

   - In “examination” mode:

     Display shows setup variables and their stored values. Setup data such as calibration values, low and high endpoints for range expand, etc. are called up in the sequence shown in Figure 3-3 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 canceled 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.

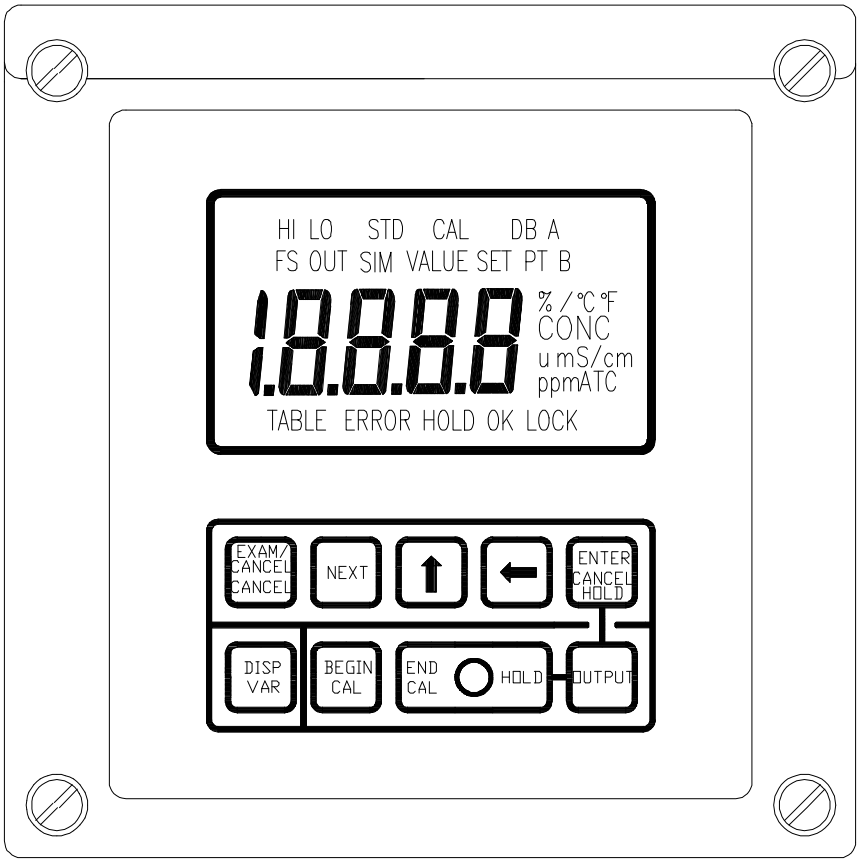


FIGURE 3-1 Keypad Switches

- 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.

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. % Concentration -- only when one of the solution concentration conversion tables (built-in or user-defined) is used to convert the measured conductivity.

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

C. Temperature in °C or °F

D. The 4-20 mA transmitter 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 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 Slide Switches

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

    These two response time switches configure the 692E for:

    A. The time it takes for the display and transmitter output 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 Response Time	Rate Of Change		Switch Position	
	For Cond. Input	For Temp. Input	**X**	**Y**
1 sec.	10% F.S./6 sec.	1°C/30 sec.	**OFF** (dn)	**OFF** (dn)
3 sec.	0.1% F.S./2 sec.	1°C/2 min.	**OFF** (dn)	**ON** (up)
10 sec.	0.1% F.S./3 sec.	1°C/3 min.	**ON** (up)	**OFF** (dn
30 sec.	0.1% F.S./5 sec.	1°C/5 min.	**ON** (up)	**ON** (up)

11. **°C/°F** switch (No. 3, Figure 3-2)

    In the **ON** (up) position, this switch selects measured temperature to be displayed in °F. In the **OFF** (down) position, the measured temperature is displayed in °C.

12. **CONC NONE** switch (No. 4, Figure 3-2)

    In the **ON** (up) position, this switch selects the 692E to be used as a conductivity instrument -- not a % concentration monitor. This switch has no effect in the **OFF** (down) position.

13. **CONC TABLE** switch (No. 5, Figure 3-2)

    In the **ON** (up) 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 **OFF** (down) position.

14. **CONC USER** switch (No. 6, Figure 3-2)

    In the **ON** (up) position, this switch selects the user-defined solution concentration conversion table for converting measured conductivity to % concentration. This switch has no effect in the **OFF** (down) position.

15. **TEMP COMP NONE** switch (No. 7, Figure 3-2)

    In the **ON** (up) position, this switch selects that there will not 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 **OFF** (down) position.

