Rosemount Analytical

MODEL 815
EXPLOSION PROOF
NON-DISPERSIVE INFRARED
ANALYZER

INSTRUCTION MANUAL

748175-F

Notice

Information contained in this document is subject to change without notice.

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Rosemount Analytical
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PREFACE

PURPOSE/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 815 Explosion Proof Non-Dispersive Infrared Analyzer should be thoroughly familiar with and strictly follow the instructions in this manual. **Save these instructions.**

If this equipment is used in a manner not specified in these instructions, protective systems may be impaired.

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.

This instrument is shipped from the factory set up to operate on 115 volt, 50/60 Hz electric power. For operation on 230 volt, 50/60 Hz power, see Section 2.3 and Figures 2-2 and 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 explosion-proof enclosure must be suitable for the gas.

WARNING: EXPLOSION HAZARD

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.

Do not operate the Model 815 Explosion-Proof Analyzer without lens cover and door in place with all bolts secured, unless location has been determined to be non-hazardous.

WARNING: HIGH PRESSURE GAS CYLINDERS

This analyzer requires periodic calibration with known zero and standard gases. Refer to General Precautions for Handling and Storing High Pressure Cylinders, in the rear of this manual.

WARNING: PARTS INTEGRITY

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

SPECIFICATIONS

POWER REQUIREMENTS:	120/220 VAC ±10%, 50/60 ±3 Hz, 150 W; 350 W with optional case heater
AMBIENT TEMPERATURE:	32°F to 113°F (0°C to 45°C) Some configurations may require optional case heater for temperatures outside 59°F to 95°F (15°C to 35°C). Refer to Appendix A.
DIMENSIONS:	21.5 in (55.0 cm) H 15.5 in. (39 cm) W 11.8 in. (30 cm) D
WEIGHT:	119 lbs (54 kg)
ENCLOSURE:	Explosion Proof, Class I, Groups B,C,D, Division 1. Mount in weather protected area.
SIGNAL OUTPUT:	Standard: 0-5 VDC (0-1 VDC field selectable on board) Optional: 4-20 mA or 0-20 mA (field selectable), 750 ohms max.
REPEATABILITY:	1% of fullscale
NOISE:	1% of fullscale
ZERO DRIFT:[1]	±1% of fullscale per 24 hours
SPAN DRIFT:[1]	±1% of fullscale per 24 hours
RESPONSE TIME: (ELECTRONIC)	Variable, 90% of fullscale in 1 sec to 10 sec, field selectable. (Application dependent)
SAMPLE CELL LENGTH:	0.04 in. (1 mm) to 10.0 in. (254 mm)
REFERENCE:	Sealed
MATERIALS IN CONTACT WITH SAMPLE:	
WINDOWS:	Sapphire, quartz, Irtran
CELLS:	Gold plated Pyrex or stainless steel
TUBING:	FEP Teflon
FITTINGS:	316 stainless steel
SAMPLE PRESSURE:	Max 10 psig (69 kPa), standard

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

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

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 815 Explosion Proof Non-Dispersive Infrared Analyzer instruction materials are available. Contact Customer Service or the local representative to order.

748175 Instruction Manual (this document)

COMPLIANCES

The Model 815 Explosion Proof Non-Dispersive Infrared Analyzer is approved by Factory Mutual for use in Class I, Groups B, C and D Division 1 hazardous locations.

FM APPROVED

PA 97-C209

NOTES

1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The Model 815 Non-Dispersive Infrared Analyzer is designed to continuously monitor the concentration of a particular infrared absorbing component of interest in a flowing gaseous mixture. Concentration is displayed as a percent of fullscale. Signal outputs of 0-5 VDC or 0-1 VDC are field selectable standard.

The Analyzer enclosure is designed to meet the requirements for Class I, Division 1, Groups B, C, and D, per the National Electrical Code (ANSI/NFPA 70), and should be mounted in a weather-protected area.

1.2 APPLICATIONS

Monitoring applications are found in the Application Data Sheet which is available from the local sales office (see page P-4).

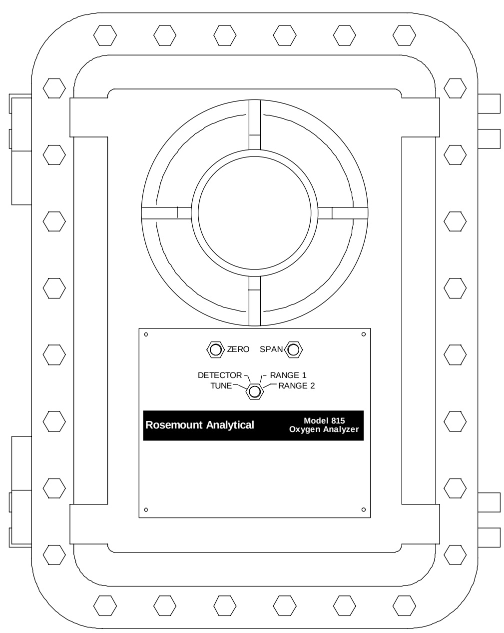


FIGURE 1-1. MODEL 815 EXPLOSION PROOF NDIR ANALYZER

Some sample streams contain various other infrared-absorbing substances, other than the component of interest. To minimize interference in such applications, the instrument may incorporate an optical filter and, if necessary, a sealed filter cell containing an appropriate gas charge, as noted in the Factory Calibration and Data Sheet located in the rear of this manual.

1.3 AVAILABLE OPTIONS

Operation of the Model 815 can be enhanced with the choice of several options, all of which can be installed in the field after the analyzer has been ordered.

SIGNAL LINEARIZER

A signal linearizer kit is available for each range. Linearizers enable the operator to convert non-linear output signals into linear output signals.

ISOLATED CURRENT OUTPUT

The current output option can be field set for either 4-20mA or 0-20mA, corresponding to 0% to 100% of fullscale. Maximum load is 750 ohms.

CASE TEMPERATURE CONTROLLER

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

AIR PURGE

The air purge kit is to be installed with user-supplied components. It is designed for use in cases where a corrosive gas is either flowing through the cell or is present in the environment. The air purge option is provided for protection of the instrument only, and is not intended as a safety feature for use in a hazardous area.

MOTOR/SOURCE ASSEMBLY PURGE

This purge is recommended in some applications to provide a CO_2 free, spectrally constant atmosphere within the Motor/Source Assembly.

SAMPLE HANDLING SYSTEM ACCESSORY

If so ordered, an associated sample-handling system may be either factory-assembled or supplied for field installation, depending on ordering instructions. Sampling systems are designed on the basis of information furnished by the customer, which includes a complete stream analysis. Refer to the Factory Calibration and Data Sheet for information on the sample handling system.

2 UNPACKING AND INSTALLATION

2.1 UNPACKING

Carefully examine the shipping carton and contents for signs of damage. Immediately notify the shipping carrier if the carton or its contents are damaged. Retain the carton and packing material until the instrument is operational

2.2 LOCATION

Locate the analyzer in a weather-protected location free from vibration. For best results mount the analyzer near the sample stream to minimize sample-transport time. Refer to Installation Drawing 652258.

If equipped with P/N 652271 air purge, refer to Section 2.9.1. The air purge is designed to provide a corrosion-free or spectrally-constant internal atmosphere, and ***is not intended to provide explosion hazard protection.***

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.

Verify that power switch settings are set for the power available at the site (115 VAC or 220 VAC).

Analyzers are shipped from the factory set for 120 VAC, 50/60 Hz operation. To convert to 220 VAC, 50/60 Hz power, position voltage select switches S1, S2 (located on Power Supply Board, Figure 2-2), and S3 (located on the optional Case Heater Temperature Control Board, Figure 2-3), to the 230 VAC position.

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

2.4 ELECTRICAL CONNECTIONS

2.4.1 LINE POWER CONNECTIONS

Refer to Figures 2-1 and 2-5, Installation Drawing 652258 and Pictorial Wiring Diagram 652559.

Route the power cable (customer supplied 3-wire, minimum 18 AWG) through the power conduit opening in the bottom of the instrument.

Connect to power terminal block TB1 as follows:

HOT/L1	=	TB1-1
NEUTRAL/L2	=	TB1-2
GROUND	=	TB1-3 or TB1-4

2.4.2 RECORDER CONNECTIONS

Refer to Figure 2-1 and 2-5, Installation Drawing 652258 and Pictorial Wiring Diagram 652559.

Route the cable (customer supplied 2-wire shielded cable) through the signal output conduit opening at the bottom of the enclosure.

Connect to recorder output/current output terminal block TB2 as follows:

(+)OUTPUT	=	TB2-1
(-) OUTPUT	=	TB2-2
SHIELD (GND)	=	TB2-3

2.5 SAMPLE CONNECTIONS

Refer to Figure 2-1 and Installation Drawing 652258. Connect sample gas tubing to the Model 815 through the 1/4-inch ferrule type compression fittings located on the bottom of the enclosure.

2.6 CALIBRATION GAS CONNECTIONS AND REQUIREMENTS

Refer to Figure 2-1 and Installation Drawing 652258.

Zero and span gases are to be connected to the same inlet fitting as the sample gas.

All applications require a zero standard gas to set the baseline point on the digital display or output signal. Refer to the Calibration and Data Sheet. Use the background gas as the zero gas. If a background gas is not specified, use dry nitrogen for the zero gas.

Span gas concentration is normally between 80% and 100% of the fullscale range the analyzer will be set on. The background gas is also indicated on the Calibration and Data Sheet. If no background gas is specified, use dry nitrogen.

2.7 SAMPLE HANDLING SYSTEM

The Model 815 does not contain any filters in the sample flow system to prevent contamination of the sample lines or cells.

The sample must be clean and kept above the dew point to minimize maintenance and to prolong the life of the components in the sample flow system. Sample Handling components and tubing must be constructed of materials compatible with the sample. Contact the local representative or the factory if an additional sample handling system is required.

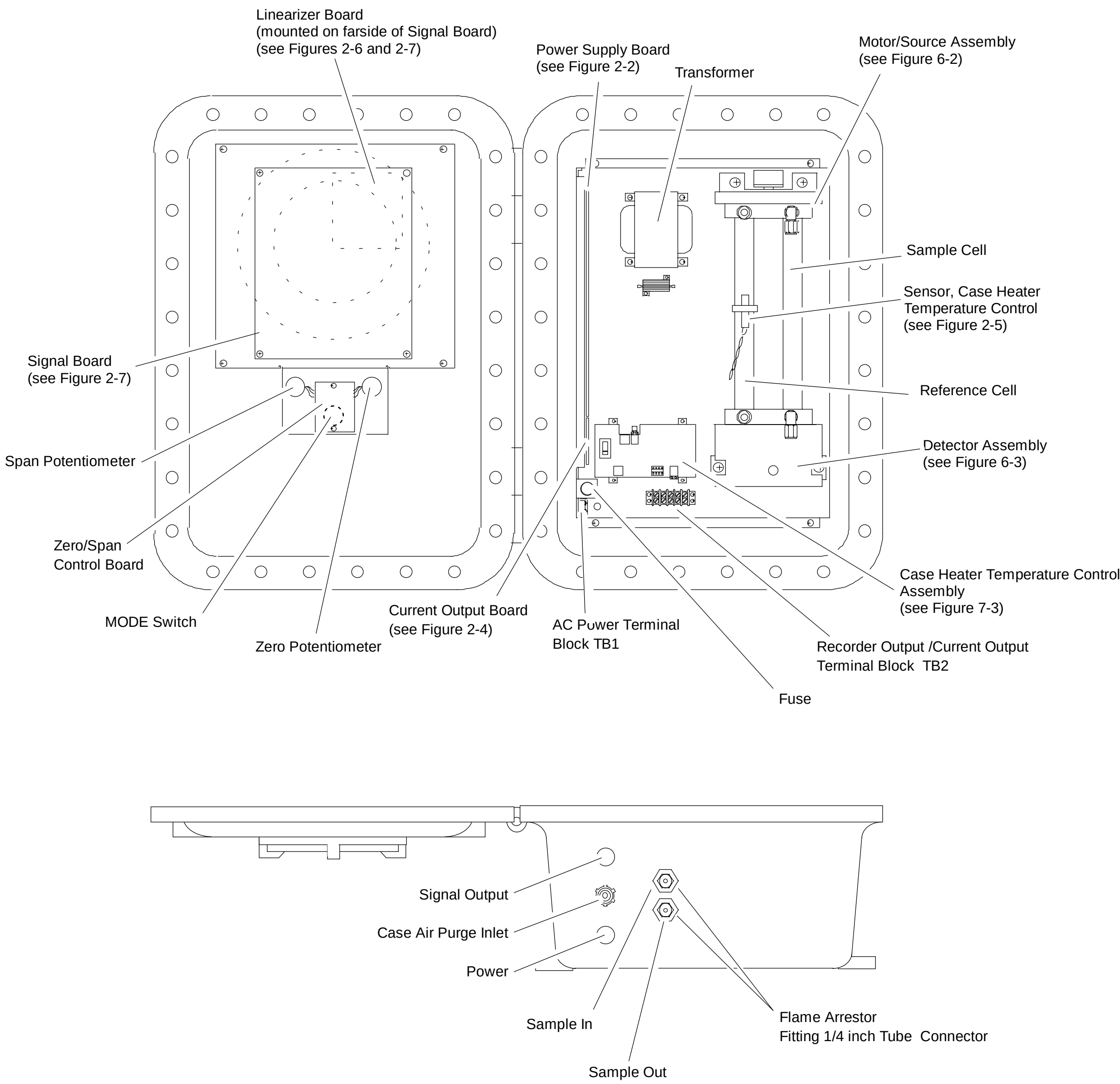


FIGURE 2-1. MODEL 815 COMPONENT LOCATIONS

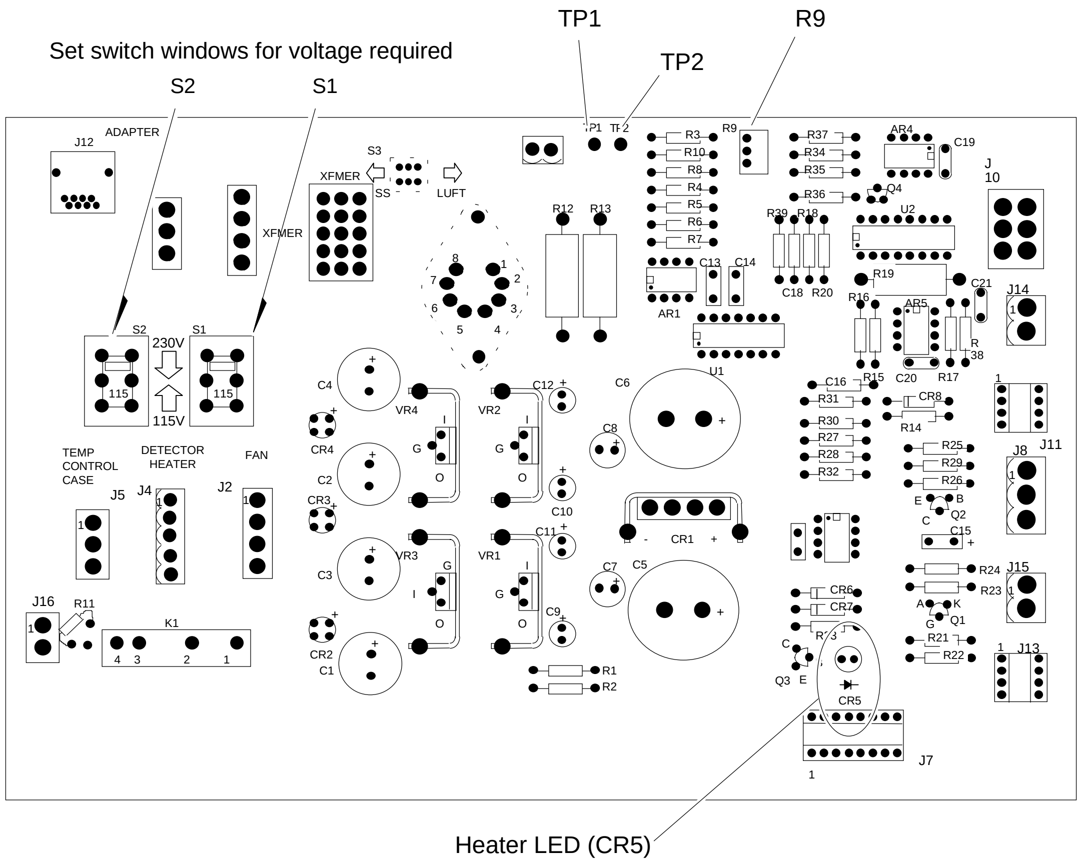
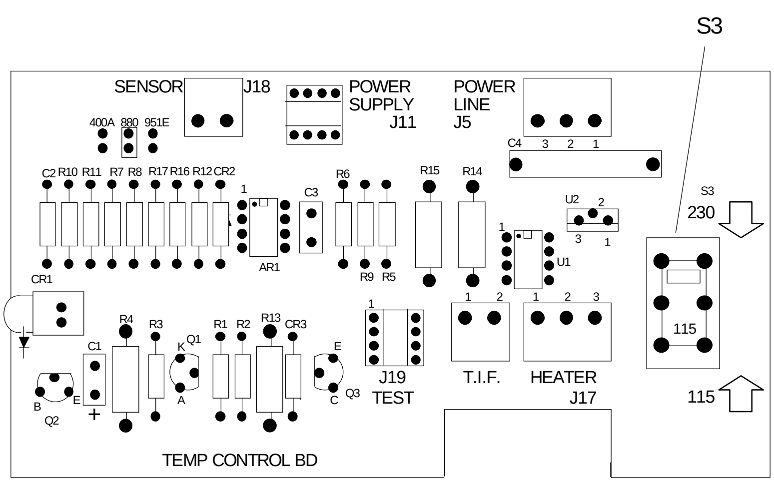


FIGURE 2-2. POWER SUPPLY BOARD



Set switch window for voltage required

FIGURE 2-3. CASE HEATER TEMPERATURE CONTROL BOARD

2.8 LEAK TEST

Any leakage must be corrected before introduction of sample and/or application of electrical power.

