
Rosemount Analytical

MODEL 880 NON-DISPERSIVE INFRARED ANALYZER

INSTRUCTION MANUAL

748176-N

NOTICE

This Model 880 instruction manual is for use with instruments with a software version of 2.0 or greater.

The information contained in this document is subject to change without notice.

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PREFACE

SAFETY SUMMARY

To avoid explosion, loss of life, personal injury and damage to this equipment and on-site property, all personnel authorized to install, operate and service the Model 880 Non-Dispersive Infrared Analyzer should be thoroughly familiar with and strictly follow the instructions in this manual. **Save these instructions.**

DANGER is used to indicate the presence of a hazard which **will** cause **severe** personal injury, death, or substantial property damage if the warning is ignored

WARNING is used to indicate the presence of a hazard which **can** cause **severe** personal injury, death, or substantial property damage if the warning is ignored.

CAUTION is used to indicate the presence of a hazard which **will** or **can** cause **minor** personal injury or property damage if the warning is ignored.

NOTE is used to indicate installation, operation, or maintenance information which is important but not hazard-related.



WARNING: ELECTRICAL SHOCK HAZARD

Do not operate without doors and covers secure. Servicing requires access to live parts which can cause death or serious injury. Refer servicing to qualified personnel.

For safety and proper performance this instrument must be connected to a properly grounded three-wire source of power.

Alarm and zero/span switching relay contacts wired to separate power sources must be disconnected before servicing.

This instrument is shipped from the factory set up to operate on 115 VAC, 50/60 Hz electric power. For operation on 230 VAC, 50/60 Hz electrical power, see Section 2.3 for modifications.



WARNING: POSSIBLE EXPLOSION HAZARD

This analyzer is of a type capable of analysis of sample gases which may be flammable. If used for analysis of such gases the instrument must be protected by a continuous dilution purge system in accordance with Standard ANSI/NFPA 496-1989, Chapter 8.

If explosive gases are introduced into this analyzer, the sample containment system must be carefully leak-checked upon installation and before initial startup, during routine maintenance and any time the integrity of the sample containment system is broken, to ensure the system is in leak-proof condition. Leak-check instructions are provided in Section 2.8.

Internal leaks resulting from failure to observe these precautions could result in an explosion causing death, personal injury or property damage.



WARNING: PARTS INTEGRITY

Tampering or unauthorized substitution of components may adversely affect safety of this product. Use only factory documented components for repair



CAUTION: TOPPLING HAZARD

This instrument's internal pullout chassis is equipped with a safety stop latch located on the left side of the chassis.

When extracting the chassis, verify that the safety latch is in its proper (counter-clockwise) orientation.

If access to the rear of the chassis is required, the safety stop may be overridden by lifting the latch; however, further extraction must be done very carefully to insure the chassis does not fall out of its enclosure.

If the instrument is located on top of a table or bench near the edge, and the chassis is extracted, it must be supported to prevent toppling.



CAUTION: HIGH PRESSURE GAS CYLINDERS

This analyzer requires periodic calibration with known zero and standard gases. Refer to Sections 2.6, 3.7, 3.9, 3.10 and 3.11. See also General Precautions for Handling and Storing High Pressure Cylinders, following Section 7.

SPECIFICATIONS¹

CATALOG NUMBERS:

191809 Standard Case
191810 Extended Case

POWER REQUIREMENTS:

115/230 VAC $\pm 10\%$, 50/60 ± 3 Hz, 150 W; 350 W with optional case heater

OPERATING TEMPERATURE:

32°F to 113°F (0°C to 45°C)
Some configuration may require optional case heater

DIMENSIONS:

8.7 in (22.0 cm) H x 19 in. (483 mm) W x 19 in. (483 mm) D, standard case
8.7 in (22.0 cm) H x 19 in. (483 mm) W x 24 IN. (610 MM) D, extended case

WEIGHT:

56 lbs (25 kg), standard case
68 lbs (31 kg), extended case

REPEATABILITY:

1% of fullscale

NOISE:

1% of fullscale

ZERO DRIFT:

$\pm 1\%$ of fullscale per 24 hours

SPAN DRIFT:

$\pm 1\%$ of fullscale per 24 hours

RESPONSE TIME: (ELECTRONIC)

Variable, 90% of fullscale in 0.5 sec to 20 sec, field selectable²

SENSITIVITY:

100 ppm fullscale carbon monoxide at atmospheric pressure
50 ppm fullscale carbon dioxide at atmospheric pressure

SAMPLE CELL LENGTH:

0.04 in. (1 mm) to 15.0 in. (381 mm)

MATERIALS IN CONTACT WITH SAMPLE:

WINDOWS: Sapphire, quartz, Irtran
CELLS: Gold plated Pyrex or stainless steel
TUBING: FEP Teflon
FITTINGS: 316 stainless steel
O-RINGS: Viton-A

¹ Performance specifications based on ambient temperature shifts of less than 20°F (11°C) per hour.

² Application dependent.

SPECIFICATIONS (CONTINUED)

SAMPLE PRESSURE:

Max 10 psig (69 kPa), standard
Pressurized application available upon request

ANALOG OUTPUT:

Standard: 0 to 5 VDC
Optional: 0 to 20 mA/4 to 20 mA

LINEARIZATION:

Keypad entered coefficients for linearizing 1, 2 or all 3 ranges

ENCLOSURE:

General purpose for installation in weather-protected area.
Optional purge kit per Type Z, ANSI/NFPA 496-1989.³

³ When installed with user-supplied components, meets requirements for Class I, Division 2 locations per National Electrical Code (ANSI/NFPA 70) for analyzers sampling non-flammable gases. Analyzes sampling flammable gases must be protected by a continuous dilution purge system in accordance with Standard ANSI/NFPA 496-1989, Chapter 8. Consult factory for recommendations.

SPECIFICATIONS - OPTIONS

ALARM

RELAY OUTPUTS: Two single point, field programmable high or low, deadband up to 20% of fullscale.
Two form C contacts rated 3A-125/250 VAC or 5A-30 VDC (resistive)

CAL GAS CONTROL

RELAY OUTPUTS: Two front panel actuated contact closures
Two form C contacts rated 3 A, 125/250 VAC or 5 A, 30 VDC (resistive)

AUTO ZERO/SPAN

RELAY OUTPUTS: Four contact closures, field programmable frequency and duration of closure. Two contact closures for indication of insufficient zero and span adjustment.
Four form C contacts rated 3A-125/250 VAC or 5A-30 VDC (resistive),
Two form A contact rated (resistive load):
Max switching power: 10 Watts
Max switching voltage: 30 VDC
Max switching current: 0.5 A

REMOTE I/O

RELAY OUTPUTS: Three remotely changeable ranges with positive identification.
Binary or decimal field selectable.

INPUTS: Eight form A contacts rated (resistive load):
Max switching power: 10 Watts
Max switching voltage: 30 VDC
Max switching current: 0.5 A

Eight optical couplers
Input Range: +5 VDC to +24 VDC

CUSTOMER SERVICE, TECHNICAL ASSISTANCE AND FIELD SERVICE

For order administration, replacement Parts, application assistance, on-site or factory repair, service or maintenance contract information, contact:

**Rosemount Analytical Inc.
Process Analytical Division
Customer Service Center
1-800-433-6076**

RETURNING PARTS TO THE FACTORY

Before returning parts, contact the Customer Service Center and request a Returned Materials Authorization (RMA) number. Please have the following information when you call: *Model Number, Serial Number, and Purchase Order Number or Sales Order Number.*

Prior authorization by the factory must be obtained before returned materials will be accepted. Unauthorized returns will be returned to the sender, freight collect.

When returning any product or component that has been exposed to a toxic, corrosive or other hazardous material or used in such a hazardous environment, the user must attach an appropriate Material Safety Data Sheet (M.S.D.S.) or a written certification that the material has been decontaminated, disinfected and/or detoxified.

Return to:

**Rosemount Analytical Inc.
4125 East La Palma Avenue
Anaheim, California 92807-1802**

TRAINING

A comprehensive Factory Training Program of operator and service classes is available. For a copy of the *Current Operator and Service Training Schedule* contact the Technical Services Department at:

**Rosemount Analytical Inc.
Phone: 1-714-986-7600
FAX: 1-714-577-8006**

DOCUMENTATION

The following Model 880 Non-Dispersive Infrared Analyzer instruction materials are available. Contact Customer Service or the local representative to order.

748176 Instruction Manual (this document)

QUICK STARTUP AND TROUBLESHOOTING GUIDE



WARNING: ELECTRICAL SHOCK HAZARD

Do not operate without doors and covers secure. Servicing requires access to live parts which can cause death or serious injury. Refer servicing to qualified personnel.

The purpose of this guide is to give quick and simplified instructions on getting started. Some of the non-critical details may have been left out. Refer to the appropriate section in this manual for complete descriptions of all procedures. Read this guide completely before starting up the analyzer. This guide contains step-by-step instructions for startup and includes information helpful in simplifying some procedures detailed in the manual. The analyzer has been setup and tested at the factory per the specified sales order. Generally the only settings and adjustments required are calibration gas values, zero/span calibrations, and adjustments on option boards. Refer to the appropriate section in the manual for information on option boards.

HOW TO USE THIS GUIDE

First, read Section 1, Introduction and install analyzer per Section 2 of this manual. Familiarize yourself with Keypad Operation. Step through Mode Functions. Go to Section 3, Initial Startup and continue (in sequence) through this guide.

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GAS REQUIREMENTS

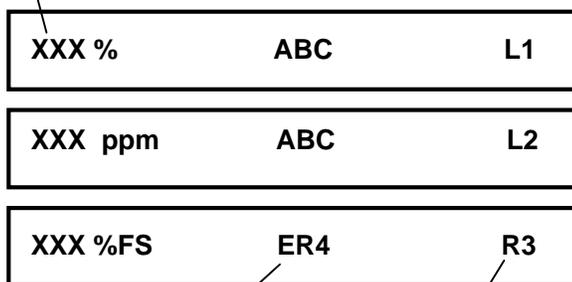
Zero - Use a gas containing less than 25% of the measured component, preferably 0%.

Span - Use a gas containing from 51 to 100% of the measured component, for each range. 80 to 100% is recommended. If calibration is attempted with a span gas less than 51% of the measured component, an error message will be displayed.

DISPLAYS

RUN MODE

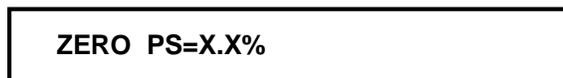
Concentration, Engineering Units, or % Fullscale.
 If Linearization ON, reads in engineering units. If
 Linearization OFF, reads in % Fullscale.



Code for measured component or
 Error Message

Local, or Remote Control, Range 1, 2 or 3.

ZERO MODE



% of ZERO potentiometer used
 (Hardware pot)



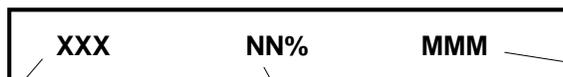
Present RUN Mode value

% of ZERO potentiometer used
 (Hardware pot)

SPAN MODE



% of SPAN potentiometer used
 (Hardware pot)



Present RUN Mode value

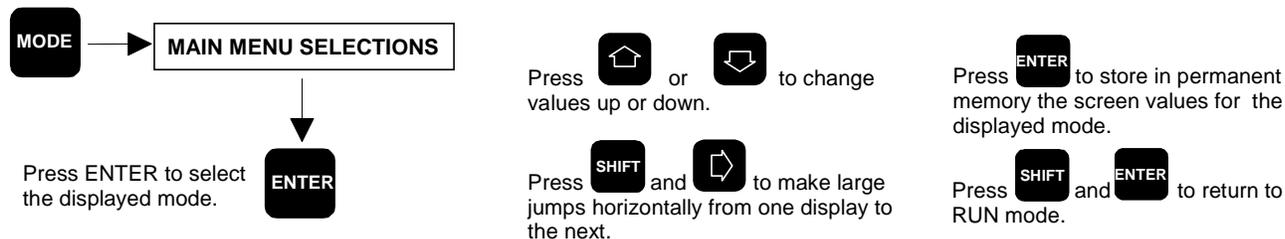
% of SPAN potentiometer
 used (Hardware pot)

Calibration Span gas value
 entered by user while in RANGE
 Mode.
 Calibration Gas value displayed
 if Linearizer is OFF.

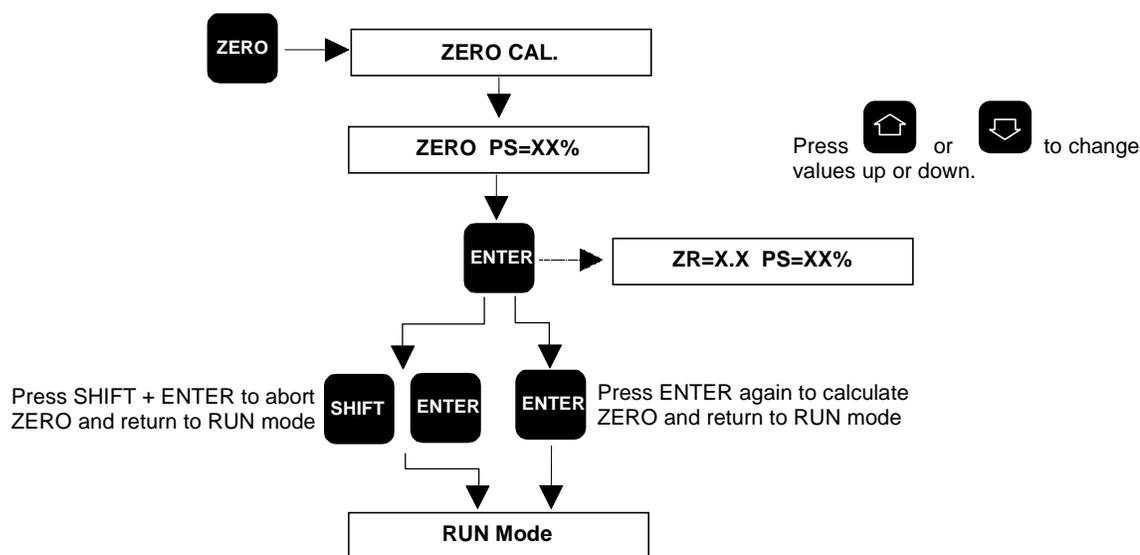
FRONT PANEL KEYPAD

The following flow diagram describes the *basic* functions of the front panel keypad, starting in RUN mode. Flow diagrams for other operations are located in this guide and Section 3.

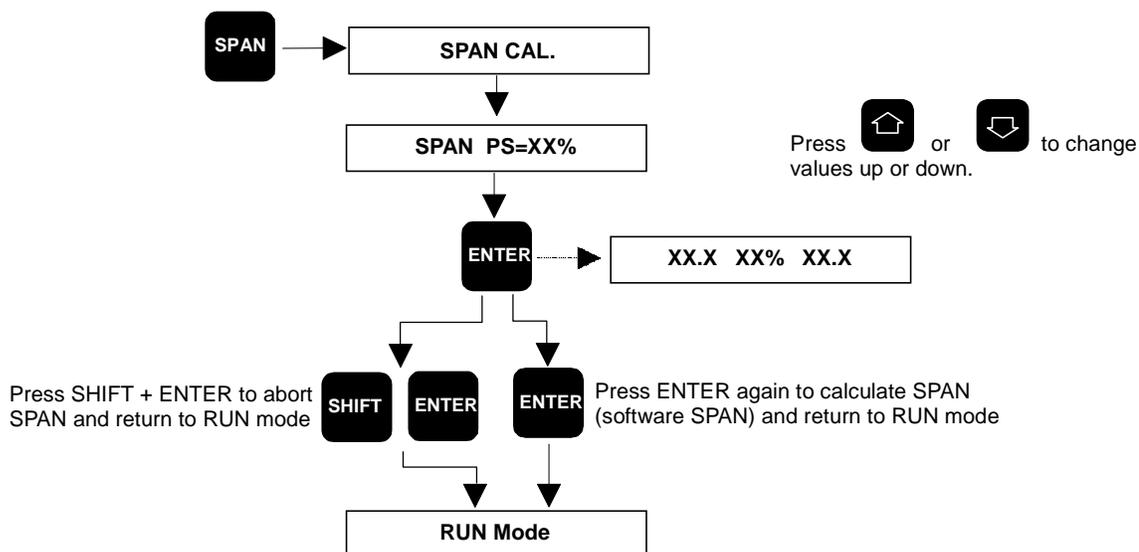
MODE



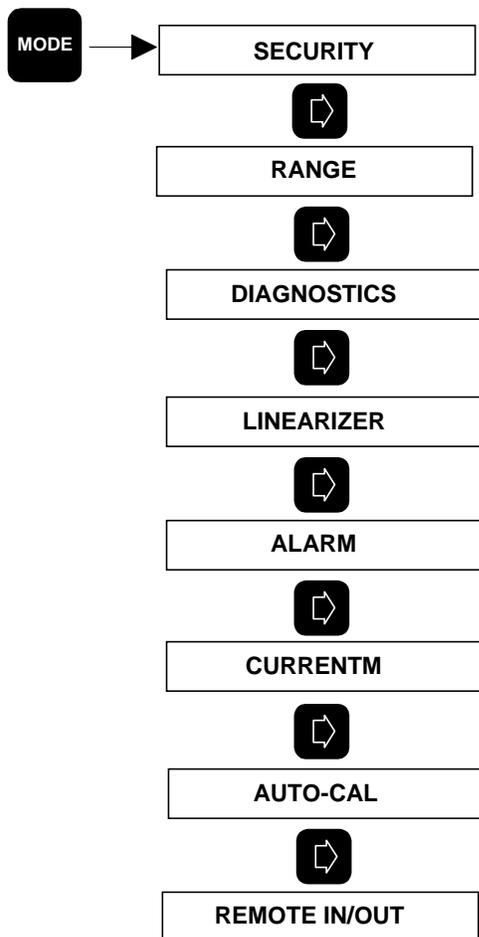
ZERO



SPAN



MODE FUNCTION



Press **ENTER** to enter displayed mode.

Press **SHIFT** and **ENTER** to return to RUN mode.

INITIAL STARTUP

RANGE MODE

As a first step, check range mode settings and enter your calibration gas values. See Range Mode flow diagram on following page.

RANGE NUMBER

Setup desired operating range (1, 2 or 3) using up and down arrow keys. Remember to press ENTER after changing values to store data.

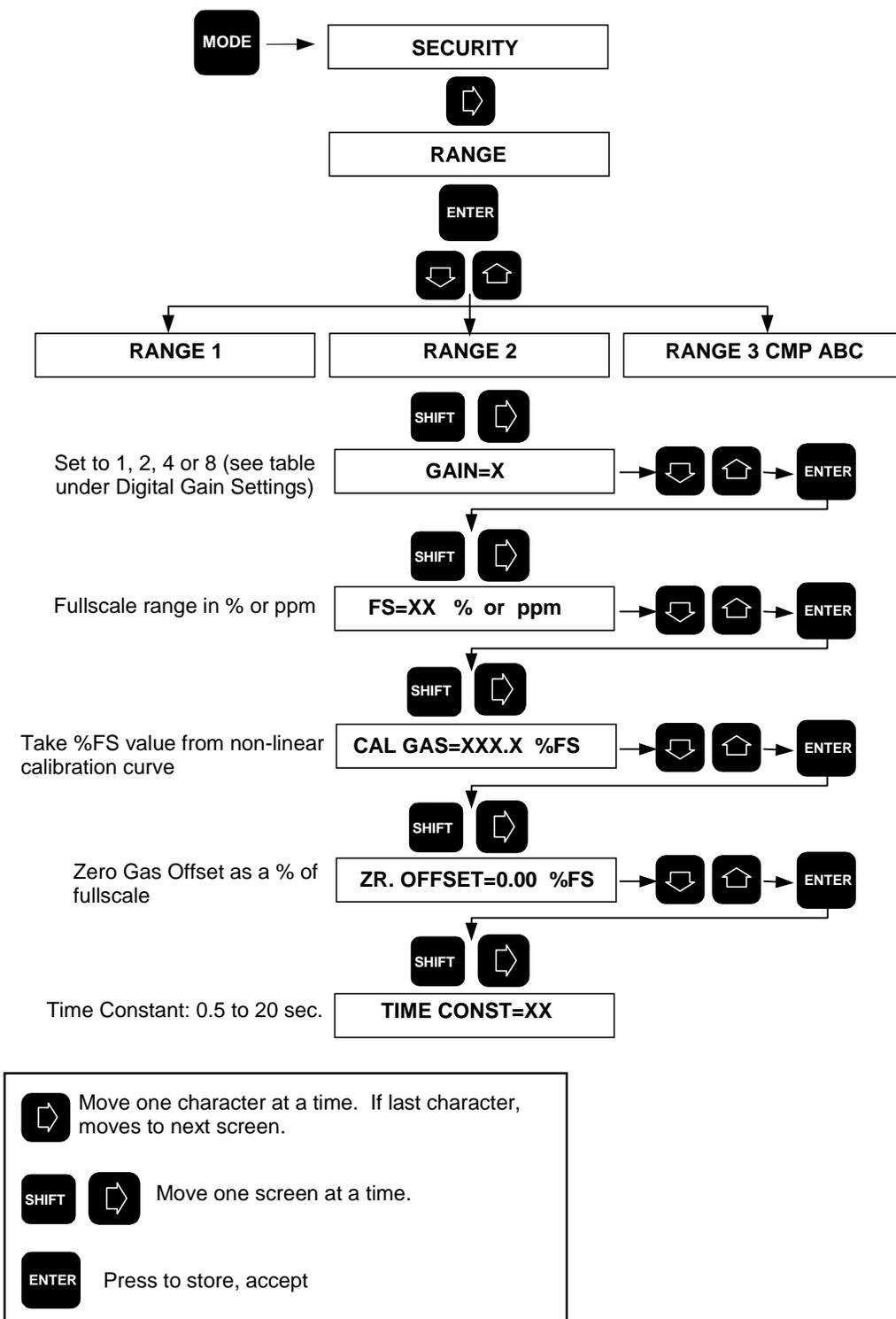
GAIN=1, 2, 4 OR 8

Don't change from factory setting at this time. If it becomes necessary to make a change during calibration, use the following table as a guide:

DIGITAL GAIN SETTINGS	
DETECTOR SIGNAL (DET SIG)	GAIN SETTING
≤ 7.5 V and > 4 V	1
≤ 4 V and > 2.2 V	2
≤ 2.2 V and > 15 V	4
≤ 1.5 V	8

Note

The detector signal voltages can be observed in the DIAGNOSTICS mode. Some deviations from these recommended settings are permissible, if the instrument can't be spanned keeping the %PS reading between 5% and 95%. Additional information on the gain setting is located in Section 5.7.



LINEARIZATION MODE

Verify that LINEARIZER ON/OFF is in the desired position.

Verify the analyzer coefficients for each range against the values supplied on the factory calibration sheet in the rear of this manual.

Note

The linearizer range positions 1, 2 and 3 allow setting coefficients for these ranges. When the operating range is selected from the "Range" mode, the correct coefficients for that range will be selected regardless of which linearization range settings (1, 2 or 3) was used in the linearization mode. Linearization position A is an "ALL" range position, using coefficients from range 3 for all ranges. Position A can only be used if the range to range ratio is equal to or less than 3:1.

DIAGNOSTICS MODE

If the display is unstable (oscillating) in OSC, TUNE, DET SIG and/or SCR CURRENT, there probably is an ER4 error message. Refer to the Troubleshooting chart.

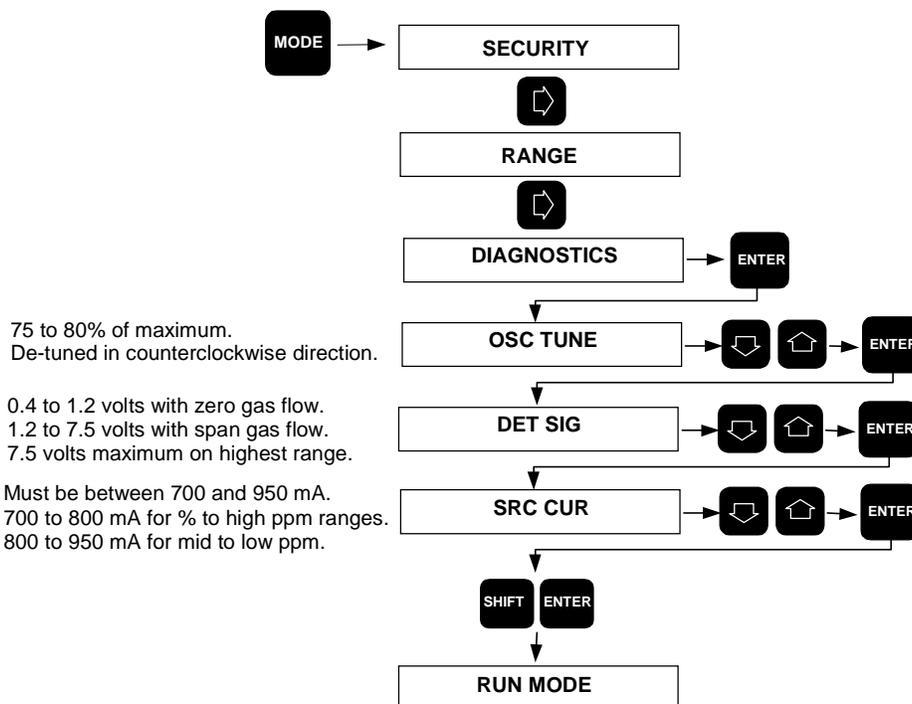
OSC TUNE - Tune to 75 to 80% of maximum. Turn *counterclockwise* from maximum.

DET SIG (WITH ZERO GAS FLOW) - Must be between 0.4 to 1.2 volts. If <0.4 volts: Re-adjust source balance per Section 3.5. If >1.2 volts: See Troubleshooting Chart, Source Balance and Source Alignment.

DET SIG (WITH SPAN GAS FLOW) - Adjust detector signal voltage with GAIN potentiometer R3 on the Signal Board (see Drawing 624055 in the rear of this manual). For Range 3 (least sensitive) adjust this voltage as close to 7.5 volts as possible. *Do not exceed 7.5 volts.* Must be between 0.4 to 1.2 volts. For low ppm applications the maximum attainable voltage may be considerably below 7.5 volts. If span gas is less than 100% fullscale, the detector voltage should be set roughly equal to $(7.5 \text{ volts}) \times (\% \text{ fullscale read off of the non-linear curve})/100$.

Detector signal voltages with span gas flowing will dictate the digital GAIN settings. (see table under Range Mode, Gain.)