16. **TEMP COMP LINEAR** switch (No. 8, Figure 3-2)

    In the **ON** (up) 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 **OFF** (down) position.

17. **TEMP COMP TABLE** switch (No. 9, Figure 3-2)

    In the **ON** (up) 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 **OFF** (down) 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 **OFF** (down) position.*

18. **TEMP COMP USER** switch (No. 10, Figure 3-2)

    In the **ON** (up) 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 **OFF** (down) position.

1.3 Status Indicators

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

    Indicates that the output hold feature is in use (instrument output value is maintained).

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

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

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

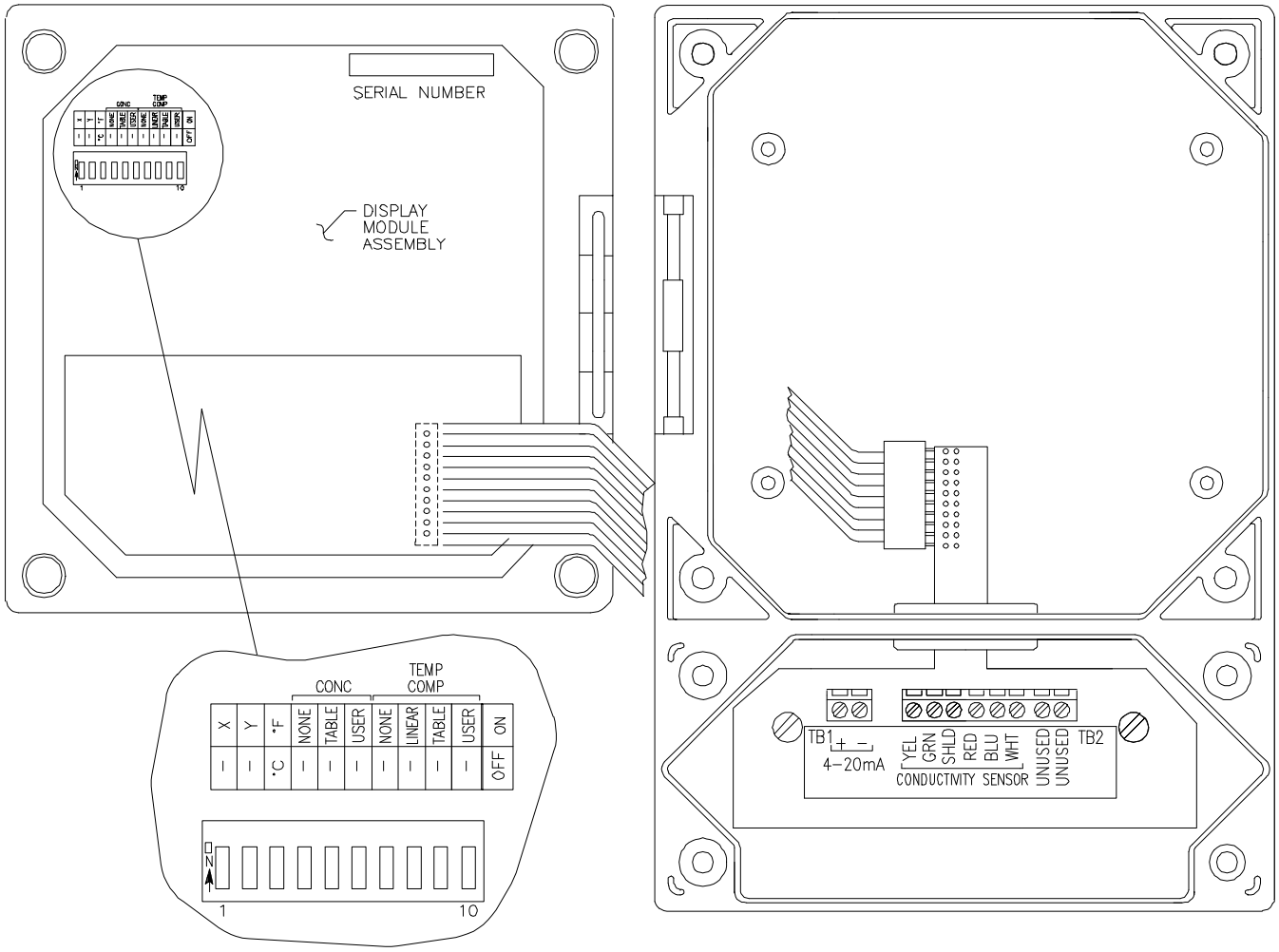


FIGURE 3-2 Controls on Backside of Display Module Assembly and Electrical Hookup Details

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

    Indicates that instrument keypad entry is “locked” to prevent unauthorized alteration of stored setup variable values. Refer to Section 10 for security lock feature instructions.