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 explosion-proof enclosure must be suitable for the gas.

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 this section.

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. Connect air (or other inert gas such as nitrogen) at 10 psig (69 kPa) to analyzer via a flow indicator and set flow rate to fullscale at the sample inlet (unless otherwise specified by the Calibration and Data Sheet.

2. Seal off sample outlet with a cap while air or inert gas is flowing into the sample inlet. If the flowmeter reading drops to zero, the system is leak free. If the flowmeter does not drop to zero, a leak in the system is present and must be located and sealed before operating the Model 815.

Note:

Whether or not a leak is suspected, the sample flow system should be leak checked under pressure before the analyzer is placed in operation.

3. Refer to the note below, then liberally cover the outlet plug and all gas connections with a suitable test liquid such as SNOOP (PN 837810) to detect leaks. Apply to all fittings, seals, and other possible leak sources. Bubbling or foaming indicates leakage, but the absence of bubbles does not necessarily indicate that no leaks exist.

4. If a flow is indicated, a leak is present and may be in an area that is inaccessible to SNOOP. Continue leak testing and tighten all connections until the flow rate drops to zero.

Note:

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

2.9 OPTIONS

The following options may be ordered as kits and installed in the field:

2.9.1 AIR PURGE KIT 652271

WARNING: POSSIBLE EXPLOSION HAZARD

If an air purge is used, the purge inlet fitting must be equipped with a Flame Arrestor Assembly (PN 638426) to prevent propagation of a flame or explosion from inside the enclosure to the ambient atmosphere.

All precautions relating to the installation and operation of this instrument must be strictly adhered to whether or not the air purge option is installed. **The air purge option is not intended as protection from explosion in hazardous areas.**

Purging of the enclosure of the explosion-proof Model 815 may be recommended in some applications to provide a corrosion free internal atmosphere. If the instrument is to be equipped with an optional Air Purge Kit, refer to instruction sheet (748184) supplied in kit for installation. This kit is designed to provide a corrosion free or spectrally-constant internal atmosphere, and ***is not intended to provide explosion hazard protection.***

2.9.2 CURRENT OUTPUT KIT 652269

Refer to Figures 2-1, 2-2, 2-4, 2-5, Pictorial Wiring Diagram 652259 and installation Drawing 652258.

INSTALLATION

1. Mount the Current Output Board to the chassis next to the Power Supply Board using the spacer and hex nut supplied in the kit.
2. Connect the two-wire cable supplied in kit (PN 749068) as follows:

Wire	From	To
Blue	Current Output Board TB1-1 (-)	Recorder Output/Current Output Terminal Block TB2-5 (Current Output -)
Orange	Current Output Board TB1-2 (+)	Recorder Output/Current Output Terminal Block TB2-4 (Current Output +)

3. Connect the eight conductor flat cable supplied in kit (PN 652257) from Current Output Board J2 to Power Supply Board J9.

4. Refer to Section 3.6 for 4-20mA or 0-20mA adjustment procedure.

2.9.3 CASE HEATER TEMPERATURE CONTROL KIT 652270

Refer to Figures 2-1, 2-2, 2-3, 2-5, 7-3 and Pictorial Wiring Diagram 652259.

INSTALLATION

1. Mount the Temperature Control Assembly to the chassis with the 4 screws supplied in the kit.
2. Attach the sensor (at T.I.F. 2-position terminal block) to the reference cell with a tie wrap as shown in Figure 2-1.
3. Connect the 3-conductor cable supplied in kit (PN 622903) from Temperature Control Board J5 to Power Supply Board J5.
4. Connect the 8-conductor flat cable supplied in kit (PN 901768) from Temperature Control Board J11 to Power Supply Board J11.

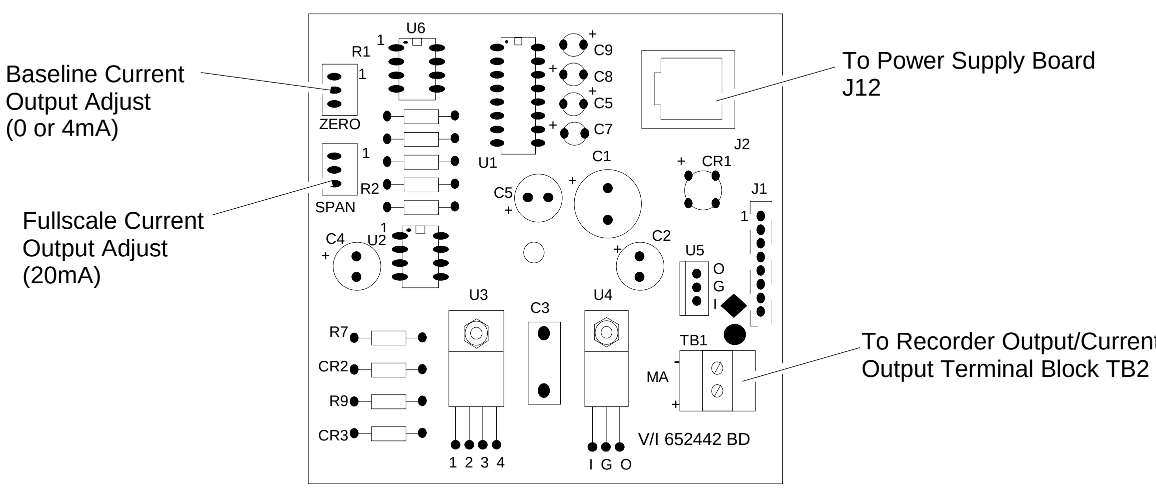


FIGURE 2-4. CURRENT OUTPUT BOARD

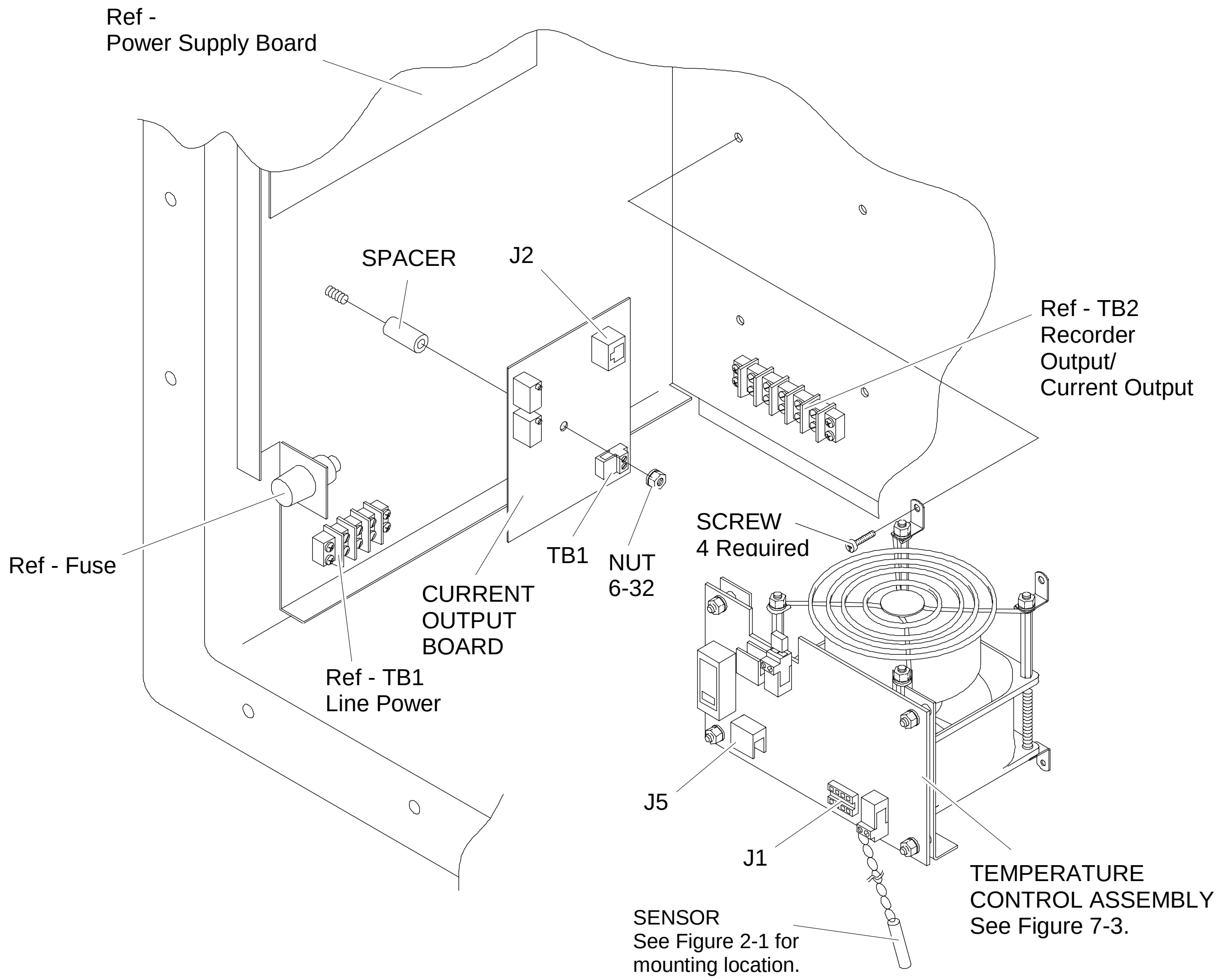


FIGURE 2-5. INSTALLATION OF CURRENT OUTPUT AND TEMPERATURE CONTROL OPTIONS

2.9.4 LINEARIZER KIT 652268

Refer to Figures 2-1, 2-6, 2-7 and Pictorial Wiring Diagram 656659

INSTALLATION

1. Mount the Linearizer Board to the Signal Board by inserting the 6-pin header on the wiring side of the Linearizer Board into the 6-position single-in-line socket on the Signal board. The through hole on the Linearizer Board (next to R19) should be in-line with the swaged threaded spacer on the Signal Board.
2. Secure the Linearizer Board to the Signal Board with the screw, lock washer and flat washer supplied in the kit.

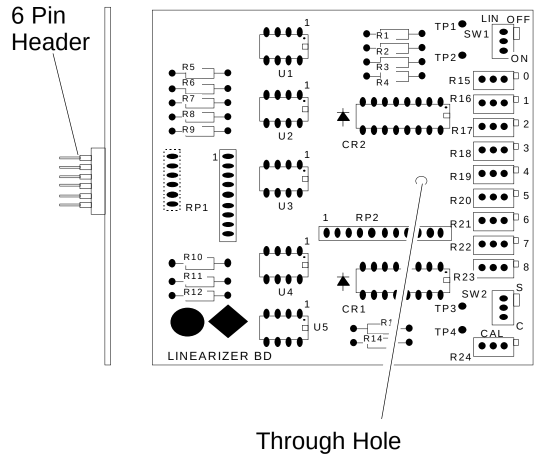


FIGURE 2-6. LINEARIZER BOARD

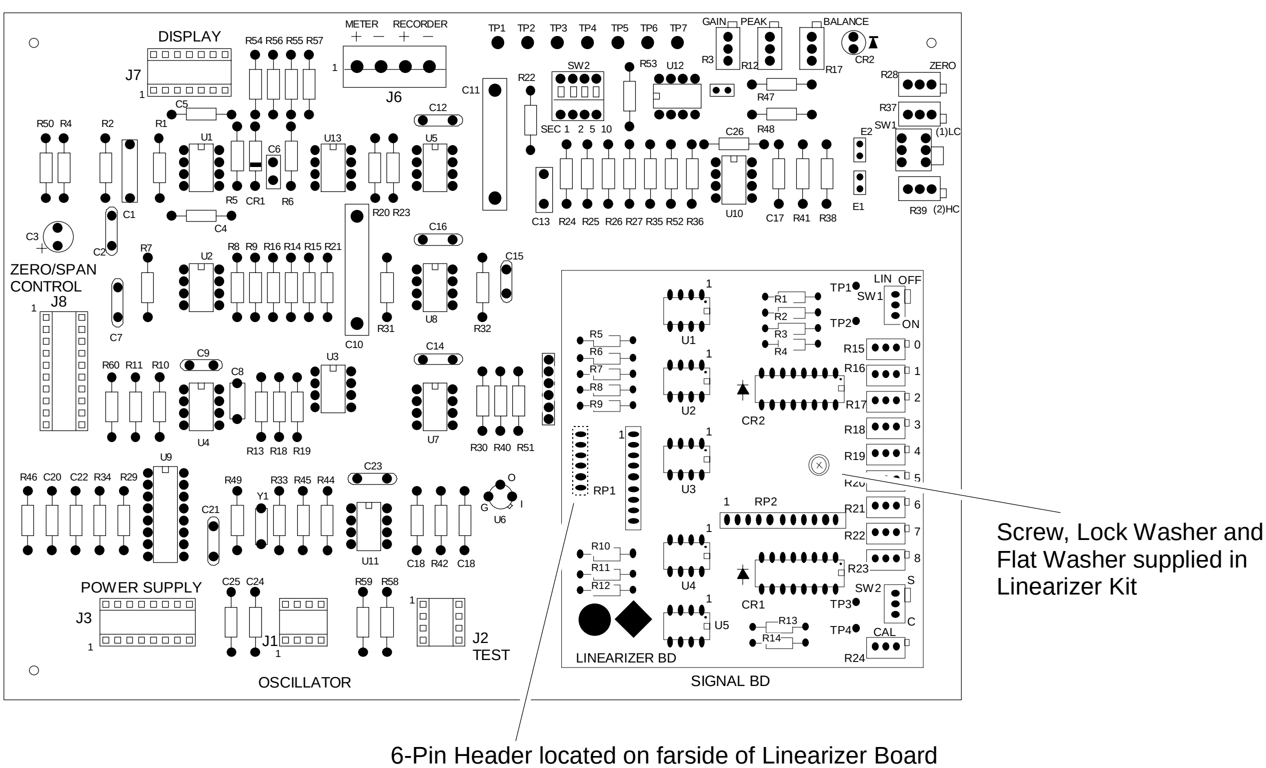


FIGURE 2-7. SIGNAL BOARD WITH LINEARIZER BOARD INSTALLED

2.9.5 MOTOR/SOURCE ASSEMBLY PURGE KIT 655094

WARNING: POSSIBLE EXPLOSION HAZARD

If a motor/source purge is used, the purge inlet fitting must be equipped with a Flame Arrestor Assembly (PN 638426) to prevent propagation of a flame or explosion from inside the enclosure to the ambient atmosphere.

All precautions relating to the installation and operation of this instrument must be strictly adhered to whether or not the air purge option is installed. The air purge option is not intended as protection from explosion in hazardous areas.

Purging of the Model 815 motor/source assembly may be installed or recommended in some applications to provide CO_2 free, spectrally-constant atmosphere. Refer to instruction sheet (748256) supplied in kit. This kit ***is not intended to provide explosion hazard protection.***

INSTALLATION

Refer to instruction sheet (748256) supplied in kit

3 INITIAL STARTUP AND CALIBRATION

Prior to shipment, the Model 815 was subjected to extensive factory performance testing, during which all necessary optical and electrical adjustments were made.