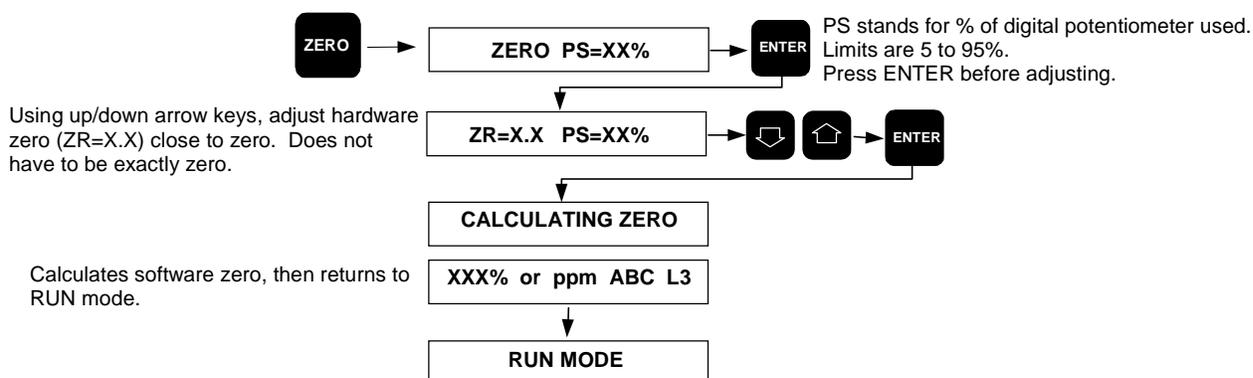
SRC CUR - Adjust Source Current with R9 on the Power Supply Board. Source current will be between 700 to 950 mA. The source will have a longer life on lower currents. Current setting will be lower on high concentration, short cell path applications, such as % level measurements. Will be higher on low concentration, long cell path measurements, such as 0 to 10 ppm CO₂.



ZERO CALIBRATION

There is one hardware zero for all three ranges, and three software zeros, one for each range. Once the hardware zero has been adjusted for one of the ranges, *IT SHOULD NOT BE CHANGED* when doing software zero on the other two ranges. See flow chart below.

If problems are encountered, such as error messages (ER0, ER1, ER2, ER3 or ER4) go to DIAGNOSTICS mode to locate the cause of the problem. Use the Troubleshooting chart in this section, as well as Section 5, Troubleshooting.

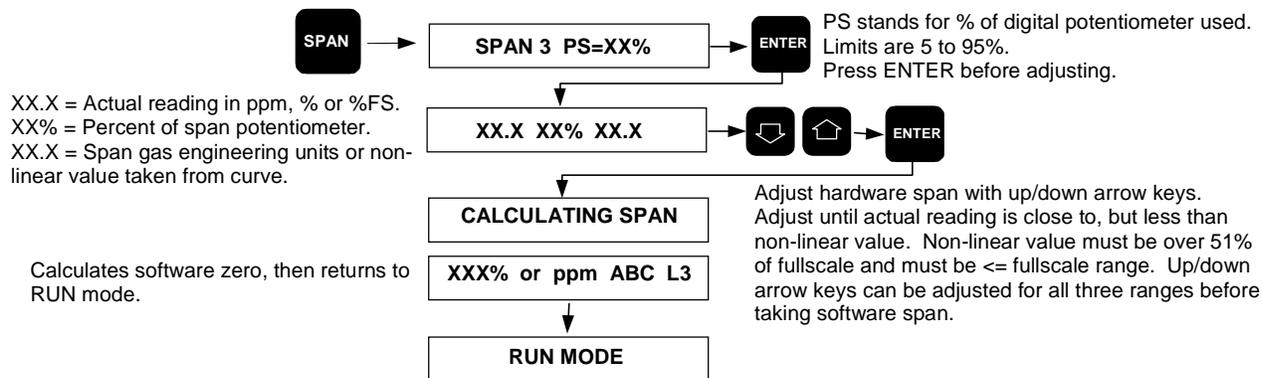


Note: Use up/down arrow keys on one range only. Take a software zero on the other ranges.

SPAN CALIBRATION

There are three hardware spans and three software spans. Use the flow diagram as a guide.

If problems are encountered, such as error messages (ER0, ER1, ER2, ER3 or ER4) go to DIAGNOSTICS mode to locate the cause of the problem. Use the Troubleshooting chart in this section, as well as Section 5, Troubleshooting.



See Troubleshooting if error message appears.

SHIFT+ENTER will abort function and return to RUN mode.

SOURCE BALANCE ADJUSTMENT

This procedure should not be necessary on a new analyzer unless problems are encountered.

1. Access the DET SIG display in DIAGNOSTICS mode.
2. Flow zero gas through the sample cell for a minimum of two minutes.
3. Slightly loosen the hex standoff on the sample cell adjust screw.
4. Rotate the shutter adjust screw until a minimum reading is obtained.
5. Add 0.4 to 0.5 volts to this reading. If this reading exceeds 1.2 volts, a source alignment is required.
6. Rotate the shutter adjust screw clockwise until the display reads the value obtain in step 5.
7. Re-tighten the hex standoff. Verify that the display does not change.
8. Close analyzer. Allow one hour for analyzer readings to stabilize. If zero gas reading has changed appreciably, re-balance the analyzer.

SOURCE ALIGNMENT

Source balance adjustment must be performed prior to source alignment.

This procedure is necessary when the detector signal is greater than 1.2 volts after step 5 in the source balance adjustment procedure.

1. Connect a DVM between TP6 and TP2 on the Signal Board.
2. Set the source balance screw halfway in. (1/2 inch of the threads are visible.)
3. Loosen the two screws holding each source in place.
4. Adjust both measurement and reference sources up and down to reach the minimum detector signal. Tighten screws.
5. Perform source balance adjustment procedure above.

TROUBLESHOOTING

If problems are encountered, such as error messages ER0, ER1, ER2, ER3 or ER4, go to the DIAGNOSTICS mode (page P-12) to assist in locating the cause of the problem.

Use the following Troubleshooting Chart as well as Section 5 Troubleshooting.

SPAN GAS ERRORS ER1, ER2 OR ER3

Check RANGE, CAL GAS, CL GAS

- CAL GAS (Span gas) must be \leq FS (fullscale range).
- Span gas must be 51 to 100% of the fullscale range.
- CL GAS must be read off of the non-linear curve.
- The RUN mode concentration reading must be less than the CL GAS value. (See SPAN Mode Display flow diagram, page P-8)

Note

Spanning with Linearizer ON

If spanning with linearizer ON, RUN MODE values will be in engineering units, and CAL GAS values will appear in the right-side display.

The microprocessor will be using the non-linear values for the initial stages of calibration. It may calculate a CAL GAS value that is higher than the entered value. An error message will be displayed if this occurs.

ANY OF THE FOLLOWING MAY CORRECT THE PROBLEM:

1. Re-check CAL GAS and CL GAS values entered in RANGE mode.
2. Verify that the NON-LINEAR curve is read for CL GAS entry.
3. During hardware span adjust, make the run value lower than the CAL value.
4. Re-calibrate with the linearizer OFF.

RUN MODE VALUE TOO LOW DURING HARDWARE SPAN ADJUSTMENT

Hardware potentiometer is adjusted to 95% and RUN Mode value still too low;

- Check SPAN GAS bottle for correct concentration and flow
- Check for leaks
- Check DET SIG adjustments
- Check DIGITAL GAIN adjustments

RUN MODE VALUE TOO HIGH DURING HARDWARE SPAN ADJUSTMENT

Hardware potentiometer is adjusted to 5% and RUN Mode value still higher than CL or CAL GAS display when software zero taken by pressing ENTER the error message appears.

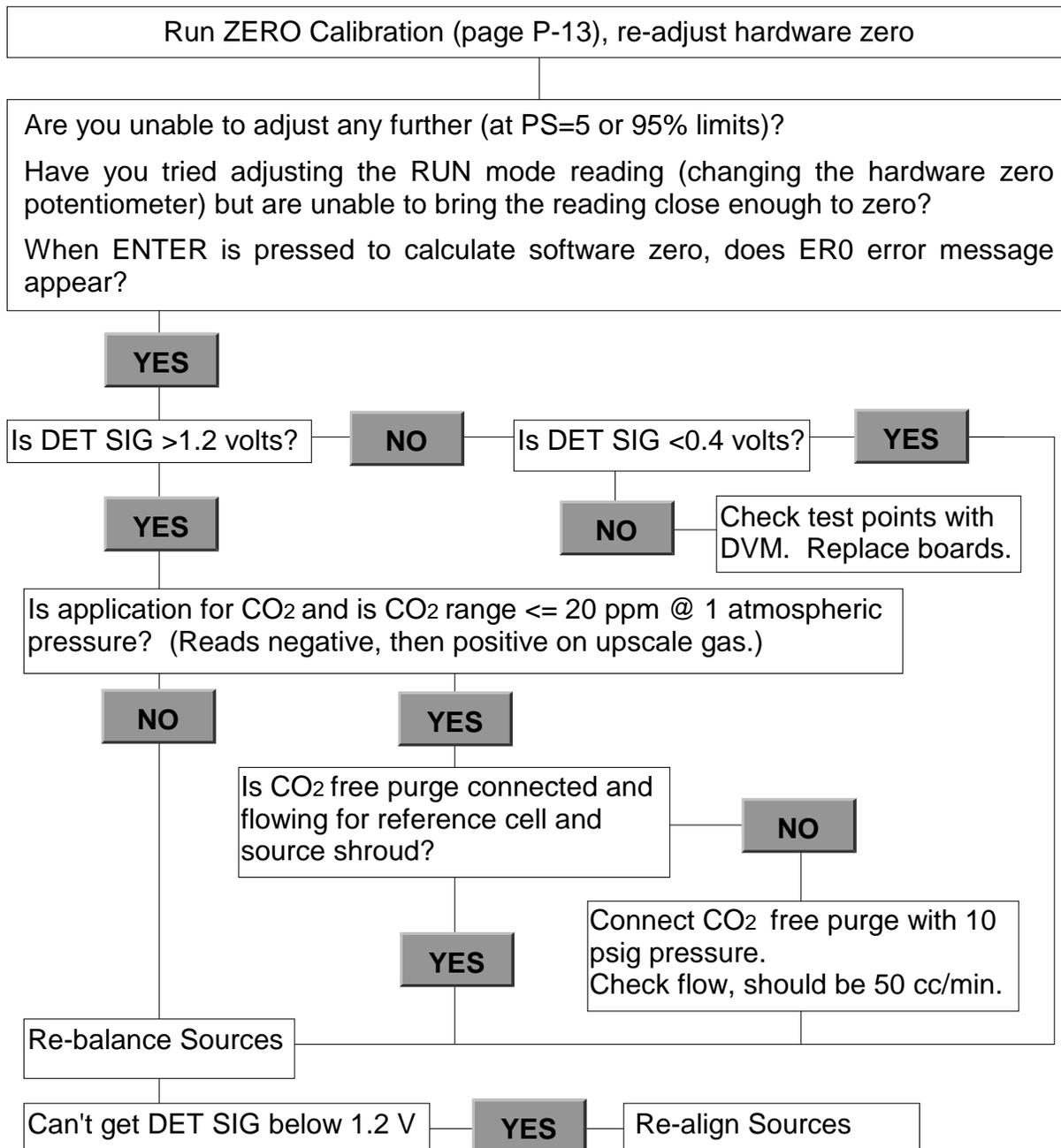
- Check SPAN GAS bottle for correct concentration and flow
- Check DET SIG adjustments
- Check DIGITAL GAIN adjustments

TROUBLESHOOTING CHART

Prior to troubleshooting, verify that OSC TUNE (oscillator tune) is properly adjusted. If reading is oscillating (and can't be correct by OSC TUNE adjustment), check DET SIG and digital GAIN adjustment.

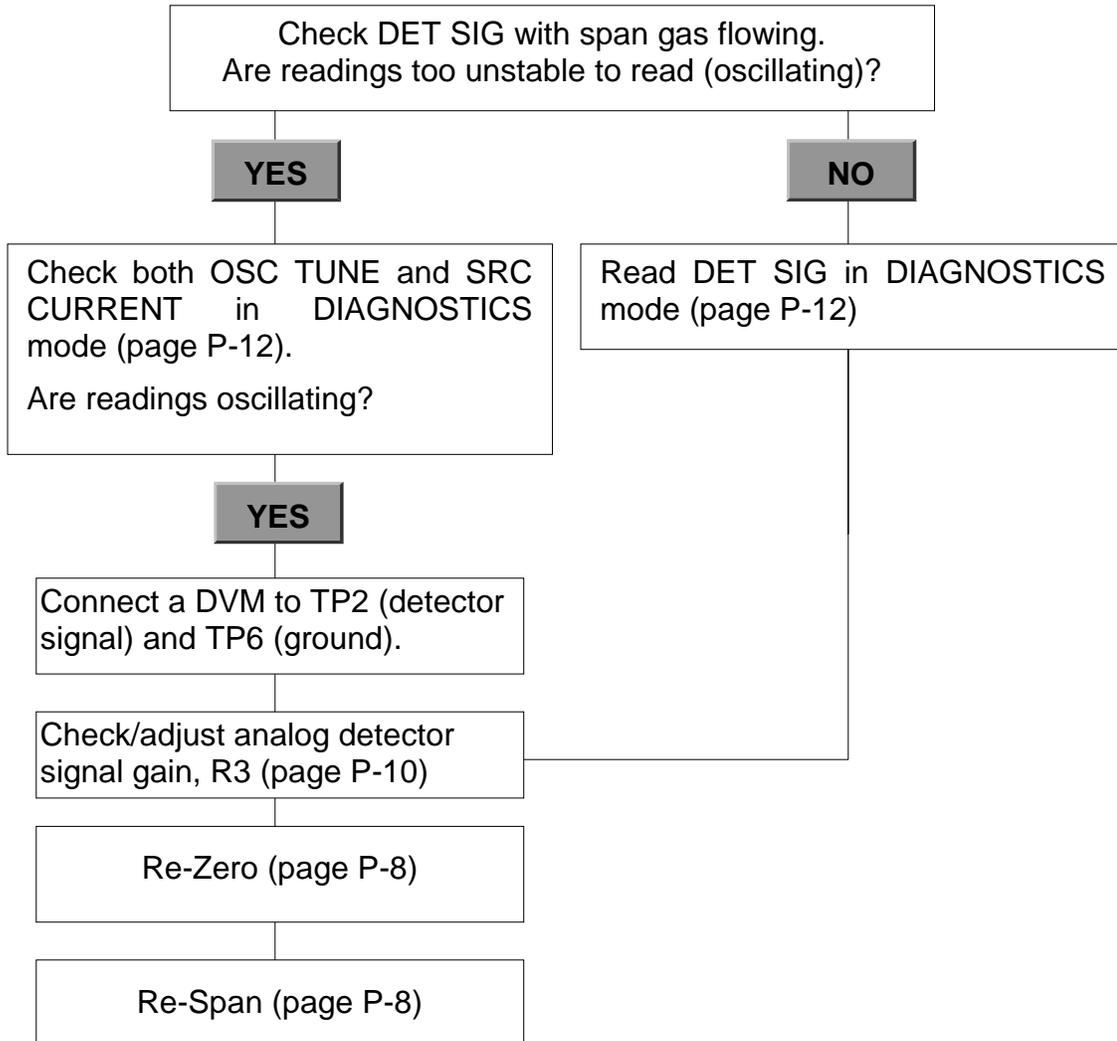
ZERO

ER0



ER4

Digital error - Generally caused by combination of too high an analog signal for the digital gain setting used.



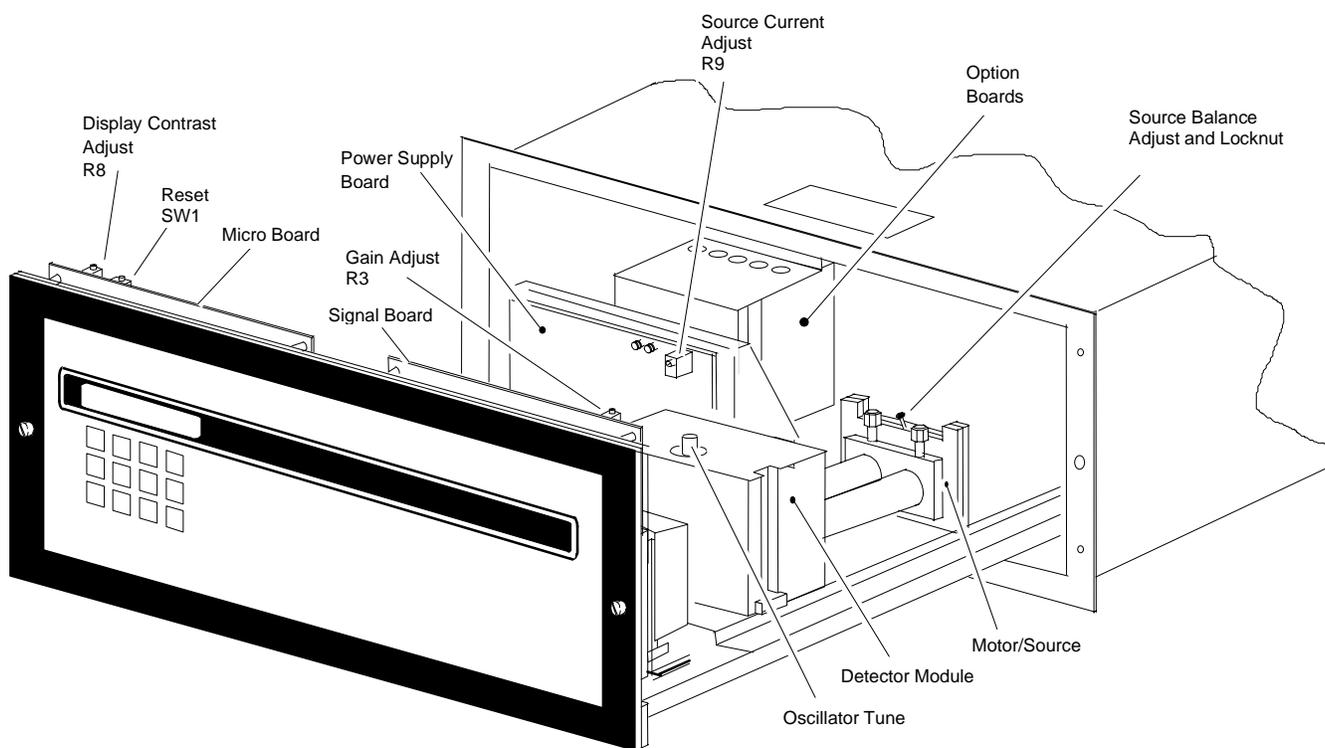
READS WRONG WAY ON UPSCALE GAS

Reads downscale, then upscale on low flows of upscale gas (the negative swing might be missed if flow is too fast)

This is caused by imbalance in reference/measuring energy to detector.

- Check for purge for ≤ 20 ppm CO₂ applications
- Check source balance (page P-14)

COMPONENT LOCATION



NOTES

1 INTRODUCTION

1.1 DESCRIPTION

The Model 880 Non-Dispersive Infrared Analyzer is designed to continuously determine the concentration of a particular component of interest in a flowing gaseous mixture. Within the analyzer, two equal energy infrared beams are directed through two parallel optical cells, a flow-through sample cell and a reference cell. The Luft detector continuously measures the difference in the amount of infrared energy absorbed within each of the two cells. This difference is a measure of the concentration of the component of interest in the sample. Readout is on the 16 character, backlit liquid crystal display in parts per million, percent of composition or percent of fullscale. Additionally, a 0 to +5 VDC output for a potentiometric (voltage) recorder is provided as standard.

By turning the linearizer ON and entering linearizing coefficients, a calibration curve may be used to convert display or recorder readings into linearized engineering units. When this feature is ON, the analyzer utilizes a linearizing function for linear readout of concentration values on the display and on a recorder. A diagnostics mode is provided as standard.

1.2 AVAILABLE OPTIONS

Operation of the Model 880 can be enhanced with the choice of several options:

DUAL ALARMS

User-set dual alarms are available with configurable HI/LO designations and deadband.

ISOLATED CURRENT OUTPUT

For normal usage, the 0 to 20 mA or 4 to 20 mA current output can be set to represent 0 to 100% of fullscale, or a suppressed range of 25% or more of fullscale may be selected.

AUTO ZERO/SPAN

An Automatic Zero/Span is available for unattended calibration of all three ranges.

CALIBRATION GAS CONTROL

A Calibration Gas Control allows two solenoids to be remotely actuated from the front panel, enabling one-man calibration without leaving the analyzer.

REMOTE RANGE I/O

An optional remote range input/output is available.

CASE HEATER

A proportional temperature controller with fan assembly maintains proper operating temperature inside the case.

PURGE KITS

An air purge kit, when installed with user-supplied components, meets Type Z requirements of standard ANSI/NFPA 496-1989 for installation in Class I, Division 2 locations as defined in the National Electrical Code (ANSI/NFPA 70) when sampling non-flammable gases. If analyzer is used to sample a flammable gases it must be protected by a continuous dilution purge system per standard ANSI/NFPA 496-1989, Chapter 8. Consult factory for further information.

UNPACKING AND INSTALLATION

2

2.1 UNPACKING

Examine the shipping carton carefully. If there are any signs of damage, notify the carrier immediately. Open the carton and inspect the contents for signs of damage. If there is concealed damage, save the carton and packing material and notify the carrier.

2.2 LOCATION

Locate the analyzer in a weather-protected, non-hazardous location away from vibration. For best results mount the analyzer near the sample stream to minimize sample-transport time. Refer to Installation Drawing 010-624190.

If equipped with P/N 624446 optional air purge kit and installed with user-provided components per Instructions 015-748157, the analyzer may be located in a Class I, Division 2 area as defined by the National Electrical Code (ANSI/NFPA 70). This kit is designed to provide Type Z protection in accordance with Standard ANSI/NFPA 496-1989, Chapter 2, when sampling nonflammable gases. For flammable samples the instrument must be equipped with a continuous dilution purge system in accordance with ANSI/NFPA 496-1989 Chapter 8 or IEC Publication 79-2 (1983) Section Three. Consult Factory for recommendations on sample flow limitations and minimum purge flow requirements for your particular application.

2.3 VOLTAGE REQUIREMENTS



WARNING: ELECTRICAL SHOCK HAZARD

For safety and proper performance, this instrument must be connected to a properly grounded three-wire source of electrical power.

This instrument was shipped from the factory set up to operate on 115 VAC, 50/60 Hz electric power. For operation on 230 VAC, 50/60 Hz the installer must position voltage select switches S1 and S2 located on power supply board and switch S3 located on case temperature heater assembly (optional) to the 230 VAC position (refer to Figures 2-1 and 2-2).

Power consumption is less than 150 watts without optional case heater or 350 watts with optional case heater.

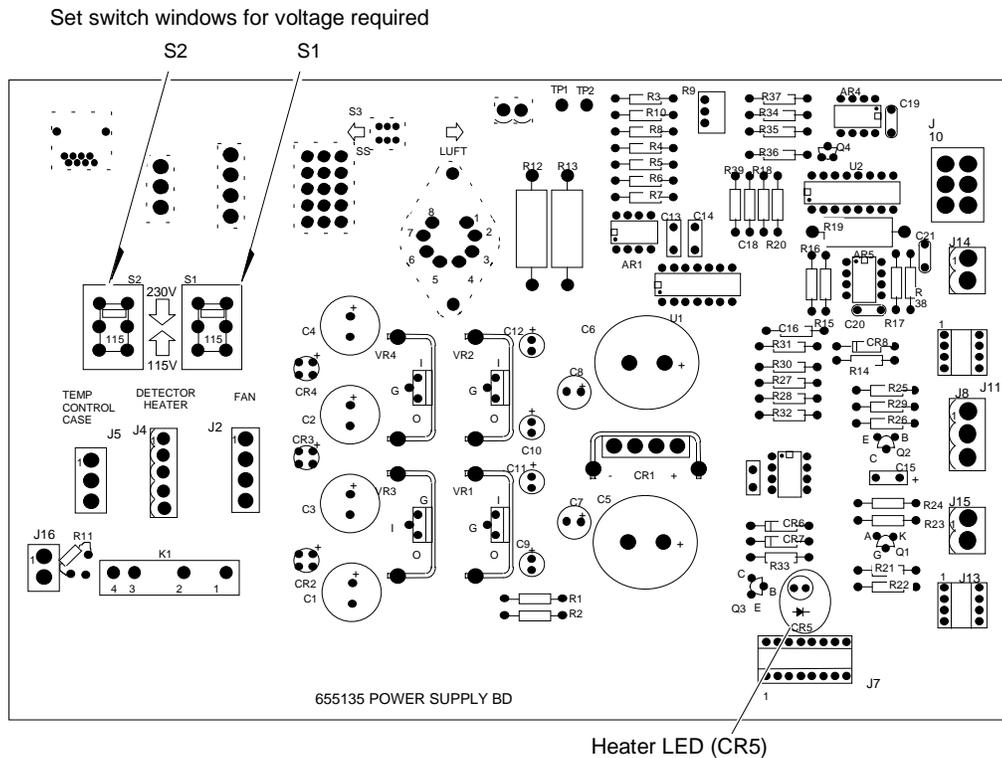


FIGURE 2-1. POWER SUPPLY BOARD

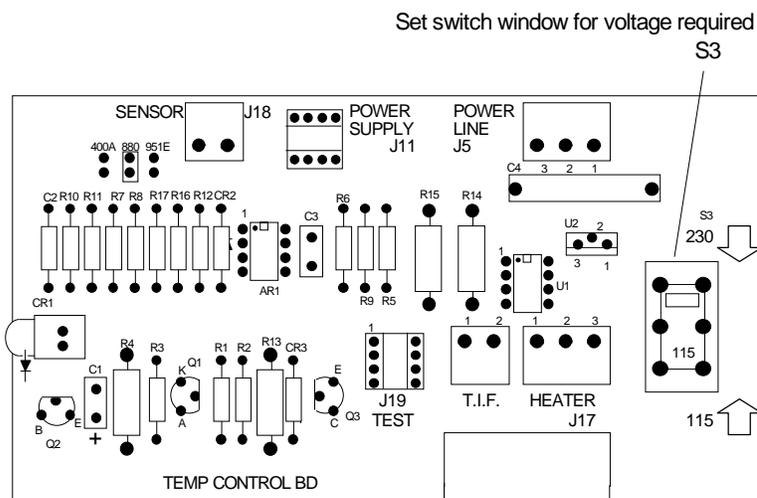
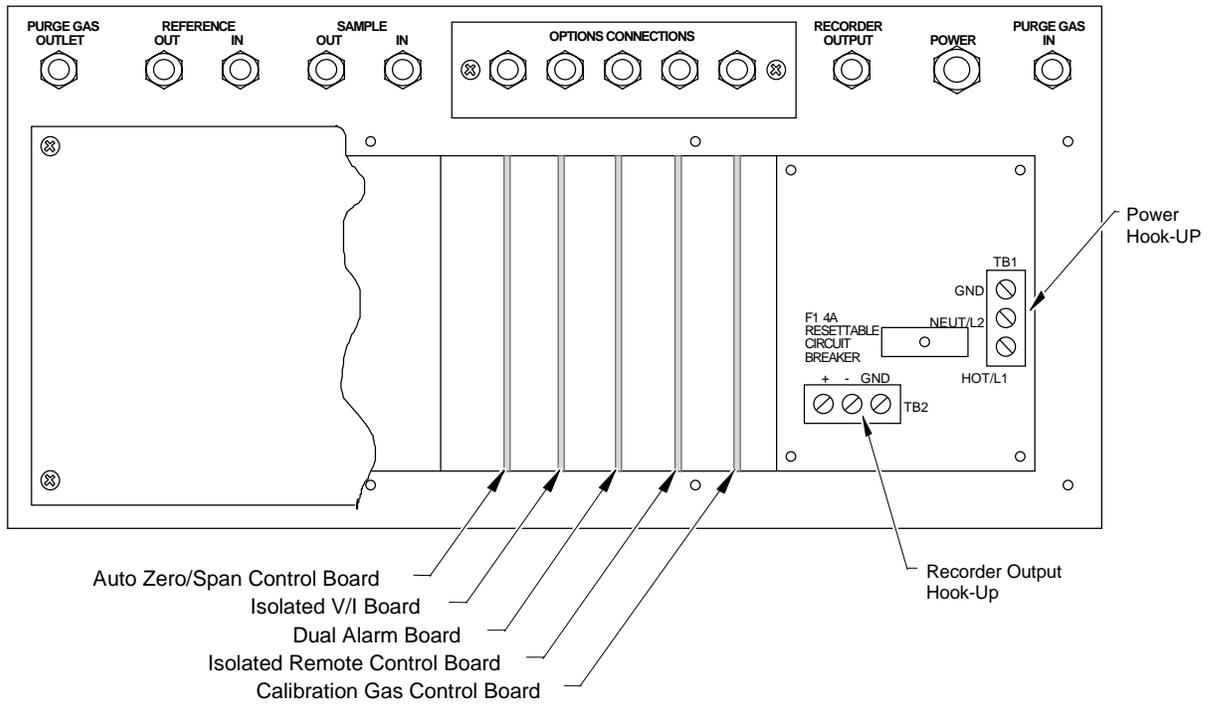


FIGURE 2-2. CASE HEATER TEMPERATURE CONTROL BOARD



OPTION BOARDS INSTALLED WITH COMPONENT SIDE TO THE LEFT.

