OPERATION AND MAINTENANCE

MANUAL FOR MODEL 100F ANALYZER

gasanalyzers.com

California Analytical
Instruments, Inc.

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1. INTRODUCTION

1.1. Overview

Thank you and congratulations! You have just purchased one of the most reliable gas analyzers in the world. Before using the analyzer, please familiarize yourself with its operation by reading this manual. If you have any questions, please do not hesitate to call California Analytical Instruments for assistance. We want you to be a member of our thousands of satisfied customers.

1.2. Unpacking Instructions

Open the shipping container and carefully remove the analyzer from the packing materials. Inspect the instrument for any sign of damage. Remove the retaining screws and lift off the cover panel. Visually check for loose parts or connectors that are not properly seated. If all internal components appear to have no defects, replace the cover and secure it with the screws previously removed.

1.3. Reporting Damage

Should there be any apparent damage to the inside or outside of the instrument due to shipping or handling, notify the shipper immediately. The shipping container or packing materials should be retained for inspection by the shipper.

1.4. Contact Information

California Analytical Instruments, Inc.
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1.5. Warranty Certificate

Subject to the exceptions and upon the conditions stated below, California Analytical Instruments (CAI) warrants that the products sold under this sales order shall be free from defects in workmanship and materials for one year after delivery of the product to the original Buyer by CAI and if any such product should prove to be defective within such one year period, CAI agrees, at its option, either (i) to correct by repair or, at CAI's election, by replacement with equivalent product any such defective product, provided that investigation and factory inspection discloses that such defect developed under normal and proper uses, or (ii) to refund the purchase price. The exceptions and conditions mentioned above are as follows:

a) components or accessories manufactured by CAI that, by their nature are not intended to or will not function for one year, are warranted only to give reasonable service for a reasonable time; which constitutes reasonable time and reasonable services shall be determined solely by CAI. A complete list of such components and accessories is maintained at the factory;

b) CAI makes no warranty with respect to components or accessories not manufactured by it; in the event of defect in any such component or accessory CAI will give reasonable assistance to Buyer in obtaining from the respective manufacturer whatever adjustment is authorized by the manufacturer's warranty;

c) any product claimed to be defective must be returned to the factory transportation charges prepaid and CAI will return the repaired or replaced product freight collect;

d) if the product claimed to be defective requires on-site repair, such warranty labor will be provided at no charge; however, transportation and living expenses will be charged to Buyer;

e) if the product is a consumable or the like, it is warranted only to conform to the quantity and content and for the period (but not in excess of one year) stated on the label at the time of delivery or 90 days;

f) CAI may from time to time provide a special printed warranty with respect to a certain product, and where applicable, such warranty shall be deemed incorporated herein by reference;

g) CAI shall be released from all obligations under all warranties, either expressed or implied, if any product covered hereby is repaired or modified by persons other than its own authorized service personnel unless such repair by others is made with the written consent of CAI.

IT IS EXPRESSLY AGREED THAT THE ABOVE WARRANTY SHALL BE IN LIEU OF ALL WARRANTIES OF FITNESS AND OF THE WARRANTY OF MERCHANTABILITY AND THAT CAI SHALL HAVE NO LIABILITY FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND OR FROM ANY CAUSE WHATSOEVER ARISING OUT OF THE MANUFACTURE USE, SALE, HANDLING, REPAIR, MAINTENANCE OR REPLACEMENT OF ANY OF THE PRODUCTS SOLD UNDER THIS SALES ORDER. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THAT THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY HAVE OTHER RIGHTS, WHICH VARY FROM STATE TO STATE.

Representations and warranties made by any person, including dealers and representatives of CAI, which are inconsistent or in conflict with the terms of this warranty, shall not be binding upon CAI unless produced in writing and approved by an expressly authorized officer of CAI.

2. FEATURES AND PRINCIPLES OF OPERATION

2.1. Description

The Model 100F is a single component general-purpose oxygen analyzer. The oxygen level is displayed on a digital panel meter.

The Model 100F analyzer utilizes a low cost replaceable fuel cell to determine the percent level of oxygen contained in the sample gas. A fuel cell analyzer features linear output from 0.1 ppm to 100% with low noise and excellent repeatability

It is available in two versions; one for oxygen levels up to 25%, and the second for oxygen up to 100%.