Normally, the analyzer requires only a verification of zero and span settings (refer to Section 3.3) before being put into operation. If operation is unsatisfactory, refer to Section 5, Troubleshooting. If the problem is not corrected, contact the nearest field service facility (see Field Service and Repair Facilities in rear of this manual).

The following instructions are recommended for initial start-up, and subsequent standardization of the analyzer.

WARNING: POSSIBLE EXPLOSION HAZARD

If explosive gas samples are introduced into the analyzer, it is recommended that sample containment system fittings and components be thoroughly leak tested prior to initial application of electrical power, routinely on a periodic basis thereafter, and after any maintenance which entails breaking the integrity of the sample containment system. Leakage of flammable samples could result in an explosion. Refer to leak test procedure, Section 2.8.

3.1 LEAK TEST

Per Section 2.8, perform the Leak Test.

3.2 POWER VERIFICATION

1. Verify power select switches S1, S2 (on Power Supply Board) and S3 (on Temperature Control Board)are set for available power (115 VAC/220 VAC). Refer to Section 2.3.
2. Verify electrical connections are correct. Refer to Section 2.
3. Apply power. Verify that heater LED (CR5 on the Power Supply Board) is ON. Refer to Figure 2-2 and Drawing 624073.

3.3 OPERATING CONTROLS AND INDICATORS

External controls (located on the analyzer door) are described in the following section. Refer to Figure 3-1.

3.3.1 DIGITAL DISPLAY

3 1/2 digit LCD displays sample data or oscillator tuning check, depending on position of the 4-position MODE switch (see Section 3.3.2).

During linearization, a calibration curve is used to convert display readings into concentration values. (Alternatively, linear readout of concentration values for a given operating range is obtainable through use of an optional signal output linearizer board.)

3.3.2 MODE SWITCH

A 4-position rotary switch for selection of the following:

TUNE - Test position used periodically to verify and adjust proper oscillator tuning. In TUNE mode, digital display should indicate the previously determined “Normal Tuning Value.” If not, adjust the OSC TUNE (refer to Section 5.4 Oscillator Tune Adjustment).

DETECTOR - To adjust preamp gain (see Section 5.5 Preamp Gain Adjustment).

RANGE 1 - *Low concentration range.* Percent of fullscale of the lower concentration range is displayed on the digital display and a proportional signal is output at Recorder Output/Current Output Terminal Block TB2.

RANGE 2 - *High concentration range.* Percent of fullscale of the lower concentration range is displayed on the digital display and a proportional signal is output at Recorder Output/Current Output Terminal Block TB2.

3.3.3 ZERO ADJUSTMENT

To adjust zero point on digital display or signal output.

3.3.4 SPAN ADJUSTMENT

To adjust calibration span point on display or signal output.

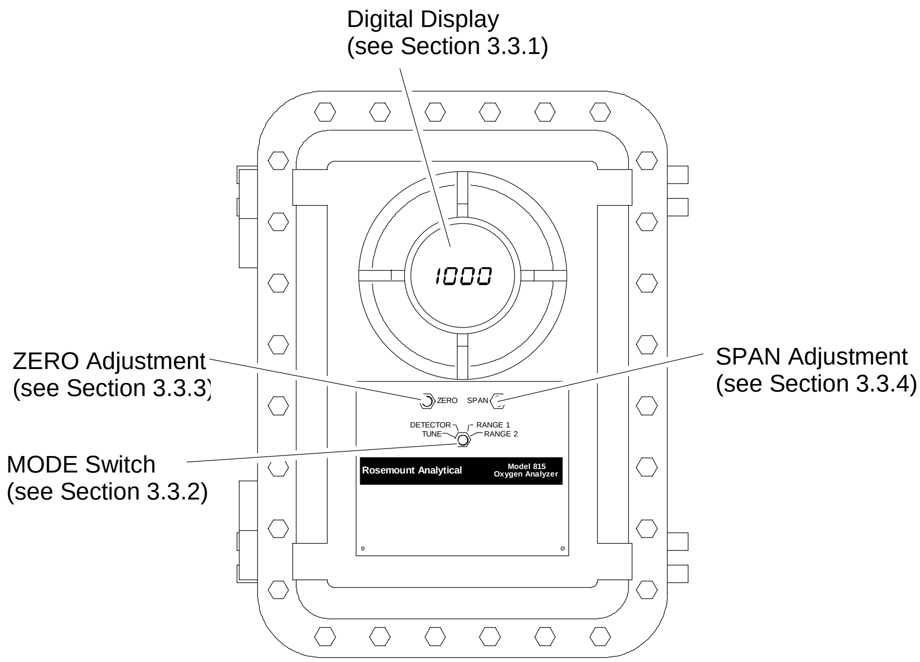


FIGURE 3-1. MODEL 815 OPERATING CONTROLS AND INDICATORS

3.4 CALIBRATION

CAUTION: HIGH PRESSURE GAS CYLINDERS

This analyzer requires periodic calibration with known zero and standard gases. Refer to General Precautions for Handling and Storing High Pressure Cylinders, in the rear of this manual.

Note:

Refer to the Factory Calibration and Data Sheet at the end of this manual for specifications of the calibration gases and procedures.

Note:

Component electronic offsets will shift slightly as the interior temperature of the instrument changes. For this reason, it is recommended that immediately prior to adjustment of the electronics, the instrument be allowed to run with the enclosure door securely closed for at least two hours (or long enough for the instrument to reach its regulated operating temperature).

Clean, dry nitrogen is recommended for use as the zero gas, unless otherwise specified on the data sheet. Span gas is typically 80-100% of the fullscale concentration of the range being used. Background composition of the span gas is typically as similar to the composition of the sample being monitored as practical.

3.4.1 CALIBRATION PROCEDURE

Refer to Figures 2-1 and 3-1.

1. Connect zero or span gases to the sample ***inlet*** connection port on the bottom of the enclosure.
2. Set the calibration gas flow rate to the same flow rate as the sample being analyzed, typically 1-2 SCFH (500-1000 /min.), and at the same pressure as the sample gas. Note that the analyzer is not flow rate dependent; however, calibration and sampling conditions should always be as similar as possible.
3. Monitor the signal at the recorder output or the analyzer digital display.
4. Introduce zero gas through the sample inlet, and set the ZERO adjustment for a reading of zero output.
5. Set the MODE switch to RANGE 2 (high range). Introduce a span gas of 80-100% fullscale. Set the SPAN adjustment for the corresponding voltage.

   For example, if fullscale is 10% and the span gas is 8.5%, adjust the span screw for 85% of fullscale, if linearizer is installed. If linearizer is not used, refer to the Calibration and Data Sheet.
6. Set the MODE switch to RANGE 1 (Low Range), introduce a low range span gas, and check the output for the correct value. If the lower range span gas value agrees with the calculated value, the analyzer has been calibrated correctly.

If the output value does not agree, verify the concentration of the span gas.

3.4.2 LINEARIZER BOARD CALIBRATION

Linearizers ordered with the instrument are calibrated at the factory for the particular operating range specified by the order and should need no further adjustment.

To verify proper operation, connect different concentrations of span gas to the sample inlet and record the output signal or digital display (on analyzer door) reading. Plot these values versus concentration (typical curve shown in Figure 3-4). If the curve is linear, the linearizer for that range is properly calibrated.

If the calibration curve is not linear, perform one of the following calibration procedures.

The first method requires use of a DVM; the second uses recorder output.

3.4.3 CALIBRATION CURVE CONSTRUCTION

A typical calibration curve showing the relationship between the non-linearized and linearized output is shown in Figure 3-4. The curve is a plot of signal output versus concentration. Examples of curves normalized for concentration and for recorder output are shown in Figure 3-4.

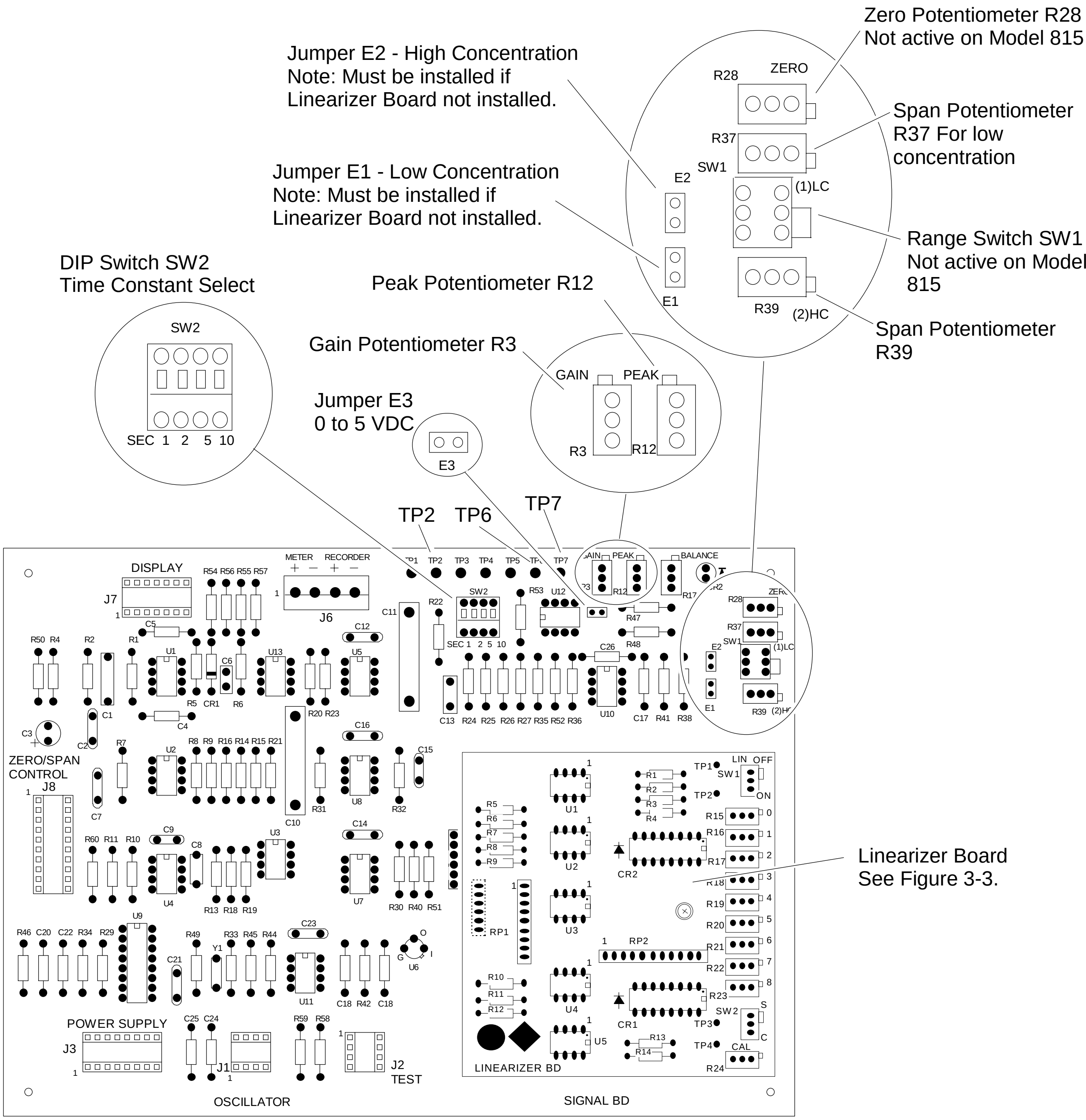


FIGURE 3-2. SIGNAL BOARD COMPONENT LOCATIONS

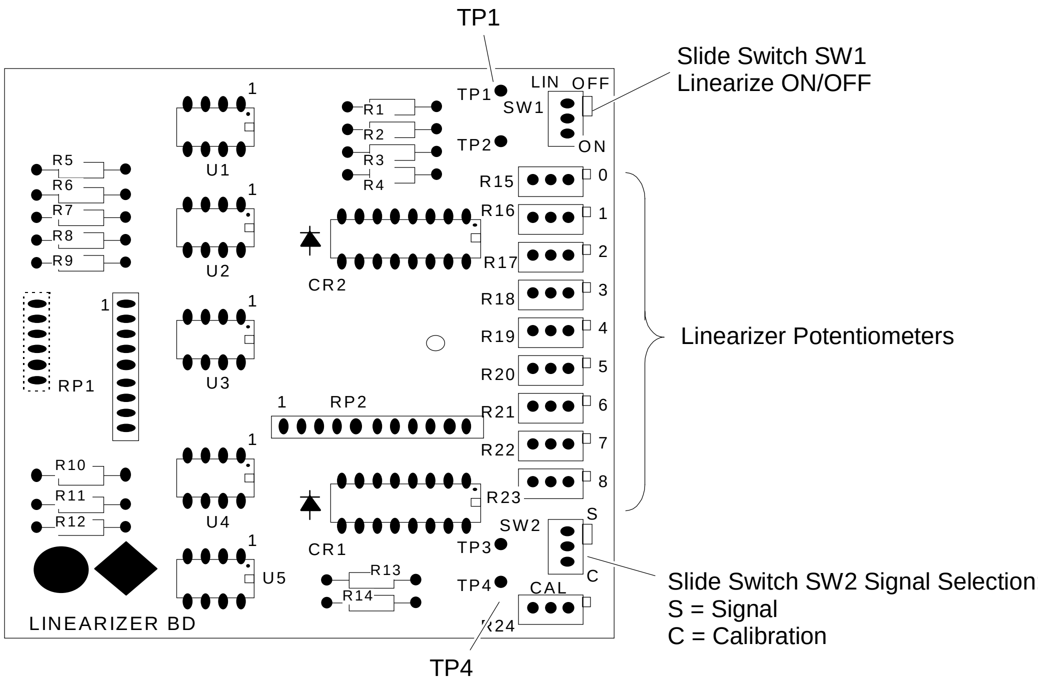


FIGURE 3-3. LINEARIZER BOARD ADJUSTMENTS

To construct a new calibration curve, use the following procedure:

1. Determine the fullscale range to be calibrated. On the Linearizer Board (Figure 3-3) set SW1 to OFF.
2. Obtain calibration gases (or use a dilution system) of concentrations from 0-100% fullscale in 10% increments.
3. Introduce the zero gas and note the recorder output voltage (or digital display reading).
4. Repeat step 3 using the other calibration gases.
5. Normalize the readings, so that 100% fullscale is 1 and 0% is 0. Plot the concentration versus linearizer output on a graph similar to Figure 3-4.
6. Draw a straight line from the 0% data point to the 100% point. This will be the linear output after the linearizer is properly adjusted.
7. Segment the line into eight equal points for an 8-point linearization. Draw the vertical lines from each of the data points to the straight line. From where the vertical lines intersect the straight line, draw horizontal line to the right axis. The value on the right axis will be the value to which each data point will be adjusted.
8. Enter the values in Table 3-2, using Table 3-1 as a guide. These values will be used to perform Section 3.5.3 Linearization Procedure.
9. The linearizer can now be adjusted using potentiometers R15 through R23 on the Linearizer Board (Figure 3-3).

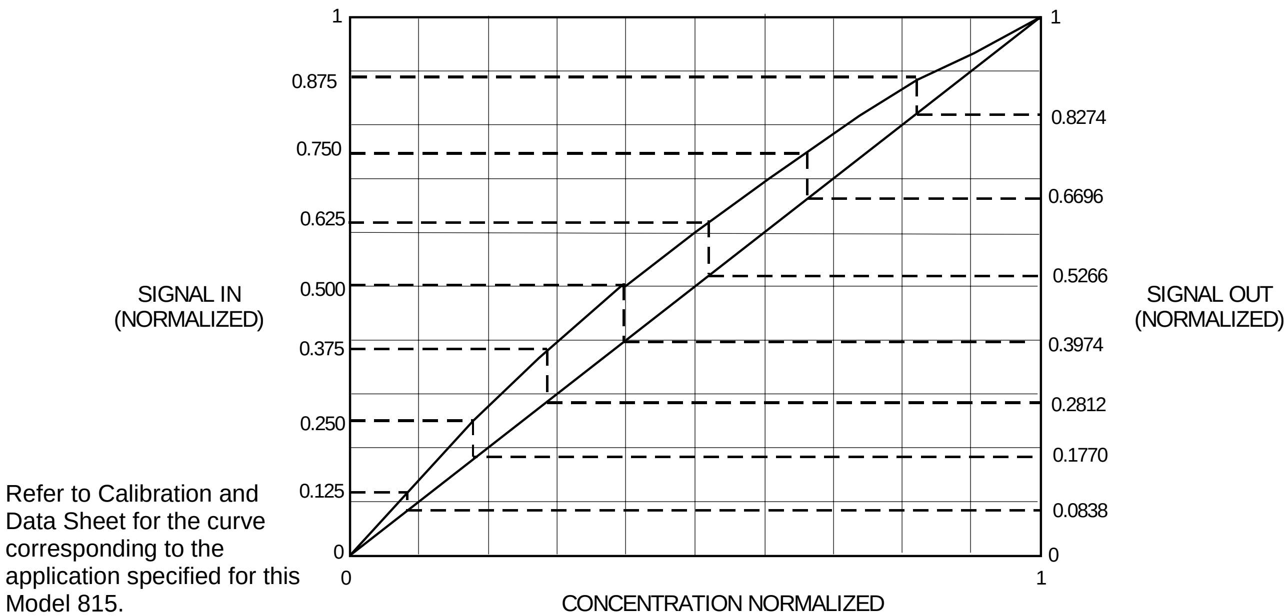


FIGURE 3-4. TYPICAL LINEARIZATION CURVE

3.5 LINEARIZATION PROCEDURE

WARNING: EXPLOSION HAZARD

Do not operate the Model 815 Explosion-Proof Analyzer without lens cover and door in place with all bolts secured, unless location has been determined to be non-hazardous.