FIGURE 2-3. REAR VIEW OF MODEL 880

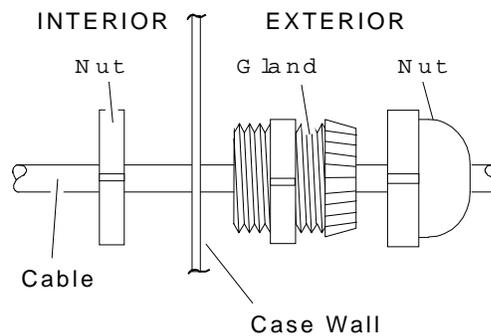


FIGURE 2-4. CABLE GLAND

2.4 ELECTRICAL CONNECTIONS

The power, recorder and option board cable glands are shipped loose in the shipping kit to allow cable installation to connectors or terminal strips. Route the cable through the cable gland parts and connect to a connector or terminal strip as shown in Figure 2-4, then tighten the gland.

CABLE GLAND	PART NUMBER
POWER	899330
RECORDER	899329
OPTION BOARD	899329

Remove the rear cover to access the terminals.

2.4.1 LINE POWER CONNECTIONS

If this instrument is located on a bench or table top or is installed in a protected rack, panel or cabinet, power may be connected to it via a 3-wire flexible power cord, minimum 18 AWG (max. O.D. 0.480", min. O.D. 0.270") through hole "H" (refer to Drawing 010-624190) utilizing the connector gland (P/N 899330) provided in the ship kit. Accessory kits are available which include a 10 foot North American power cord set plus four enclosure support feet for bench top use (P/N 654008) or the power cord only (P/N 634061) or the four feet only. If the instrument is permanently mounted in an open panel or rack, use electrical metal tubing or conduit.

Refer to Figure 2-4. Route the power cable through the cable clamp and connect the leads to TB1. Tighten the cable clamp after connecting the leads. Since the rear terminals do not slide out with the chassis, no excess power cable slack is necessary.

2.4.2 RECORDER CONNECTIONS

Recorder connections are made to the rear panel. Refer to Drawing 624190. Route the recorder cable through the cable clamp and connect the end to TB2.

Recorder Interconnection Cable:

Distance recorder to analyzer - maximum 1000 feet (305 meters).

Input impedance - greater than 5000 ohms.

Customer supplied two-conductor shielded cable, 20 AWG min.

Voltage output: 0 to +5 VDC.

2.5 SAMPLE AND REFERENCE INLET/OUTLET CONNECTIONS

The standard Model 880 is intended for atmospheric pressure operation only and must be vented to atmosphere. Pressurized cells are available for special applications. Sample inlet and outlet and, when used, flowing reference inlet and outlet connections are located on the rear panel. All connections are 1/4-inch bulkhead fittings.

2.6 CALIBRATION GAS REQUIREMENTS

Analyzer calibration consists of setting a zero point and one or more upscale points.

All applications require a zero standard gas to set the zero point on the display or recorder chart. If the factory Calibration and Data Sheet (included with the drawings at the end of the manual) specifies a background gas, use this as the zero gas. If a background gas is not specified, use dry nitrogen for the zero gas.

2.7 SAMPLE HANDLING SYSTEM

Many different sample handling systems are available, either assembled completely or as loose components. The type used depends on the requirements of the particular application and the preferences of the individual user. Typically, the sample handling

system incorporates such components as pumps and valves to permit selection of sample, zero standard, or upscale standard gas; needle valve in sample-inlet line for flow adjustment; flowmeter for flow measurement and/or indication of flow stoppage; and filter(s) to remove particulate matter.

2.8 LEAK TEST PROCEDURE



WARNING: POSSIBLE EXPLOSION HAZARD

This analyzer is of a type capable of analysis of sample gases which may be flammable. If used for analysis of such gases, the instrument must be either in an explosion-proof enclosure suitable for the gas, or protected by a continuous dilution purge system in accordance with Standard ANSI/NFPA-496-1986 (Chapter 8) or IEC Publication 79-2-1983 (Section Three).

If explosive gases are introduced into this analyzer, the sample containment system must be carefully leak checked upon installation and before initial startup, during routine maintenance and any time the integrity of the sample containment system is broken, to ensure the system is in leak proof condition.

Internal leaks resulting from failure to observe these precautions could result in an explosion causing death, personal injury or property damage.

The following test is designed for sample pressure up to 10 psig (69 kPa).

1. Supply air or inert gas such as nitrogen at 10 psig (69 kPa) to analyzer via a flow indicator with a range of 0 to 250 cc/min and set flow rate at 125 cc/min to the sample inlet.
2. Seal off with a cap.
3. Use a suitable test liquid such as SNOOP® (P/N 837801) to detect leaks. Cover all fittings, seals, or possible leak sources.
4. Check for bubbling or foaming which indicates leakage and repair as required. Any leakage must be corrected before introduction of sample and/or application of electrical power.
5. If the instrument incorporates a flow-through reference, the above test must be repeated for that gas system.

Note

Do not allow test liquid to contaminate cells or detector and source windows. Should this occur, the cells should be cleaned (Section 6.1).

2.9 SAMPLE FLOW RATE

For best results, the sample flow rate must be in the range of 1 to 2 SCFH (500 to 1000 cc/min). A subnormal flow rate will result in an undesirable time lag. However, an excessive flow rate will result in cell pressurization.

Assume that two cell volumes are required to flush any cell. Table 2-1 indicates approximate flushing time at atmospheric sampling pressure, i.e., the outlet of the cell venting to atmosphere for various cell lengths.

Flushing time is inversely proportional to flow rate.

The primary effect of flow rate, other than flushing time, is cell pressure. Due to the restriction of the exit tubing, an increasing flow rate increases sample pressure in the cell. For a 9-inch (232 mm) cell venting to atmosphere, the cell pressure rises from 0 psig (0 kPa) at no flow, essentially linearly, by 1 mm Hg per CFH flow up to at least 20 CFH (10 L/min).

CELL LENGTH		CELL VOLUME IN CC WITHOUT INLET TUBE	TOTAL VOLUME IN CC CELL WITH INLET TUBE	TIME FOR 2 VOLUMES AT 2 SCFH (1 L/MIN) AT 750 MM HG
MM	INCH			
3	0.118	0.85	12	2 sec.
4	0.157	1.14	12	2 sec.
8	0.315	2.28	13	2 sec.
16	0.630	3.56	16	2 sec.
32	1.25	9.12	20	2 sec.
64	2.52	18.24	25	3 sec.
128	4.03	35.48	44	3 sec.
232	9.13	65.12	73	6 sec.
343	13.50	97.76	105	13 sec.
381	15.00	108.60	116	14 sec.

TABLE 2-1. PURGING TIME AT ATMOSPHERIC SAMPLE PRESSURE

At 7.5 to 8.0 CFH (3.8 to 4 L/min), therefore, the pressure is increased by about 1%, and the output signal is thereby increased by about the same 1% over static conditions. In all cases, the effect of pressure on readout is eliminated if the same flow rate is used for the measured sample as well as for the zero gas and span gas.

Note that at higher flow rates the non-linearity of the calibration curve increases, because of increase in sample cell pressure. Therefore, if higher flow rates are required, the calibration curve should be redrawn at the higher rate.

At 2 CFH (1 L/min) gaseous sample temperatures are equilibrated to instrument temperature regardless of stream temperature. At extremely high flow rates, this may not be true, but no such effect has been noted up to 18 CFH (9 L/min).

2.10 DIFFERENTIAL ANALYSIS WITH FLOW-THROUGH REFERENCE CELL

In some applications the analyzer is used to measure the difference between the concentration of the component of interest in two sample streams. If so, the reference side of the analyzer, as well as the sample side, utilizes a flow-through cell. The sample cell receives the sample stream, which contains the higher concentration of the component of interest. The reference cell receives the stream containing the lower concentration of this component. The flow rate through both cells should be monitored with a flowmeter and kept the same.

2.11 OPTION BOARDS

The following option boards may be ordered factory installed, or may be ordered as kits from the factory at a later date: Alarm, Current Output, Calibration Gas Control, Auto Zero/Span and Remote Range I/O. The boards are equipped with mating plugs for field wiring attached to the connector at the edge of each board. Attach the cable (customer supplied) to the plug and socket connector according to the schematic for each option board.

If an option board has been ordered installed at the factory, this board will be in one of the five slots inside the rear of the analyzer. Each option will require a cable (user-provided) which connects to a female plug. The female plug comes attached to the appropriate terminal block on the option board. If the instrument came equipped with one option, the interconnect cable will be in place for all options.

The Alarm, Auto Zero/Span, Calibration Gas Control and Remote Range Change Boards have jumper-selectable addresses (Figures 2-5, 2-7, 2-8 and 2-9).

2.11.1 ALARM CONNECTIONS

Refer to Drawing 624204 and Figure 2-5. Connect cable (customer supplied) to the 6-pin connector J2. The Dual Alarm Option consists of two form C contacts rated 3A-125/250 VAC or 5A-30 VDC (resistive) .

Run the cable through the cable gland and tighten once attached to connector (Figure 2-4).

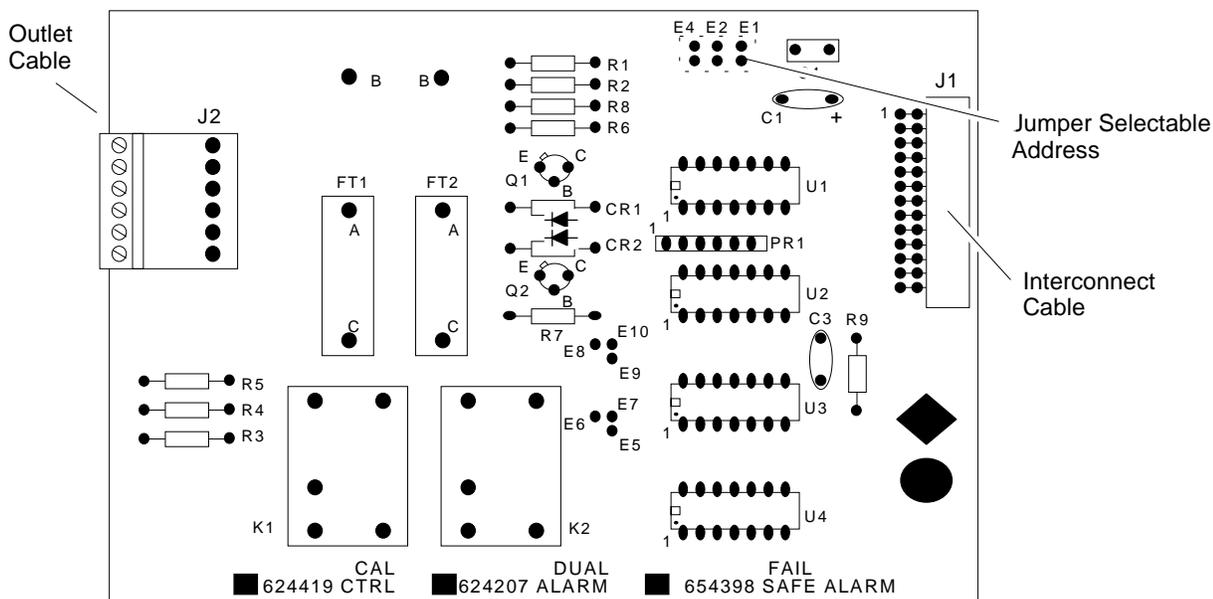
This board may be configured to provide any one of three functions:

Fail Safe Alarm - Jumpers E1, E2, E6, E7, E8, E10

Dual Alarm - Jumpers E1, E2, E5, E7, E9, E10

Calibration Gas Control - Jumpers E1, E4, E5, E7, E9, E10.

The hook wiring remains the same on each.



Note: The Dual Alarm, Fail Safe Alarm and Calibration Gas Control use the same board. However, the jumpers locations are different.

- Cal Gas Control: E1, E4, E5 - E7 and E9 - E10
- Dual Alarm: E1, E2, E5 - E7 and E9 - E10
- Fail Safe Alarm: E1, E2, E6 - E7 and E8 - E10

FIGURE 2-5. CALIBRATION GAS CONTROL AND ALARM CONNECTIONS

2.11.2 CURRENT OUTPUT OPTION CONNECTIONS

Refer to Drawing 624291 and Figure 2-6. Connect cable (customer supplied) to the 2-pin connector J2. The voltage-to-current board has a fixed address at the top of the board. Run the cable through the cable gland and tighten once the connector has been made up (Figure 2-4).

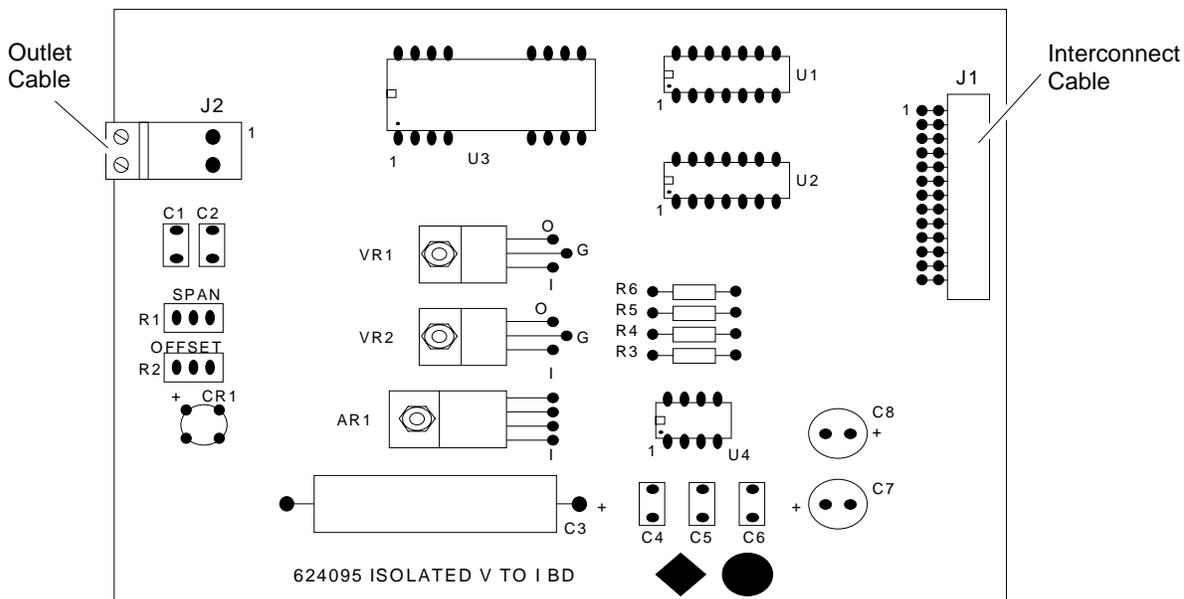


FIGURE 2-6. CURRENT OUTPUT CONNECTIONS

2.11.3 CALIBRATION GAS CONTROL CONNECTIONS

Refer to Drawing 624204 and Figure 2-5. Connect cable (customer supplied) to the 6-pin connector J2. The Calibration Gas Control Option consists of two form C contacts rated 3A-125/250 VAC or 5A-30 VDC (resistive).

Run the cable through the cable gland and tighten once the connector has been made up (Figure 2-4).

2.11.4 AUTO ZERO/SPAN CONNECTIONS

Refer to Drawing 624202 and Figure 2-7. Connect cable (customer supplied) to the 9-pin connectors J2 and 13. The Auto Zero/Span Option consists of four form C contacts rated 3A-125/250 VAC or 5A-30 VDC (resistive) and two form A contacts rated at 10 watts maximum switching power, 200 VDC maximum switching voltage and 0.5 A maximum switching current.

Run the cable through the cable gland and tighten once the connector has been made up (Figure 2-4).

If installed, this board can also be activated from the keyboard (Zero/Span) for the selected range.

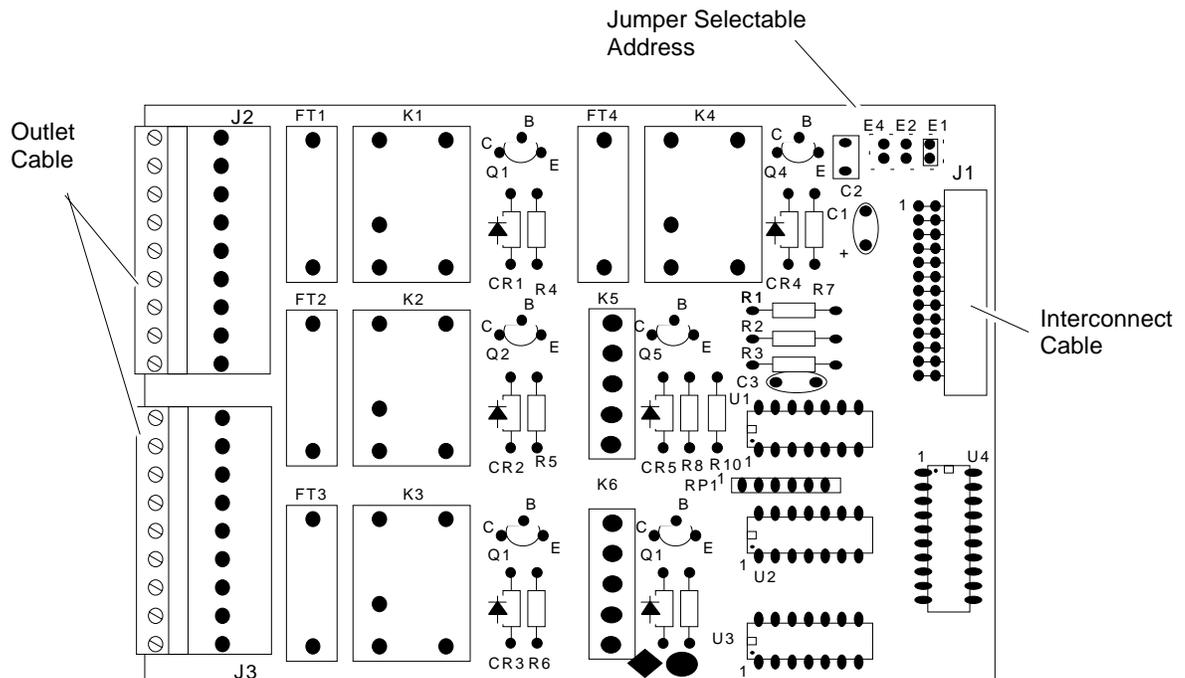


FIGURE 2-7. AUTO ZERO/SPAN CONNECTIONS

2.11.5 REMOTE INPUT/OUTPUT CONNECTIONS

Refer to Drawing 624249 and Figure 2-9. Connect cable (customer supplied) to the 9-pin connectors J2 and J3.

The signal output is at J2 which consists of eight form A contacts rated (resistive load) 10 watts, maximum switching power, 200 VDC maximum switching voltage and 0.5 A maximum switching current.

The signal input is at J3 which consists of eight opto-couplers, operated from a user-supplied 24 VDC power source.

Run the cable through the cable gland and tighten once the connector has been made up (Figure 2-4).

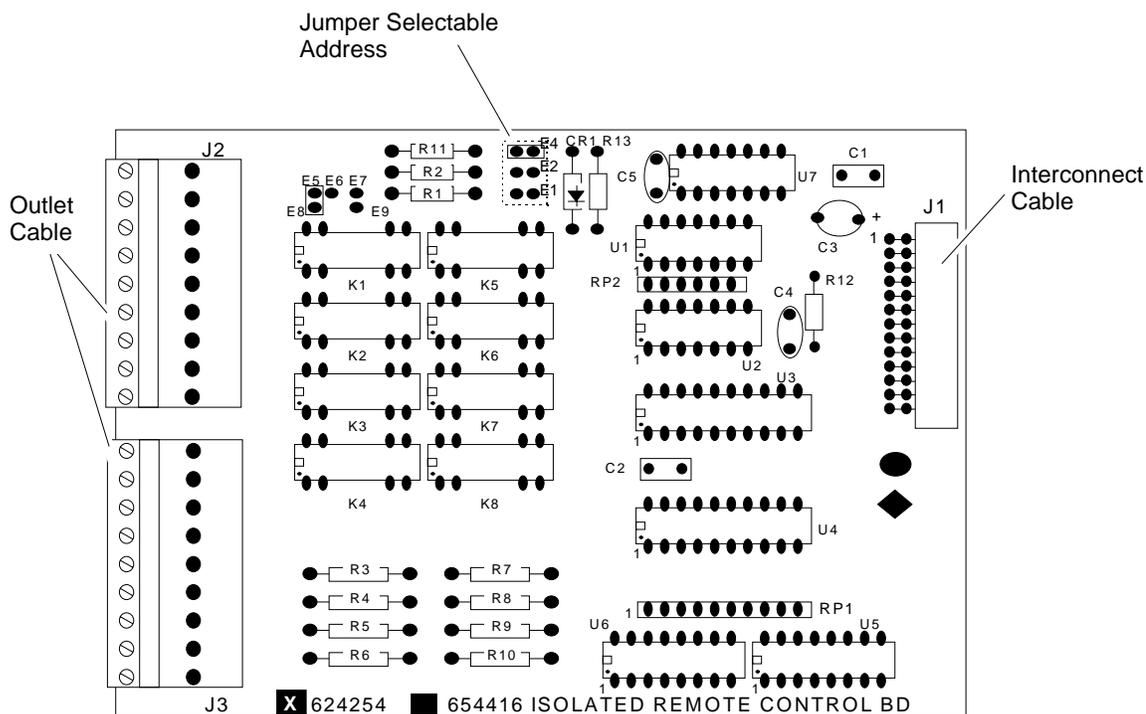


FIGURE 2-9. REMOTE INPUT/OUTPUT CONNECTIONS

2.12 ORDERING OPTION KITS

Options not ordered from the factory at the time of purchase may be ordered as the following kits:

624422 Isolated Remote Control Kit

624423 Dual Alarm Kit

624424 Auto Zero/Span Control Kit

624425 Isolated Current Output Kit

624426 Calibration Gas Control Kit

The option kit consists of the circuit board, a cable gland and two circuit card guides which press into predrilled holes in the card cage. Mount the option in the board as shown and follow the wiring directions in section 2.4. There are five connectors on the interconnect cable. It is important for the slot to be connected to the correct connector on the interconnect cable.

To install any of the above kits, the Common Parts Kit, P/N 624414, must be ordered. If not originally ordered with the analyzer. This kit consists of a card cage which mounts in the rear as shown in Figure 2-3 and three interconnect cables that plug in as shown on DWG 026-624191. Once this kit is installed, it need not be ordered again for other kits.

NOTES

3 INITIAL STARTUP AND CALIBRATION

Prior to shipment this instrument was subjected to extensive factory performance testing, during which all necessary optical and electrical adjustments were made. The following instructions are recommended for initial startup and subsequent standardization of the analyzer.

3.1 LEAK TEST

Perform the Leak Test Procedure in Section 2.8.

3.2 POWER VERIFICATION

1. Verify power switch settings are for available power (115 VAC/230 VAC). Refer to Section 2.
2. Apply power. On the Power Supply Board, verify that heater LED (CR5) is ON. Refer to Figure 2-1 and Drawing 624073.

3.3 SOFTWARE VERSION

When power is first applied to the Model 880 analyzer, the display will read [INITIALIZING]. Next, the display will show the current software revision number, [VERSION 2.XX]. This manual is intended only for use with instruments with a software version of 2.0 or greater.

3.4 FRONT PANEL INDICATORS AND CONTROLS

3.4.1 DISPLAY

The display consists of a 16-character, backlighted liquid crystal display. The contrast on the display may be adjusted so that the display can be read from any vertical angle. This adjustment is made by loosening the two screws on the front of the case and sliding the front panel forward (up to 8.2 inches), then turning the potentiometer (R8) adjust the contrast (Figure 3-1) until the best view of the display is obtained.

In the normal RUN mode of operation, the display will show current process value, component name, control mode and range. In other modes, relevant information will be displayed as is necessary.