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

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

    Flashes to indicate an incorrect entry or alternately flashes with “Er 1”, “Er 2”, etc. up to “Er 12” to indicate a system diagnostic error causing improper system operation. See Part Six, Section 2.1 for details.

SECTION 2 - MEASURED VARIABLES

The 692 can display four measured variables. With the display in the measurement mode, each press of the **DISP VAR** key sequentially displays:

- % Concentration -- only when one of the solution concentration conversion tables (built-in or user-defined) is used to convert the measured conductivity.
- Conductivity in µS/cm, mS/cm or S/cm
- 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 four 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 Callup Chart and Table of Descriptions

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

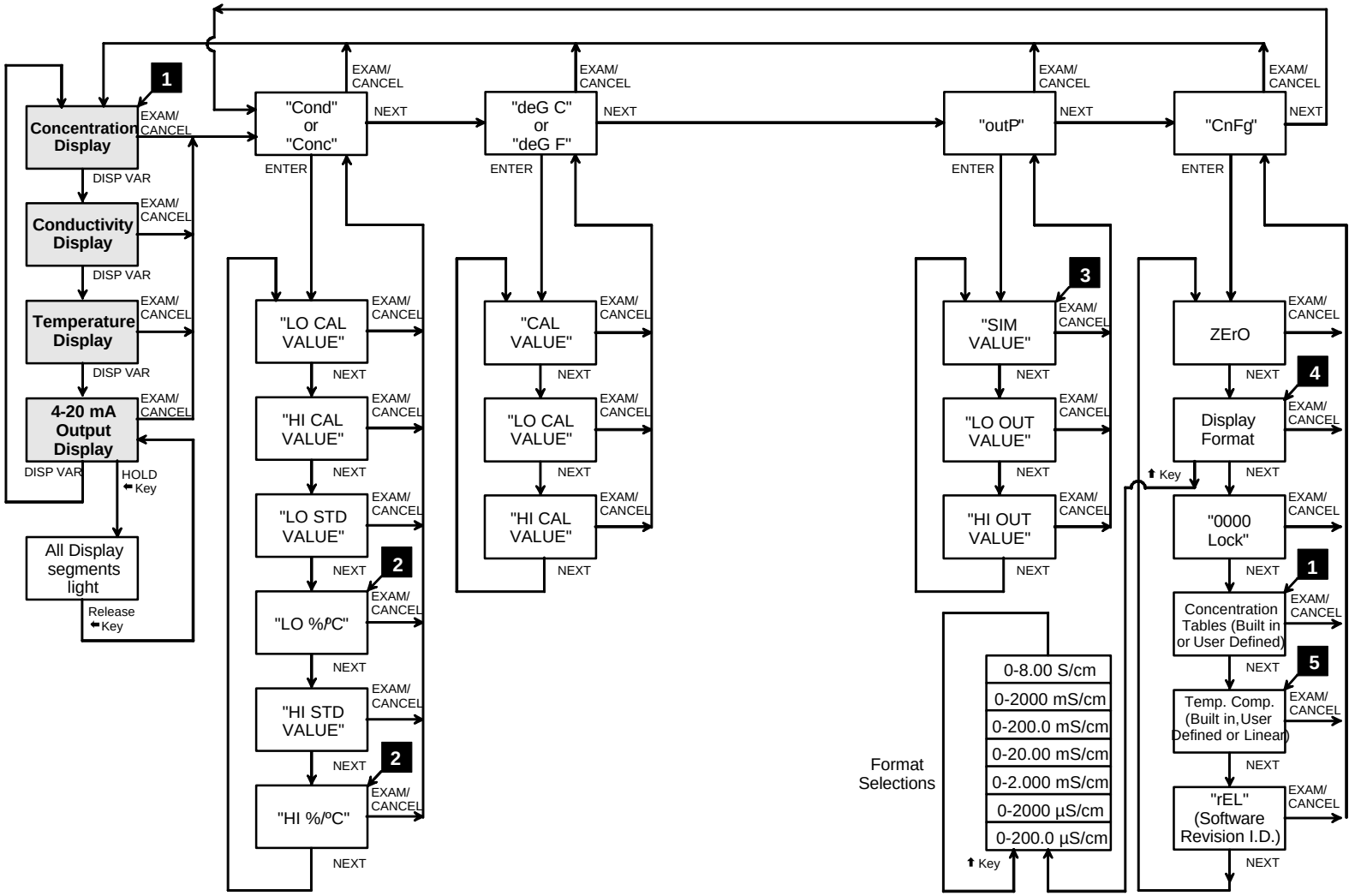


FIGURE 3-3 Display Modes and Callup Chart of Setup Variables

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 692E is in the conductivity measuring mode.