1. Locate analyzer in a non-hazardous area before opening the enclosure door.
2. Allow the analyzer to warm-up for a minimum of two hours prior to calibration.
3. Remove the bolts fastening the enclosure door to access the Linearizer Board which is mounted to the Signal Board inside the enclosure door (see Figure 2-1).
4. On the Linearizer Board (Figure 3-3):
    a. Set SW2 to C (Calibration)
    b. Connect a DVM to TP4
    c. Set SW1 to ON
    d. Connect another DVM to TP1

5. Adjust R16 through R23 full counterclockwise.
6. Refer to Table 3-2 or the Calibration and Data Sheet and make the following adjustments: (Note: Adjusting R24 simulates an input signal to the Linearizer Board. R15 through R23 are adjusted to bring the output signal at the level onto the linear curve.)
   a. Adjust R24 so TP4 reads 0 volts.
   b. Adjust R15 so TP1 reads 0 volts.
   c. Adjust R24 so TP4 reads 0.625 volts.
   d. Adjust R16 so TP1 reads 0.419 volts (or the value indicated in the Calibration and Data Sheet or Table 3-2).
   e. Adjust R24 so TP4 reads 1.25 volts.
   f. Adjust R17 so TP1 reads 0.885 volts (or the value indicated in the Calibration and Data Sheet or Table 3-2).
   g. Continue with the remaining potentiometers (R18 through R23), adjusting R24 to each value in column 3 of Table 3-2, and then adjusting R18 through R23 to each value in column 5.
7. Set SW2 to S (Signal).
8. The Linearizer Board is now calibrated.

TEST METER READING INPUT VOLTAGE TO LINEARIZER AT TP4 **Reading to be obtained by setting SW2 to C (CAL) and adjusting potentiometers R15 through R23 on Linearizer Board**			LINEARIZED OUTPUT **Reading at TP1 obtained with the specified linearizer potentiometer**		
% FULLSCALE	NORMALIZED VALUE/GRAPH	VOLTAGE AT TP4	POTENTIOMETER	NORMALIZED VALUE/GRAPH	VOLTAGE AT TP1
0.0	0.000	0.000	R15	0.000	0.000
12.5	0.125	0.625	R16	0.084	0.419
25.0	0.250	1.250	R17	0.177	0.885
37.5	0.375	1.875	R18	0.281	1.405
50.0	0.500	2.500	R19	0.397	1.987
62.5	0.625	3.125	R20	0.527	2.633
75.0	0.750	3.750	R21	0.670	3.348
87.5	0.875	4.375	R22	0.827	4.137
100.0	1.000	5.000	R23	1.000	5.000

TABLE 3-1. TYPICAL LINEARIZATION CALIBRATION VALUES

TEST METER READING INPUT VOLTAGE TO LINEARIZER AT TP4 **Reading to be obtained by setting SW2 to C (CAL) and adjusting potentiometers R15 through R23 on Linearizer Board**			LINEARIZED OUTPUT **Reading at TP1 obtained with the specified linearizer potentiometer**		
% FULLSCALE	NORMALIZED VALUE/GRAPH	VOLTAGE AT TP4	POTENTIOMETER	NORMALIZED VALUE/GRAPH	VOLTAGE AT TP1
			R15		
			R16		
			R17		
			R18		
			R19		
			R20		
			R21		
			R22		
			R23		

TABLE 3-2. LINEARIZATION CALIBRATION VALUES

3.6 CURRENT OUTPUT

The current output board can be adjusted for 4-20mA or 0-20mA.

Refer to Figure 3-5. Adjust potentiometer R1 for the baseline output current (0 or 4mA), and R2 for the fullscale output (20mA).

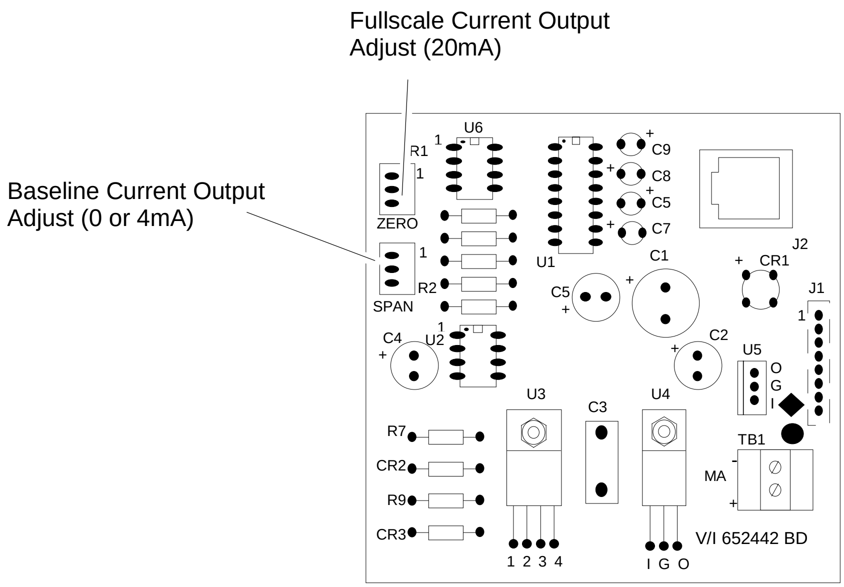


FIGURE 3-5. CURRENT OUTPUT BOARD

NOTES

4 ROUTINE OPERATION AND THEORY

4.1 ROUTINE OPERATION

As a check of instrument performance, a log book should be kept with the analyzer for recording notes on operation, calibration, performance and maintenance.

4.2 RECOMMENDED CALIBRATION FREQUENCY

The calibration interval should be determined by the user based on the accuracy required. Initially, the instrument should be calibrated every 24 hours until experience indicates that some other interval is more appropriate.

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

4.3 SHUTDOWN

Instrument power is normally left on at all times except during a prolonged shutdown or maintenance.

1. To shutdown the instrument:
2. Disconnect electrical power.
3. If hazardous samples have been flowing through the analyzer, adequate venting of the gases and adequate ventilation must be provided for before disconnecting sample lines from the analyzer.
4. Inspect the sample lines and “wetted” parts of the analyzer, clean if necessary.
5. Flush sample lines and analyzer cell with dry nitrogen or dry air, verify that they are dry.
6. Plug sample lines.

Following prolonged shutdown, repeat Section 2.8 Leak Test, Section 3.1 Initial Startup and Calibration to restore analyzer to service.

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. The two equal beams are then directed through two parallel optical cell, a flow-through sample cell and a sealed reference cell.

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 continuously monitors the infrared energy passing through the sample and reference cells. During the portion of the chopping cycle when the chopper is not blocking the sample and reference beams, the diaphragm distends away from the metal button, thus decreasing detector capacitance. This capacitance is directly proportional to the difference between the reference and sample cells signals, and is used to modulate the amplitude of a radio frequency voltage, which is demodulated into a resulting DC voltage signal. The output signal is proportional to the component concentration; it is amplified and sent to the digital display and to the recorder connections.

The analyzer can incorporate cells of short or long optical path lengths, depending on the particular component of interest and its concentration range. If cell length is 4 to 32mm, the pair of sample and reference cells consists of a single stainless steel cell block with two parallel holes bored through (see Figure 7.2). If cell length is over 32mm, sample and reference cells are separate cylindrical Pyrex tubes, with gold plated inner diameter (see Figure 7.1).

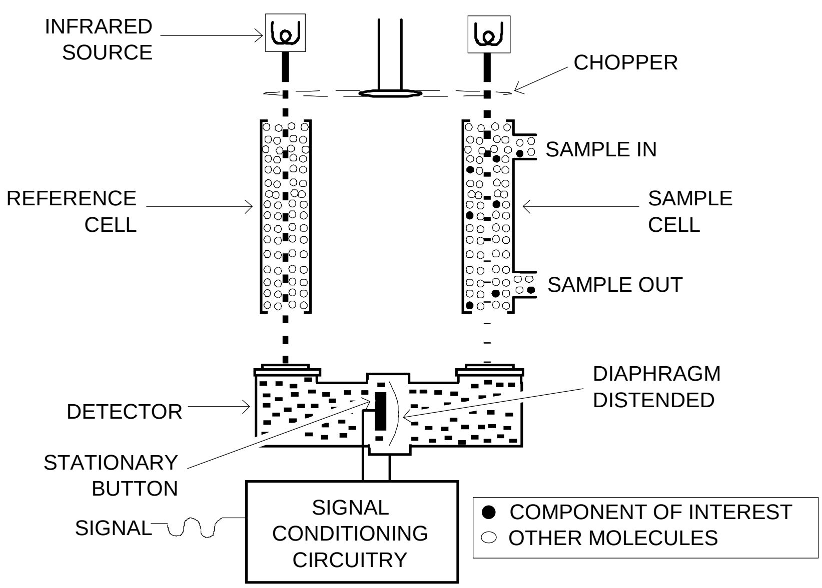


FIGURE 4-1. NDIR DETECTION SYSTEM

4.5 ELECTRONIC CIRCUITRY

The block diagram in Figure 4-2 traces the signal through the electronic circuitry and depicts the various waveforms involved.

4.5.1 OSCILLATOR CIRCUIT BOARD (SCHEMATIC 623995) AND ASSOCIATED ELEMENTS OF AMPLITUDE MODULATION CIRCUIT

A 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. Considered electronically, the detector is a two-plate variable capacitor. The tuned tank circuit is coupled inductively, through one winding of inductance in L1, to the oscillator. Amplitude of the 10 MHz carrier thus varies with the 5 Hz modulation signal, which corresponds to the capacitance change of the detector. See Section 4.3 Detection System Theory.

4.5.2 FUNCTIONING OF MODULATION SYSTEM IN TUNE MODE

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:

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 5-1B.

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 Tuning, above. See Resonance Curve Number 2, Figure 5-1B. This curve has the same shape as that obtained in Tuning, but is displaced to the right.

4.5.3 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 5-1B.

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 5-1B. 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 75% to 80% 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.

4.5.4 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.

4.5.5 SIGNAL BOARD (SCHEMATIC 652431)

The 5 Hz sinewave 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 to a time constant network and then to inverting buffer amplifier U8 with zero control R28.

The signal goes to either range amplifier high concentration SW2, U10A and R39 or range amplifier low concentration SW2, U10A and R37. For the low concentration range, the gain of U10A is adjustable with R37.

The recorder/digital display output consists of a non-inverting buffer amplifier U12A/B. The signal board is designed to accept two operational linearizer boards. J4 is the connector for the linearizer range low concentration and J5 is the connector for the linearizer range high concentration. If a linearizer board is installed, the appropriate jumper (E1 for low concentration, E2 for high concentration) must be removed.

4.5.6 POWER SUPPLY BOARD (SCHEMATIC 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 and proportional temperature controller circuit.

4.5.7 CASE HEATER TEMPERATURE CONTROL BOARD (SCHEMATIC 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 0°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.

4.5.8 CURRENT OUTPUT BOARD (SCHEMATIC 652439)

The Current Output Board converts the standard DC voltage output to 0-20mA or 4-20mA for use with external recorders or data gathering systems.

The output voltage signal is connected to J2-6 and is converted to a current signal using rectified 24 VDC input power from pins 1 and 2. The isolated current signal is output at pins 8 (+) and 7 (-) of J1 and also on connections 2 (+) and 1 (-) of terminal block TB1.

4.5.9 LINEARIZER BOARD (SCHEMATIC 624674)

The Linearizer Board converts a non-linear

signal input into a linearized signal which is output to the display or recorder. Switch SW2 selects the input for the buffer amplifier AR5B. In calibration mode (SW2 on C), the input signal can be simulated with R24.

A linear or non-linear output may be selected by switching SW1 ON (linear) or OFF (non-linear).

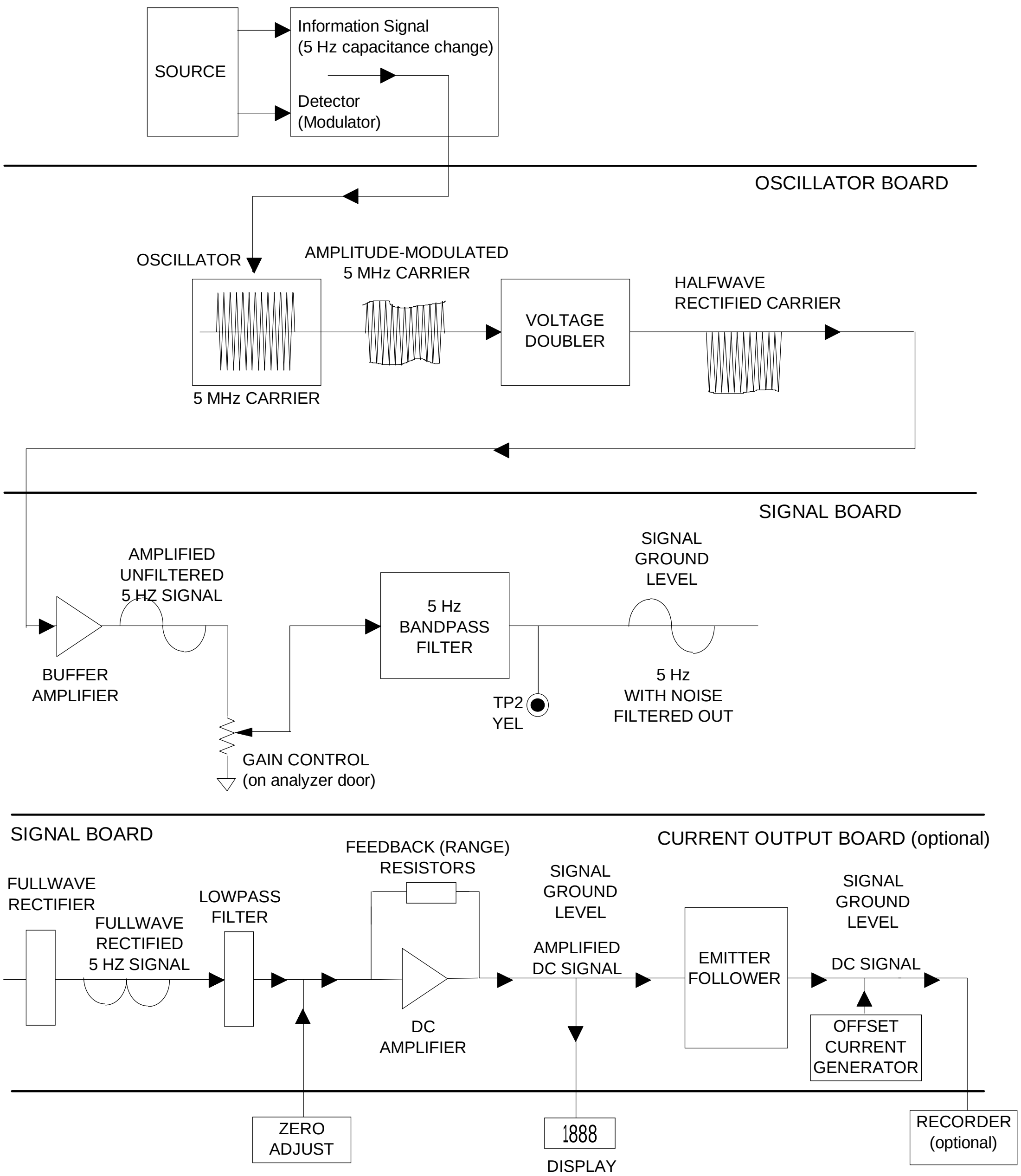


FIGURE 4-2. FUNCTIONAL BLOCK DIAGRAM

5 TROUBLESHOOTING

WARNING: POSSIBLE EXPLOSION HAZARD

If explosive gas samples are introduced into the analyzer, it is recommended that sample containment system fittings and components be thoroughly leak checked prior to initial application of electrical power, routinely on a periodic basis thereafter, and after any maintenance which entails breaking the integrity of the sample containment system. Leakage of flammable samples could result in an explosion. Refer to leak check procedure, Section 2.8.