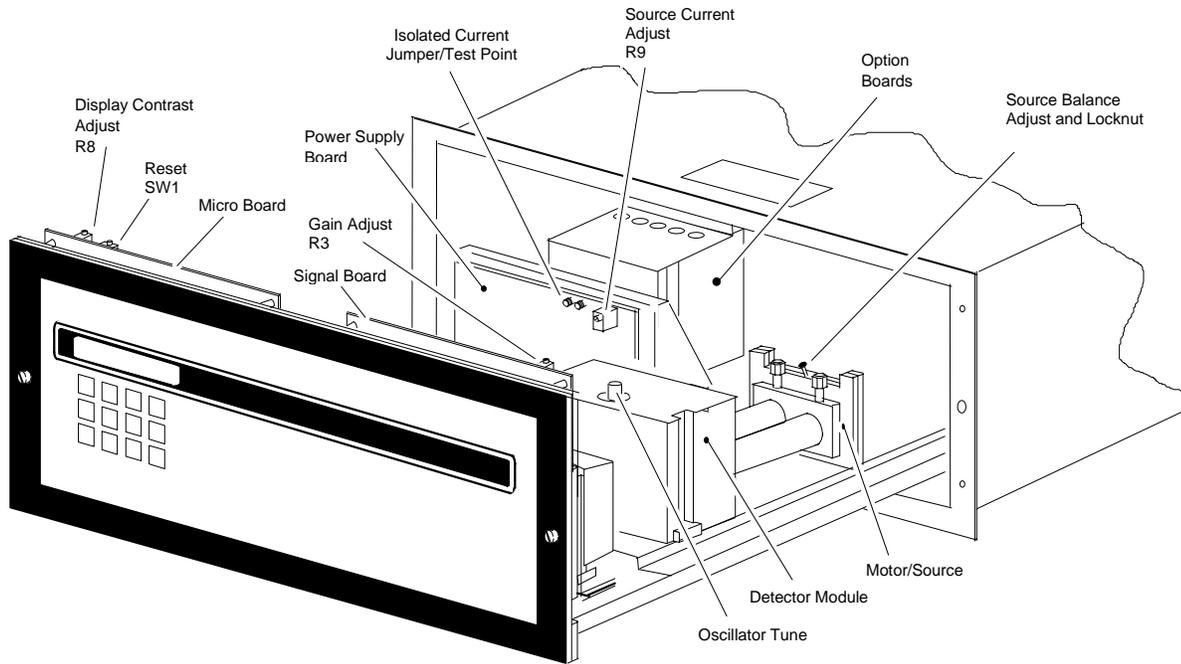


FIGURE 3.1 MODEL 880 ADJUSTMENTS

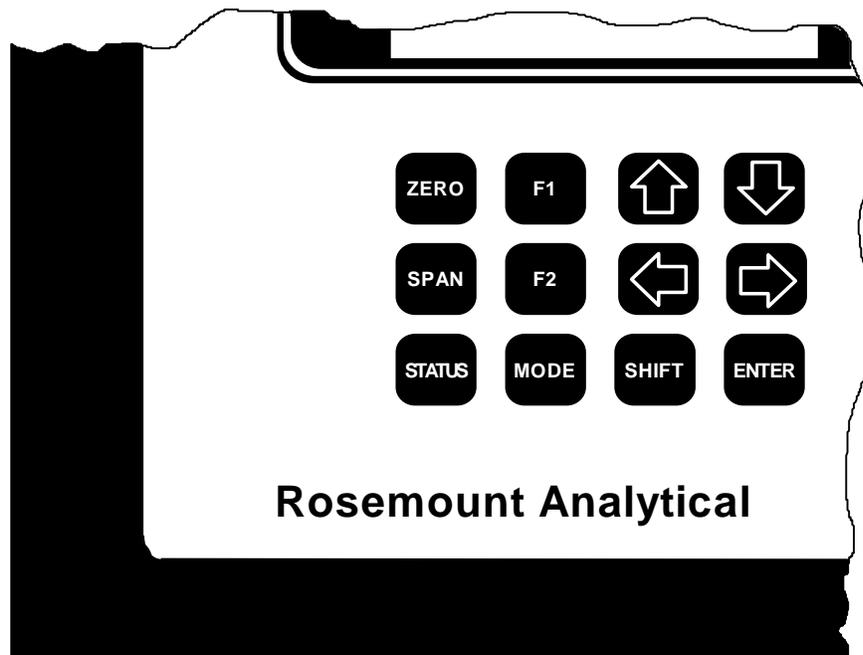


FIGURE 3-2. MODEL 880 KEYPAD

3.4.2 FUNCTION KEYS

The Model 880 has twelve function keys (Figure 3-2). Each key must be pressed firmly to insure that the microprocessor recognizes the keystroke. The definitions for these keys are as follows:



To activate the manual zero calibration of the analyzer.



To activate the manual span calibration of the analyzer.



To display the configuration and the status of alarms and error messages.



Used in conjunction with left and right or up and down arrows, F1, F2 and ENTER keys. Pressing the SHIFT key in any display except Run Mode, Zero Setting, Span Setting and Status causes a ↑ to be displayed at the far right hand position. Pressing → will then move the cursor 16 characters to the right, pressing ← will move the cursor 16 characters to the left, and, if a displayed parameter is being modified, pressing ↑ will access the highest value allowed for that parameter and pressing ↓ will access the lowest value allowed for that parameter.



Software programmable keys for quick access to mode functions. When used in conjunction with the SHIFT key, two additional functions are available: SHIFT/F1 and SHIFT/F2. The computer acknowledges the keystrokes by flashing [** KEY SAVED **] on the display. These four functions can immediately access a particular display for the following modes: Range, Diagnostics, Linearization, Alarm, Current Output, Auto Zero/Span or Remote Range I/O.

F2



To display instrument functions. The standard functions are security, range, diagnostics, and linearization. Additional functions (in conjunction with option boards) are Auto Zero/Span, Remote Range I/O, Current Output, and Alarm.



The up and down arrow keys are used to modify the data in the display. Press either the up or down arrow to change the values displayed. When used in one of the editing modes, pressing SHIFT ↑ will display the highest value allowed in a function. Pressing SHIFT ↓ will display the lowest value. In the zero and span calibrations, these keys will display the highest and lowest potentiometer settings.

Press the arrow key once to change one digit; press and hold either key to scroll (continuous value change), thereby reducing the time required to make large value changes.



To move cursor one position at a time or, when used in conjunction with the SHIFT key moves the cursor 16 characters, one full display, at a time.



To access a function, to store a value in nonvolatile memory or to return to run mode from span, zero and security screens. The computer acknowledges ENTER by momentarily flashing [** DATA STORED **] on the display when display when used to store a setting in non-volatile memory. Use ENTER to engage the span and zero functions, which are initiated by the SPAN and ZERO keys. [CALCULATING SPAN] or [CALCULATING ZERO] will then be momentarily displayed. Instruments with the Calibration Gas Control option or Auto Zero/Span option, ENTER also turns ON and OFF a solenoid valve for zero and span gas.



The ENTER key in conjunction with the SHIFT key will return to Run Mode. In the event of a power outage, items placed in volatile memory will be lost. First press the SHIFT key, followed by the ENTER key.

SHIFT+ENTER does not shut off the solenoid valve for instruments with the Calibration Gas Control or Auto Zero/Span.

The SHIFT+ENTER combination is the Escape feature.

3.4.3 USER-PROGRAMMABLE KEYS

F1, F2, SHIFT/F1 and SHIFT/F2 are software-programmable keys which can be user-programmed to access any frequently used display or sub-menu for the following modes: Range, Diagnostics, Linearization, Auto Zero/Span, Remote Range I/O or Alarm, provided the option board selected is still present.

To use this feature, the function keys must be preprogrammed by the user through the following steps:

1. Access a display or sub-menu that will be frequently used.
2. Access a display or submenu by following the steps in the particular set of instructions given in Figures 3-7 through 3-24 until the desired display is obtained.
3. Press F1, F2, SHIFT/F1 or SHIFT/F2 to program the analyzer to return to this display from the RUN mode. This will assign F1, F2, SHIFT/F1 or SHIFT/F2 to this particular display, and will retain those assignments until the key or combination of keys is reprogrammed using the same procedure described in this section. The analyzer acknowledges this command by flashing [**KEY SAVED**] on the display.
4. Exit to the RUN mode display by completing the remaining steps in the figure chosen in Step 2.
5. When the analyzer returns to the RUN mode display, press the key or keys selected in Step 3 (F1, F2, SHIFT/F1 or SHIFT/F2) to check the setup. The analyzer will return to the display or sub-menu selected in Step 1.

6. Press SHIFT+ENTER to return to the RUN mode.

To reprogram the key or keys selected in Step 2, repeat Steps 1 through 5 for another display or sub-menu.

For example, if the GAIN is frequently changed, access the RANGE sub-menu to access the GAIN display and press the F1 key. Press SHIFT+ENTER to return to the RUN mode. To get to the GAIN display from the RUN mode display, press the F1 key. To reprogram the F1 key, go to another display other than the RUN mode display and press the F1 key. This will reprogram the F1 key to the new display.

3.4.4 RUN MODE DISPLAY

The RUN mode is the normal mode of operation. In this mode the display will show current process value component designation, control mode and range. Should an error condition or an alarm condition occur, [ER?] (where ? is an alphanumeric character) or [AL#] (where # is either the number 1 or 2) will flash on the display in the component name location. A list of error messages is located in Section 5.1. Refer to Figure 3-3 for the different run mode displays.

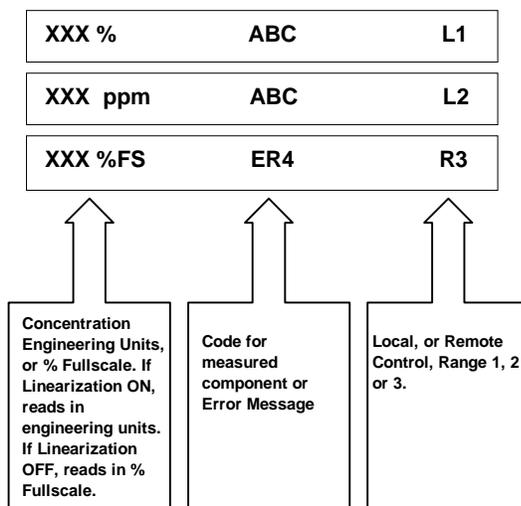


FIGURE 3-3. RUN MODE DISPLAY

3.4.5 GENERAL DISPLAY INFORMATION

The following features are present to the right of all display sequences:

→ The beginning of a sub-menu is indicated by → in the extreme right position of the display. This arrow indicates that there will be more information in subsequent displays which can be obtained by either pressing the → key until the next display is obtained, or pressing SHIFT → to move 16 characters, one full display, at a time.

* Indicates that there are subsequent displays which can be accessed by pressing the → key to view a new display or the ← key to return to a previous display. To move 16 characters, one full display at a time, press SHIFT → or SHIFT ←.

← The last display of a routine is indicated by the ← To return to other displays in the routine, press the → key or SHIFT ← to move 16 characters, one full display at a time.

Note:

At any point in the sequence, a sub-menu may be exited by pressing SHIFT+ENTER.

3.5 ACCESSING MODE DISPLAYS

Ensure that all MODE displays are functional and that all options ordered from the factory are present by following the flow chart in Figure 3-4. To follow the logic flow chart, use the following steps:

Note:

For more detailed instructions, refer to Figures 3-7 through 3-24.

1. Press MODE.
2. Use the → key to move to the desired sub-menu (SECURITY, RANGE, DIAGNOSTICS, LINEARIZER, ALARM, CURRENT OUTPUT, AUTO-CAL or REMOTE I/O) and press ENTER.
3. Press SHIFT then → to move through each sub-menu.
4. At the end of each routine, press SHIFT+ENTER to return to the RUN mode.
5. Repeat steps 1 through 4 to check the next function.

3.6 SECURITY CODE

The Model 880 is equipped with a security code feature, which is deactivated when the instrument is shipped from the factory. When the security feature is activated, only the STATUS and MODE function keys are active to access the STATUS and SECURITY displays. A valid password must be entered to activate the rest of the keyboard.

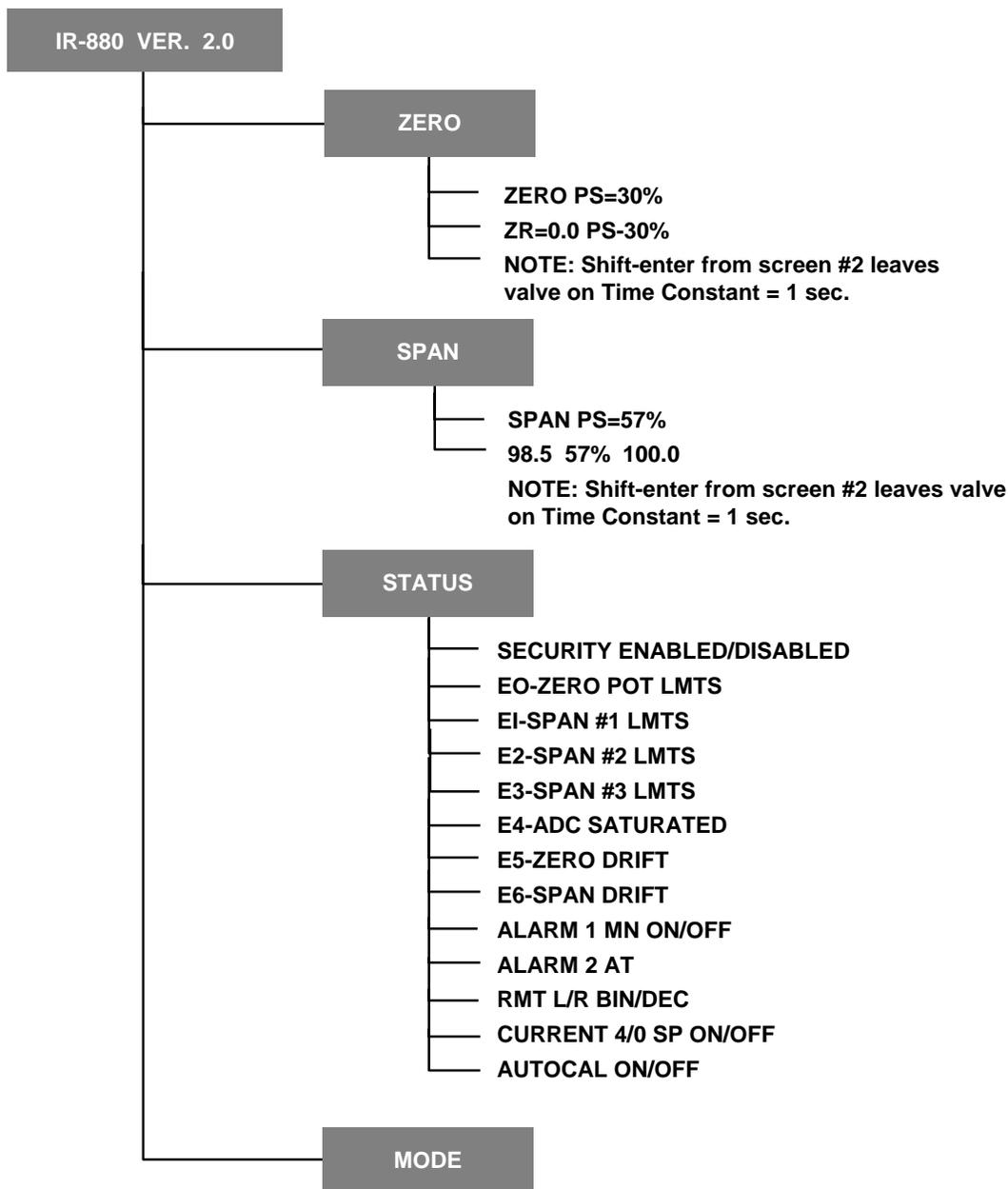
INITIAL PASSWORD IS "880"

This password may be changed to any three character group as shown in Figure 3-7. Entering the correct password activates the keyboard.

To gain access, follow the steps in the appropriate figure in this section. Once access has been gained, the procedure described in Sections 3.6 through 3.16 may be performed.

In the event the password is misplaced, the operator may return to the initial password (880) through the following steps:

1. Press and release the RESET push-button switch on the Micro Board (see Figure 3-1).
2. Press and hold the ENTER key until the RUN mode display appears.



(continue to Figure 3-4B)

FIGURE 3-4. LOGIC FLOW CHART (CONTINUED ON NEXT PAGE)

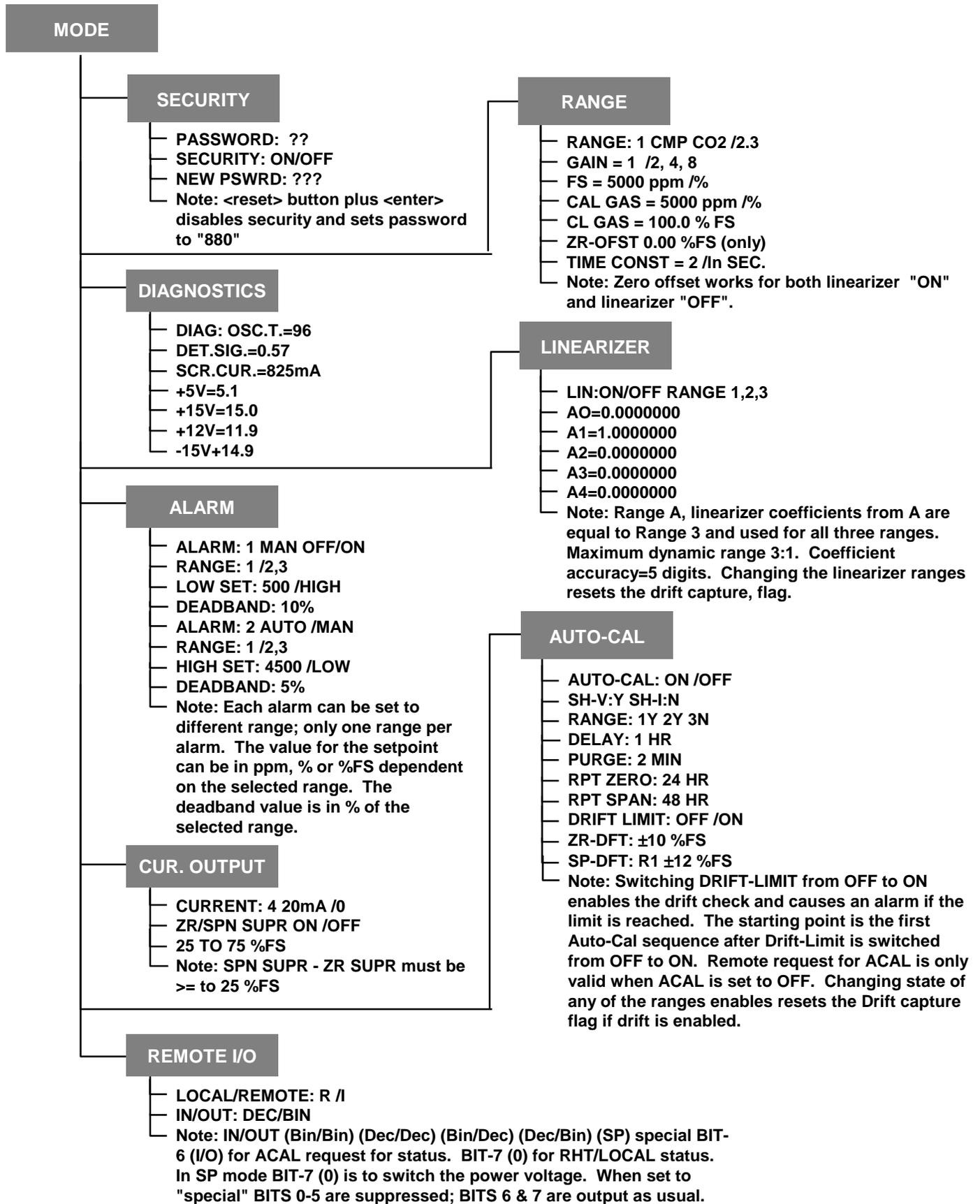


FIGURE 3-4. LOGIC FLOW CHART (CONTINUED FROM PREVIOUS PAGE)

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	MODE	<u>S</u> ECURITY →	Pressing the MODE key accesses the security feature. If the security feature is activated as indicated by ← at the right of the display, continue with Step 2. If the security feature is not activated as indicated by the → at the right of the display, use the → to access the other functions in Figures 3-7 through 3-24.
2	ENTER	PASSWORD: <u>?</u> ?? →	Pressing ENTER accesses the PASSWORD display. ← at the right of the display indicates that the security feature is activated. Use the ↑ or ↓ key to enter the first password character. Use the → key to move the cursor to the next position and enter the next character. Repeat for the third character.
3	ENTER	PASSWORD VALID (or) INVALID PASSWORD	Pressing ENTER completes the authorization sequence, displays whether the password is valid or invalid and returns the analyzer to the run mode. If the password is valid, the user may now access the other analyzer functions in Figures 3-7 through 3-24.
4		X.X %FS CH4 L1 XXXX ppm CH4 L1 X.X % CH4 L1	This is the RUN mode. One of these three displays will be present on the digital display.

FIGURE 3-5. ACCESSING THE SECURITY LOCKOUT FEATURE

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	MODE	<u>S</u> ECURITY →	Pressing the MODE key accesses the security feature.
2	ENTER	PASSWORD: <u>?</u> ?? →	Pressing ENTER accesses the password display. If the security feature is engaged, as indicated by ← at the right of the display, enter the password as in Figure 3-5, then repeat step 1.
3	→	SECURITY: <u>O</u> N *	Use the ↑ or ↓ key to toggle SECURITY ON/OFF. To activate the security feature, toggle SECURITY ON.
4	ENTER	**DATA STORED**	Pressing ENTER stores the data in non-volatile memory.
5	SHIFT+ENTER	X.X %FS CH4 L1 XXXX ppm CH4 L1 X.X % CH4 L1	Pressing SHIFT+ENTER returns the user to the RUN mode.

FIGURE 3-6. ACTIVATING/DEACTIVATING THE SECURITY LOCKOUT FEATURE

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	MODE	SECURITY →	Pressing the MODE key accesses the security feature.
2	ENTER	PASSWORD: ??? →	Pressing ENTER accesses the password display. If the security feature is OFF (PASSWORD: ??? →), use the → to move to the next display. If the security feature is ON, as indicated by ← at the right of the display, enter the password as in Figure 3-5, then proceed to step 3.
3	→	SECURITY: OFF *	Use the → to move to the next display.
4	→	NEW PSWRD: ??? ←	A new password may be entered in the NEW PSWRD: ??? display. Use the ↑ or ↓ key to change the first character. Use the → key to move the cursor to the next position and change the second and third characters. Valid characters are "space", "0 ... 9" and "A ... Z".
5	ENTER	PSWRD IS NOW ABC	Pressing ENTER stores the new password in non-volatile memory and returns the analyzer to RUN mode.
		X.X %FS CH4 L1 XXXX ppm CH4 L1 X.X % CH4 L1	This is the RUN mode. One of these three displays will be present on the digital display.

FIGURE 3-7. CHANGING THE PASSWORD

3.7 RANGE PARAMETERS

There are several range parameters that may be changed. The first display [RANGE:# CMP NNN →] allows RANGE1, RANGE2 or RANGE3 to be selected with the ↑ or ↓ key. Of these three independent ranges, RANGE3 should always be the least sensitive range.

The Model 880 Analyzer allows a different set of linearizing coefficients (Section 3.13) to be entered for each range. Or, if desired, one set of linearizing coefficients may be used for all three ranges when the dynamic range ratio is 3:1 or less. When using one set of coefficients, this set should always be entered in Range 3. Coefficients placed in Range 3 will automatically be used for Range A (All).

The component of interest is designated by a three digit group of letters or numbers. This gas name or designation may be selected for each range by placing the cursor under the desired digit [NNN] and selecting a letter or number with the ↑ or ↓ key. Valid characters are "space", "0"... "9" and "A"... "Z". This name will appear on the display when the analyzer is in the run mode.

On the [GAIN=X] display, an amplifier gain of 1, 2, 4 or 8 can be selected for each range with the ↑ or ↓ key depending on the sensitivity desired. Refer to Sections 5.7 and 5.10. Range 3 is normally the least sensitive range. Other ranges are generally set with gains that are proportional to their relative fullscale spans. Thus, if range 1 is 0 to 10 % CO and range 3 is 0 to 100 % CO, then the respective gains will usually be 8 and 1.

On the [FS=XXXX ppm *] or [FS=XX.X % *] display, up to a four digit fullscale value is entered in ppm (parts per million) or % (percent) for each linearized range.

On the [CAL GAS=XXXX ppm *] or [CAL GAS=XX.X % *] display, up to a four digit calibration gas value is entered in ppm or % (percent) for each linearized range. **Each calibration gas concentration must be between 75 to 100 % of fullscale.**

On the [CL GAS=XXX.X%FS] display, the calibration gas in percent fullscale is entered for each range. This value is obtained from the non-linear Response Curve for Each Range located at the back of the manual. This curve will be different for each different application. Locate the calibration gas value on the bottom scale and find the corresponding non-linearized Recorder Deflection value on the side scale. This is the value that should be entered in [CL GAS=XXX.X%FS].

On the [ZR-OFFSET:X.XX *] display, the amount of zero offset in percent of fullscale is entered for each range. The zero offset feature compensates for impurities in zero calibration gas. If there are no impurities in the zero gas, set ZR-OFFSET to 0.00. Otherwise, the value should be obtained from the Response Curve for Each Range located at the back of the manual. Locate the amount of zero offset desired on the bottom scale and find the corresponding Recorder Deflection value on the side scale. This is the value that should be entered in [ZR-OFFSET:X.XX *].

On the [TIME CONST=XX ←] display, the value of the TIME CONSTANT can be changed for each range. This TIME CONSTANT is responsible for the amount of time (in seconds) in which the analyzer responds to change. A different TIME CONSTANT can be selected for each range.

To change or check the settings of the different range parameters, press the keys in the following sequence:

Note

After changing a setting, press ENTER to retain the new setting in nonvolatile memory. Should a power outage occur, settings stored in nonvolatile memory will be saved.

At any point in the sequence, the routine may be exited by pressing SHIFT+ENTER.

The analyzer must be in local mode (L1, L2 or L3 will show in the run mode display) to change ranges in STEP 3 of Figure 3-8.

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	MODE	SECURITY →	Pressing the MODE key accesses the security feature.
2	→	RANGE	Use the → to move to the next display.
3	ENTER	RANGE=1 CMP CO →	Pressing ENTER allows the range parameters to be changed or viewed. Range 1, 2, or 3 can be selected with the ↑ or ↓ keys. Use the → key to move the cursor to the component of interest section of the display. Use the ↑ or ↓ keys to enter up to three characters. Store any changes made in non-volatile memory by pressing ENTER.
4	→	GAIN=X	Use the ↑ or ↓ keys to select a GAIN of 1, 2, 4, or 8. Store the new GAIN setting in non-volatile memory for the selected range by pressing ENTER.
5	→	FS=XXX.X % FS=XXXX ppm	XXXX is fullscale value in ppm or %. This value may be changed by moving the cursor to a digit with the → and using the ↑ or ↓ keys to obtain the desired value. In the linear mode, ppm can be toggled with % with the ↑ or ↓ keys, depending on the engineering units to be used in the RUN mode. Store the new fullscale value in non-volatile memory by pressing ENTER.
6	→	CAL GAS=XXXX ppm	XXXX is the calibration gas value in ppm or %. This value may be changed by moving the cursor to a digit with the → key and using the ↑ or ↓ keys to obtain the desired value. Store the new calibration gas value (in % fullscale) in non-volatile memory by pressing ENTER.
7	→	CL GAS=XXX.X%FS	XXX.XX% is the amount of non-linearized recorder deflection for the calibration gas value on the Response Curve at the back of the manual. Use the ↑ or ↓ keys to obtain the desired value. Store the new value (in % fullscale) in non-volatile memory by pressing ENTER.
8	→	ZR-OFFSET: X.XX	Use the ↑ or ↓ keys to select the amount of zero offset.
9	→	TIME CONST=XX←	Use the ↑ or ↓ keys to change the TIME CONSTANT to a value between 0.5 and 20 seconds. Store the new TIME CONSTANT setting in non-volatile memory by pressing ENTER.
10	SHIFT+ENTER	X.X %FS CH4 L1 XXXX ppm CH4 L1 X.X % CH4 L1	Pressing SHIFT+ENTER returns the analyzer to RUN mode. One of these three displays will be present on the digital display.