Warning: This is a general-purpose analyzer, and is not suitable for hazardous areas. High-pressure oxygen is very dangerous. Virtually any material will burn in it, possibly explosively. It is essential that all persons using this analyzer are aware of the dangers of oxygen, and take all appropriate precautions.

2.2. Product Specifications Model 100F (Galvanic Fuel Cell Detector)

SAMPLE CONTACT MATERIAL: Stainless steel and Tygon*	DISPLAY: 3 ½" digit panel meter
RANGES: Standard fixed ranges, either A or B	OUTPUTS: 0 to 10 VDC and 4 to 20 mA (0 to 20 mA)
A) Range 1: 0 to 5%; Range 2: 0 to 10%; Range 3: 0 to 25%	AMBIENT TEMPERATURE: 5 to 45° C SAMPLE TEMPERATURE: 0 to 50° C
B) Range 1: 0 to 25%; Range 2: 0 to 40%; Range 3: 0 to 100%	SAMPLE CONDITION: Particles < 1μ, non-corrosive dry gas
RESPONSE TIME: 90% full scale in 5 seconds	FITTINGS: ¼" tube
NOISE: Less than 1% full scale	SAMPLE FLOW RATE: 0.5 –2.0 L/MIN
LINEARITY: Better than 1% full scale	Power Requirements: 115/230 (± 10%) VAC, 50/60 Hz, 70 watts/channel
REPEATABILITY: Better than 1% full scale	Relative Humidity: Less than 90% R.H.**
ZERO SPAN DRIFT: Less than 1% full scale in 24 hours	WEIGHT: 10 lbs. (4.8 kg) (Model 100F)
ZERO & SPAN ADJUSTMENT: Ten turn potentiometer	Dimensions: 5 ¼" H x 19" W x 15" D (133 mm H x 483 mm W x 381 mm D)

*Tygon is a registered trademark of the Norton Performance Plastics Corporation

**Non-condensing

Specifications subject to change without notice

2.3. Principle of operation

The Model 100F is designed to measure percent levels of oxygen. The analyzer uses a galvanic fuel cell, which is an electrochemical transducer. The fuel cell contains a cathode, anode, and an electrolyte. A permeable membrane holds the electrolyte in the cell. The sample flows over the membrane and oxygen diffuses in to the fuel cell, where it reacts with the electrolyte. This reaction produces an electrical current. This current is directly proportional to the concentration of oxygen in the gaseous mixture surrounding the cell. The current output is linear with an absolute zero. With the absence of oxygen, the fuel cell produces no current.

2.4. Oxygen Fuel Cells

The standard oxygen sensor (type PSR-39-11) has a shelf life of approximately three years. It is designed to measure oxygen in ambient air. The other gases contained in ambient air are low enough concentrations so as not to be a factor of concern. When used for ambient air measurement the manufacturer estimates the life of the sensor to be approximately three years.

If the standard PSR type sensor is used to measure pure oxygen, oxygen in flue gas or oxygen in stack emissions the life of the standard PSR type sensor will be shorter.

One of the most common emission gases is CO2 and is usually found in concentrations of between 4-20 percent by volume. High levels Of CO2 change the pH of the gel and thus shorten the life of the standard PSR type sensor. The life expectancy dramatically shortens from three years to approximately four weeks at CO2 concentrations of 20% volume.

For the reason stated above, sensor type XLT-39-11 was developed. The XLT type sensor has an electrolytic gel that is strongly buffered and highly caustic. A caustic gel is required to combat the effects of high CO2 concentrations. The average life of this type of sensor is approximately eight to ten months at CO2 levels of 20% by volume; however, the caustic nature of the electrolytic gel creates vapors that clog the cell membrane within a very short time if the cell is not put into immediate use. The shelf life of this type of sensor is approximately two weeks if not stored at a cold, constant temperature. A shelf life of 30 days or so can be achieved if the sensor is kept refrigerated.

As previously stated the XLT-39-11 sensor was developed for use in sample gases containing high levels Of CO2 (approximately 20% volume. or greater). It provides a longer life at high CO2 levels, but the linearity of response has been sacrificed. Typical linearity with this type of sensor is within ± 1% Volume O2.

Because of the non-linearity issue, a third type of sensor was developed. Type XLT-39-11-1 provides a signal that is linear to within ± 0.25% volume O2. This sensor has an average life of eight to ten months at medium CO2 levels of 10% by volume. Levels of CO2 at 20% by volume will shorten the life of this sensor to approximately 3-4 months. The shelf life of this sensor is similar to the XLT-39-11.