3 Displayed only when the output hold feature is not in use.

4 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.

5 Not displayed when a built-in concentration conversion table is selected.

The following table lists each of the four 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 value of lower conductivity or % concentration reference solution 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 value of higher conductivity or % conc. reference solution 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	
"outP" (Output) Menu					
"SIM VALUE"[2]	Sets simulated conductivity or % concentration value for diagnostic purposes. The transmitter output (loop current) responds to the displayed value.	Cond.	0.0	100.0%F.S.	
		Conc.	0.0%	100.0%	
"LO OUT VALUE"	Sets low endpoint at which the minimum output (4 mA) is provided.	Cond.	0.0	100.0%F.S.	
		Conc.	0.0%	100.0%	
"HI OUT VALUE"	Set high endpoint at which the maximum output (20 mA) is 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.		
"500.0 µS/cm," "2000 µS/cm," "2.000 mS/cm," "20.00 mS/cm," "200.0 mS/cm," "2000 mS/cm," - or - "8.00 S/cm"[3]	Selects display format (measurement units and decimal point position) during initial instrument setup.		⇧ key is used to select display format.		

[1] Only provided and displayed when the linear %/°C temperature compensation method is selected and the 692E is in the conductivity measuring mode.

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

[3] 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.

Table A -- DESCRIPTION OF SETUP VARIABLES (continued)				
Displayed Identifier	Use	Entry Value Range		Record Your
		Min.	Max.	Entry ⇩
"CnFg" (Configuration) Menu continued				
"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 1 CONC"[4]	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 slide 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"[5]	Selects a temperature compensation method to be applied to the measured conductivity.	T.C. method is selected by slide switch settings.		

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

[5] 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 Model 692E is used for measuring conductivity, use the setup instructions in this section. If the 692E is to be used to display solution %concentration, disregard this section and, depending on if you are using a built-in or the user-defined conversion table, use the setup instructions in Section 6 or Section 8 respectively.

4.1 Selecting Conductivity Measurement Mode

Locate the group of ten switches on backside of display module assembly (Figure 3-2) and place **CONC NONE** switch in **ON** (up) position.

NOTE: *The **CONC TABLE** and **CONC USER** switches must be set to their **OFF** (down) positions.*

4.2 Selecting Display Format

1. With display in conductivity measuring mode, press **EXAM/CANCEL** key to place display in "examination" mode (display indicated "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 3-3).

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.

   NOTE: *“Er 12” will appear after this step to alert operator that alarms, setpoints, deadbands and outputs may need to be reconsidered with respect to the new measuring scale. If necessary, new values may need to be entered.*

Establishing Temperature Units (°C or °F)

8. Locate the group of ten switches on backside of display module assembly (Figure 3-2) and place °**C**/°**F** switch in the **ON** (up) position for temperature values to be displayed in °F. Place in the **OFF** (down) position for °C readout.

4.3 Selecting Temperature Compensation Method

One of four methods of temperature compensation can be selected when the 692E is used as a conductivity analyzer.

No Compensation

Temperature compensation may be purposely bypassed to provide raw, uncompensated conductivity readings (typically used when uncompensated readings are desired). Locate the group of ten switches on the backside of display module assembly (Figure 3-2) and place **TEMP COMP**

NONE switch in **ON** (up) position.

NOTE: *The other three **TEMP COMP** switches (**LINEAR**, **TABLE** and **USER**) must be set to their **OFF** (down) 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 group of ten switches on backside of display module assembly (Figure 3-2) and place **TEMP COMP LINEAR** switch in **ON** (up) position.

   NOTE: *The other three **TEMP COMP** switches (**NONE**, **TABLE** and **USER**) must be set to their **OFF** (down) 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 Slide Switches

1. Locate the group of ten switches on backside of display module assembly (Figure 3-2) and place **TEMP COMP TABLE** switch in **ON** (up) position.