FIGURE 3-8. SETUP/CHECKOUT OF RANGE PARAMETERS

3.8 ANALYZER DIAGNOSTICS

Diagnostics is selectable through the mode function. This function allows the oscillator tune, detector signal, source current and four power supply values to be viewed. It is recommended that the values for oscillator tune, detector signal and source current be recorded when the diagnostic display is first accessed.

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	MODE	SECURITY →	Pressing the MODE key accesses the security feature.
2	→	RANGE	Use the → to move to the next display.
3	→	DIAGNOSTICS	Press → to move to the next display.
4	ENTER	DIAG:OSC.T.=XXX→	Pressing ENTER allows the analyzer diagnostic displays to be viewed. This display gives the current oscillator tune reading. The value may be changed by making a hardware adjustment (Section 5.2).
5	→	DET. SIG.=X.XX	DET. SIG. is the detector signal value in volts. The value may be changed by making a hardware adjustment (Section 5.4).
6	→	SRC.CUR.=XXXXmA	SRC CUR is the value of the source current in milliamps. The value may be changed by making a hardware adjustment (Section 5.5).
7	→	+5V=X.X	A power supply voltage.
8	→	+15V=XX.X	A power supply voltage.
9	→	+12V=XX.X	A power supply voltage
10	→	-15V=XX.X←	A power supply voltage
11	SHIFT+ENTER	X.X %FS CO2 L1	Pressing SHIFT+ENTER returns the analyzer to RUN mode.

FIGURE 3-9. ANALYZER DIAGNOSTICS

3.9 ZERO CALIBRATION

3.9.1 HARDWARE AND SOFTWARE ZERO

The Model 880 Analyzer has both a hardware and a software zero. The hardware zero is the adjustment of the zero potentiometer with the up and down arrows when the analyzer is in the zero setpoint mode. Using the up and down arrows adjusts the percentage of the zero potentiometer currently being used. The zero potentiometer should be adjusted so that the zero value [ZR=X.X] in the zero display [ZR=X.X PS=XX% →] is as close as possible to absolute zero while keeping the potentiometer status [PS=XX%] between 5% and 95%. Values outside this range will not be accepted.

Note

There is only one hardware zero for all three ranges. However, there are three software zeros, one for each range. When the hardware zero is engaged, the amplifier GAIN is automatically set to one and the TIME CONSTANT is set to one second. Engaging the software zero resets the GAIN and TIME CONSTANT to the values selected in Range Parameters (Figures 3.8, Step 9).

Pressing the up or down arrow sets the present value of the software zero to absolute zero. Pressing ENTER after the hardware zero has been set, engages the software zero. The analyzer can use up to ± 500 mV to compensate for the hardware zero. In the run mode, the analyzer will now read zero. This new zero value set by software will be used as zero for the range in which it was calibrated until the analyzer is recalibrated.

While there is only one hardware zero for all three ranges, there are three software zeros. When calibrating more than one range, after the hardware and software zero has been set for the first range, the operator should select a second range that will be used and re-enter the zero mode. Pressing ENTER twice while flowing zero gas without making a potentiometer adjustment will complete a software zero for the second range. This step should be repeated for the third range, should this range be used.

Note

When entering this function, make sure that there is zero calibration gas flowing through the analyzer. When entering this function for viewing purposes only, press SHIFT+ENTER to exit. Press ENTER to exit the function only if a calibration has been made.

Note

If the zero potentiometer has been changed, pressing SHIFT+ENTER instead of ENTER will leave the software zero set to absolute zero. This will cause the analyzer to give faulty readings unless the hardware zero gives an absolute zero reading.

3.9.2 CALIBRATING THE ANALYZER WITH ZERO GAS

1. Allow system to warm up a minimum of one and one half hours.
2. Connect zero gas to the sample cell inlet at the back of the analyzer. Flow the gas at a flow rate of 500 cc/min, as read on a flowmeter, through the analyzer for at least two minutes.
3. Press the keys in the following sequence to calibrate the zero setting for the analyzer for each range desired.

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	ZERO	ZERO PS=XX%	ZERO indicates that the instrument is in the zero setting mode. PS=XX% is the zero potentiometer status. XX is the percent of the zero potentiometer being used. → indicates beginning of routine.
2	SHIFT+ENTER	X.X % CO2 L2 XXXX ppm CO2 L2 X.X %FS CO2 L2	SHIFT+ENTER returns the analyzer to the RUN mode without engaging the software or hardware zero. To avoid un-calibrating the analyzer, do not use the ENTER key to exit this function unless a change has been made.
3		X.X % CO2 L2 XXXX ppm CO2 L2 X.X %FS CO2 L2	To make a change in the zero setting, go to Figure 3-11 for the standard analyzer. Figure 3-12 for the analyzer with Calibration Gas Control or Figure 3-23 for the analyzer with Auto Zero/Span option.

FIGURE 3-10. VIEWING THE ZERO DISPLAY

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	NONE	X.X % CO2 L2 XXXX ppm CO2 L2 X.X %FS CO2 L2	This is the RUN mode display. Verify that zero calibration gas is connected to the rear of the analyzer and turn the gas ON.
2	ZERO	ZERO PS=XX%	Zero indicates that the analyzer is in the zero setting mode. PS=XX% is the zero potentiometer status. This is the percent of the zero potentiometer being used.
3	ENTER	ZR=X.X PS=XX%	Pressing ENTER sets the gain amplification to one, bypasses the linearizer if this feature is ON and allows the zero setting to be changed. ZR=X.X is the present numeric value of the zero signal in %FS for the non-linear mode. The next two digits are the zero potentiometer status. Use the ↑ or ↓ key to change the zero potentiometer (PS=XX%) and set the zero signal (ZR=X.X) as close to absolute zero as possible. The first time the ↑ or ↓ key is pressed, the software zero is set to absolute zero. Subsequent moves change the setting of the zero potentiometer. Valid settings for the zero potentiometer are between 5% and 95%.
4	ENTER	CALCULATING ZERO then X.X % CO2 L2 XXXX ppm CO2 L2 X.X %FS CO2 L2	Pressing ENTER when the desired value has been obtained to exit the functions changes the GAIN to the value set in the range parameters (Figure 3-8, Step 4), engages the linearizer if this feature is ON, engages the software zero, stores the new zero value in non-volatile memory and returns the analyzer to the RUN mode.

FIGURE 3-11. CHANGE THE ZERO SETTING

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	NONE	X.X % H2O L1 XXXX ppm H2O L1 X.X %FS H2O L1	This is the RUN mode display. Verify that zero calibration gas is connected to the rear of the analyzer and turn the gas ON.
2	ZERO	ZERO PS=XX%	Zero indicates that the analyzer is in the zero setting mode. PS=XX% is the zero potentiometer status. This is the percent of the zero potentiometer being used.
3	ENTER	ZR=X.X PS=XX%	Pressing ENTER turns ON the solenoid valve (customer supplied) for zero calibration gas, sets the GAIN amplification to one, bypasses the linearizer if this feature is ON, and allows the zero setting to be changed. Allow the zero gas to flow for two minutes before proceeding with the rest of the calibration. ZR=X.X is the present numeric value of the zero signal in %FS. The next two digits are the zero potentiometer status. Use the ↑ or ↓ key to change the zero potentiometer (PS=XX%) and set the zero signal (ZR=X.X) as close to absolute zero as possible. The first time the ↑ or ↓ key is pressed, the software zero is set to absolute zero. Subsequent moves change the setting of the zero potentiometer. Valid settings for the zero potentiometer are between 5% and 95%.
4	ENTER	CALCULATING ZERO then X.X % H2O L1 XXXX ppm H2O L1 X.X %FS H2O L1	Pressing ENTER when the desired value has been obtained to exit the functions changes the GAIN and the TIME CONSTANT to the values set in the range parameters (Figure 3-8, Steps 4 and 9), engages the linearizer if this feature is ON, engages the software zero, stores the new zero value in non-volatile memory and turns OFF the solenoid valve for zero gas and returns the analyzer to the RUN mode. Pressing SHIFT+ENTER to exit this function will NOT turn the zero gas OFF or set the software zero.

FIGURE 3-12. CHANGING THE ZERO SETTING FOR ANALYZERS WITH CALIBRATION GAS CONTROL

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	SPAN		SPAN indicates that the analyzer is in the span mode for the range selected in the range parameters. PS=XX% is the percent of span potentiometer being used.
2	SHIFT+ENTER	X.X %FS SO2 L2 XXXX ppm SO2 L2 X.X % SO2 L2	SHIFT+ENTER returns the analyzer to the RUN mode without engaging the software span. Do not use the ENTER key to exit this function unless a calibration is desired.
3		X.X %FS SO2 L2 XXXX ppm SO2 L2 X.X % SO2 L2	To make a change in the span setting, go to Figure 3-14 for the standard analyzer, Figure 3-15 for the analyzer with the Cal Gas Control option or Figure 3-23 for the analyzer with Auto Zero/Span option.

FIGURE 3-13. VIEWING THE SPAN SETTING

3.10 ZERO CALIBRATION FOR THE ANALYZER WITH THE CAL GAS CONTROL OPTION

The Calibration Gas Control Option allows one-man calibration. This option consists of two form C contacts rated 3A-125/250 VAC or 5A-30 VDC, (resistive). These contacts are connected to a solenoid valve (customer supplied) which will turn zero and span calibration gases on and off when activated. Pressing ENTER at the [ZERO PS=XX%] display activates the solenoid valve, turning on the zero calibration gas. Pressing ENTER to exit the function at the [ZR=X.X PS=XX%] display deactivates the solenoid valve, turning off the zero calibration gas.

Note

For instruments with Calibration Gas Control Option or Auto Zero/Span Option, pressing ENTER at the [ZERO PS=XX%] display turns on the solenoid valve (customer supplied) for zero calibration gas. To turn this valve off, press ENTER to exit this function. Pressing SHIFT+ENTER to exit this function will NOT turn off the relay for this valve.

Note

When entering this function for viewing purposes only, press SHIFT+ENTER to exit. Press ENTER to exit the function only if a calibration has been made.

3.10.1 CALIBRATING THE ANALYZER WITH CALIBRATION GAS CONTROL OPTION WITH ZERO GAS

1. Allow system to warm up a minimum of one and one half hours.
2. Connect the solenoid valve for the zero gas to the two form C contacts. Connect the zero gas to the sample cell inlet located on the back of the analyzer. The gas should flow at a flow rate of 500 cc/min, as read on a flowmeter.
3. Press the keys in the following sequence to calibrate the zero setting for the analyzer for each range desired:

3.11 SPAN CALIBRATION

3.11.1 HARDWARE AND SOFTWARE SETTINGS FOR SPAN GAS

The Model 880 Analyzer has both a hardware and a software span for all three ranges. The hardware span is the adjustment of the span potentiometer with the up and down arrows when the analyzer is in the span setting mode. The display for the span setting mode is [X.XX NN% MMM →] where X.XX is the run mode value, NN% is the percentage of span potentiometer in use and MMM is the span gas value.

There are three span potentiometers, one for each range, that can be calibrated. These span potentiometers should be adjusted with the up or down arrows at the [X.XX NN% MMM →] display so that the run mode value [X.XX] is between 51 % and 99 % of the span gas value [MMM] while keeping the span potentiometer [NN %] between 5 % and 95 %. Span potentiometer values outside this range will not be accepted. Also, if the run mode value is not between 51 % and 99 % of the span gas value, the software span cannot be made and an error message of ER1, ER2 or ER3 will flash on the run mode screen. If the setting cannot be made while keeping within these ranges, the digital GAIN must be changed. Refer to Section 5.7 and Figure 3-8, STEP 4.

Pressing the up or down arrow for the first time resets the present software span factor to one. Pressing ENTER after the hardware span has been set engages the software to multiply the run mode value by the span factor. This new span factor will be stored in nonvolatile memory until the analyzer is recalibrated. Pressing SHIFT+ENTER does not engage the software span.

Note

If the span potentiometer has been changed, pressing SHIFT+ENTER instead of ENTER will cause the span factor to be one. This will cause the analyzer to give faulty readings unless the span gas value is the same as the run mode value.

For instruments with the Calibration Gas Control Option, pressing ENTER at the [SPAN PS=XX%] display turns on the solenoid valve (customer supplied) for span calibration gas. To turn this valve off, press the ENTER key when exiting this function. Pressing SHIFT+ENTER to exit this function will NOT turn off the relay for this valve.

When entering this function, make sure that there is span calibration gas connected to the analyzer. When entering this function for viewing purposes only, press SHIFT+ENTER to exit. Press ENTER to exit the function only if a calibration is desired.

When the hardware span is engaged, the TIME CONSTANT is set to one second. Engaging the software span, resets the TIME CONSTANT to the value selected in Range Parameters (Figure 3.8, STEP 9).

3.11.2 CALIBRATING THE ANALYZER WITH SPAN GAS

1. Allow system to warm up a minimum of one and one half hours.
2. Connect span gas to the sample cell inlet at the back of the analyzer. Flow the gas at a flow rate of 500 cc/min, as read on a flowmeter, through the analyzer for at least two minutes.
3. Press the keys in the following sequence for those ranges being calibrated.

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	NONE	X.X %FS H2O L3 XXXX ppm H2O L3 X.X %FS H2O L3	This is the RUN mode display. Verify that zero calibration gas is connected to the rear of the analyzer and turn the gas ON.
2	SPAN	SPAN PS=XX%	Span indicates that the analyzer is in the span mode for the current range. PS=XX% is the percent of the span potentiometer being used.
3	ENTER	X.XX NN% MMM.M	The first set of digits (X.XX) is the present RUN mode value. The next digits (NN%) are the percent of the span potentiometer being used. The third set of digits (MMM) is the calibration span gas value. Use the ↑ or ↓ key to change the percent of the span potentiometer used so that the RUN mode value (X.XX) is between 51% and 99% of the span gas value (MMM) while keeping the span potentiometer (NN%) between 5% and 95%. The first time the ↑ or ↓ key is pressed, it engages the hardware span. Subsequent moves changes the setting of the span potentiometer. Span potentiometer settings outside the range of 5% to 95% are not allowed.
4	ENTER	CALCULATING SPAN then X.X %FS H2O L3 XXXX ppm H2O L3 X.X % H2O L3	Pressing ENTER when the desired value has been obtained to exit the function engages the software span, stores the new factor in non-volatile memory and returns the analyzer to RUN mode.

Repeat Steps 1 through 4 for Ranges 2 and 3, if used.

FIGURE 3-14. CHANGING THE SPAN SETTING

3.12 SPAN CALIBRATION FOR THE ANALYZER WITH THE CAL GAS CONTROL OPTION

The Calibration Gas Control Option allows one-man calibration. This option consists of two form C contacts rated 3A-125/250 VAC or SA-30 VDC, (resistive). These contacts are connected to a solenoid valve (customer supplied) which will turn zero and span calibration gases on and off when activated. Pressing ENTER at the [SPAN PS=XX%] display activates the solenoid valve, turning on the span calibration gas. Pressing ENTER to exit the function at the [X.XX NN % MMM] display deactivates the solenoid valve, turning off the span calibration gas.

Note

For instruments with the Calibration Gas Control Option, pressing ENTER at the [SPAN1 PS=XX%] display turns on the solenoid valve (customer supplied) for span calibration gas. To turn this valve off, press the ENTER key when exiting this function. Pressing SHIFT+ENTER to exit this function will NOT turn off the relay for this valve.

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	NONE	X.X %FS HEX L1 XXXX ppm HEX L1 X.X % HEX L1	This is the RUN mode display. Verify that zero calibration gas is connected to the rear of the analyzer.
2	SPAN	SPAN PS=XX%	Span indicates that the analyzer is in the span mode for the current range. To change ranges, refer to Figure 3-8. PS=XX% is the percent of the span potentiometer being used for current range.
3	ENTER	X.XX NN% MMM	Pressing ENTER turns ON the solenoid valve (customer supplied) for span calibration gas and allows the span setting to be changed. Allow the span gas to flow for two minutes before proceeding with the calibration. The first set of digits (X.XX) is the present RUN mode value. The second set of digits (NN%) is the percent of span potentiometer being used. The third set of digits (MMM) is the calibration span gas value. Use the ↑ or ↓ key to change the percent of the span potentiometer used so that the RUN mode value (X.XX) is between 51% and 99% of the span gas value (MMM) while keeping the span potentiometer (NN%) between 5% and 95%. The first time ↑ or ↓ key is pressed engages the hardware span and sets the software span to one. Subsequent moves change the setting of the span potentiometer. Span potentiometer settings outside the range of 5% and 95% are not allowed.
4	ENTER	CALCULATING SPAN then X.X %FS HEX L1 XXXX ppm HEX L1 X.X % HEX L1	Pressing ENTER when the desired value has been obtained to exit the function engages the software span, stores the new factor in non-volatile memory, turns the solenoid valve for span gas OFF, and returns the analyzer to RUN mode. Pressing SHIFT+ENTER to exit this function will NOT turn the span gas OFF or set the software span.

FIGURE 3-15. CHANGING THE SPAN SETTING FOR ANALYZERS WITH CALIBRATION GAS CONTROL

3.13 LINEARIZATION

The Model 880 Analyzer can be operated in the linear and non-linear mode. Linearization can be toggled ON/OFF with the 1' or J, key. In the OFF position, linearization is disabled for all ranges. In the linear mode the component of interest is measured in engineering units, either ppm (parts per million) or 5 (percent of composition), in the non-linear mode measurement is in %FS (percent of fullscale).

The analyzer is linearized with a fourth-order polynomial.

$$Y = A_0 + A_1X + A_2X^2 + A_3X^3 + A_4X^4$$

where X is the non-linear input, A₀, A₁, A₂, A₃ and A₄ are the linearization coefficients and Y is the linear output.

A typical response curve is located on the application sheet at the back of the manual. This curve is plotted with X as the concentration and Y as the output deflection.

Each range can be linearized using a separate curve, or the same curve can be used for all three ranges (Range A=All) when the dynamic range ratio is 3:1 or less. If Range A is selected, the microprocessor will use the coefficients in Range 3. Also, if the linearizer is ON and in Range A, the microprocessor will use the GAIN and TIME CONSTANT from Range 3, regardless of the GAIN and TIME CONSTANT selected for Ranges 1 and 2.

When ordered, the linearization coefficients are entered in the appropriate range(s) at the factory. If one set of linearization coefficients have been ordered and a range has not been specified, these coefficients will be for Range 3.

To operate the analyzer with a combination of linearized and non-linearized ranges, turn the linearizer ON and enter the appropriate coefficients for the range(s) to be linearized. For the non-linearized range(s), enter the following coefficients:

$$A_0 = 0$$

$$A_1 = 1$$

$$A_2 = 0$$

$$A_3 = 0$$

$$A_4 = 0$$

Using these coefficients will make the output equal to the input (Y=X). For reasons of accuracy, this procedure is only recommended for narrow ranges that span a linear section of the standard curve such as 0 to 100 ppm CO. In the range parameters select ppm (Figure 3-8, STEP 5) and enter the span gas in ppm (Figure 3-8, STEP 6). In the run mode, the display will read ppm.

To calculate linearization coefficients other than those installed at the factory, either 11 or 21 data points must be taken. These data points are obtained by using a precision gas divider with an accuracy of $\pm 0.5\%$ such as the Model SGD Series-710 Standard Gas Divider™ and following the STEPS in Figure 3-18. These data points can be entered into any program capable of computing a fourth order polynomial curve fit. The curve obtained with these data points (Figure 3-17) will have X as the output (recorder) voltage and Y as the signal concentration. This curve will be the mirror image of the curve on the application sheet at the back of the manual (Figure 3-16), however the linearization coefficients will be different. Use the coefficients calculated with the curve in Figure 3-17 for linearization coefficients.

The coefficients in Figure 3-16 may be used to calculate any Recorder Deflection for a given Concentration. Use these coefficients to solve the equation and calculate the calibration gas value in Range Parameters [CL GAS XXX %F] Figure 3-8. STEP 7.

$$Y = A_0 + A_1X + A_2X^2 + A_3X^3 + A_4X^4$$

For coefficients determined for user-specific gas, after taking the data points either use any program capable of calculating a fourth order curve fit or call the factory to have the specific coefficients calculated using the data determined in Figure 3-18.

When entering user-determined coefficients, note that the microprocessor only recognizes five significant figures to the right of the decimal point, for example, 0.12345 or 0.00012345, disregard any additional digits.

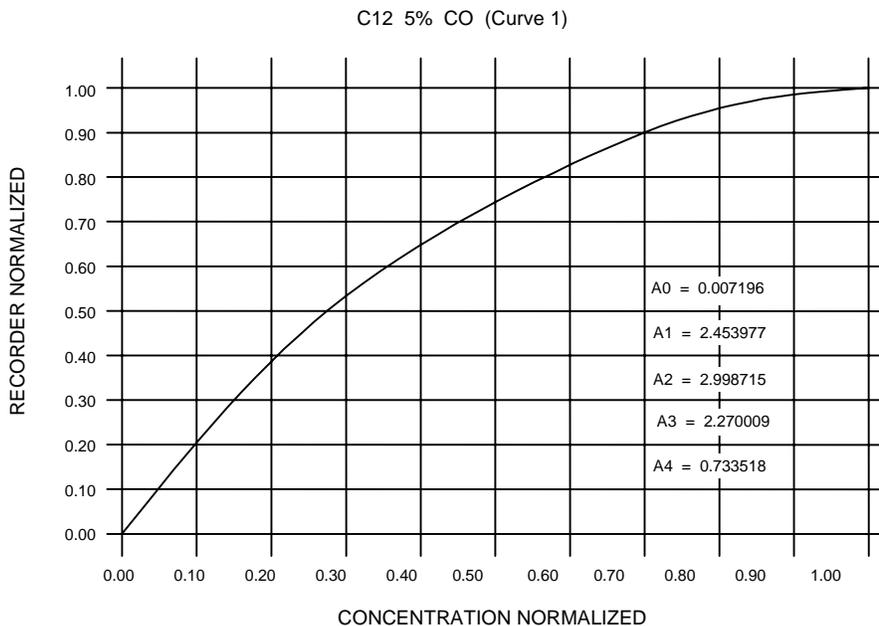


FIGURE 3-16. TYPICAL APPLICATION LINEARIZATION CURVE

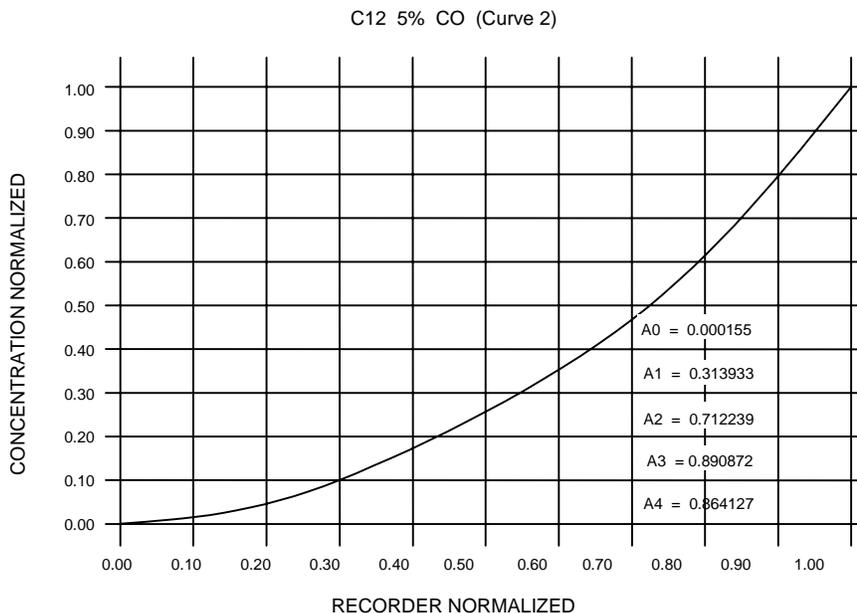


FIGURE 3-17. USER-DETERMINED LINEARIZATION CURVE

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	MODE	SECURITY →	Pressing MODE allows the mode settings to be viewed or changed
2	→	RANGE *	→ moves the cursor to the next display
3	→	DIAGNOSTICS *	→ moves the cursor to the next display
4	→	LINEARIZER *	→ moves the cursor to the next display
5	ENTER	LIN:OFF RANGE:N →	Pressing ENTER places the analyzer in the linearization mode. Use the ↑ or ↓ key to toggle the linearizer OFF. Use the → key to move to the range number. Select Range 1, 2, or 3 with ↑ or ↓ keys.
6	SHIFT+ENTER	XX.X %FS CH4 L1	Pressing SHIFT+ENTER returns the analyzer to the RUN mode.
7	MODE	SECURITY →	Pressing MODE allows the mode settings to be viewed or changed
8	→	RANGE *	→ moves the cursor to the next display
9	ENTER	RANGE:N CMP CO →	Pressing ENTER allows the range parameters to be changed. Range 1, 2 or 3 can be selected with the ↑ or ↓ key.
10	→	GAIN=X	→ moves the cursor to the next display.
11	→	FS=XX.X % * FS=XXXX ppm *	XXXX is fullscale value in ppm or %. This value may be changed by moving the cursor to a digit with the → and using the ↑ or ↓ key to obtain the desired value. In the linear mode, ppm can be toggled to % with the ↑ or ↓ key, depending on the engineering units to be used in the RUN mode. Enter the span gas value as fullscale value.
12	→	CAL GAS=XXXX ppm *	XXXX is the calibration gas value in ppm or %. This value may be changed by moving the cursor to a digit with the → key and using the ↑ or ↓ key to obtain the desired value. Enter the span gas value.
13	SHIFT+ENTER	XX.X %FS CH4 L1	Pressing SHIFT+ENTER returns the analyzer to RUN mode.
14	ZERO	ZERO PS=XX%	Using zero and span gas, zero and span the analyzer as described in Figures 3-11 and 3-14 for the standard equipment or 3-12 and 3-15 for the analyzer with Calibration Gas Control option or Auto Zero/Span option.
15	SPAN	XXXX %FS CH4 L3	Using a gas divider, deliver 10% span gas to the analyzer and note the RUN mode value.
16			Repeat Step 15 for 20% through 100% span gas in increments of 10%. This will produce 11 data points (0% through 100%).
17			For greater accuracy of lower range readings, take 10 more data points between 0% and 10% for a total of 21 data points
18			Use a computer program to calculate the new coefficients, or call factory for assistance.
19			When the new coefficients have been calculated, enter their values into memory (Figure 3-19).