3. INSTALLATION

3.1. General

The instrument is designed for industrial applications. These installation instructions are for a typical site. Any questions regarding specific installation situations should be directed to Technical Service of California Analytical Instruments, Inc.

Warning: This is a general-purpose analyzer, and is not suitable for hazardous areas. High-pressure oxygen is very dangerous. Virtually any material will burn in it, possibly explosively. It is essential that all persons using this analyzer are aware of the dangers of oxygen, and take all appropriate precautions.

3.2. Site and Mounting

NOTE: The following precautions must be carefully observed:

1. Select a site free from direct sunlight, radiation from a high temperature surface, or abrupt temperature variations.
2. This analyzer is not suitable for outdoor installation.
3. Select a site where the air is clean. Avoid exposing the instrument to corrosive or combustible gases.
4. The instrument must not be subject to severe vibration. If severe vibration is present, use isolation mounts.
5. The instrument is designed for rack mounting. Optional rack mount slides are available.
6. Do not install near equipment emitting electromagnetic interference (EMI).

NOTE: A rear supporting brace or equivalent is required if the optional rack mount slides were not purchased.

3.3. Electrical

All wiring is connected at the rear of the instrument. The connect outputs, etc. are shown in Table 3-1 on the following page. The AC power is connected to the power/fuse/switch as shown below in Figure 3-1.

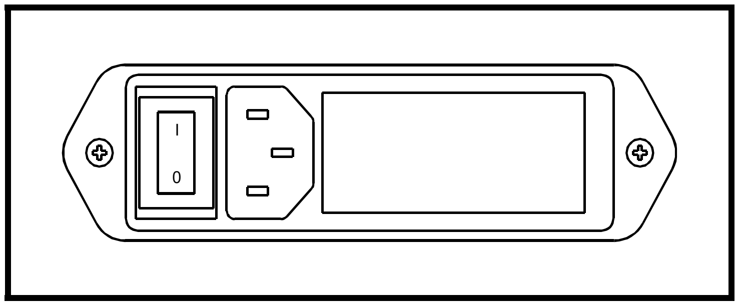


Figure 3 1 AC Power Switch, Connector, and Fuse.

NOTES: A defective ground may affect the operation of the instrument. The output voltages are connected per Table 3-1. Shielded wiring is recommended for output signals.

CAUTION: Electromagnetic interference (EMI) may affect the operation of the instrument. Do not install the instrument near electrical noise (such as high frequency furnaces, electric welding machines, etc.). If the instrument must be installed at such locations, a separate power line must be used. Noise from a relay or solenoid valve should be controlled by the use of an EMI suppressor (RC circuit) across the power wiring close to the noise-generating component (see Figure 3-2).

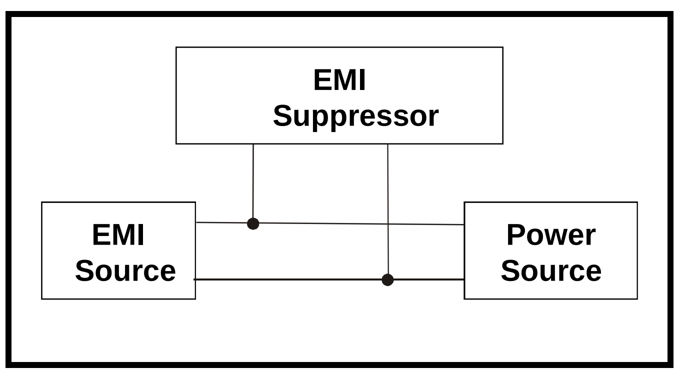


Figure 3 2 EMI Suppressor.

NOTE: The EMI Suppressor must be located close to the noise source.