   NOTE: *The other three **TEMP COMP** switches (**NONE**, **LINEAR** and **USER**) must be set to their **OFF** (down) 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. COMPENSATION TABLES

Displayed Identifier	Solution	Concentration	Ref. 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. 1 and Pt. 2) must be entered.*

Determining Data For Entry

A temperature curve must be created for the solution being measured by measuring and noting the raw, uncompensated conductivity of the solution at various temperatures, including a reference temperature. The 692E can be used to do this under the following provisions:

- The **CONC NONE** switch must be set in **ON** (up) position and the other two **CONC** switches (**TABLE** and **USER**) must be set to their **OFF** (down) positions.
- The **TEMP COMP NONE** switch must be set in **ON** (up) position and the other three **TEMP COMP** switches (**LINEAR**, **TABLE** and **USER)** must be set to their **OFF** (down) positions.
- The 692E 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 Slide Switches

1. Locate the group of ten switches on backside of display module assembly (Figure 3-2) and place **TEMP COMP USER** switch in **ON** (up) position.

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

Entering Temperature and Compensation Factor Values

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

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.

4.4 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 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 transmitter output is held at its minimum value (4 mA).*

4.5 Initial Calibration

Before initially calibrating this 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, a qualified person must first enter two reference solution values. 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 692E’s full-scale value.

NOTE: *For applications requiring high measurement accuracy within a segment of the measuring scale, the 692E 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 conductivity 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 1,000	0.50 1.00	0.25 0.50
2,000 5,000	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 of 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 10 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 **OFF** (down) positions. However, when the “two-key” method is used for calibration, the 30 second response time (**X** and **Y** switches in their **ON**, up, 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 692E 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 preset calibration points.

1. With display in conductivity measuring mode, press **BEGIN CAL** key (display indicates one of the preset 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 629E is used for monitoring % concentration and the solution is represented by one of the built-in conversion tables listed in Section 6.1 -- 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 692E is to be used for measuring conductivity, disregard Sections 6 through 8 and use the setup instructions in Section 4.

6.1 Reviewing Built-in Concentration Tables

Setting Slide Switches

1. Locate the group of ten switches on backside of display module assembly (Figure 3-2) and place **CONC TABLE** switch in **ON** (up) position.

   NOTE: *The **CONC NONE** and **CONC USER** switches must be set to their **OFF** (down) positions.*

2. Place **TEMP COMP TABLE** switch in **ON** (up) position.

   NOTE: *The other three **TEMP COMP** switches (**NONE**, **LINEAR** and **USER**) must be set to their **OFF** (down) 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 “tb1 (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).

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

Locate the group of ten switches on backside of display module assembly (Figure 3-2) and place **°C/°F** switch in the **ON** (up) position for temperature values to be displayed in °F. Place in the **OFF** (down) position for °C readout.

6.3 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 transmitter output is held at its minimum value (4 mA).*

6.4 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, a qualified person must first enter two reference solution values. 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 692E’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 692E 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 Preparing % 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. Calibration is also possible using conductivity reference solution(s) with the 692E temporarily in the conductivity mode. In this case, use the calibration instructions in Section 5.3 or 5.4.

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 "buSy" 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 once to make display indicate “HI CAL VALUE.”

11. Use ⇧ and ⇦ keys to make display indicate the known value of the “high” % 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 10 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 **OFF** (down) positions. However, when the "two-key" method is used for calibration, the 30 second response time (**X** and **Y** switches in their **ON**, up, 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 692E 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 preset calibration points.

1. With display in % concentration measuring mode, press **BEGIN CAL** key (display indicates one of the preset 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 Model 692E is used for measuring % concentration and the solution is not represented by one of the built-in conversion tables listed in Section 6.1 -- 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 692E is to be used for measuring conductivity, disregard Sections 6 through 8 and use the setup instructions in Section 4.

8.1 Setting Slide Switches

Locate the group of ten switches on backside of display module assembly (Figure 3-2) and place **CONC USER** switch in **ON** (up) position.

NOTE: *The **CONC NONE** and **CONC TABLE** switches must be set to their **OFF** (down) positions.*

8.2 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 692E 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 692E measuring scale described in Section 8.3.)

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		

8.3 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 once to access the display format setup variable (display indicates one of the format selections shown in Figure 3-3).

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 8.2 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.

   NOTE: *"ER 12" will appear after this step to alert operator that alarms, setpoints, deadbands and outputs may need to be reconsidered with respect to the new measuring scale. If necessary, new values may need to be entered.*

Establishing Temperature Units (°C or °F)

8. Locate the group of ten switches on backside of display module assembly (Figure 3-2) and place **°C/°F** switch in the **ON** (up) position for temperature values to be displayed in °F. Place in the **OFF** (down) position for °C readout.

# # #

8.4 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.

8.5 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 (typically used when uncompensated readings are desired). Locate the group of ten switches on backside of display module assembly (Figure 3-2) and place **TEMP COMP NONE** switch in **ON** (up) position.