FIGURE 3-18. DATA POINTS FOR USER-DETERMINED LINEARIZATION COEFFICIENTS

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	MODE	SECURITY →	Pressing MODE allows the mode settings to be viewed or changed
2	→	RANGE *	→ moves the cursor to the next display
3	→	DIAGNOSTICS *	→ moves the cursor to the next display
4	→	LINEARIZER *	→ moves the cursor to the next display
5	ENTER	LINE:OFF RANGE:N →	Pressing ENTER places the analyzer in the linearization mode. Use the ↑ or ↓ key to toggle the linearizer OFF. Use the → key to move to the range number. Select Range 1, 2, or 3 with ↑ or ↓ keys.
6	ENTER		Pressing ENTER stores the range number (1, 2 or 3) in non-volatile memory.
7	→	AO=(-)X.XXXXXXXXX ←	Accessing this display allows the linearizing coefficients to be changed. Use the ↑ or ↓ key to select A0. Use the → key to move to the next position and toggle the - (minus) sign ON/OFF with the ↑ or ↓ keys. Using the → key to move to the correct position, enter a nine digit coefficient with the ↑ or ↓ key.
8	ENTER	A1=(-)X.XXXXXXXXX ←	Pressing ENTER stores the first linearization coefficient in non-volatile memory and causes the display to prompt the user to enter the next coefficient. Enter the linearizing coefficient for A1 as in Step 7.
9	ENTER	A2=(-)X.XXXXXXXXX ← A2=(-)X.XXXXXXXXX ← A2=(-)X.XXXXXXXXX ←	Repeat Steps 7 and 8 and enter the linearizing coefficients for A2, A3 and A4.
10	SHIFT ←	LIN:OFF RANGE N →	If linearizing coefficients are to be entered for another range, repeat Steps 5 through 9 for the next range. If not, turn the linearizer back on with the ↑ or ↓ keys.
11	ENTER	LIN:ON RANGE N →	Pressing ENTER stores the linearizer ON setting in non-volatile memory.
12	SHIFT+ENTER	XXXX ppm CH4 L3 XX.X % CH4 L3	Pressing SHIFT+ENTER returns the analyzer to RUN mode.

FIGURE 3-19. SETUP/CHECKOUT OF LINEARIZATION FUNCTION

3.14 ALARM OPTION

The Alarm Option consists of two single point, field-programmable high or low outputs with a deadband up to 20% of fullscale. The two alarm setpoints are programmable for one range selected in Figure 3-20, STEP 6, and are dimensionless. The alarms can be set with one alarm HIGH and one alarm LOW, both alarms HIGH or both alarms LOW. This option is completely user configurable.

The Status Display will reflect an alarm condition, should one occur. When the instrument is in alarm condition (exceeding the alarm setpoint), the latch associated with the alarm is set. When the alarm condition clears, (run mode value is less than the alarm setpoint plus the deadband) the latch is reset.

The high alarm is determined when run mode value exceeds the alarm setpoint. The alarm is cleared when run mode value is less than alarm setpoint minus the deadband.

The low alarm is determined when the run mode value is less than the alarm setpoint. This alarm is cleared when the run mode value is greater than the alarm setpoint plus the deadband.

ALARM1 and ALARM2 can be toggled with the up and down arrows to either AT. (automatic) or MAN (manual). In the AUTO (automatic) setting, an alarm relay will be activated should an alarm condition occur. Alarms are calculated in the AUTO mode on the basis of parameter settings. The MANUAL mode is the test mode and alarms are not scanned by CPU. In the MANUAL (test) mode, the ALARM ON/OFF can be toggled with the up and down arrows to set and reset the alarm latch.

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	MODE	SECURITY →	Pressing MODE allows the mode settings to be viewed or changed
2	→	RANGE *	→ moves the cursor to the next display
3	→	DIAGNOSTICS *	→ moves the cursor to the next display
4	→	LINEARIZER *	→ moves the cursor to the next display
5	→	ALARM *	→ moves the cursor to the next display
6	ENTER	ALARM:1 MAN OFF →	Pressing ENTER accesses the ALARM SETPOINT MODE. Use the ↑ or ↓ key to toggle between ALARM1 and ALARM2. Use the → key to move the cursor to the next characters, then use the ↑ or ↓ key to toggle between MAN (manual) or AUTO (automatic). Use the → key to move to the next character, then use the ↑ or ↓ key to toggle between OFF/ON.
7	ENTER		Pressing ENTER stores the setting in non-volatile memory.
8	→	RANGE: 1 *	Use the ↑ or ↓ key to select Range 1, 2 or 3 for the alarm. The alarm is only valid for the selected range. Selecting a range disables the alarm for the other two ranges.
9	ENTER		Pressing ENTER stores the setting in non-volatile memory.
10	→	HIGH SET:XXXX *	Use the ↑ or ↓ key to toggle between HIGH SET and LOW SET. Move the cursor with the → key to the four digits and change to the desired value with the ↑ or ↓ keys.
11	ENTER		Pressing ENTER stores the setting in non-volatile memory.
12	→	DEADBAND:XX % ←	Use the ↑ or ↓ key to change the value of the deadband up to 20% of fullscale.
13	ENTER		Pressing ENTER stores the setting in non-volatile memory.
14	SHIFT+ENTER	X.X %FS CO L1	Pressing SHIFT+ENTER returns the analyzer to RUN mode.

FIGURE 3-20. SETUP/CHECKOUT OF ALARM OPTION

3.14.1 STATUS DISPLAY

The STATUS display shows the alarms, error messages and security lockout status. An explanation of error messages is given in Section 5.1. The STATUS display can be used to check the following alarm setpoints without entering one of the MODE functions: HIGH/LOW, AUTO/MANUAL and ON/OFF. Refer to Figure 3-21.

The order of priority for error messages, security status and alarms is as follows:

- [SECURITY ENABLED/DISABLED]
- [E0-ZERO POT LMTS]
- [E1-SPAN #1 LMTS]
- [E2-SPAN #2 LMTS]
- [E3-SPAN #3 LMTS]
- [E4-ADC SATURATED]
- [E5-ZERO DRIFT]
- [E6-SPAN DRIFT]
- [RMT: R/L]
- [ALARM 1 AUTO/{MAN ON/OFF}]
- [ALARM 2 AUTO/{MAN ON/OFF}]
- [CAL-CTL PRESENT]
- [AUTOCAL: ON/OFF]
- [CURRENT 0/4 SP ON/OFF]

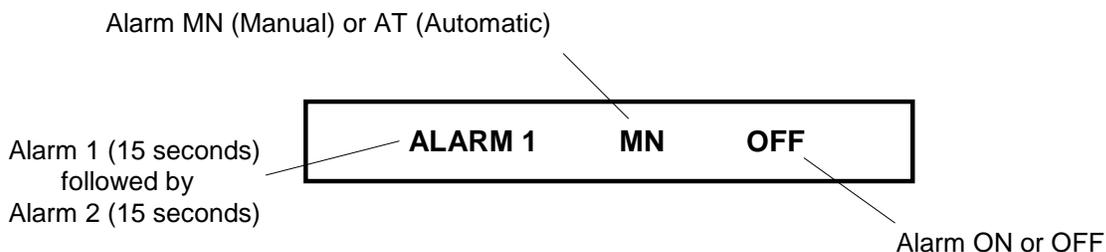


FIGURE 3-21. STATUS DISPLAY

3.15 CURRENT OUTPUT OPTION

The Model 880 Analyzer has an optional 0 to 20 or 4 to 20 mA current output with zero span suppression. With this option, the current output can represent any suppressed range with at least a 25% span. For example, a valid range could be 0 to 25%, 28 to 61% or 33 to 100%. When the Zero Span Suppression is off (NO), the analyzer defaults to the 0 to 100% range. Refer to Figure 3-22.

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	MODE	SECURITY →	Pressing MODE allows the mode settings to be viewed or changed
2	→	RANGE *	→ moves the cursor to the next display
3	→	DIAGNOSTICS *	→ moves the cursor to the next display
4	→	LINEARIZER *	→ moves the cursor to the next display
5	→	ALARM *	→ moves the cursor to the next display
6	→	CURRENT OUTPUT *	→ moves the cursor to the next display
7	ENTER	CURRENT:4 20mA →	Pressing ENTER allows the Current Output option to be changed. Use the ↑ or ↓ key to toggle between 0 and 4 mA.
8	ENTER		Pressing ENTER stores the setting in non-volatile memory.
9	→	ZR/SPN SUPR:NO *	→ moves the cursor to the next display. Use the ↑ or ↓ keys to toggle between YES/NO (zero suppression on or off).
10	ENTER		Pressing ENTER stores the setting in non-volatile memory.
11	→	XX TO XXX %FS ←	→ moves the cursor to the next display. Change the zero suppression range by moving the cursor to a digit with the → key and changing the setting with the ↑ or ↓ key. The value of the upper and lower limits will always be in percent fullscale, even in the linear mode. Any range may be selected as long as the span is at least 25% of fullscale.
12	ENTER		Pressing ENTER stores the setting in non-volatile memory.
13	SHIFT+ENTER	X.X %FS CO2 L1	Pressing SHIFT+ENTER returns the analyzer to RUN mode.

FIGURE 3-22. SETUP/CHECKOUT OF CURRENT OUTPUT OPTION

3.16 AUTO ZERO/SPAN OPTION

The Auto Zero/Span Option allows automatic unattended calibration at set intervals. The option has six contact closures, four of which are field programmable for frequency and duration of the calibration cycle (span 1, span 2, span 3 and zero), while the other two contact closures indicate insufficient zero and span adjustments, and also drift limits for zero and span, if activated.

The auto zero/span [ACAL: ON] display allows the user to select ON or OFF to turn the Auto Zero/Span Option "on" or "off". Toggling from OFF to ON resets the timers for the Auto Zero/Span Option. To reset the timers when the Auto Zero/Span Option is "on", toggle from ON to OFF to ON.

The sample and hold [SH: YES] display allows the user to select YES or NO to turn the automatic sample and hold "on" or "off". When the sample and hold feature is "on", the recorder and Current Output Option do not get updated until the calibration sequence is completed.

The range selection [RANGE: 1Y 2Y 3Y] display allows the user to select the ranges which will be automatically calibrated with span gas by using the → arrow to move the cursor to the desired range and using the ↑ or ↓, key to select Y (yes) or N (no) for each range. The zero for all three ranges will be calibrated at each interval regardless of range(s) selected.

The initial delay [DELAY nnn HR] display allows the user to select the amount of time until the first automatic calibration occurs. This is the initial delay until the automatic cycle starts. At this time a zero and span calibration is made, regardless of selection. If a zero delay is selected, there will be an automatic two minute delay.

The purge [PURGE: nnn MIN] display allows the user to select the amount of time for the calibration gas to flow through the analyzer before the calibration starts for zero and span, or the amount of time for sample gas to flow through the analyzer before run mode values are recorded when the sample and hold feature is selected. The analyzer is calibrated during the final minute of purge time. During the remaining purge time, the signal is modified according to previous calibration data.

The repeat zero [RPT ZERO nnn HR] display allows the user to select the amount of time between zero calibrations. This is the amount of time after the initial calibration before the zero calibration is repeated without repeating the span calibration.

Note

Each time a span calibration is made, a zero calibration is also made regardless of selection. The keyboard is disabled during the auto zero/span sequence. During the auto zero/span sequence, the time constant is set to one second. Upon completion of the calibration sequence, the time constant is reset to the value chosen in Range Parameters, Figure 3-8, STEP 9. In order to engage the Auto-Cal function with the Remote Range I/O Option, the Auto-Cal function must be disabled by toggling AUTO-CAL to OFF in the [AUTO-CAL:OFF] display, STEP 8, Figure 3-23.

The repeat span [RPT SPAN nnn HR] display allows the user to select the amount of time between span calibrations. This is the amount of time after the initial span calibration before this calibration is repeated.

The [DRIFT LIMIT: ON] display allows the user to determine the maximum amount of span and zero drift allowable. The [ZR-DFT: +/- XX%] or [SP-DFT: =/- XX%] displays allow the user to select the percentage of fullscale by which the analyzer is allowed to drift from the reference span or zero calibration values. The maximum zero drift limit is 10% fullscale and the maximum span drift is 15% fullscale.

In the linearized mode, these values should be obtained from the Response Curve for Range located at the back of the manual. For the linear mode, locate the amount of span or zero drift limit desired on the bottom scale and find the corresponding Recorder Deflection value on the side scale. These are the values that should be entered in [ZR-DFT: +/-XX % *] or [S-DFT:R# +/- XX% ←].

The reference span or zero calibration is the first calibration after the drift feature is toggled to "ON" in the DRIFT LIMIT display (Figure 3-23, STEP 8) or the first calibration after a range is reset from "N" (off) to "Y" (on) in the [RANGE: 1Y 2Y 3Y] display (Figure 3-23, STEPS 12, 14 and 16) if the DRIFT LIMIT has been toggled to ON in the [DRIFT LIMIT: ON] display.

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	MODE	SECURITY →	Pressing MODE allows the mode settings to be viewed or changed
2	→	RANGE *	→ moves the cursor to the next display
3	→	DIAGNOSTICS *	→ moves the cursor to the next display
4	→	LINEARIZER *	→ moves the cursor to the next display
5	→	ALARM *	→ moves the cursor to the next display
6	→	CURRENT OUTPUT *	→ moves the cursor to the next display
7	→	AUTO-CAL *	→ moves the cursor to the next display
8	ENTER	AUTO-CAL: OFF →	Pressing ENTER allows the Auto Zero/Span option to be set or checked.. Use the ↑ or ↓ key to toggle between ON/OFF (Auto Zero/Span feature ON/OFF). This activates the Auto Zero/Span Option. Toggling from OFF to ON resets the CPU and the timers.
9	ENTER		Pressing ENTER stores the setting in non-volatile memory.
10	→	SH-V:N SH-I:N *	→ moves the cursor to the next display. Use the ↑ or ↓ keys to toggle between Y (YES) or N (NO) (sample and hold feature for current for voltage).
11	ENTER		Pressing ENTER stores the setting in non-volatile memory.
12	→	SH-V:N SH-I:N *	Use the → key to move the cursor to SH-I:N. Use the → or ← keys to toggle between Y (YES) (sample and hold feature for current "ON") or N (NO) (sample and hold feature for current "OFF").
13	ENTER		Pressing ENTER stores the setting in non-volatile memory.
14	→	RANGE 1Y 2Y 3Y *	→ moves the cursor to the next display. Use the ↑ or ↓ keys to toggle between Y (YES) or N (NO) for Range 1.
15	ENTER		Pressing ENTER stores the setting in non-volatile memory.
16	→	RANGE 1Y 2Y 3Y *	Use the → key to move the cursor to Range 2 and select Y or N.
17	ENTER		Pressing ENTER stores the setting in non-volatile memory.
18	→	RANGE 1Y 2Y 3Y *	Use the → key to move the cursor to Range 3 and select Y or N.
19	ENTER		Pressing ENTER stores the setting in non-volatile memory.
20	→	DELAY nn HR *	→ moves the cursor to the next display. Use the ↑ or ↓ keys to select the number of hours (0...99) until the initial calibration
21	ENTER		Pressing ENTER stores the setting in non-volatile memory.

FIGURE 3-23. SETUP/CHECKOUT OF AUTO ZERO/SPAN OPTION (CONTINUED ON NEXT PAGE)

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
22	→	PURGE: nn MIN *	→ moves the cursor to the next display. Use the ↑ or ↓ keys to select the number of minutes (2...99) for the analyzer to be purged with sample or calibration gas.
23	ENTER		Pressing ENTER stores the setting in non-volatile memory.
24	→	RPT ZERO: nnn HR *	→ moves the cursor to the next display. Use the ↑ or ↓ keys to select the number of hours (0...99) between each span calibration. Since a zero calibration is automatically made each time a span calibration is made, enter only the number of hours between each zero calibration made without an accompanying span calibration.
25	ENTER		Pressing ENTER stores the setting in non-volatile memory.
26	→	RPT SPAN: nnn HR *	→ moves the cursor to the next display. Use the ↑ or ↓ keys to select the number of hours (0...99) between each zero calibration. A zero calibration is automatically made each time a span calibration is made.
27	ENTER		Pressing ENTER stores the setting in non-volatile memory.
28	→	DRIFT LIMIT: OFF *	Use the → key to move the cursor to the next display. Use the ↑ or ↓ keys to toggle the DRIFT LIMIT feature ON/OFF.
29	ENTER		Pressing ENTER stores the setting in non-volatile memory.
30	→	ZR-DFT: +/-10%	Use the → key to move the cursor to the next display. Use the ↑ or ↓ keys to select the percent fullscale of zero drift (1...50) allowable for all three ranges.
31	ENTER		Pressing ENTER stores the setting in non-volatile memory.
32	→	S-DFT:R1 +/-15% ←	→ moves the cursor to the next display. Use the ↑ or ↓ keys to select range 1, 2 or 3. Use the → key to move the cursor to the right and select the percent fullscale of span drift (1...50) allowable for the selected range.
33	ENTER	S-DFT:R1 +/-15% ←	With the cursor under the value, pressing ENTER stores the setting in non-volatile memory.
34	→	S-DFT:R2 +/-15% ←	Use the ← key to return to range selection and select another range. Repeat step 30, pressing ENTER with the cursor under the value to store the setting in non-volatile memory. Repeat for third range.
35	SHIFT+ENTER	XXXX ppm H2O L2	Pressing SHIFT+ENTER return the analyzer to RUN mode.

FIGURE 3-23. SETUP/CHECKOUT OF AUTO ZERO/SPAN OPTION (CONTINUED FROM PREVIOUS PAGE)

3.17 REMOTE RANGE INPUT/OUTPUT OPTION

The Model 880 Analyzer has optional remote input/output capability. When the Remote Range Input/Output Option is switched to REMOTE, in the run mode the range indicator at the right corner of the display will be R# instead of L#. Refer to Table 3-2 for explanations of BIN (binary) and DEC (decimal). When SPECIAL (Figure 3-24, STEP 11) is selected, only autocal status and remote/local output on bits 6 and 7, respectively.

STEP	KEYBOARD ENTRY	DIGITAL DISPLAY	EXPLANATION
1	MODE	SECURITY →	Pressing MODE allows the mode settings to be viewed or changed
2	→	RANGE *	→ moves the cursor to the next display
3	→	DIAGNOSTICS *	→ moves the cursor to the next display
4	→	LINEARIZER *	→ moves the cursor to the next display
5	→	ALARM *	→ moves the cursor to the next display
6	→	CURRENT OUTPUT *	→ moves the cursor to the next display
7	→	AUTO-CAL *	→ moves the cursor to the next display
8	→	REMOTE I/O ←	→ moves the cursor to the next display
9	ENTER	CNTRL:REMOTE →	Pressing ENTER allows the analyzer to be placed in remote or local input/output. Use the ↑ or ↓ key to toggle between LOCAL or REMOTE.
10	ENTER		Pressing ENTER stores the setting in non-volatile memory.
11	→	IN/OUT:BIN/BIN ←	→ moves the cursor to the next display. Use the ↑ or ↓ keys to select BIN/BIN (binary/binary), BIN/DEC (binary/decimal), SPECIAL or DEC/DEC (decimal/decimal).
12	ENTER		Pressing ENTER stores the setting in non-volatile memory.
13	SHIFT+ENTER	X.X %FS CO2 R1	Pressing SHIFT+ENTER returns the analyzer to RUN mode.

FIGURE 3-24. SETUP/CHECKOUT OF REMOTE INPUT/OUTPUT OPTION

OUTPUT

BIT	DESIGNATION
0	RANGE I.D.
1	RANGE I.D.
2	RANGE I.D.
3	Not used
4	Not used
5	Not used
6	AUTO-CAL STATUS
7	REMOTE/LOCAL STATUS

INPUT

BIT	DESIGNATION
0	RANGE SELECTION IN REMOTE
1	RANGE SELECTION IN REMOTE
2	RANGE SELECTION IN REMOTE
3	Not used
4	Not used
5	Not used
6	AUTO-CAL REQUEST
7	NOT USED

Note: The Auto-Cal request BIT is level triggered and therefore, it is the responsibility of the user to verify that the BIT is brought low before the analyzer completes the Auto-Cal process.

TABLE 3-1. REMOTE RANGE I/O BIT DESIGNATION

MODE	RANGE	BIT 2	BIT 1	BIT 0
BIN	R3	0	1	1
BIN	R2	0	1	0
BIN	R1	0	0	1
DEC	R3	1	0	0
DEC	R2	0	1	0
DEC	R1	0	0	1

TABLE 3-2. REMOTE RANGE I/O BINARY AND DECIMAL BIT CODING

ROUTINE OPERATION AND THEORY

4

4.1 ROUTINE OPERATION

First set the range for desired operating range: 1, 2, or 3. Then follow the steps for zero and span (Sections 3.8 and 3.9). Next supply sample gas through the instrument. The Model 880 will now automatically and continuously analyze the sample stream.

As a check of instrument performance, it is recommended that the operator keep a log of the zero/span status.

4.2 RECOMMENDED CALIBRATION FREQUENCY

Maximum permissible interval between calibrations depends on the analytical accuracy required and cannot, therefore, be specified. It is recommended initially that the instrument be calibrated once every 8 hours and that this practice be continued unless experience indicates that some other interval is more appropriate.

A change in cell pressure of 1 inch of mercury (3.38 kPa) will result in a readout error of approximately 3% of reading. Therefore, if barometric pressure changes significantly, it is advisable to recheck the calibration against an upscale standard gas.

4.3 SHUTDOWN

The Model 880 will retain settings during prolonged shutdown. Recalibrate the instrument upon restart.

4.4 DETECTION SYSTEM THEORY

As shown in Figure 4-1, infrared radiation is produced from two separate energy sources. This radiation is interrupted by a chopper at 5 Hz. Depending on the application, the radiation may then be optically filtered to reduce background interference from other infrared-absorbing components.

Each infrared beam passes through a cell, one containing a continuously flowing sample and the other cell sealed or with a continuously flowing reference gas.

During analysis, a portion of the infrared radiation is absorbed by the component of interest in the sample, with the quantity of infrared radiation absorbed being proportional to the component concentration. The detector is a "gas microphone" based on the Luft principle. It converts the difference in energy between sample and reference cells to a capacitance change. This capacitance change, proportional to component concentration, is processed and indicated on the display.

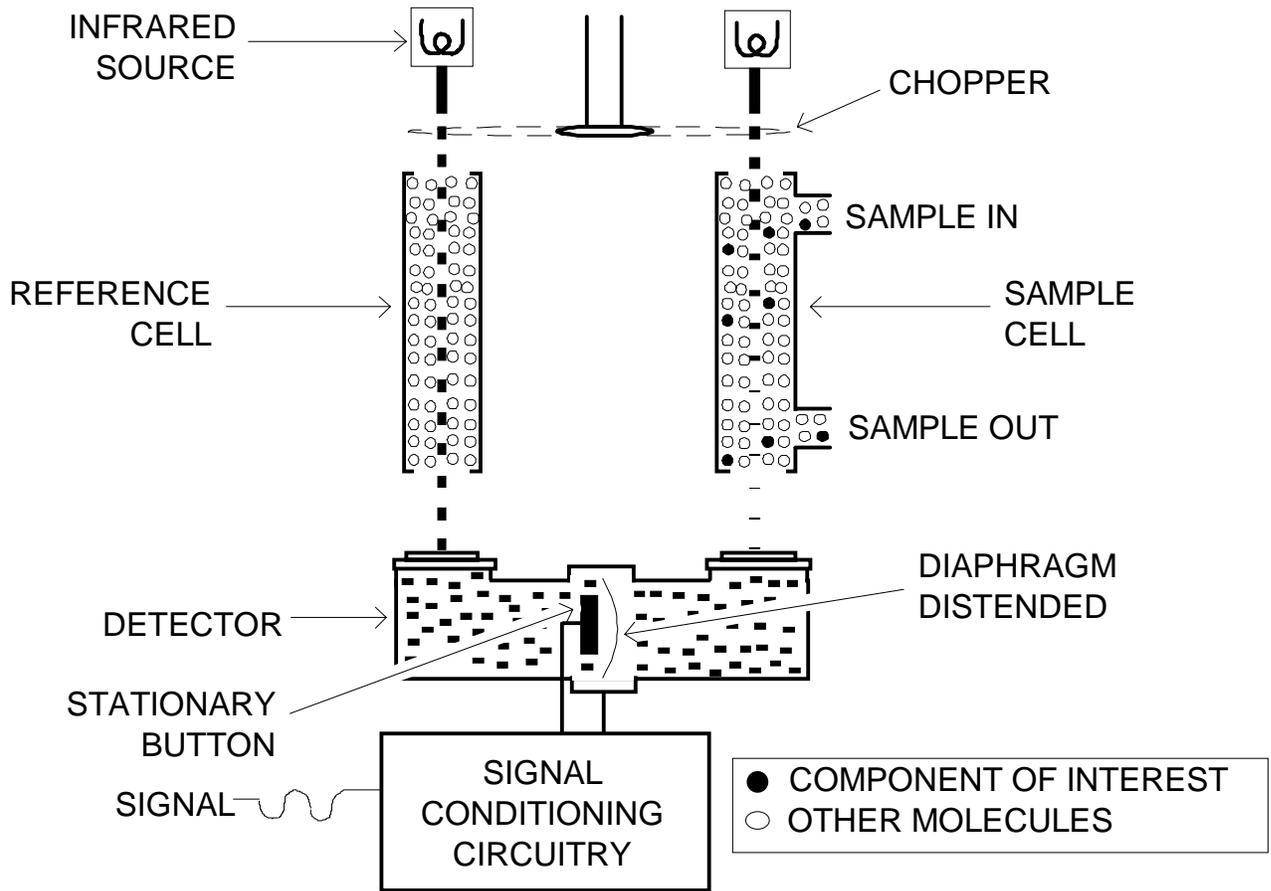


FIGURE 4-1. FUNCTIONAL DIAGRAM OF DETECTION SYSTEM

5 TROUBLESHOOTING

5.1 ERROR CODE SUMMARY

In the Run Mode, the error codes described in Table 5-1 may appear on the display. These messages also are shown on the STATUS display in a slightly different format. Error messages in Table 5-1 are listed in order of priority.

Note:

When using the DIAGNOSTICS display to help make hardware adjustments, set the analyzer GAIN to one. Otherwise, the ADC may be in saturation resulting in a false value in the DIAGNOSTICS display.

RUN MODE DISPLAY	STATUS DISPLAY	EXPLANATION
ERO	[EO-ZERO POT LMTS]	Zero Potentiometer setting is such that <i>more</i> than 500 mV is required to make a software zero. Zero must be reset.
ER1	[E1-SPAN #1 LMTS]	
ER2	[E2-SPAN #2 LMTS]	Span errors for Range 1, Range 2, or Range 3. Software span is outside limits so that the run mode value is not between 55% and 99% of the span gas value while in the Span Mode.
ER3	[E3-SPAN #3 LMTS]	
ER4	[E4-ADC SATURATED]	Signal into ADC is greater than fullscale rating. Refer to Figure 3-6 and reduce the digital GAIN setting by one value, i.e. 8 to 4, 4 to 2 or 2 to 1. If the GAIN is initially on 1, switch from High to Low gain.
ER5	[E5-ZERO DRIFT]	Zero drift limit exceeded. To clear, recalibrate or toggle the drift limit OFF and then ON. See Figure 3-14.
ER6	[E6-SPAN DRIFT]	Span drift limit exceeded. To clear, recalibrate or toggle the drift limit OFF and then ON. See Figure 3-14.

Note: If any of the above error messages occur, software will restore previous values.