Table 3-1 I/O Connections

	Model 100F	
Pin #	**Outputs (Voltage or Current)**	**Channel**
1	Positive (0-10 VDC)	
2	Negative (0-10 VDC)	
3	Positive (4-20 mA)	
4	Negative (4-20 mA)	
5	Not used	
6	Not used	
7	Not used	
8	Range 2	
9	Range 3	
10	Ground (Remote control)	
11	Positive 15 Volts (Remote control)	
12	Ground	
	Note 13-28 not used	

Table 3 2 Twenty Eight (28) Conductor Cable Color Chart

Pin Number	Wire Color	Wire Color Abbreviation
1	DARK BROWN	DK BR
2	RED	RD
3	ORANGE	OR
4	YELLOW	YL
5	GREEN	GR
6	LIGHT BLUE	LT BL
7	VIOLET	VI
8	GRAY	GY
9	WHITE	WH
10	BLACK	BK
11	LIGHT BROWN	LT BR
12	PINK	PN
13	BLUE	BL
14	LIGHT GREEN	LT GR
15	WHITE/BLACK	WH/BK
16	WHITE/RED	WH/RD
17	WHITE/GREEN	WH/GN
18	WHITE/YELLOW	WHNL
19	WHITE/BLUE	WH/BL
20	WHITE/BROWN	WH/BR
21	WHITE/ORANGE	WH/OR
22	WHITE/GRAY	WH/GR
23	WHITE/VIOLET	WH/I
24	WHITE/PINK	WH/PN
25	WHITE/LIGHT GRAY	WH/LT GY
26	BLACK/RED	BK/RD
27	BLACK/ORANGE	BK/OR
28	BLACK/BROWN	BK/BR

3.4. Required Gases and Gas Handling Equipment

1. Nitrogen (zero gas) in a pressurized cylinder.
2. Standard span gas(es) near full-scale concentration (typically 80-95% of the analyzers measuring range) with a nitrogen balance, in a pressurized, certified cylinder.
3. Pressure regulators for zero and span gas cylinders.
4. Corrosive resistant gas tubing.
5. Flow meter with valve (0-2 L/min) — if not supplied as an analyzer option.
6. Pump— if not supplied as an analyzer option.

3.5. Gas Connections

The tubing from the sampling system to the gas analyzer should be corrosive resistant material such as Teflon® or stainless steel. When the gases being sampled are non-corrosive, rubber or soft vinyl tubing should not be used since readings may be inaccurate due to gas absorption into the piping material. To obtain fast response, the tube should be as short as possible. Optimum tube internal diameter is 0.16 inch (4 mm). Instrument couplings are ¼-inch tube. A sample-gas outlet fitting is located on the rear panel (¼-inch tube). Pressure at this outlet must be kept at the atmospheric level. This gas should be vented from the instrument.

NOTE: Be sure tubing and joints are clean. Dust entering the instrument may cause it to malfunction.

3.6. Sampling Requirements

3.6.1. Filtration

Dust must be completely eliminated. Use filters as necessary. The filter must be capable of removing particles larger than one micron.

3.6.2. Condensation

Dew point of the sample gases must be lower than the ambient temperature to prevent accidental condensation within the instrument. When water vapor is present, pass the sample through a dehumidifier to reduce the dew point of the sample to less that ambient.

If the sample contains an acid mist, use an acid mist filter, cooler, or similar device to remove all traces of the mist.

NOTE: Teflon® is a registered trademark of E. I. du Pont de Nemours and Company.

3.6.3. Presence of Corrosive Gases

Useful service life of the instrument will be shortened if high concentrations of corrosive gases such as Cl2, F2, HCI, etc. are present in the sample gas.

3.6.4. Gas Temperature

When measuring high temperature gases, ensure that the maximum rating of the instrument (122o F (50o C) is not exceeded.

3.6.5. Flow Rate

The gas entering the instrument should flow at a rate between 0.5 to 2 liters/min.