NOTE: *The other three **TEMP COMP** switches **(LINEAR**, **TABLE** and **USER**) must be set to their **OFF** (down) 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 group of ten switches on backside of display module assembly (Figure 3-2) and place **TEMP COMP LINEAR** switch in **ON** (up) position.

   NOTE: *The other three **TEMP COMP** switches (**NONE**, **TABLE** and **USER**) must be set to their **OFF** (down) 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 692E can be used to do this under the following provisions:

- The **CONC NONE** switch must be set in **ON** (up) position and the other two **CONC** switches (**TABLE** and **USER**) must be set to their **OFF** (down) positions.
- The **TEMP COMP NONE** switch must be set in **ON** (up) position and the other three **TEMP COMP** switches (**LINEAR**, **TABLE** and **USER**) must be set to their **OFF** (down) positions.
- The 692E 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	Compensation Factor	Data Point	Temp. (in °C)	Raw Cond. Value	Compensation 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 G -- VALUES FOR USER-DEFINED TEMPERATURE TABLE							
Data Point	Temp. (in°C)	Raw Cond. Value	Compensation Factor	Data Point	Temp. (in °C)	Raw Cond. Value	Compensation Factor
Pt 1				Pt 6			
Pt 2				Pt 7			
Pt 3				Pt 8			
Pt 4				Pt 9			
Pt 5				Pt 10			

Setting Slide Switches

1. Locate the group of ten switches on backside of display module assembly (Figure 3-2) and place **TEMP COMP USER** switch in **ON** (up) position.

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

8.6 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 transmitter output is held at its minimum value (4 mA).*

8.7 Initial Calibration

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

SECTION 9 - OUTPUT SETUP

The 692E provides an isolated 4-20 mA output signal which tracks the measured conductivity or % concentration.

9.1 Selecting Response Time

Refer to Section 1.2 - item 10 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 **OFF** (down) positions. However, if the "two-key" method is used for calibration, the 30 second response time (**X** and **Y** switches in their **ON**, up, 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 692E 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.

9.2 Using Range Expand Feature

The isolated 4-20 mA transmitter output 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 4 mA and 20 mA is desired. Note these important points:

- The desired segment, represented by the 4-20 mA output, cannot be smaller than 10.0% of the measuring scale.
- The output can be inverted (output decreases 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 output is limited to 4 mA or 20 mA 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 output (4 mA) is 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 "Cond" 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 once to make display indicate "LO OUT VALUE".

4. Use ⇧ and ⇦ keys to make display indicate the low endpoint at which 4 mA is to be provided (30.0 mS/cm 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 output (20 mA) is 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 20 mA is to provided (70.0 mS/cm for this example).

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

9.3 Using Output Hold Feature

The isolated 4-20 mA transmitter output can be held during calibration or while setting up the instrument to suspend operation of a receiving device.

When pressed simultaneously, the **OUTPUT** key and recessed **END CAL/HOLD** button activate the hold mode feature. At this time, the **HOLD** status indicator lights and the output value is held for 30 minutes unless the hold feature is extended or canceled. 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 canceled at any time by simultaneously pressing the **CANCEL HOLD** and **OUTPUT** keys.

SECTION 10 - USING SECURITY LOCK FEATURE

A security lock feature is provided to prevent unauthorized alteration of stored values. When the 692E 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.

10.1 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.

10.2 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 to calibrate 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 Interference

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 692E is factory-calibrated for temperature to provide very accurate temperature measurement. However, the 692E 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 water (or process solution) that has a known temperature value of 90-100°C (194-212°F) or is approximately equal to the normal operating temperature of the process.

1. Place conductivity sensor in 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 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. Press **NEXT** key once to make display indicate temperature “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 known higher temperature water (or process solution). Allow sensor to attain temperature equilibrium with the solution.

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 temperature “HI CAL VALUE.”

12. Use ⇦ and ⇧ keys to make display indicate the known temperature value.

    NOTE: *Entry value must be between 40.0 and 200.0°C and at least 10.0°C higher than the lower calibration point (0.0°C from* step 6).

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). “VALUE ERROR” flashes if the difference between entry values is less than 10.0°C. If “HI/LO ERROR” flashes, entry value is out of range (less than 40.0°C or greater than 200.0°C) or the difference

between the entry value and actual solution temperature is greater than 10.0°C.

This completes the two-point temperature calibration.