TABLE 5-1. ERROR CODE SUMMARY

5.2 OSCILLATOR TUNE ADJUSTMENT

This procedure should not be performed on a routine basis:

1. Refer to Section 3.8, and access the Oscillator Tune display.
2. Adjust coil knob (Oscillator Tune, located on top of the detector housing) clockwise or counterclockwise until a maximum reading is obtained on the display.
3. Adjust the coil knob **counterclockwise** until the unit reads between 75 and 80% of the maximum value.

5.3 PREAMP GAIN

The preamp gain is used to adjust the fullscale value at TP2 and the diagnostic display to 7.5V. To prevent saturation, this value must never be higher than 7.5V, fullscale. If this value is too low or is above 7.5V, adjust the preamp gain.

1. Refer to Section 3.8, and access the Detector Signal display.
2. Flow SPAN calibration gas for the **least** sensitive range through the SAMPLE CELL for a minimum of two minutes.

Example:

Range 1 - 500 ppm CO

Range 2 - 2000 ppm CO

Range 3 - 5000 ppm CO

In this case, the least sensitive range would be 5000 ppm.

3. If the calibration gas is not equal to fullscale, find the percent fullscale of the calibration gas by looking at the application curve at the back of the manual.
4. Multiply this value by 7.5 and record the resultant value for Step 5. For example, if the SPAN gas is 67 % of fullscale, then:

$$0.67 \times 7.5 = 5$$

In this case, the value to be used in Step 5 is 5.

5. Adjust the displayed value with preamplifier gain potentiometer R3, located on the Signal Board, for the value obtained in Step 4. **THIS VALUE SHOULD NEVER BE HIGHER THAN 7.5.**

Note:

For applications with very low concentrations (for example Range 3 = 400 ppm CO), the fullscale value at TP2 and the Diagnostics Display may be considerably less than 7.5V.

5.4 SOURCE BALANCE SHUTTER ADJUSTMENT

Note:

These adjustments are part of the factory checkout and are not normally required for routine operation, but must be performed whenever the optical system is disturbed (i.e., removal of cells for cleaning).

1. Access Diagnostics Mode (See Section 3.8), and access the Detector Signal display.
2. Flow zero gas (nitrogen) through the SAMPLE CELL for a minimum of two minutes.
3. Slightly loosen the threaded hex standoff on the sample cell shutter adjust screw. The shutter adjust screw is located on top of the motor source assembly (Figure 7-1)
4. Using a screwdriver, rotate the shutter adjust screw until a minimum reading on the display is obtained. A typical reading is 0.2 to 0.5. Add 0.4 to this value. Use this value for Step 5.
5. Rotate the shutter adjust screw clockwise (viewed from the screw head) until the display reads the value obtained in Step 4.
6. Re-tighten the threaded hex standoff. Ensure that the display does not change.

5.5 SOURCE CURRENT ADJUSTMENT

1. Follow steps 1 through 6 in Figure 3-9 to access the Source Current display.

Refer to DWG 624073. Adjust the trim potentiometer (R9) located on the Power Supply Board to view the desired current on the digital display until the value on the display is within ± 10 of the value on the application data sheet. Clockwise adjustment of R9 will increase the value. Counterclockwise will decrease the value.

5.6 VOLTAGE CHECKS

Refer to Section 3.8 and ensure that the voltages for the detector signal and the three power supplies are correct.

5.7 DIGITAL GAIN ADJUSTMENT

The digitally controlled GAIN amplifier does not normally need adjustment, however, in the event that the analyzer cannot be spanned, the GAIN must be adjusted as follows:

1. Follow the STEPS for Spanning the Analyzer in Sections 3.14 (standard analyzer) or 3.15 (analyzer with the Calibration Gas Control Option) and span the analyzer. If the Run Mode value is not between 51% and 100% of the span gas value, while keeping the span potentiometer between 5% and 95%, then the digital GAIN should be adjusted. (The ideal span pot setting is 50%.) Note the final value of the PS (potentiometer status) for Step 4.

2. Exit to Run Mode.
3. Follow steps 1 through 4 in Figure 3-8 to obtain the GAIN display in the RANGE parameters menu.
4. Change the GAIN setting to a value higher or lower than the original value. The GAIN may be changed to 1, 2, 4, or 8. If the span potentiometer status (PS) was at the top of its range in Step 2 (95%), then the GAIN should be raised. If the span potentiometer status (PS) was at the bottom of its range in Step 2 (5%), the GAIN should be lowered.
5. Press SHIFT/ENTER to return to Run Mode.
6. Repeat Step 1. If the analyzer still cannot be spanned, repeat steps 3 through 5 for a new GAIN value.

5.8 CASE HEATER TEMPERATURE CONTROL

Malfunction in this option can occur in three sections:

HEATER

Check with an ohmmeter for continuity. The heater resistance is approximately 113 ohms.

TEMPERATURE SENSOR

This is an RTD and should have approximately 550 ohms at 25°C. Check with ohmmeter for continuity.

OVER TEMPERATURE FUSE

This is a thermal fuse that opens above 72°C. Check for continuity with an ohmmeter.

If the above are functional, refer to Drawing 624073 for circuit diagram and troubleshoot board.

5.9 DETECTOR HEATER

There are three sections that can cause a malfunction

HEATER

Check with an ohmmeter for continuity. The heater resistance is approximately 113 ohms.

TEMPERATURE SENSOR

This is an RTD and should have approximately 550 ohms at 25°C. Check with ohmmeter for continuity.

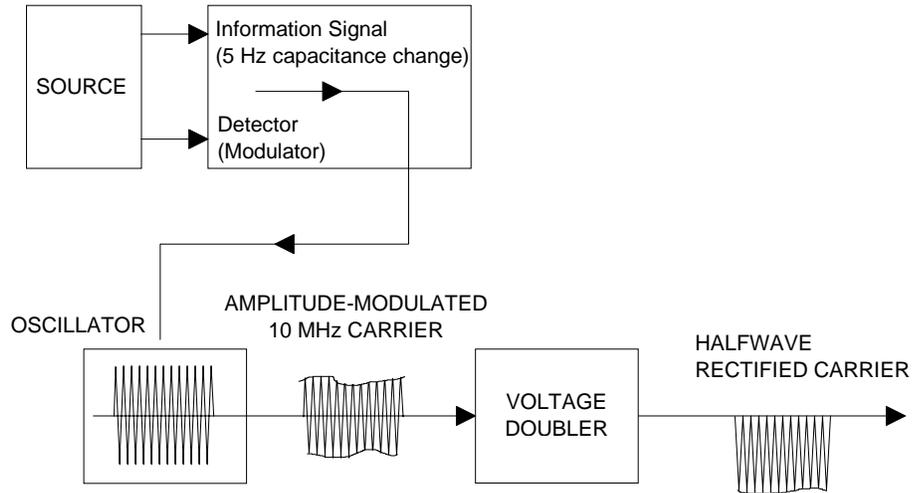
OVER TEMPERATURE FUSE

This is a thermal fuse that opens above 72°C. Check for continuity with an ohmmeter.

PROBLEM	PROBABLE CAUSE	ACTION TO BE TAKEN
<i>DIGITAL DISPLAY DOES NOT LIGHT UP</i>	No power to analyzer	Check fuse; reset if necessary. Check input power and connections. Check Power Supply Board.
	CPU Board	Check power connector to CPU Board.
<i>UNABLE TO SPAN ANALYZER</i>	Digital GAIN needs adjustment	See Section 5.7
	Preamplifier gain needs adjustment	See Section 5.3
	Source current needs adjustment	See Section 5.5
<i>UNSTABLE, NOISY SIGNAL</i>	Oscillator tune	See Section 5.2
	Time constant too low	See Section 3.7
<i>EXCESSIVE DRIFT WITH CHANGING AMBIENT TEMPERATURE</i>	Temperature Control Assembly	See Section 5.8
<i>LOW SENSITIVITY</i>	Sources need to be replaced	The resistance of both sources should be 24 ± 3 ohms.
	Loss of source current	See Section 5.5
<i>BASELINE DRIFT</i>	Source balance	See Section 5.4
<i>ERROR MESSAGES WHEN ATTEMPTING TO CALIBRATE</i>	Check Diagnostics Display	Detector signal should be between 0.4 and 1 volt with zero gas, 7.5 volts, maximum, on high range with 100% fullscale span gas. Adjust GAIN potentiometer, see Section 5.3
<i>UNABLE TO SPAN OR ZERO ANALYZER</i>	Calibration parameters incorrect	The zero value must be close to zero before pressing ENTER.
		The concentration display (left side of display) must be less than the span gas displayed in the right side of the display, but greater than 50% of the fullscale range.

FIGURE 5-1. TROUBLESHOOTING CHART

OSCILLATOR BOARD



SIGNAL BOARD

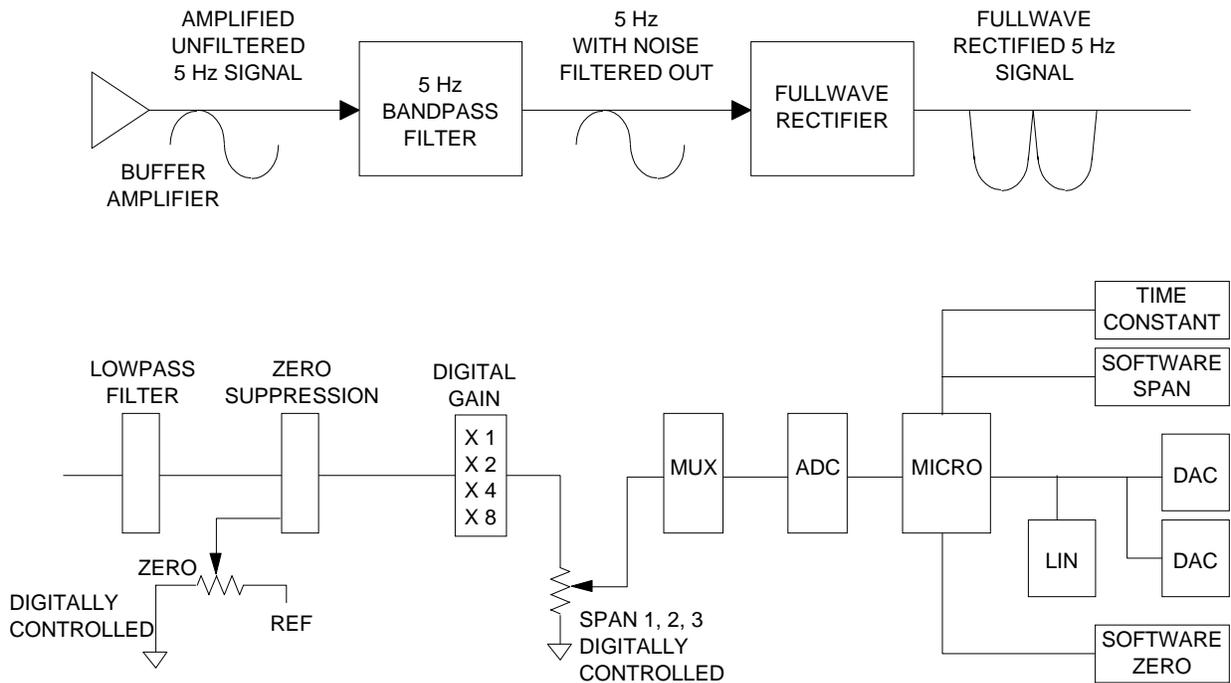
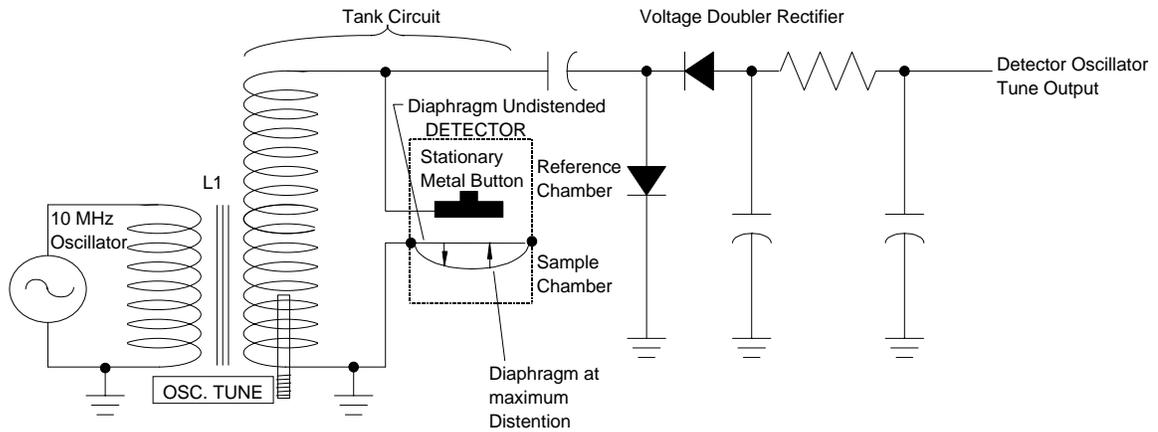


FIGURE 5-2. SIGNAL WAVEFORMS

A. Functional Diagram - Circuitry in Tune Mode



B. Tank Circuit Resonance Curves

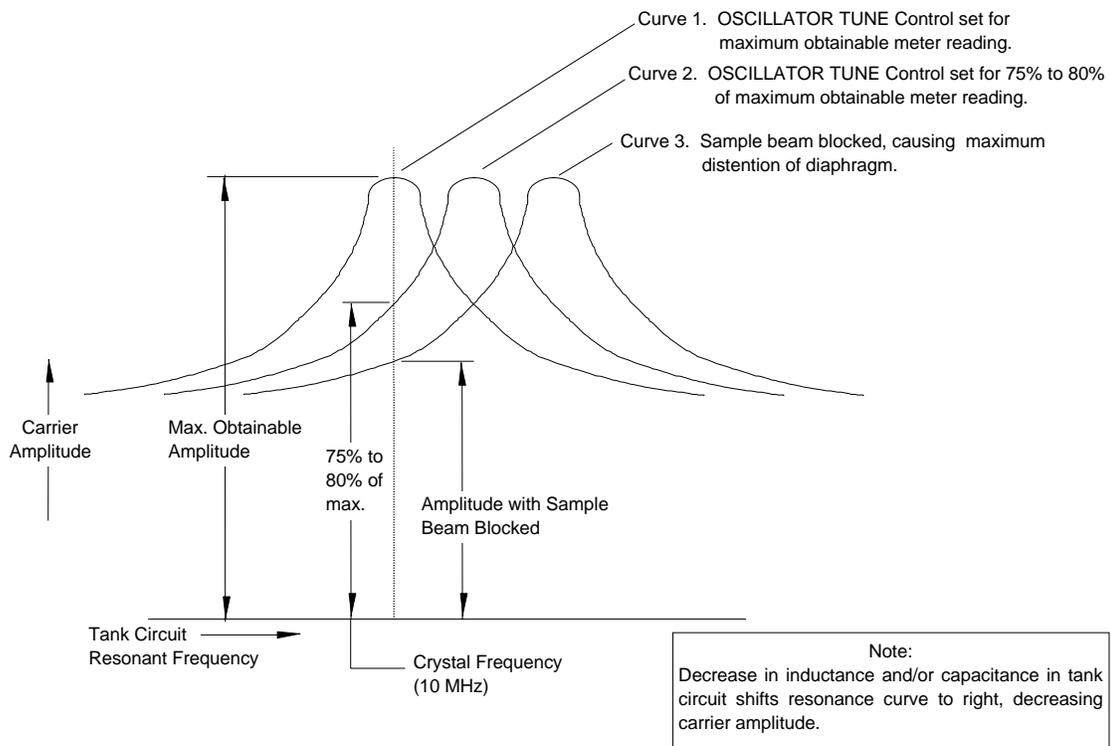


FIGURE 5-3. MODULATION SYSTEM

NOTES

6 ROUTINE SERVICING



WARNING: ELECTRICAL SHOCK HAZARD

Servicing requires access to live parts which can cause death or serious injury. Refer servicing to qualified personnel.

Note:

Before servicing analyzer, disconnect power and shut off sample flow to unit.

6.1 CELL REMOVAL, CLEANING AND INSTALLATION

1. Slide chassis out.
2. Remove sample lines:
 - a. From the end cap assemblies (long cell).
 - b. From the sample cell (short cell).
3. Remove the two hold-down screws on the motor/source assembly (Figure 7-1).
4. Gently move the motor/source assembly away from the detector.
5. For long cell models, support the cell while performing Step 4. The cell and its O-rings will now be free.
6. For short cell models, the three retaining screws holding the two end caps and sample cell must be removed. The cell, end caps and O-rings will now be free.
7. Rinse the cell with acetone. If this does not remove all foreign matter, use a soft brush. Do not use any metallic object inside the cell because it will scratch the gold plating.
8. After all matter has been removed, rinse the cell with distilled water and allow to air dry. Do not use towels.
9. Inspect the cell inside by holding it up to a bright light. If particles are seen, repeat Steps 7 and 8 as often as necessary.
10. After cleaning cell, examine O-rings at the source, detector, and end caps. If damaged, replace with new O-rings.

11. Remove any contaminants from windows with a lint free cloth soaked in acetone. Do not use alcohol or other solvents. Allow to air dry.
12. To replace the cell perform the following steps:
 - a. Long cell - fit it into position. Make sure that the O-rings seat properly.
 - b. Short cell - replace the three retaining screws holding two end caps. Make sure that the O-rings seat properly.
 - c. Move the motor/source assembly back into position. Make sure that the O-rings seat properly.
13. Replace the two hold-down screws on the motor/source assembly. Do not overtighten.
14. Check for leaks as instructed in Condensed Startup and Standardization Procedure (Section A). Take corrective action if necessary.

GAS	DESICCANT	PART NUMBER
CO ₂	Cardoxide	096218
CO	Mg (ClO ₄) ₂	096217
H ₂ O	Mg (ClO ₄) ₂	096217
SOS	Mg (ClO ₄) ₂	096217
CH ₄	Mg (ClO ₄) ₂	096217
Hexane	Mg (ClO ₄) ₂	096217
CO + CO ₂	Cardoxide + Mg (ClO ₄) ₂	096217/096218

TABLE 6-1. TYPES OF DESICCANT

6.2 CELL DESICCANT

The reference cell may use a flowing reference. If so, desiccant is required.

A desiccant holder is used on the inlet and outlets to keep moisture from entering the reference cell. The desiccant should be replaced each time the cell is opened. To determine the type of desiccant used, refer to Table 6-1.

6.3 SOURCE REPLACEMENT

Refer to Figure 6-2. Sources are marked with the resistance value, for example, 11.5 - 11.6 in matched pairs. Install the higher value as the reference source.

Note:

Refer to Figure 7-1. Observe how the parts are disassembled so that the reverse procedure can be used for reassembly.

1. Loosen the two screws on the front of the case and slide the front panel forward.

2. Remove the two screws holding the source housing to the chopper housing.
3. Remove the two screws holding the source to the source housing. Note how the source is mounted. There is a front and back side.
4. If replacing the source, insure that its orientation is exactly the same as the old one. Each source is marked on the back. Install the source with the higher designation at the reference site.
5. Reverse the procedure outlined above to reinstall the new source assembly,

6.4 SOURCE BALANCE SHUTTER ADJUSTMENT

When the sources are replaced, follow the Source Balance Procedure in Section 5.4 to adjust the source balance shutter.

6.5 CHOPPER MOTOR ASSEMBLY (P/N 658313)

1. Remove Source Assembly front cover.
2. Remove chopper blade.
3. Remove two screws from rear of motor and remove motor.

6.6 MICROBOARD REPLACEMENT

All calibration constants and settings stored in nonvolatile memory must be changed when the microboard is replaced. These procedures are given in Section Three, Initial Startup and Calibration.

Additionally, the zero potentiometer and the three span potentiometers must be resynchronized with software. To resynchronize the zero potentiometer follow the steps listed below:

1. Follow the instructions in Figure 3-11 for the standard instrument or 3-12 for the instrument with Calibration Gas Control Option and access the [ZR=X.X PS=XX% →] display.
2. Press SHIFT then ↓.
3. Proceed with the zero calibration.

The span potentiometer must be resynchronized for all three ranges as follows:

1. Choose the first range by selecting a range using the range parameters in Figure 3-8.
2. Follow the instructions in Figure 3-14 for the standard instrument or 3-15 for the instrument with Calibration Gas Control Option and access the [X.XX XX% 100 ↓] display.

3. Press SHIFT then ↓.
4. Proceed with the span calibration.

6.7 DETECTOR REMOVAL

Refer to Figure 7-1, Part 5.

Slide chassis out.

1. Remove sample lines:
 - a. From the end cap assemblies (long cell).
 - b. From the sample cell (short cell).
2. Remove top cover from detector housing.
3. Remove entire detector assembly by removing the four screws from the base plate.
4. For long cell configurations, support the cell while performing Step 4. The cell and its O-rings will now be free.
5. Remove oscillator board.
6. Remove dual end cap assembly for long cells or sample cell and cell assembly for short cell.
7. Remove two screws holding detector to detector base.
8. Remove detector.
9. Wipe off all the white heat sink compounds from the base plate.
10. Apply new heat sink compound to the detector (supplied with the new detector).
11. Replace detector and reverse the removal process.

Note

When replacing detector, insure that the thermal fuse and temperature sensor mounted in the base plate is in good thermal contact with the base plate.

6.8 ELECTRONIC CIRCUITRY

6.8.1 OSCILLATOR CIRCUIT BOARD AND ASSOCIATED ELEMENTS OF AMPLITUDE-MODULATION CIRCUIT

In the Oscillator Circuit (DWG 623995) the 10 MHz carrier wave is generated by a crystal-controlled radio-frequency oscillator using crystal Y1 and transistors Q1 and Q2.

The modulation circuit is driven by the detector, the sensing element of the analyzer. Mechanical functioning of the detector is explained in Paragraph 4.4. Considered electronically, the detector is a two-plate variable capacitor. The modulator is coupled inductively, through one winding of inductance T1, to the oscillator. Amplitude of the 10 MHz carrier thus varies with the 5 Hz modulation signal.

6.8.2 FUNCTIONING OF MODULATION SYSTEM IN TUNE MODE

Preparatory to oscillator tuning, access Oscillator Tune (OT=XX) in the Diagnostic Display (Figure 39). In this mode the display indicates the rms value of the halfwave-rectified carrier. The tank circuit is now adjusted in the following two-step sequence:

1. **Tuning:** Initially, the OSC TUNE adjustment is set somewhat counterclockwise from its correct setting. Then, it is rotated clockwise to move the slug into the core, thus increasing inductance and decreasing resonant frequency. The adjustment is set for maximum obtainable reading. At this setting, tank-circuit resonant frequency is the same as oscillator frequency (i.e., nominal 10 MHz). See Resonance Curve Number 1, Figure 5-2.
2. **Detuning:** By counterclockwise rotation of the OSC TUNE adjustment, the slug is partially withdrawn from the core, thus decreasing inductance and increasing resonant frequency. The adjustment is set so reading decreases to between 75% and 80% of the maximum obtainable value noted in Step 1, above. See Resonance Curve Number 2, Figure 5-2. This curve has the same shape as that obtained in Step 1, immediately preceding, but is displaced to the right.

6.8.3 FUNCTIONING OF MODULATION SYSTEM IN OPERATING MODE

Overall sensitivity of the analyzer system may now be checked by placing span gas in the sample beam to simulate absorption of sample-beam energy and thus provide the maximum obtainable 5 Hz detector-output signal. During that portion of the chopping cycle, while the chopper is not blocking the sample and reference beams, the diaphragm distends away from the metal button, thus decreasing detector capacitance and shifting the tank-circuit resonance curve to the right. At the moment the diaphragm reaches maximum distention, the curve reaches the position of Curve 3, Figure 5-3.

The diaphragm now pulses cyclically, causing the resonance curve to move continuously back and forth within the limits defined by Curves 2 and 3 of Figure 5-2. Carrier amplitude decreases as the curve moves to the right and increases as it moves to the left. Thus, the response characteristics of the system depend on the location of Curve 2. Position of this curve depends on the degree of tank-circuit detuning used. By detuning to 70% to 75% of the maximum obtainable carrier amplitude and operating on the portion of the curve thus obtained, maximum slope yields highest sensitivity and minimum curvature provides best linearity.

6.8.4 RADIO-FREQUENCY DEMODULATOR

The amplitude-modulated 10 MHz carrier from the detector/oscillator circuit is applied to the radio-frequency demodulator. This circuit is a voltage-doubler type rectifier utilizing diodes CR1, CR2, CR3, CR4, and capacitor C7. The circuit gives approximately double the output voltage of a conventional halfwave rectifier. This result is obtained by charging a capacitor during the normally wasted half-cycle, and then discharging it in series with the output voltage during the next half-cycle.

6.8.5 SIGNAL BOARD (DWG 624085)

The 5 Hz sine wave detector signal goes through an AC amplifier U1A and associated resistor. The output signal goes through bandpass filter network U2 and U4 to remove harmonics and distortion. The signal next goes through a precision signal rectifier U3 and Q1 and then through low pass filter U5. This output goes through an RC low pass filter R29, C13 and U7 and then to inverting buffer amplifier U8 with zero control U11. The signal goes through a range amplifier consisting of eight bit DAC U9 and the amplifier U10.

The GAIN is digitally controlled via U15, U16 and U18 resulting in a selectable digital GAIN of X1, X2, X4 and X8.

The span is controlled for the three ranges with SPAN 1 (U12), SPAN 2 (U13) and SPAN 3 (U14).

The eight-channel multiplexer (U17) selects the input signals by commands applied to the switch driver and feeds the selected signal to pin two of J2.

6.8.6 POWER SUPPLY BOARD (DWG 624073)

The power supply board supplies the different voltages to the various boards. Additionally, the power supply board includes an adjustable source driver circuit, a chopper motor driver circuit, a proportional temperature controller circuit and a DC to AC converter for backlight.

6.8.7 ADAPTOR BOARD (DWG 624127)

The adaptor board which includes a resettable fuse is used for line power distribution. The adaptor board also serves as an interface board for all the option boards and provides the recorder output on TB2.

6.8.8 MICROBOARD

The microboard is a self-contained circuit assembly which includes an advanced microprocessor and multiple I/O functions with a complete analog domain consisting of analog-to-digital converters and digital-to-analog converters. Multiple output registers allow the transmission of digital data to and from the board under program control. The circuit board can be used alone or in conjunction with I/O boards that satisfy special interfacing requirements such as the following:

1. Current Output
2. Bi-directional Remote Range I/O board
3. Dual Alarm assembly
4. Auto Zero/Span
5. Calibration Gas Control

The board is configured with an analog domain that allows the processing of analog signals directly with a 12-bit plus sign ADC. In addition, two independent DAC's, each 12 bytes wide, allow the presentation of analog voltages for peripheral functions immediately.

6.8.9 OPTIONAL CASE HEATER TEMPERATURE CONTROL BOARD (DWG 624003)

This is a proportional temperature controller. which works on a variable time method.

Resistors R7, R8, R9, R10, R11 and the sensor form a bridge which feeds a comparator, AR1. AR1 operates in an ON/OFF mode to drive transistor Q3. The sensor is a resistor with a positive temperature coefficient (1.925 ohms/°C). The resistance is 500 ohms at 25 °C.