WARNING: ELECTRICAL SHOCK HAZARD

Troubleshooting in the field requires access to live parts which can cause death or serious injury. Refer servicing to qualified personnel.

A logical isolation procedure should be followed in troubleshooting the Model 815 NDIR Analyzer. Refer to the appropriate illustrations, parts lists and schematic diagrams in this manual to isolate the problem to the sample flow system (tubing, connections, cell assembly), the optical bench electronics (detector, source, oscillator circuit) or the supporting electronics (power supply, Signal Board, electrical connections).

Troubleshooting is normally limited to cleaning of the optical cell assembly, adjusting electronics, checking connections or problem isolation at the assembly or circuit board level. Troubleshooting to the circuit board component level in the field is not covered in this manual.

Contact the local service facility (see Field Service and Repair Facilities in rear of manual) if troubleshooting assistance is required.

5.1 SYMPTOM CHART

Some common symptoms, probable causes and the recommended corrective action are shown in Table 5-1.

5.2 TEST EQUIPMENT

Standard test equipment can be used for the routine adjustments that are made in the field. Standard test equipment should include a digital voltmeter, an insulated potentiometer adjustment tool, and a suitable leak test liquid, such as SNOOP (PN 837810).

5.3 VOLTAGE CHECKS

Refer to Section 3 and verify that voltages are correct. If a voltage other than that indicated is obtained, use a logical isolation technique to isolate the defective circuit.

5.4 OSCILLATOR TUNE ADJUSTMENT

This procedure should not be performed on a routine basis.

1. Connect a DVM between TP6 and TP7 (ground) on the Signal Board (Figure 3-2).
2. Refer to Figure 6-1. Adjust coil knob (Oscillator Tune, located on top of detector housing) fully counterclockwise.
3. Adjust the Oscillator Tune knob clockwise, increasing the inductance and decreasing the resonant frequency, until a maximum value is obtained. Note, at this setting, tank-circuit resonant frequency is the same as oscillator frequency, nominal 10 MHz. See Resonance Curve Number 1, Figure 5-1B.
4. Adjust the Oscillator Tune knob counterclockwise (de-tune the circuit) until the unit reads between 75% and 80% of the maximum value. See Resonance Curve Number 2, Figure 5-1B. This curve has the same shape as Curve Number 1, but is displaced to the right.

5.5 PREAMP GAIN

Note:

The preamp gain adjustment and source balance shutter adjustment (Section 5.6) are interactive. After adjusting one, the other should be re-checked before proceeding.

The preamp gain potentiometer, R3 on the Signal Board, is used to set the fullscale detector output signal at TP2 (on the Signal Board) to a maximum of 7.5 volts.

Refer to Figures 3-1 and 3-2.

1. Connect a DVM between TP2 and TP7 (ground) on the Signal Board.
2. Set the MODE switch to DETECTOR.

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
NON-LINEAR OUTPUT WHEN LINEARIZER BOARD IS IN	Linearizer board need adjustment Linearizer switch SW1 is OFF	Refer to Section 3.5 Turn SW1 to ON position
UNABLE TO PROPERLY SPAN ANALYZER	Incorrect span gas Preamplifier gain needs adjustment Source current needs adjustment	Check composition and concentration Refer to Section 5.5 Refer To Section 5.8
UNSTABLE, NOISY SIGNAL	Oscillator tune	Refer to Section 5.4 Defective electronics
LOW SENSITIVE. LOW SOURCE CURRENT	Sources need changing. Resistance of both sources should be 24 ohms ±3 ohms	Check source resistances and replace if needed. Refer to Section 6.3
DRIFTING BASE LINE OR LOW SENSITIVITY	Leaks in sample flow system Purge and reseal reference cell Defective source Dirty sample cell walls and/or windows	Refer to Section 2.8 Refer to Section 6.2 Refer to Section 6.3 Clean cell. Refer to Section 6.1
SIGNAL DRIFTING. CYCLIC	Check detector heater Check process stream for cyclic change in sample conditions	Replace detector heater temperature control N/A
REGULAR DECREASING OF SENSITIVITY OVER TIME PERIOD REQUIRING CONSTANT INCREASE IN GAIN TO SET SPAN POINT	Dirty sample cell, if accompanied by change in ZERO control setting	Cell walls and windows. Refer to Section 6.1
NO RESPONSE. APPEARS DEAD	No power	Check fuse, power at source and cable connections

TABLE 5-1. TROUBLESHOOTING CHART

3. Flow span calibration gas through the sample cell at the same flow rate as the sample gas.
4. If the calibration sample is not equal to fullscale, determine the percent fullscale of the calibration sample from the Calibration and Data Sheet.
5. Multiply this value by 7.5 and record the resultant value for use in Step 6.

Example: If the span sample used is 67% of fullscale: 0.67 x 7.5 = 5 volts.

Note:

To prevent amplifier saturation, this value must never be higher than 7.5 volts fullscale.

6. Adjust preamp gain R3 until the value obtained in Step 5 is displayed on the DVM or analyzer digital display.

5.5.1 PEAK ADJUSTMENT

1. Adjust Preamp Gain per Section 5.5.
2. Connect DVM to TP2 and TP7 on the Signal Board (Figure 3-2).
3. Adjust the peak potentiometer (R12) for maximum reading.

5.6 SOURCE BALANCE SHUTTER ADJUSTMENT

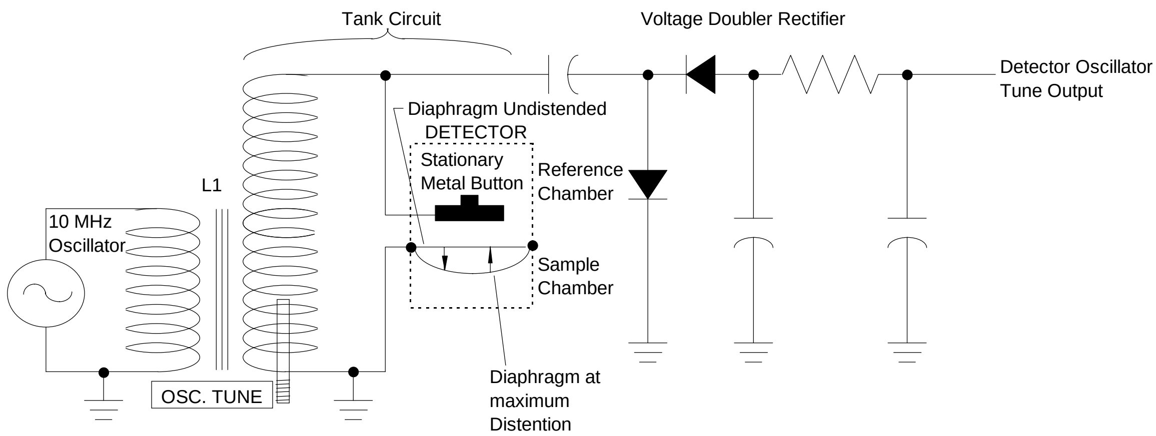
Note:

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, source replacement).

Refer to Figures 3-1, 3-2, and 6-2.

1. Set the MODE switch to DETECTOR, note value of digital display, or connect a DVM between TP2 and TP7 on the Signal Board.
2. Introduce zero gas into the sample inlet.
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.
4. Using a screwdriver, rotate the shutter adjust screw until a reading as close to zero as possible on the DVM is obtained. A typical reading is 0-.5 VDC.
5. Add 0.5 VDC to the minimum value from step 4. Rotate the shutter adjust screw clockwise (viewed from the screw head) until the display reads this value. (If this value exceeds 1.2 volts, a source alignment must performed. Section 5.7).
6. Re-tighten the threaded hex standoff. Verify that the voltage at the test point does not change.

A. Functional Diagram - Circuitry in Tune Mode



B. Tank Circuit Resonance Curves

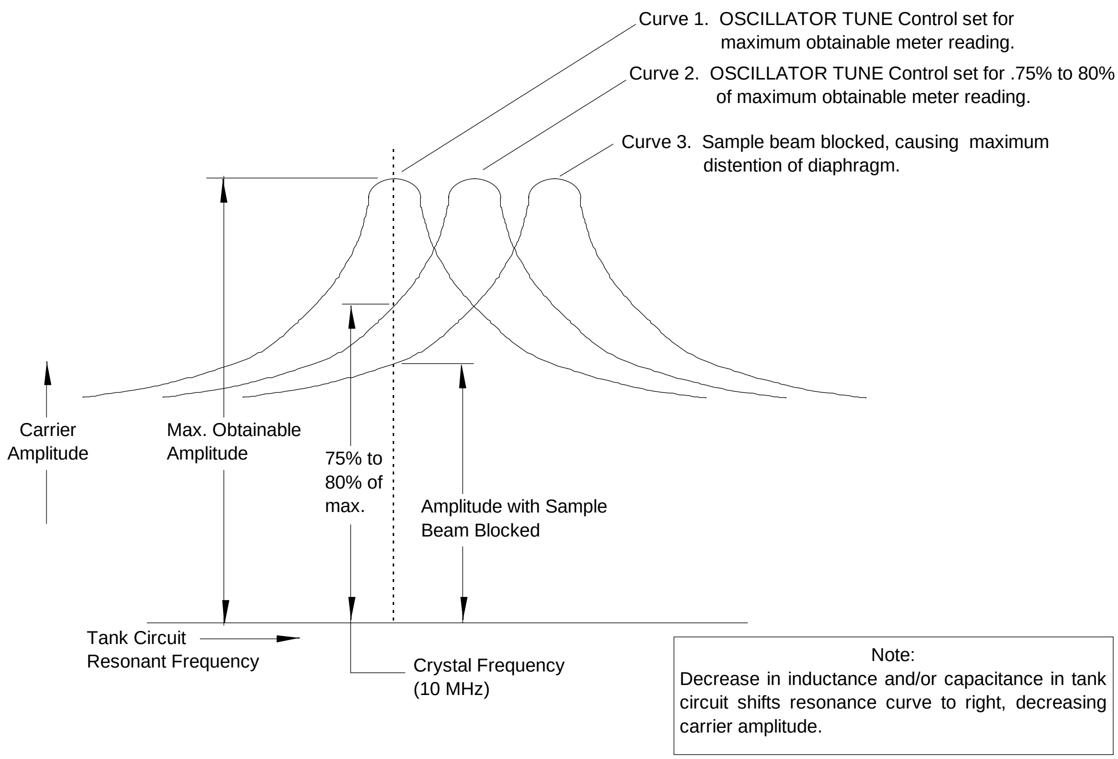


FIGURE 5-1. MODULATION SYSTEM

5.7 SOURCE ALIGNMENT

Note:

These adjustments are part of the factory checkout, are not normally required for routine operation, and should be done only if the detector signal obtained at the end of Step 5, Section 5.6, is greater than 1.2V.

CAUTION: BURN HAZARD

The source housing is very hot. Ensure adequate measures are taken to avoid touching this component during this procedure.

Refer to Figures 3-2, 6-2.

1. Connect a digital voltmeter between TP2 and TP7 (ground) on the Signal Board.
2. Set the source adjustment screw so that 1/2" of screw threads are visible (about halfway screwed in).
3. Loosen the two screws holding each source in place.
4. Adjust both measurement and reference sources up or down to reach the minimum detector signal.
5. Re-tighten source housing screws.
6. Do the Source Balance procedure in Section 5.6.

5.8 SOURCE CURRENT ADJUSTMENT

The source current for this application is indicated on the Calibration and Data Sheet.

On the Power Supply Board (Figure 2-2):

1. Connect a DVM (set for AC measurement) between TP1 and TP2. It is preferable to use a "True RMS" meter since this measurement is at 960 Hz and the waveform is not sinusoidal.
2. Adjust R9 until the value on the DVM is within 20 mV of the desired value. This value is calculated using the following equation:

Source Voltage Value = 3X Source Current Value

5.9 TIME CONSTANT

Time constant switch SW2 on the Signal Board (Figure 3-2), determines the speed of response of the electronics and the signal-to-noise ratio.

5.10 CASE HEATER TEMPERATURE CONTROL ASSEMBLY

Refer to Figures 2-1, and 7-5. Malfunction in this option can occur in three sections:

HEATER

Check with an ohmmeter for continuity. The heater resistance is approximately 113 ohms at 25°C.

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.

NOTES

6 ROUTINE SERVICING

WARNING: POSSIBLE EXPLOSION HAZARD

If explosive gas samples are introduced into the analyzer, it is recommended that sample containment system fittings and components be thoroughly leak checked prior to initial application of electrical power, routinely on a periodic basis thereafter, and after any maintenance which entails breaking the integrity of the sample containment system. Leakage of flammable samples could result in an explosion. Refer to leak check procedure, Section 2.8.

WARNING: ELECTRICAL SHOCK HAZARD

Troubleshooting in the field 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.

Periodic maintenance consists principally of changing the desiccant in the reference cell and cleaning the sample cell. An instrument maintenance log should be kept with the instrument, and all service, calibration and adjustments should be noted.

As an aid to periodic maintenance and possible future troubleshooting, the digital display reading with the MODE switch set at TUNE should be measured and recorded in the maintenance log after initial start-up, and at regular intervals thereafter. Also, a record of the detector signal with zero and span gas will indicate any instrument drift, which is an indication of the need for cleaning the sample flow system.

6.1 CELL REMOVAL, CLEANING AND REPLACEMENT

6.1.1 LONG CELL CONFIGURATIONS

Refer to Figure 6-1A.

1. Remove sample lines from the end cap assembly and the end cap/optical filter assembly.
2. If installed, remove the two motor/source assembly support brackets.
3. Remove the two screws holding the motor/source assembly to the optical bench plate.
4. Support the cells and gently move the motor/source assembly away from the detector. The cells and its o-rings will now be free.
5. 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. Loss of gold plating may require cell replacement.
6. After all matter has been removed, rinse the cell with distilled water and allow to air dry. Do not use towels.
7. Inspect the cell inside by holding it up to a bright light. If particles are seen, repeat Steps 6 and 7 as often as necessary.
8. After cleaning cells, examine o-rings at the end cap assembly and end cap/optical filter assembly and replace If damaged.
9. Remove any contaminants from optical filters with a lint free cloth soaked in acetone. Do not use alcohol or other solvents. Allow to air dry.
10. To install the cells, fit into position. Make sure that the o-rings seat properly. Move the motor/source assembly back into position. Make sure that the o-rings seat properly.
11. Replace the two screws which hold the motor/source assembly to the optical bench plate. Do not overtighten.
12. If applicable, replace the two Motor/Source Assembly support brackets.
13. Install the sample lines.
14. Check for leaks as instructed in Section 2.8. Take corrective action if necessary
15. If required, replace desiccant and purge reference cell per Section 6.2.
16. Perform source balance and source alignment adjustments per Sections 5.6 and 5.7.

6.1.2 SHORT CELL CONFIGURATIONS

Refer to Figure 6-1B.