4. OPERATION

4.1. Description & Function of Components

4.1.1. Model 100F Analyzer Front Panel

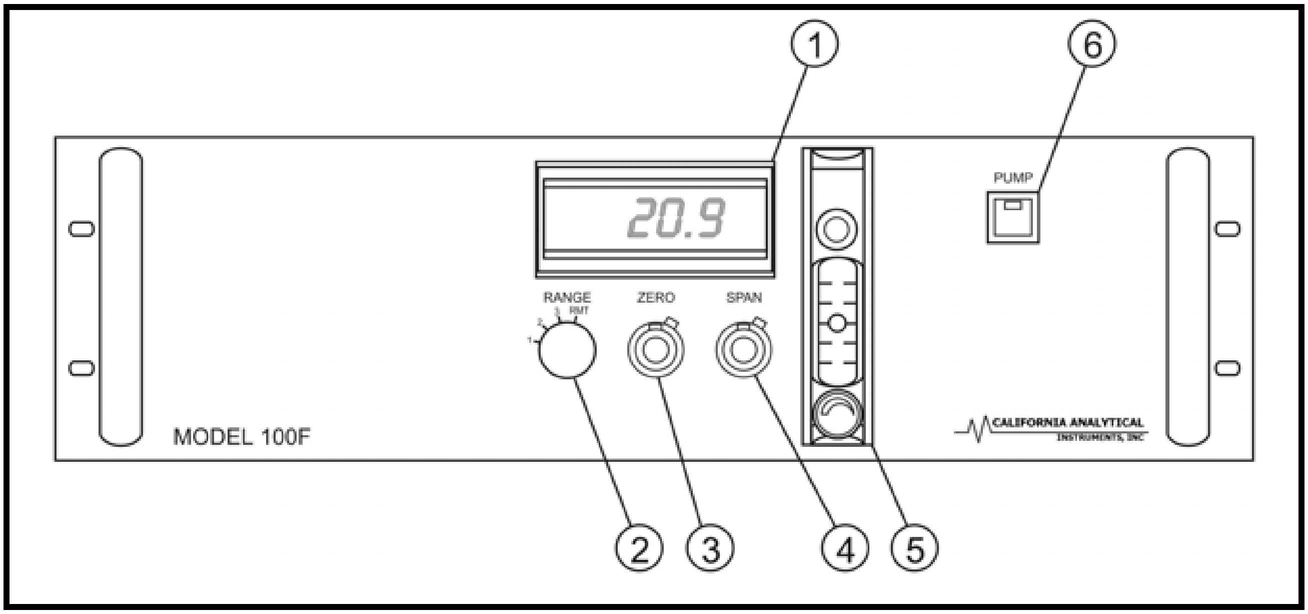


Figure 4-1 Model 100F Analyzer Front Panel

1)	**Indicator Digital Display:**
	Displays output from oxygen sensor and PCB in direct engineering units
2)	**Range Switch:**
	Used for measuring range selection
3)	**Zero Control:**
	Used for adjusting the zero level of the instrument while flowing zero gas
4)	**Span Control:**
	Used for adjusting span of the instrument while flowing span gas
5)	**Flow meter:**
	(Optional)
6)	**Pump Switch:**
	(Optional)