SECTION 3 - SIMULATING MEASURED VALUES

To aid in setting up a load device in the 4-20 mA loop (recorder, controller, etc.), 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 10.2). Accessing the “SIM VALUE” setup variable displays a conductivity or % concentration value. After entering a simulation value, the 4-20 mA loop current corresponding to the displayed value is provided. Changing the simulation value also changes the loop current value respectively. Exiting the “SIM VALUE” setup variable returns the loop current to tracking the measured conductivity or % concentration. The output hold feature (Part Three, Section 9.3) may be used in conjunction with an entered simulation value. This allows a simulation value to be entered and the loop current corresponding to that value to be held, for example while calibrating the 692.

To simulate a desired value:

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 “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). The loop current value changes from tracking measured conductivity or % concentration to that which corresponds 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.

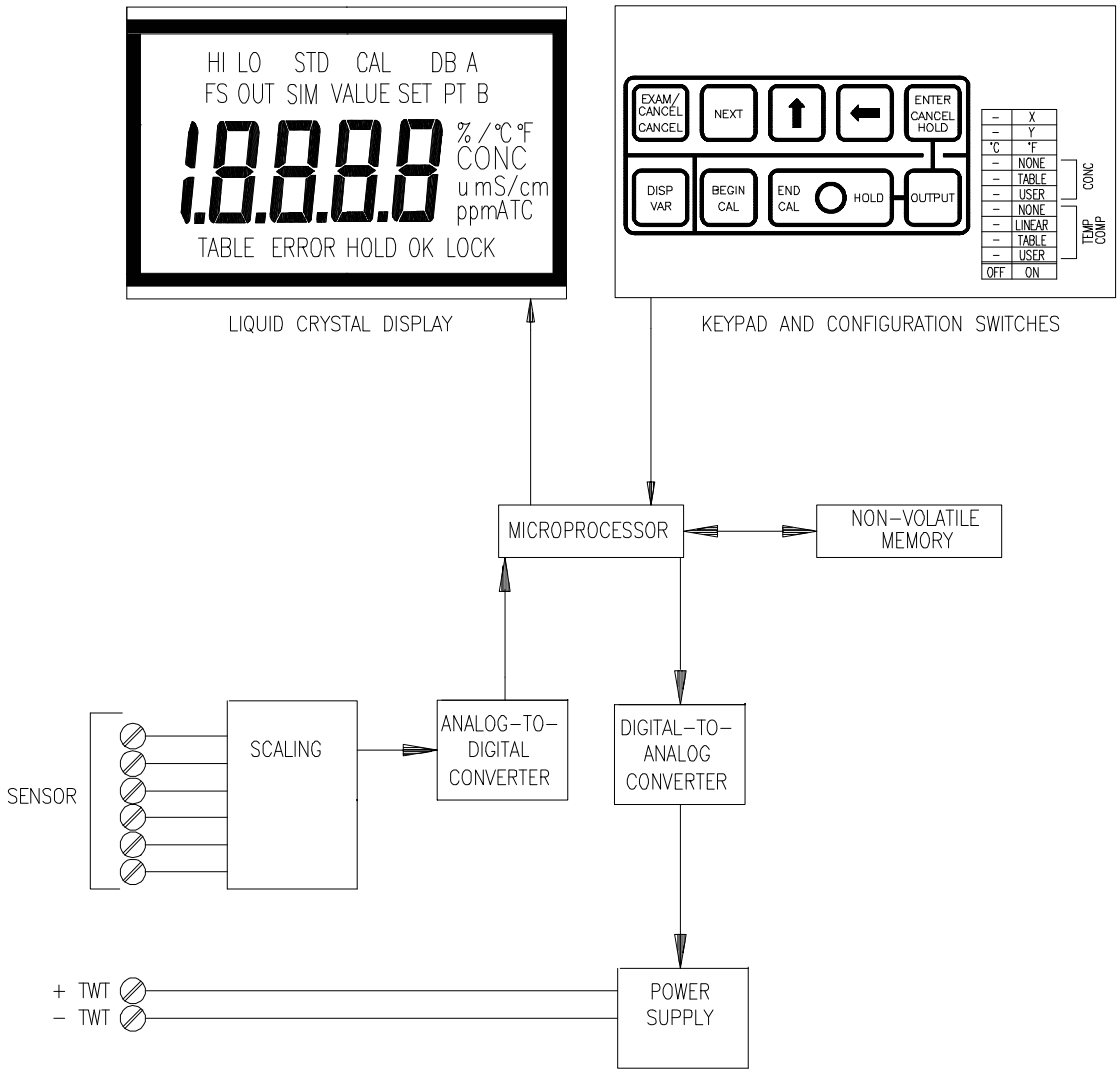


FIGURE 5-1 Instrument Operations Block Diagram

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 loop current. 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 current output value) along with a variety of annunciators to indicate the status of the transmitter. The display also indicates setup variable values, error messages and diagnostic information.