1. Slide chassis out.
2. Remove sample lines from the sample cell assembly.

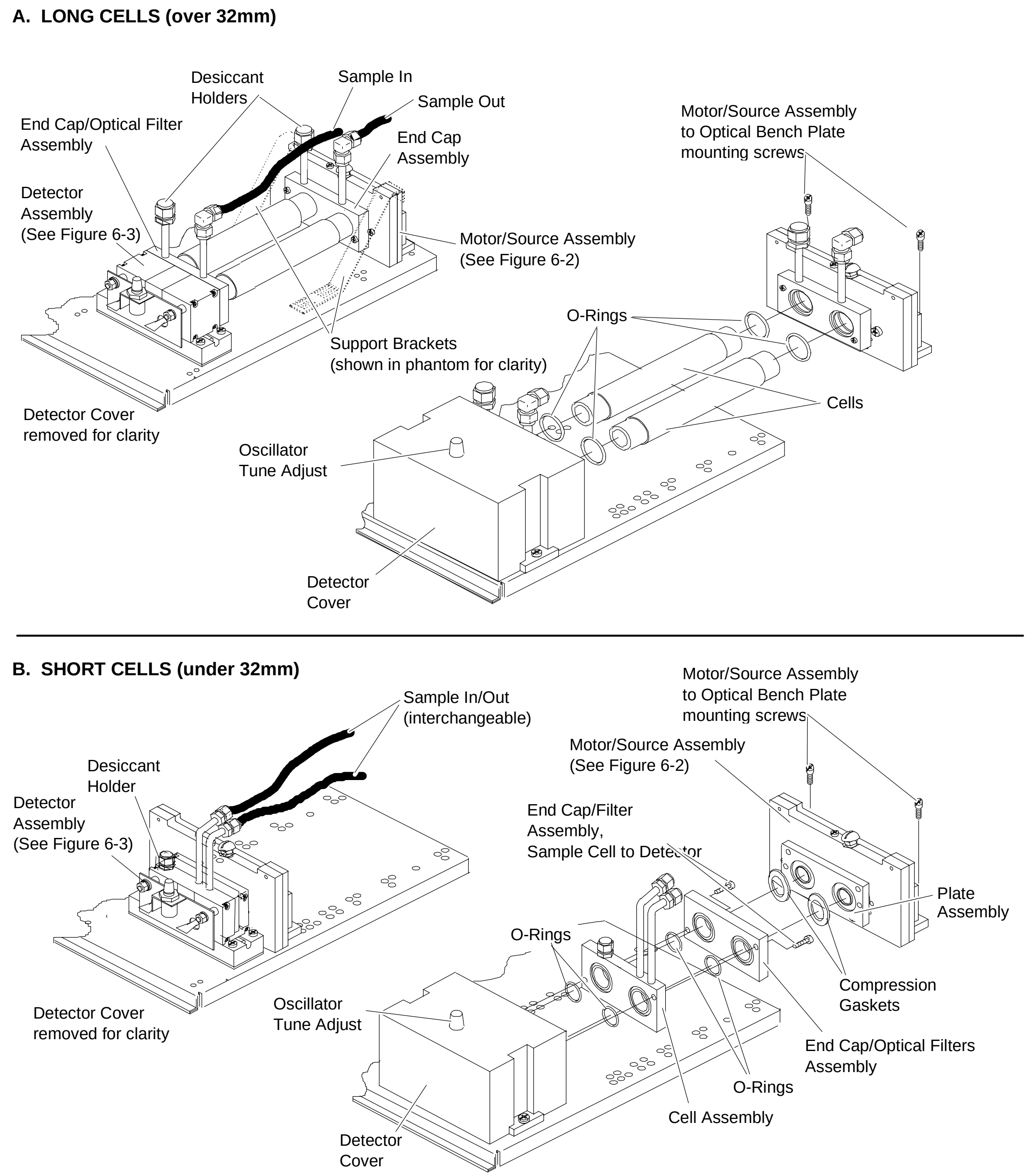


FIGURE 6-1. OPTICAL BENCH

3. Remove the two screws holding the motor/source assembly to the optical bench plate.

   Remove the two screws holding the end cap/optical filter assembly and sample cell assembly to the detector. Gently move the motor/source assembly away from the detector. The sample cell assembly, end cap/optical filter assembly and o-rings will now be free.

4. 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.
5. After all matter has been removed, rinse the cell with distilled water and allow to air dry. Do not use towels.
6. Inspect the cell inside by holding it up to a bright light. If particles are seen, repeat Steps 5 and 6 as often as necessary.
7. After cleaning cell, examine o-rings between the detector and sample cell assembly, and between the sample cell assembly and end cap/optical filters assembly, and the compression gaskets between the end cap/optical filters assembly and plate assembly, replace If damaged.
8. Remove any contaminants from windows with a lint free cloth soaked in acetone. Do not use alcohol or other solvents. Allow to air dry.
9. To install the cells, replace the two retaining screws holding the end cap/optical filter assembly and sample cell assembly to the detector. Verify that the o-rings seat properly. Move the motor/source assembly back into position. Verify that the compression gaskets seat properly.
10. Replace the two screws which hold the motor/source assembly to the optical bench plate. Do not overtighten.
11. Install the sample lines.
12. Check for leaks as instructed in Section 2.8. Take corrective action if necessary.
13. If required, replace desiccant and purge reference cell per Section 6.2.
14. Perform source balance and source alignment adjustments per Sections 5.6 and 5.7.

6.2 CELL DESICCANT

Traces of water vapor and/or carbon dioxide will eventually diffuse into the reference cell, and can change the transmittance characteristics of the cell, causing instrument drift. Therefore, all reference cells with a path length greater than 4mm contain a desiccant on the inlets and outlets to prevent moisture from entering.

Whenever the seal is opened and exposed to the atmosphere, replace the desiccant with the type specified in the Calibration and Data Sheet and Table 6-1.

6.2.1 DESICCANT REPLACEMENT

Refer to Figure 6-1.

1. Unscrew and pull out the desiccant holder.
2. Remove the depleted desiccant and felt filter.
3. Purge the cell with dry inert gas (i.e., N_2)

4. Pour a few granules of replacement desiccant into the holder and insert a new filter.
5. Loosen the desiccant holders to purge out any trapped air, re-tighten.

GAS	DESICCANT	PART NUMBER
CO_2	Cardoxide	096218
CO	Mg $(CI0_4)_2$	096217
H_2O	Mg $(CI0_4)_2$	096217
SOS	Mg $(CI0_4)_2$	096217
CH_4	Mg $(CI0_4)_2$	096217
HEXANE	Mg $(CI0_4)_2$	096217
CO + CO_2	Cardoxide + Mg $(CI0_4)_2$	096217/096218

TABLE 6-1. TYPES OF DESICCANT

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:

Observe how the parts are disassembled so that the reverse procedure can be used for reassembly.

1. Remove the two screws holding the source housing to the chopper housing.
2. Remove the two screws holding the source to the source housing. Note how the source is mounted. There is a front and back side.

When 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.

3. Reverse the procedure outlined above to reinstall the new source assembly, ensuring teflon spacers are in place and the screws have not been overtightened. Sources are ceramic and can crack or break under excessive pressure.

After replacing the source, adjust per Section 5.6 Source Balance Shutter Adjustment

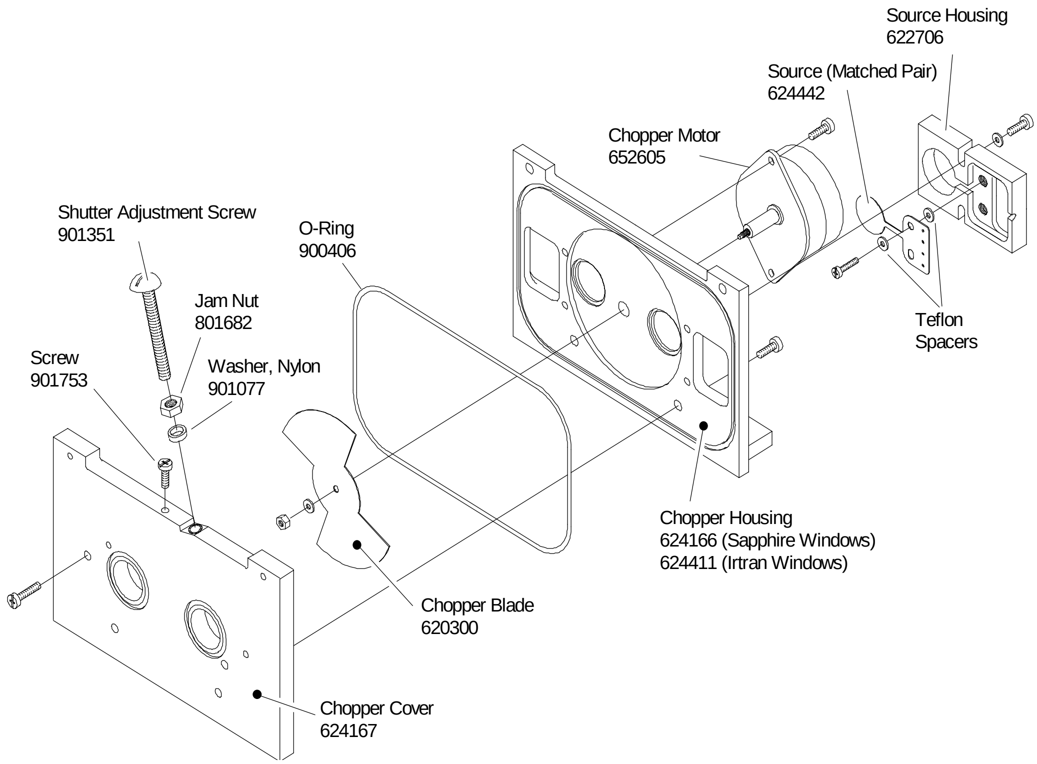


FIGURE 6-2. MOTOR/SOURCE ASSEMBLY

6.4 CHOPPER MOTOR ASSEMBLY

6.4.1 LONG CELL CONFIGURATIONS

1. Refer to Figure 6-1A. Remove the two support bracket (if supplied). Remove the two screws holding the motor/source assembly (with the end cap assembly attached) to the optical bench base plate. Support the cells and gently slide the motor/source assembly away from the cells.
2. Remove the two screws holding the end cap assembly to the motor/source assembly.
3. Refer to Figure 6-2. Remove chopper cover.
4. Remove chopper blade.
5. Remove two screws from rear of motor and remove motor.

6.4.2 SHORT CELL CONFIGURATIONS

1. Refer to Figure 6-1B. Remove the two screws holding the motor/source assembly (with the plate assembly attached) to the optical bench base plate. Gently slide the motor/source assembly away from the cells.

2. Remove the two screws holding the plate assembly to the motor/source assembly.
3. Refer to Figure 6-2. Remove chopper cover.
4. Remove chopper blade.
5. Remove two screws from rear of motor and remove motor.

6.5 DETECTOR REPLACEMENT

6.5.1 REMOVAL - LONG CELL CONFIGURATIONS

Refer to Figure 6-3A.

1. Remove sample lines from the end cap assembly and end cap/optical filter assembly.
2. Remove detector cover.
3. While supporting the cells, remove the four screws holding the detector assembly to the optical bench base plate.. The detector assembly, detector heater, detector plate, cells and o-rings are now free
4. Disconnect ribbon cables.
5. Remove oscillator board.
6. Refer to Figure 6-3C. Remove the two screws holding the end cap/optical filter assembly to the detector assembly. The end cap/optical filter assembly and o-rings are now free.
7. Remove the two screws holding detector to detector base.
8. Detector, detector pad and detector base are now free.

6.5.2 REMOVAL - SHORT CELL CONFIGURATIONS

Refer to Figure 6-3B.

1. Slide chassis out.
2. Remove the sample lines from the sample cell.
3. Remove detector cover.
4. Remove the four screws holding the detector assembly to the optical bench base plate. The detector assembly (with cell and end cap/optical filter assembly attached), detector heater, detector plate and o-rings (between end cap/optical filter assembly and plate assembly) are free.
5. Disconnect ribbon cables.
6. Remove oscillator board.
7. Refer to Figure 6-3C. Remove the two screws holding the end cap/filter assembly and cell to the detector assembly. The cell, end cap/optical filter assembly and o-

rings are now free.

8. Remove the two screws holding detector to detector base.
9. Detector, detector pad and detector base are now free.

6.5.3 DETECTOR INSTALLATION

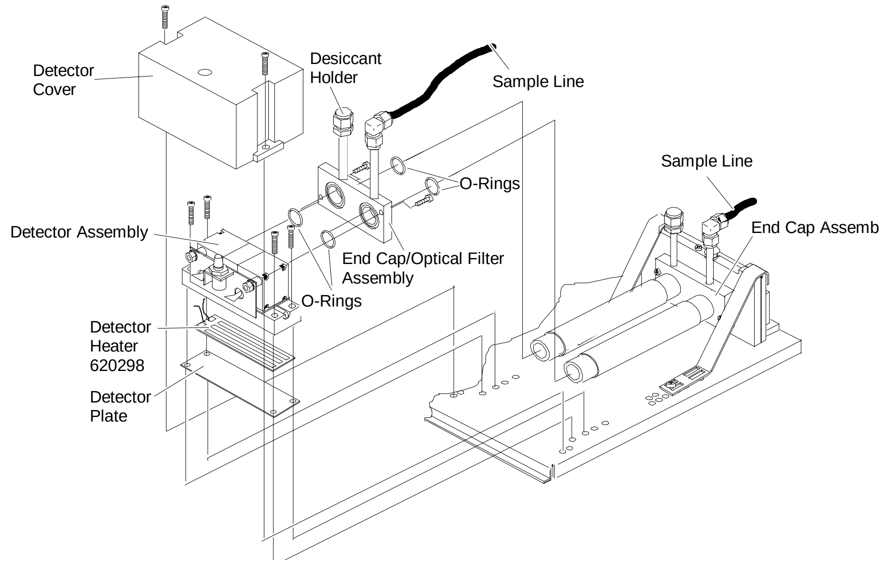
Replace detector by reversing the removal process.

Note:

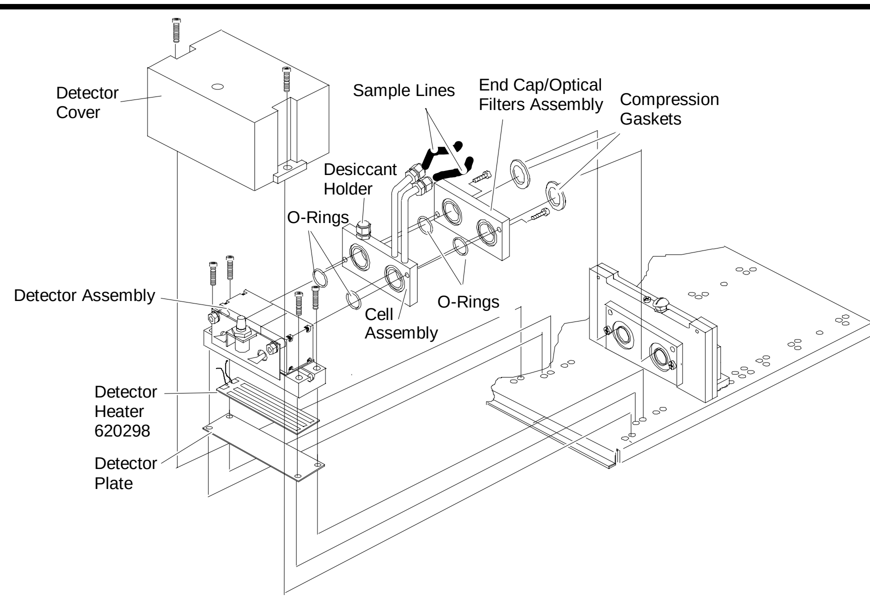
When replacing detector, insure that the thermal fuse and temperature sensor mounted in the base plate are in good thermal contact with the base plate.

Adjust source balance shutter and align source (see Sections 5.6 and 5.7).

A. LONG CELL



B. SHORT CELL



C. DETECTOR ASSEMBLY

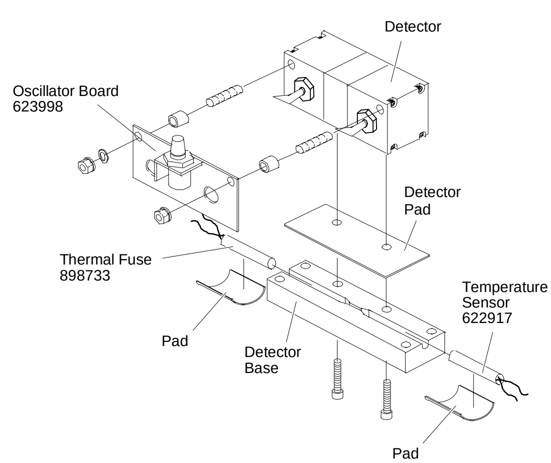


FIGURE 6-3. DETECTOR REPLACEMENT

NOTES

7 REPLACEMENT PARTS

The following parts are recommended for routine maintenance and troubleshooting of the Model 815 Explosion-Proof NDIR 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.

WARNING: PARTS INTEGRITY

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

WARNING: COMPONENTS IN CONTACT WITH SAMPLE

Components in contact with the sample are selected based on each individual application to prevent any reaction between the sample and the maters of construction. If the materials of construction react with the sample stream, the sample can leak into the enclosure resulting in damage to the analyzer and erroneous measurements. Refer to Calibration and Data Sheet when replacing these "wetted" parts, or contact the factory for additional information.

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

The following sections list parts which are common to all Model 815 applications, and parts which are specific to the instrument application. The ***configuration number*** (application number) is required when ordering parts which are specific to an individual application. The configuration number (8150-XX, the "XX" indicating the application) is on the Calibration and Data Sheet in the rear of this manual.