4.1.2. Model 100F Analyzer Rear Panel

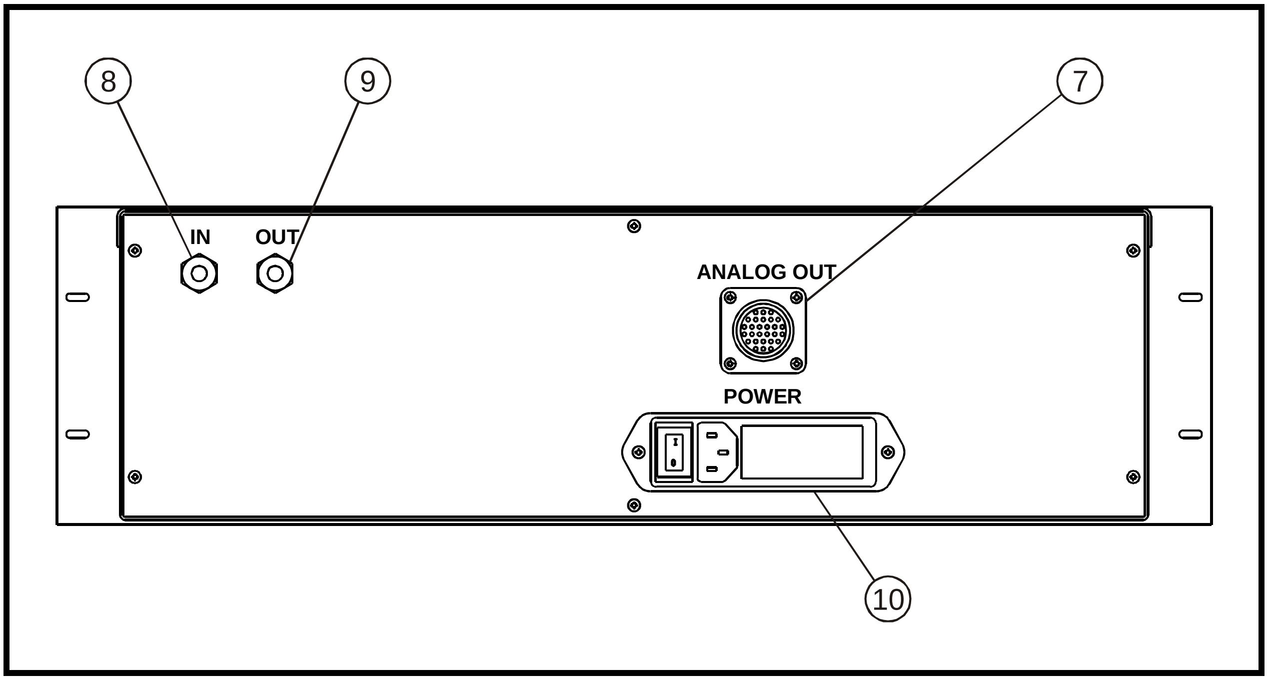


Figure 4-2 Model 100F Analyzer Rear Panel

7)	**Analog Output Connector**
	Control and Output Data
8)	**Sample Gas Inlet:**
	For introducing sample gas into the oxygen analyzer. (¼" tube)
9)	**Sample Gas Outlet:**
	For exhausting sample gas. (¼" tube)
10)	**Power Connector, On/Off Switch, Fuse**