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

6. The 4-20 mA analog output is controlled by the microprocessor. The digital output value is sent to the digital-to-analog converter section.

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.

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 H -- 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 slide switches (wrong combinations).	Depending on whether the 692E 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 692E will still operate).	Call GLI Customer Service Dept. for assistance.
“Er 6”	The system has not been “zeroed” during instrument setup.	Depending on whether the 692E is used to measure conductivity or % concentration, refer to Part Three, Section 4.4, 6.3 or 8.6 for zeroing instructions.
“Er 7”	Improper user-defined concentration conversion table.	Refer to Part Three, Sections 8.2 and 8.4 and review instructions to ensure proper table setup.
“Er 8”	Improper user-defined temperature compensation table.	Depending on whether the 692E is used to measure conductivity or % concentration, refer to Part Three, Section 4.3 or 8.5 under “User-Defined Temperature Table Compensation” subheading for table setup instructions.

Table H -- SYSTEM DIAGNOSTIC ERROR MESSAGES -- MEANINGS/CORRECTIVE ACTIONS (continued)		
Error Message	Meaning	Action To Take
“Er 9”	Improper calibration (sensor in wrong conductivity reference solution).	Recalibrate with sensor in correct value reference solution.
“Er 10”	Defective non-volatile memory (692E is inoperable).	Call GLI Customer Service Dept. for assistance.
“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” 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 I -- TROUBLESHOOTING COMMON PROBLEMS	
Symptom	Typical Causes
Display is completely blank.	1. Power is not present or connected. 2. 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 the output. Simultaneously press **CANCEL HOLD** and **OUTPUT** keys to cancel hold feature (Part Three, Section 9.3).
Valid setup variable value cannot be entered.	Instrument is in “lock” mode. Enter unlock code to unlock instrument (Part Three, Section 10.2).

2.3 Customer Assistance

If you need spare parts, assistance in troubleshooting, or repair servicing, please contact your local GLI representative, or the GLI Customer Service Department at:

GLI International, Inc.
9020 West Dean Road
Milwaukee, Wisconsin 53224

Telephone: [800] 543-8907
Fax: [414] 355-8346

— SERVICE HOURS —

	Eastern Std. Time	Central Std. Time	Mountain Std. Time	Pacific Std. Time
Monday through Thursday	8:30 a.m. to 5:30 p.m.	7:30 a.m. to 4:30 p.m.	6:30 a.m. to 3:30 p.m.	5:30 a.m. to 2:30 p.m.
Friday	8:30 a.m. to 4:00 p.m.	7:30 a.m. to 3:00 p.m.	6:30 a.m. to 2:00 p.m.	5:30 a.m. to 1:00 p.m.

When ordering spare or replacement board assemblies, be sure to use the **complete** assembly part number.

All instruments or board assemblies returned for repair, freight prepaid, should also include the following information:

1. A clearly written description of the malfunction.

2. Name of person to contact and the phone number where they can be reached.

3. Proper return address for shipping instruments(s) back. Include preferred shipping method (UPS, Federal Express, etc.) if applicable.

4. A purchase order if instruments(s) or board assemblies are out of warranty to cover costs of repair.

NOTE: *If the instrument or board assemblies are damaged during return shipment because of inadequate packaging, the customer is responsible for any resulting repair costs. (**Recommendation:** Use the original GLI shipping carton or an equivalent.) Also, GLI will not accept instruments returned for repair or replacement unless they are thoroughly cleaned and all process material is removed.*

PART SEVEN - SPARE PARTS AND ACCESSORIES

Spare Part Description	Part Number			
	Standard 692E Transmitter (no approvals)	**692E Transmitter with optional CE Compliance**	**692E Transmitter with optional FM Approval**	**692E Transmitter with opt. CE Compliance and FM Approval**
Display Module Assembly (3 boards -- includes LCD and door assembly with keyboard overlay)	692G2210	692G2210-CE	692A2210-001F	692A2210-001M
Door Assembly with Keyboard Overlay	1000G1181	1000G1181-CE	1000G1181	1000G1181-CE
Enclosure with Potted Terminal Board	1000G1222	1000G1222-CE	1000A1178-001F	1000G1222-CE
Terminal Compartment Cover (includes 4 captive fasteners and Model 692 label -- specify for elec-trodeless conductivity)	1000G1220	1000G1220-CE	1000G1220	1000G1220-CE
Liquid Crystal Display	6Q1124	6Q1124	6Q1124	6Q1124

692E Transmitter Accessory

Optional Pipe-mount Kit..... 1000G3065