7.2.1 MODEL 815 COMMON PARTS

Reference Figures 2-1, and 2-2.

638426	Flame Arrestor
000516	Fuse, 3A 250V
652255	Power Harness
622751	Transformer
624538	Power Supply Board
652434	Signal Board
652449	Zero/Span Control Board

7.2.2 OPTICAL BENCH

Figures 7-1A through 7-1C are long cell configurations (64mm and over). Figures 7-2A through 7-2D are short cell configurations (32mm and under). In Table 7-1, find the configuration number (refer to Calibration and Data Sheet in rear of manual) for the analyzer, column two lists the applicable figure number.

Find the part(s) to be ordered in the appropriate figure, note the item number. Locate the item number in Table 7-2. Several parts may be listed under the same item number, locate the applicable configuration number in the configuration column.

7.3 OPTION KITS

7.3.1 LINEARIZER KIT PN 652268

Reference Figures 2-1, 2-7, 2-8, and 3-3.

624677	Linearizer Board
901736	Screw, SEMS 6-32 x 3/8 (qty 2)

7.3.2 CURRENT OUTPUT KIT PN 652269

Reference Figures 2-1, 2-5, 2-6 and 3-5.

652442	Current Output Board
652257	Cable Assembly, Flat 8 conductor
749008	Jumper, 2 conductor
653432	Nut, KEP 6-32
832029	Spacer

7.3.3 CASE HEATER TEMPERATURE CONTROL KIT PN 652270

Reference Figures 2-1, 2-3, 2-6 and 7-3.

622903	Cable Assembly, 3 conductor
901768	Cable Assembly, Flat 8 conductor
338831	Label “CAUTION - HOT”
558237	Label “DANGER - HIGH VOLTAGE”
082775	Label “WARNING - MOVING PARTS”
622917	Sensor
624006	Temperature Control Board
624433	Thermal Fuse
622733	Fan
622732	Heater

7.3.4 AIR PURGE KIT PN 652271

Reference Figure 2-4.

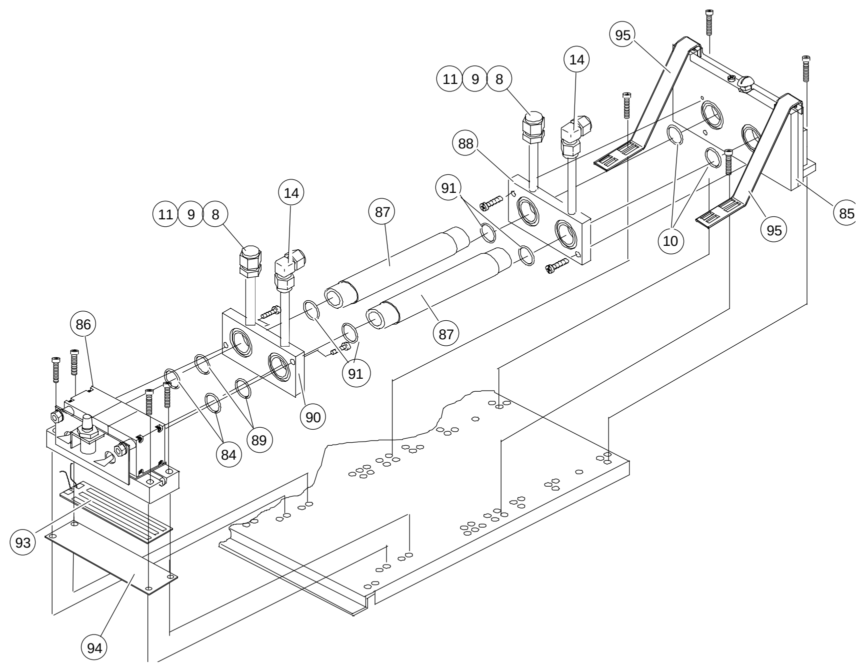
638426	Flame Arrestor
099196	Conduit Lock Nut 1/2”
023976	Fitting, Male Connector 1/4T - 1/4 NPT
748184	Instruction Sheet

7.3.5 MOTOR/SOURCE PURGE KIT PN 655094

638426	Flame Arrestor
634398	Tube
016486	Fitting, Male Connector 1/8T - 1/8NPT
029755	Fitting, Union 1/8T
888927	Fitting, Connector 1/8T
888928	Fitting, Connector 1/8T - 10-32
099196	Conduit Lock Nut 1/2”
748256	Instruction Sheet
45-049-45	Teflon Tubing 1/8 O.D. x 24”

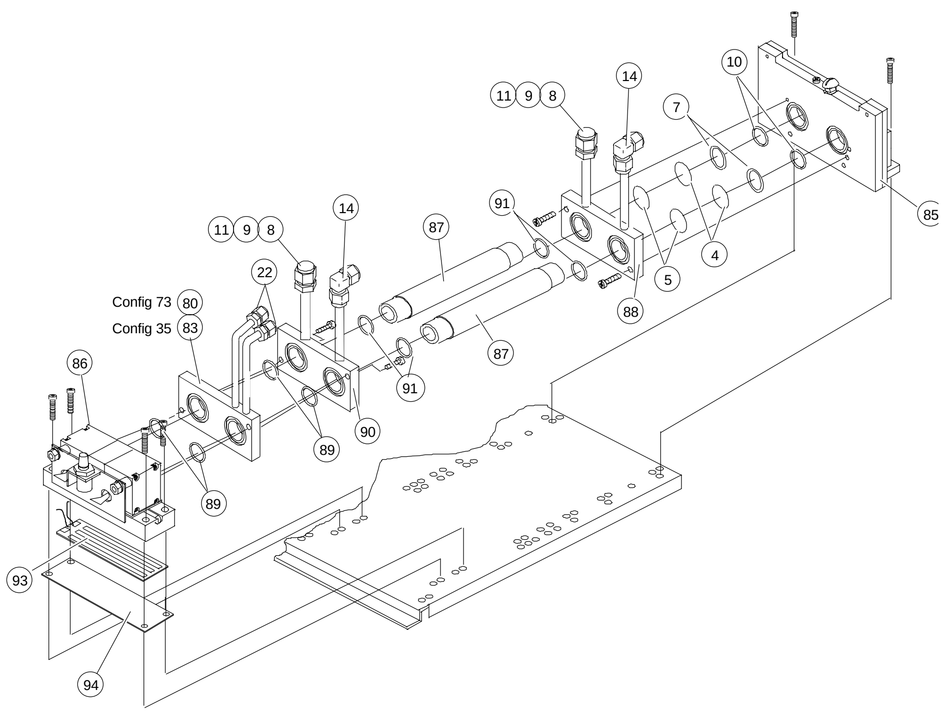
Configuration	Figure Number
06, 07, 11, 19, 21, 31, 36, 41, 45, 54, 71, 72, 81	7-1A
35, 73	7-1B
64, 83	7-1C
8, 10,12, 13, 18, 32, 39, 42, 43, 55, 63, 65, 67	7-2A
22, 23, 29, 30, 33, 34, 38,76	7-2B
26	7-2C
74, 82, 84	7-2D

TABLE 7-1. CONFIGURATION FIGURE LIST



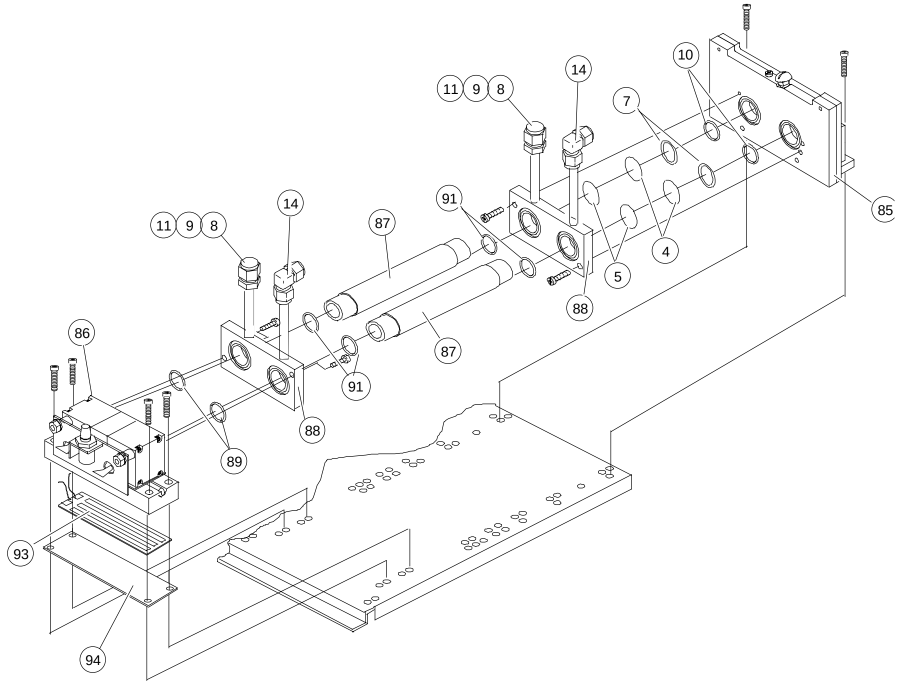
2, Item 95 used on Configuration 6, 19 and 45 only.
1. Item 84 used on Configuration 21 only.

FIGURE 7-1A CONFIGURATIONS 06, 07, 11, 19, 21, 31, 36, 41, 45, 54, 71, 72, 81



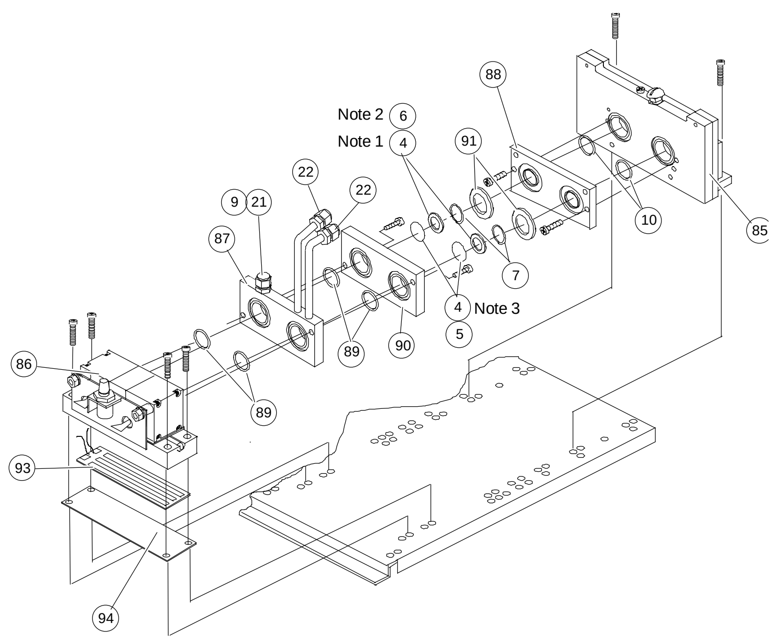
3. Item 80 used on Configuration 73 only.
2. Items 4, 5, 7 and 22 used on Configuration 35 only.
1. Item 83 used on Configuration 35 only.

FIGURE 7-1B. CONFIGURATIONS 35, 73



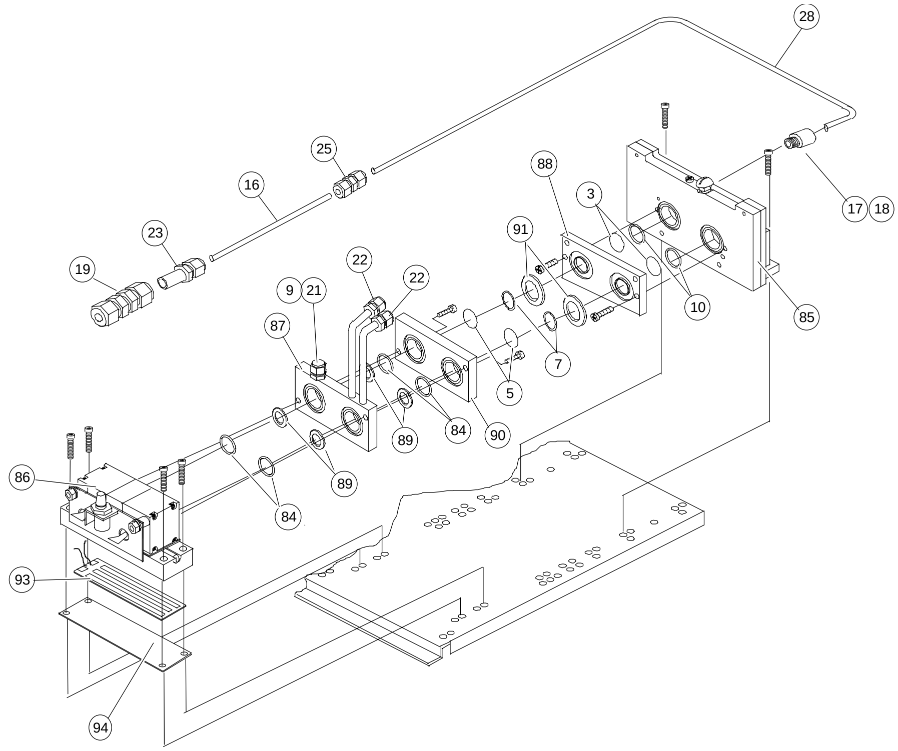
1. Item 4 used on Configuration 64 only.

FIGURE 7-1C. CONFIGURATIONS 64, 83



4. Items 9 and 21 used on Configurations 8, 10, 12, 32, 39, 42, 43, 55, 65, 67 only.
3. Item 5 is item 4 on Configuration 63 only.
2. Item 6 used on Configuration 55 only.
1. Item 4 used on Configuration 67 only.

FIGURE 7-2A. CONFIGURATION 08, 10, 12, 13, 18, 32, 39, 42, 43, 55, 63, 65, 67



4. Item 84 used on Configurations 22, 23, 29, 30, 38, and 76 only.
3. Items 16, 17, 18, 19, 23, 25, and 28 used on Configurations 23 and 76 only.
2. Items 9 and 21 used on Configurations 22, 29, and 30 only.
1. Items 3, 5, and 7 used on Configuration 76 only.