Resistors R1 through R6, Q1, Q2 and C1 provide the circuit for the time proportioning action: C1 charges until the voltage on C1 reaches 9.0 V. Q1 then discharges C1, and the charging process repeats itself. The emitter of Q2 follows the voltage on C1, which is essentially a sawtooth. This is injected into the bridge, which causes the setpoint to bump on a variable time basis. Q3 (through LED CR1) triggers optical coupler U1 which gates TRIAC (U2). U2 allows fullwave VAC to flow through the case heater element.

6.8.10 DUAL ALARM/CALIBRATION GAS CONTROL OPTION BOARD (DWG 624204)

This board is used for both dual alarm and calibration gas control, depending on the position of the jumper in the jumper-selectable address. This is a peripheral circuit function which communicates with the computer via an 8-bit buss arrangement. This option consists of two form C contacts rated 3A 125/250 VAC or 5A 30 VDC. (resistive). This circuit board satisfies a dual alarm requirement, as it provides two medium power relays that can be independently controlled from the central processor. Also, the board can be used to connect user-supplied solenoid valves to zero and span calibration gases for one-man calibration. Provision is made to assign a specific address in the range 0 through 7 using jumpers.

6.8.11 ISOLATED REMOTE RANGE I/O OPTION BOARD (DWG 624251)

The Remote Range I/O board is a peripheral circuit function which communicates with the computer via an 8-bit buss arrangement. This assembly provides isolated two way communication between the host instrument and external user devices. Provision is made to assign a specific address in the range 0 through 7 using jumpers.

6.8.12 AUTO ZERO/SPAN OPTION BOARD (DWG 624599)

The auto zero/span board is a peripheral circuit function which communicates with the computer via an 8-bit bus. With the appropriate software it satisfies the auto zero/span requirement. The assembly provides 6 form C relay contact outputs, 4 of which are suitable for medium power requirements, the remaining two are relegated to alarm or indicator functions. Snubbers are provided for the medium power relays. Provision is made to assign a specific address in the range 0 through 7 using jumpers. The auto-cal request bit is level triggered and therefore, the request line must be brought low before the analyzer completes the Auto-Cal process.

6.8.13 CURRENT OUTPUT OPTION BOARD (DWG 624092)

This board changes the instrument voltage output to an isolated current output for use with external recorders or data gathering systems.

7 REPLACEMENT PARTS

The following parts are recommended for routine maintenance and troubleshooting of the Model 880 Non-Dispersive Infrared Analyzer. If the troubleshooting procedures do not resolve the problem, contact your local Rosemount Analytical service office. A list of Rosemount Analytical Service Centers is located in the back of this manual. Figures 7-1 through 7-5 show locations of components and assemblies.



WARNING: PARTS INTEGRITY

Tampering or unauthorized substitution of components may adversely affect safety of this product. Use only factory-documented components for repair.

7.1 CIRCUIT BOARD REPLACEMENT POLICY

In most situations involving a malfunction of a circuit board, it is more practical to replace the board than to attempt isolation and replacement of the individual component. The cost of test and replacement will exceed the cost of a rebuilt assembly. As standard policy, rebuilt boards are available on an exchange basis.

Because of the exchange policy covering circuit boards the following list does not include individual electronic components. If circumstances necessitate replacement of an individual component, which can be identified by inspection or from the schematic diagrams, obtain the replacement component from a local source of supply.

7.2 SELECTED REPLACEMENT PARTS

While the following sections list parts which are common to all Model 880 applications, the **configuration number** is required when ordering parts which are specific to an individual application. The configuration number (8801-XX or 8802-XX) is on the Data Sheet in the rear of this manual.

623998	Oscillator Board
624006	Temperature Control Board
624076	Power Supply Board
624088	Signal Board

- 623785 Micro Board
- 622733 Fan, Heater (if used)
- 622732 Heater (if used)
- 624433 Thermal Fuse, Fan Heater (if used)
- 658313 Chopper Motor
- 624442 Source (Matched Pair)
- 898733 Detector Thermal Fuse
- 620298 Detector Heater
- 622917 Detector Temperature Sensor

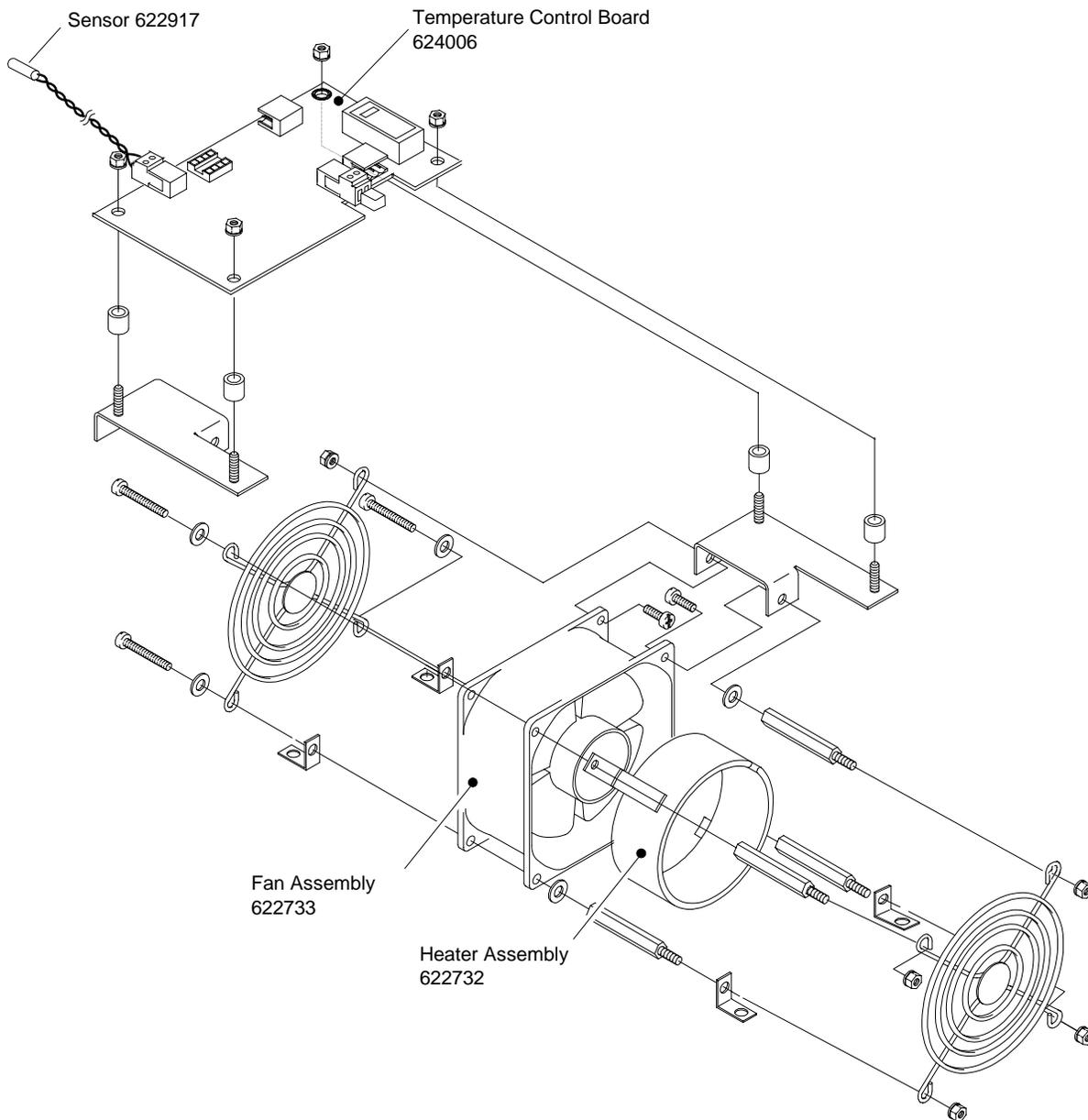


FIGURE 7-1. CASE HEATER TEMPERATURE CONTROL ASSEMBLY

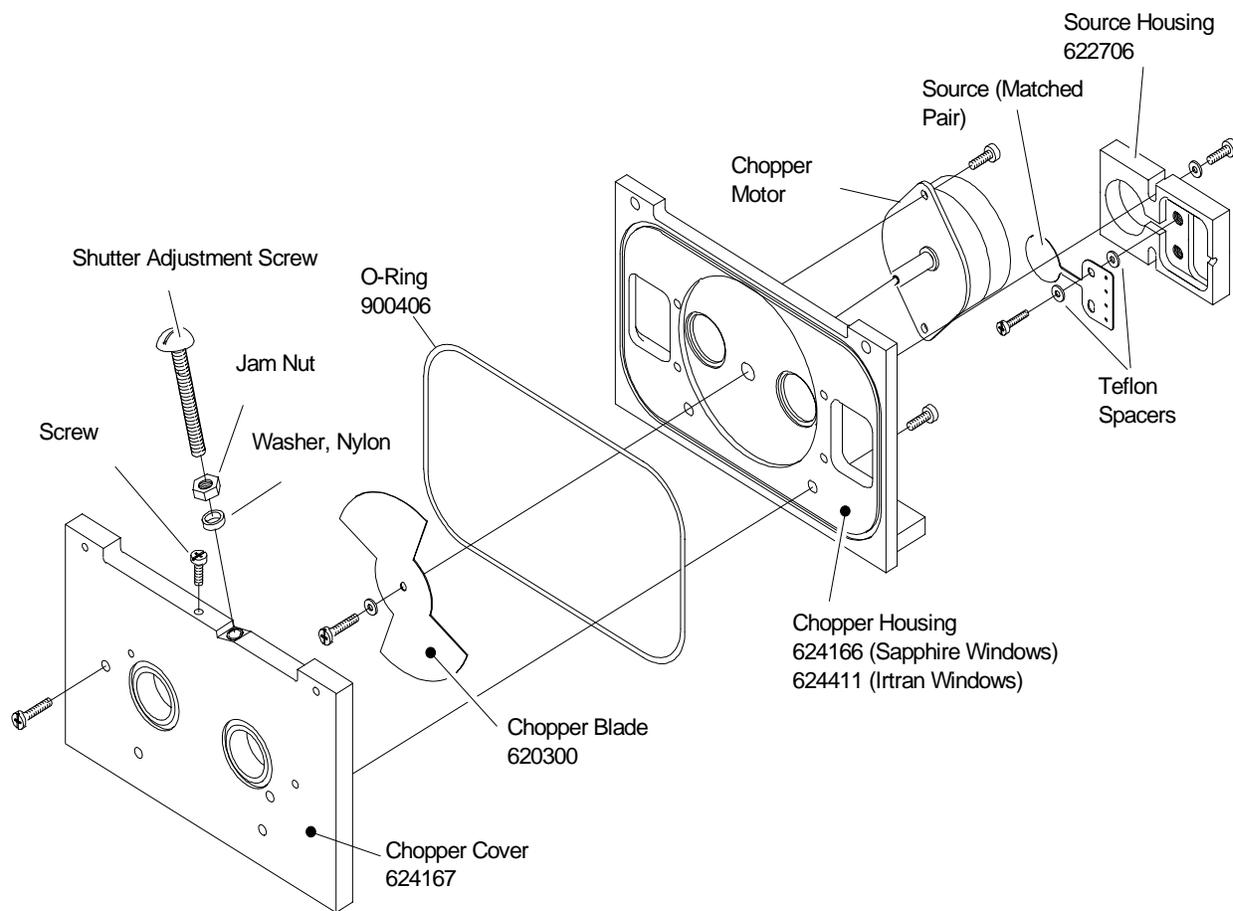


FIGURE 7-2. MOTOR/SOURCE ASSEMBLY

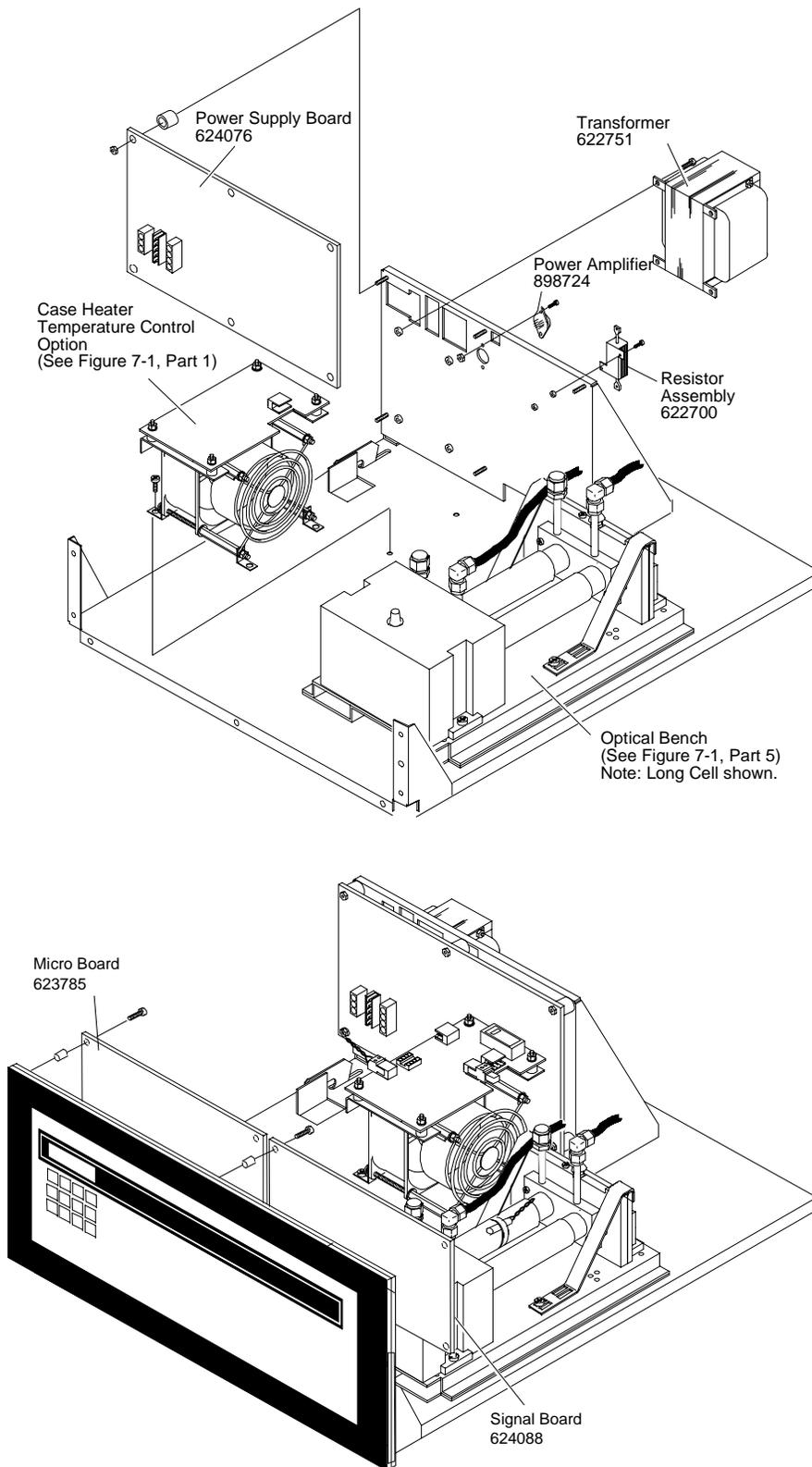
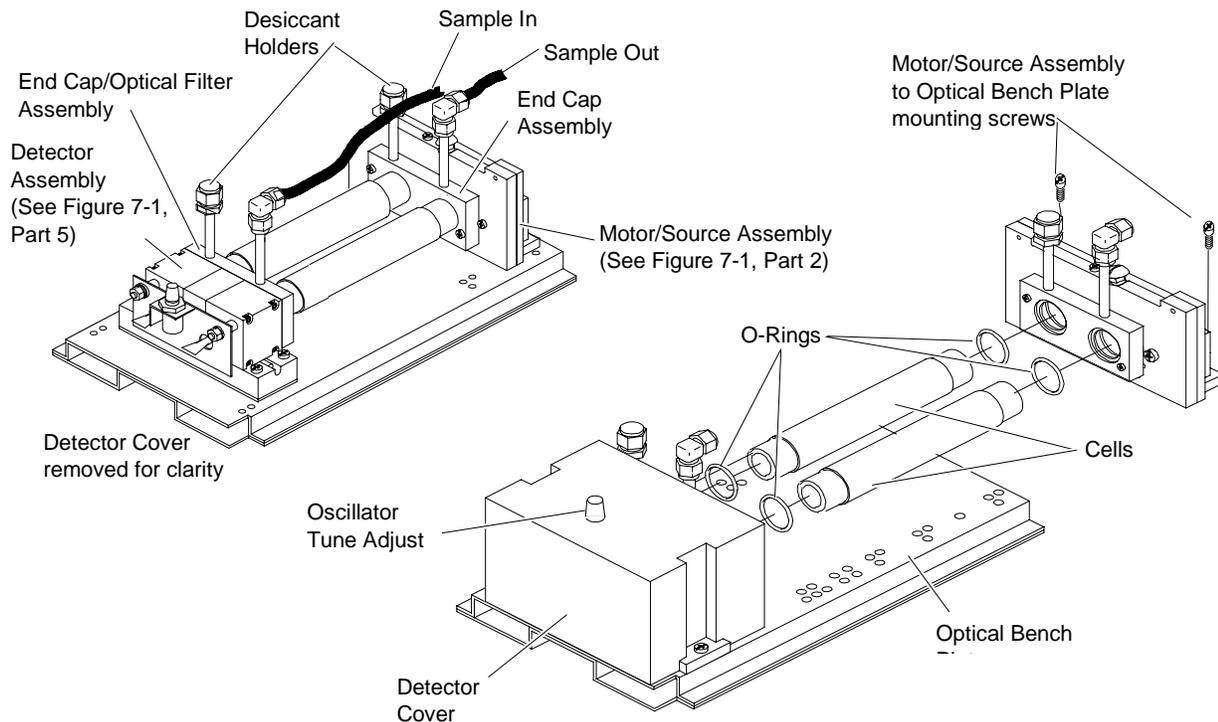


FIGURE 7-3. MODEL 880 MAJOR COMPONENTS

A. LONG CELLS



B. SHORT CELLS

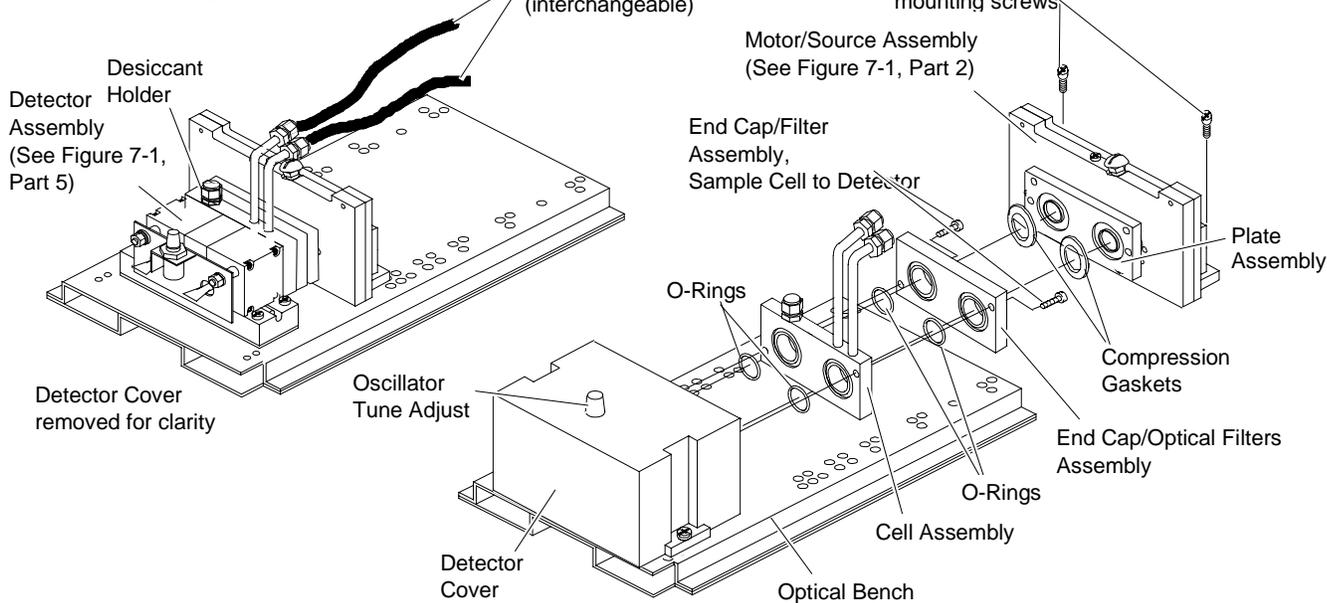
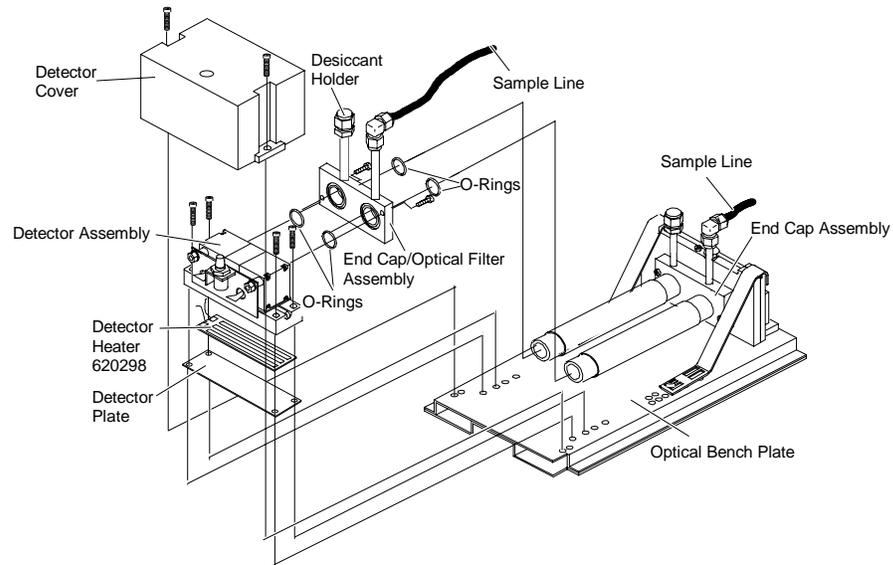
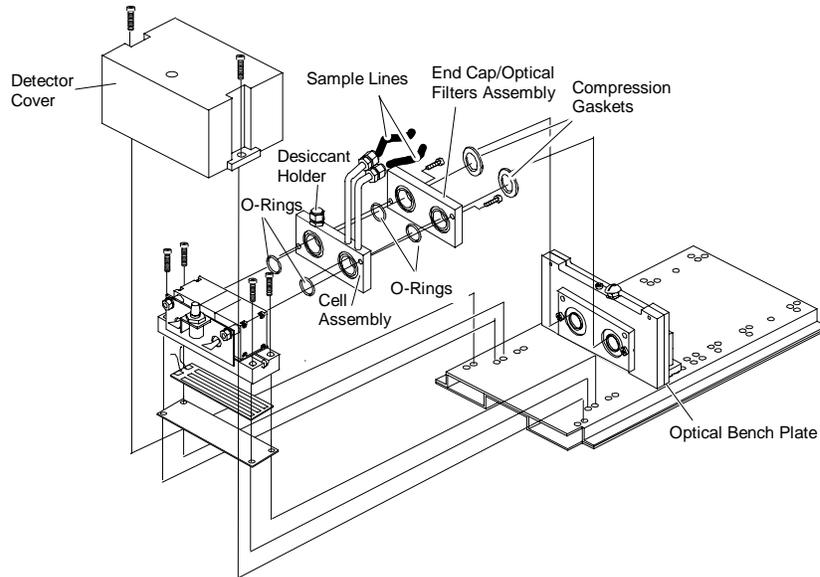


FIGURE 7-4. OPTICAL BENCH ASSEMBLY

A. LONG CELLS



B. SHORT CELLS



C. DETECTOR ASSEMBLY

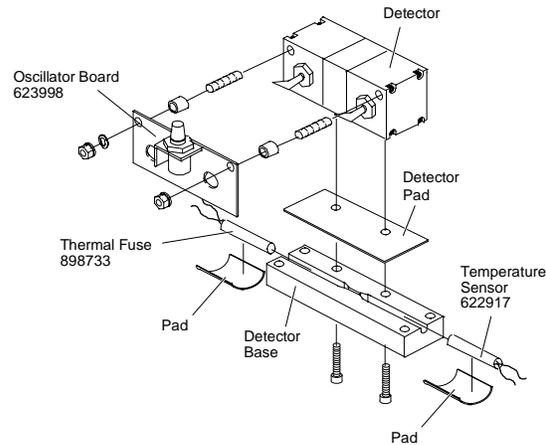


FIGURE 7-5. DETECTOR ASSEMBLY REMOVAL/INSTALLATION

GENERAL PRECAUTIONS FOR HANDLING AND STORING HIGH PRESSURE GAS CYLINDERS

*Edited from selected paragraphs of the Compressed
Gas Association's "Handbook of Compressed Gases"
published in 1981*

*Compressed Gas Association
1235 Jefferson Davis Highway
Arlington, Virginia 22202
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1. Never drop cylinders or permit them to strike each other violently.
2. Cylinders may be stored in the open, but in such cases, should be protected against extremes of weather and, to prevent rusting, from the dampness of the ground. Cylinders should be stored in the shade when located in areas where extreme temperatures are prevalent.
3. The valve protection cap should be left on each cylinder until it has been secured against a wall or bench, or placed in a cylinder stand, and is ready to be used.
4. Avoid dragging, rolling, or sliding cylinders, even for a short distance; they should be moved by using a suitable hand-truck.
5. Never tamper with safety devices in valves or cylinders.
6. Do not store full and empty cylinders together. Serious suckback can occur when an empty cylinder is attached to a pressurized system.
7. No part of cylinder should be subjected to a temperature higher than 125°F (52°C). A flame should never be permitted to come in contact with any part of a compressed gas cylinder.
8. Do not place cylinders where they may become part of an electric circuit. When electric arc welding, precautions must be taken to prevent striking an arc against the cylinder.

Rosemount Analytical Inc.

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Contact your local Rosemount Sales and Service office for service support.

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For order administration, replacement Parts, application assistance, on-site or factory repair, service or maintenance contract information, contact:

**Rosemount Analytical Inc.
Process Analytical Division
Customer Service Center
1-800-433-6076**

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Before returning parts, contact the Customer Service Center and request a Returned Materials Authorization (RMA) number. Please have the following information when you call: *Model Number, Serial Number, and Purchase Order Number or Sales Order Number.*

Prior authorization by the factory must be obtained before returned materials will be accepted. Unauthorized returns will be returned to the sender, freight collect.

When returning any product or component that has been exposed to a toxic, corrosive or other hazardous material or used in such a hazardous environment, the user must attach an appropriate Material Safety Data Sheet (M.S.D.S.) or a written certification that the material has been decontaminated, disinfected and/or detoxified.

Return to:

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Anaheim, California 92807-1802**

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