FIGURE 7-2B. CONFIGURATIONS 22, 23, 29, 30, 33, 34, 38, 76

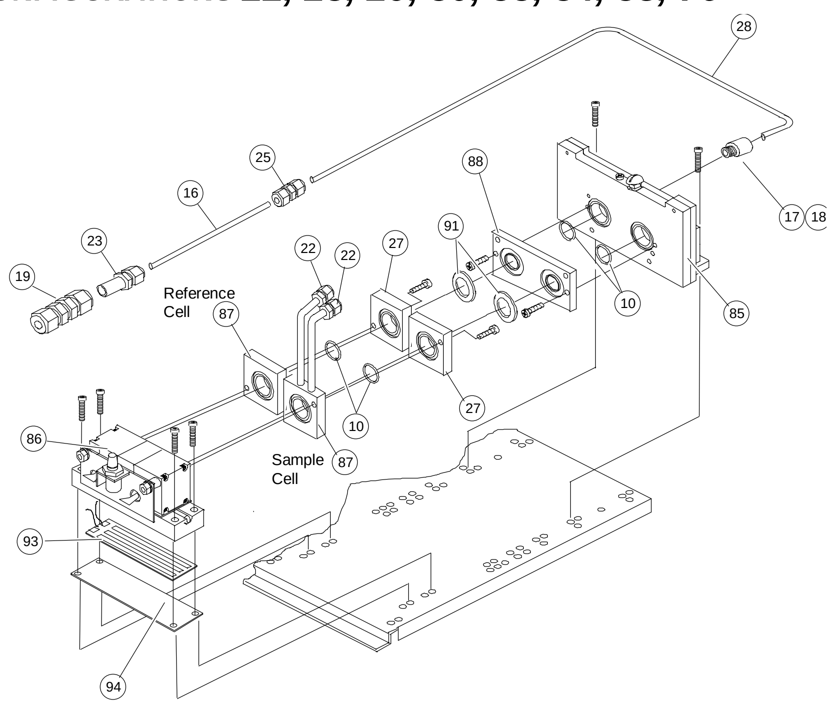
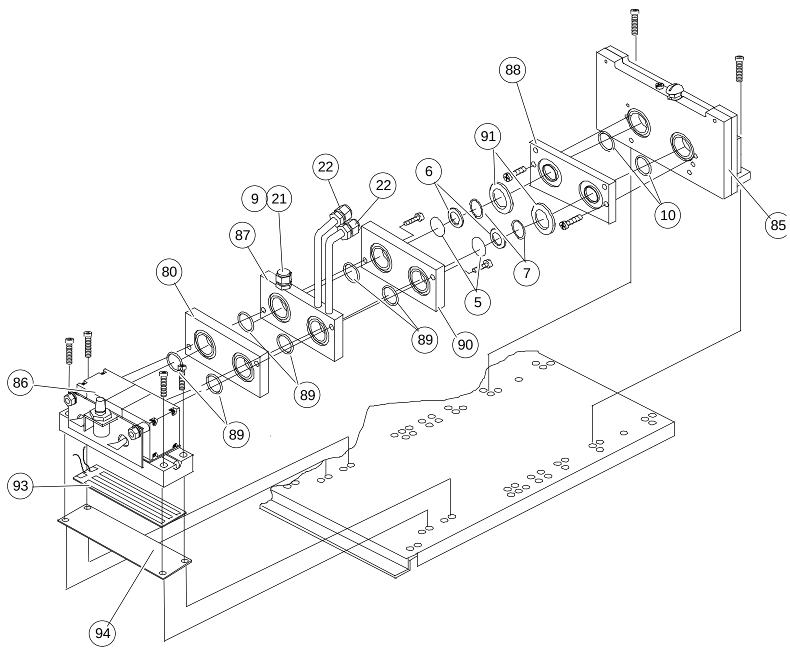


FIGURE 7-2C. CONFIGURATION 26



2. Items 5, 6, and 7 used on Configuration 84 only.
1. Items 9 and 21 used on Configuration 74 only.

FIGURE 7-2D. CONFIGURATIONS 74, 82, 84

ITEM	DESCRIPTION	PART NO.	CONFIGURATION
3	Window, Mica	635889	76 (Epoxied into item 88 at factory)
4	Screen	636606	63, 64, 67
5	Optical Filter	191112	55
5	Filter	194489	08, 10, 12, 13, 18
5	Filter	630105	76
5	Filter	630106	32, 39, 42, 43
5	Filter	193676	83, 84
5	Filter	620225	64, 65, 67
6	Spacer	634082	55, 84
7	Retaining Ring	634081	08, 10, 12, 13, 18, 32, 39, 42, 43, 55, 63, 64, 65, 67, 76, 83, 84
8	Desiccant Holder	646193	06, 07, 11, 18, 19, 21, 31, 35, 36, 41, 45, 54, 64, 71, 72, 73, 81, 83
9	Filler Plug	062758	06, 07, 08, 10, 11, 12, 19, 21, 22, 29, 30, 31, 32, 35, 36, 39, 41, 42, 43, 45, 54, 55, 64, 65, 67, 71, 72, 73, 74, 81, 83
10	O-Ring, Viton-A	853135	06, 07, 08, 10, 11, 12, 13, 18, 19, 21, 22, 23, 26, 29, 30, 31, 32, 33, 34, 35, 36, 38, 39, 41, 42, 43, 45, 54, 55, 71, 72, 73, 74, 76
10	O-Ring, Ethylene Propylene	900806	63, 64, 65, 67, 81, 82, 83, 84

TABLE 7-2. OPTICAL BENCH COMPONENTS BY CONFIGURATION (CONTINUED ON NEXT PAGE)

ITEM	DESCRIPTION	PART NO.	CONFIGURATION
11	Fitting, Cap	079616	06, 07, 11, 19, 21, 31, 35, 36, 41, 45, 54, 64, 71, 72, 73, 81, 83
14	Fitting, Elbow 1/4T	079378	06, 07, 11, 19, 21, 31, 35, 36, 41, 45, 54, 64, 71, 72, 73, 81, 83
15	Bracket, Support	652937	06, 19, 45
16	Capillary	634398	23, 26, 76
17	Fitting	888927	23, 26, 76
18	Fitting	888928	23, 26, 76
19	Fitting, Bulkhead 1/4T - 1/4T	017177	23, 26, 76
20	Fitting, Bulkhead 1/4T - 1/8T	029650	19
21	Fitting, Plug 1/8NPT	061412	08, 10, 12, 22, 29, 30, 32, 39, 42, 43, 55, 65, 67, 74
22	Fitting, Reducer 1/4T - 1/8T	016490	13, 18, 23, 26, 33, 34, 35, 38, 63, 76, 84
22	Fitting, Union 1/4T	008437	08, 10, 12, 22, 29, 30, 32, 39, 42, 43, 55, 65, 67, 74, 82
23	Fitting, Reducer 1/4T - 1/8T	812903	23, 26, 76
25	Fitting, Union 1/8T	029755	23, 26, 76
27	Plug, Cell	616919	26
28	Tubing, Teflon 1/8 O.D.	45-049-45	23, 26, 76
80	End Cap, Assembly, (Sapphire)	624170	19, 21, 36, 71
80	Filter Cell CO_2	634591	73, 74
80	End Cap Assembly	637132	82, 84
83	Cell	830825	35
84	Teflon Spacer	072860	21, 22, 23, 29, 30, 38, 76
85	Motor/Source Assembly (Sapphire)	624140	06, 07, 08, 10, 11, 12, 13, 18, 19, 21, 22, 23, 26, 29, 30, 31, 32, 33, 34, 35, 36, 38, 39, 41, 42, 43, 45, 54, 55, 71, 72, 76
85	Motor/Source, Assembly (Irtran)	624412	63, 64, 65, 67, 73, 74, 81, 82, 83, 84
86	Detector 200mm CO	633938	13
86	Detector 200mm CH_4	633944	34
86	Detector 50mm CO	633934	06, 07, 08, 10, 11, 12, 18
86	Detector 50mm NO	633935	54, 55
86	Detector 200mm CO_2	633943	23, 26, 76
86	Detector 50mm C_2H_4	633937	71, 72
86	Detector 14mm H_2O	633945	73, 74
86	Detector 50mm CH_4	633940	31, 32, 33, 35, 39
86	Detector 50mm N-Hexane	633942	41, 42, 43, 45
86	Detector 50mm CO_2	633939	19, 21, 22, 29, 30, 36, 38
86	Detector 50mm SO_3	633948	63, 64, 65, 67
86	Detector 50mm NH_3	633946	81, 82, 83, 84
87	Cell (Sample) 1mm	616906	26
87	Cell (Reference) 1mm	616907	26
87	Cell (Sample and Reference) 228mm	622434	06, 19, 45
87	Cell (Sample and Reference) 64mm	622432	07, 35, 36
87	Cell (Sample) 32mm	634581	08, 29, 39, 43
87	Cell (Sample) 8mm	634582	10, 30, 67, 82
87	Cell (Sample) 16mm	630820	12, 22, 32, 42, 55, 65, 74
87	Cell (Sample) 4mm	630825	13, 18, 23, 33, 34, 35, 38, 63, 76, 84
87	Cell (Sample and Reference) 128mm	622433	11, 21, 31, 41, 54, 64, 71, 72, 73, 81, 83

TABLE 7-2. OPTICAL BENCH COMPONENTS BY CONFIGURATION (CONTINUED ON NEXT PAGE)

ITEM	DESCRIPTION	PART NO.	CONFIGURATION
88	End Cap, Assembly, (Sapphire/Mica)	624186	36
88	End Cap, Assembly (Irtran)	624174	64, 73, 81, 83
88	End Cap, Assembly, (Sapphire)	624170	06, 07, 11, 19, 21, 31, 35, 41, 45, 54, 71, 72
88	Plate Assembly	624410	08, 10, 12, 13, 18, 22, 23, 26, 29, 30, 32, 33, 34, 38, 39, 42, 43, 55, 63, 65, 67, 74, 76, 82, 84
88	End Cap Assembly	630832	08, 10, 12, 13, 18, 22, 23, 29, 30, 32, 33, 34, 38, 39, 42, 43, 55, 76
89	O-Ring, Silicone FEP Coated	063254	21, 22, 23, 29, 30, 38, 76
89	O-Ring, Viton-A	856317	06, 07, 08, 10, 11, 12, 13, 18, 19, 31, 32, 33, 34, 35, 36, 39, 41, 42, 43, 45, 54, 55, 71, 72, 73, 74
89	O-Ring, Ethylene Propylene	878271	63, 64, 65, 67, 81, 82, 83, 84
90	Cap/Filter Assembly	624181	06, 07, 11
90	End Cap Assembly	624199	35
90	Cap/Filter Assembly	624183	31, 41, 45
90	Cap/Filter Assembly	624185	54, 72
90	End Cap, Assembly (Irtran)	624174	81, 83
90	End Cap Assembly	630831	63, 64, 65, 67, 74, 82, 84
91	O-Ring, Ethylene Propylene	900805	64, 81, 83
91	Compression Gasket	624122	08, 10, 12, 13, 18, 22, 23, 26, 29, 30, 32, 33, 34, 38, 39, 42, 43, 55, 63, 65, 67, 74, 76, 82, 84
91	O-Ring, Viton-A	899373	06, 07, 11, 19, 21, 31, 35, 36, 41, 45, 54, 71, 72, 73
93	Detector Heater	620298	All
94	Detector Plate	624134	All
95	Bracket, Support - Motor/Source	652937	06, 19, 45

TABLE 7-2. OPTICAL BENCH COMPONENTS BY CONFIGURATION

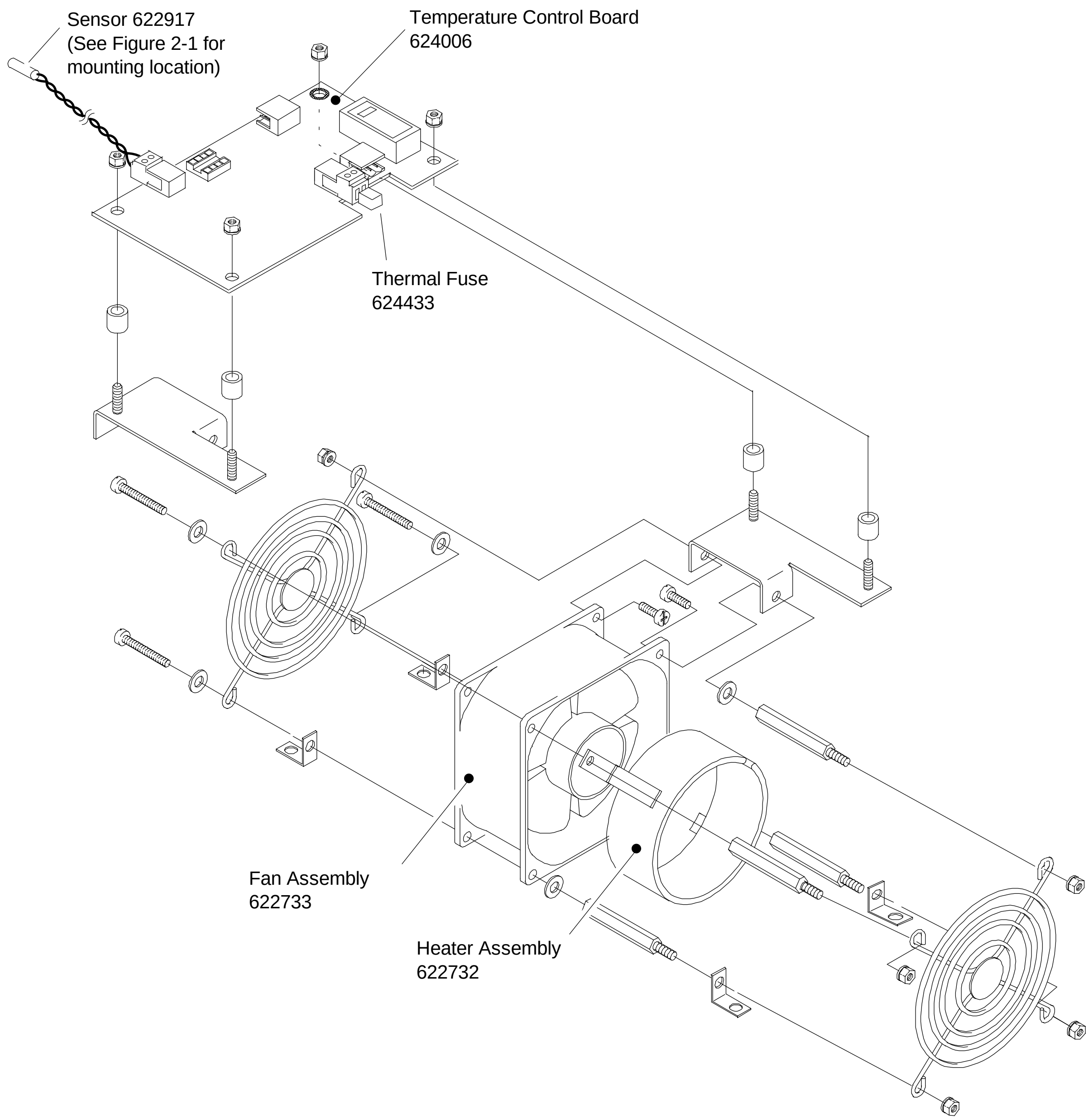


FIGURE 7-3. CASE HEATER TEMPERATURE CONTROL ASSEMBLY

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
Used by Permission

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.

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WARRANTY

Goods and part(s) (excluding consumables) manufactured by Seller are warranted to be free from defects in workmanship and material under normal use and service for a period of twelve (12) months from the date of shipment by Seller. Consumables, glass electrodes, membranes, liquid junctions, electrolyte, o-rings, etc., are warranted to be free from defects in workmanship and material under normal use and service for a period of ninety (90) days from date of shipment by Seller. Goods, part(s) and consumables proven by Seller to be defective in workmanship and/or material shall be replaced or repaired, free of charge, F.O.B. Seller's factory provided that the goods, part(s) or consumables are returned to Seller's designated factory, transportation charges prepaid, within the twelve (12) month period of warranty in the case of goods and part(s), and in the case of consumables, within the ninety (90) day period of warranty. This warranty shall be in effect for replacement or repaired goods, part(s) and the remaining portion of the ninety (90) day warranty in the case of consumables. A defect in goods, part(s) and consumables of the commercial unit shall not operate to condemn such commercial unit when such goods, part(s) and consumables are capable of being renewed, repaired or replaced.

The Seller shall not be liable to the Buyer, or to any other person, for the loss or damage directly or indirectly, arising from the use of the equipment or goods, from breach of any warranty, or from any other cause. All other warranties, expressed or implied are hereby excluded.

IN CONSIDERATION OF THE HEREIN STATED PURCHASE PRICE OF THE GOODS, SELLER GRANTS ONLY THE ABOVE STATED EXPRESS WARRANTY. NO OTHER WARRANTIES ARE GRANTED INCLUDING, BUT NOT LIMITED TO, EXPRESS AND IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Limitations of Remedy. SELLER SHALL NOT BE LIABLE FOR DAMAGES CAUSED BY DELAY IN PERFORMANCE. THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF WARRANTY SHALL BE LIMITED TO REPAIR OR REPLACEMENT UNDER THE STANDARD WARRANTY CLAUSE. IN NO CASE, REGARDLESS OF THE FORM OF THE CAUSE OF ACTION, SHALL SELLER'S LIABILITY EXCEED THE PRICE TO BUYER OF THE SPECIFIC GOODS MANUFACTURED BY SELLER GIVING RISE TO THE CAUSE OF ACTION. BUYER AGREES THAT IN NO EVENT SHALL SELLER'S LIABILITY EXTEND TO INCLUDE INCIDENTAL OR CONSEQUENTIAL DAMAGES. CONSEQUENTIAL DAMAGES SHALL INCLUDE, BUT ARE NOT LIMITED TO, LOSS OF ANTICIPATED PROFITS, LOSS OF USE, LOSS OF REVENUE, COST OF CAPITAL AND DAMAGE OR LOSS OF OTHER PROPERTY OR EQUIPMENT. IN NO EVENT SHALL SELLER BE OBLIGATED TO INDEMNIFY BUYER IN ANY MANNER NOR SHALL SELLER BE LIABLE FOR PROPERTY DAMAGE AND/OR THIRD PARTY CLAIMS COVERED BY UMBRELLA INSURANCE AND/OR INDEMNITY COVERAGE PROVIDED TO BUYER, ITS ASSIGNS, AND EACH SUCCESSOR INTEREST TO THE GOODS PROVIDED HEREUNDER.

Force Majeure. Seller shall not be liable for failure to perform due to labor strikes or acts beyond Seller's direct control.

Rosemount Analytical

Rosemount Analytical Inc.
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FIELD SERVICE AND REPAIR FACILITIES

Field service and repair facilities are located worldwide.

U.S.A.

To obtain field service on-site or assistance with a service problem, contact (24 hours, 7 days a week):

National Response Center
1-800-654-7768

INTERNATIONAL

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

FACTORY

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

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