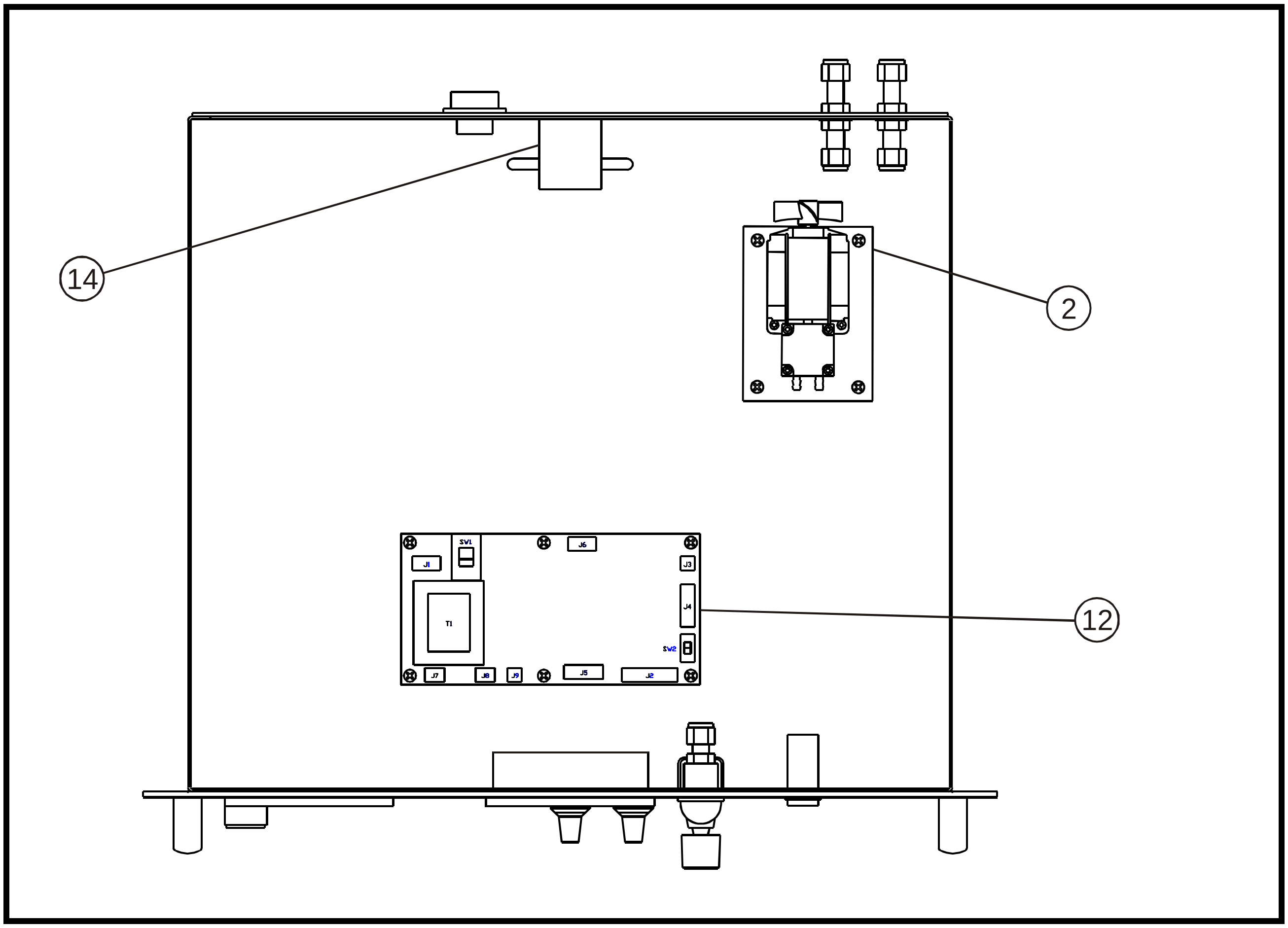


Figure 4-3 Model 100F Interior Layout – With Sample Gas Pump

4.1.3. Interior Layout Component Identification

2)	**Sample Pump:**
	(Optional)
12)	**Circuit Board:**
	(For Fuel Cell)
14)	**Oxygen Sensor.**
	Fuel Cell

4.2. Preparations for Operation

Warning: This is a general-purpose analyzer, and is not suitable for hazardous areas. High-pressure oxygen is very dangerous. Virtually any material will burn in it, possibly explosively. It is essential that all persons using this analyzer are aware of the dangers of oxygen, and take all appropriate precautions.

4.2.1. External Wiring

Make sure that the external wires have been connected as described in Section 3 Installation.

4.2.2. External Piping

Review Section 3, 3-4 through 3-7.

4.3. Power On

Turn ON the power switch located on the rear panel. The digital panel meter should illuminate. Allow the instrument to warm up for approximately 10 minutes. It is preferable, but not essential, that zero gas flow through the instrument during warm-up.

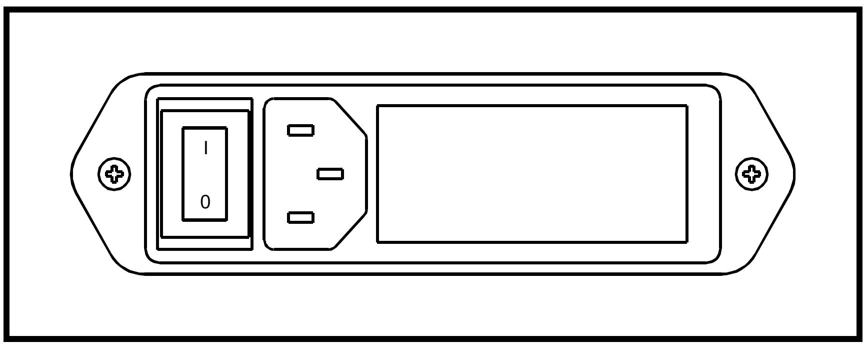


Figure 4-4 AC Power Switch, Connector, and Fuse

4.4. Zero Adjustment

Zero Adjustment: After the 10 minute warm-up period, flow nitrogen or other zero gas through the instrument at a rate of about 1 liter/min. After the reading stabilizes, adjust the zero control on the front panel until the digital meter (or analog output) is exactly at zero. Nitrogen is the preferred zero gas.

4.5. Span Adjustment

Span Adjustment: Flow span gas through the instrument at about 1 liter/min. After the reading stabilizes, adjust the span control on the front panel until the digital meter or analog output is reading the value corresponding to the span gas concentration.

Note: Span gas concentration should not be less than 80% of the range to be spanned.

Note: On the 0-25% range of the analyzer, ambient air may be used as span gas. While flowing ambient air to the analyzer, adjust the span potentiometer to 20.9% O_2 value.

4.6. Start-Up & Routine Maintenance

Prepare and check the sample system. Adjust the flow of sample gas to about 1 liter/min. Select an operating range that is suitable for the oxygen concentration of the sample. The instrument should show a meter indication. The analyzer is designed for extended operation and may be left switched on continuously.

4.7. Zero and Span Calibration Frequency

The zero and span levels should be checked and/or calibrated daily or as often as mandated. (Refer to paragraph 4.3.2).

5. ADJUSTMENTS CHECKS AND REPAIRS

Note: A millivolt generator is required for this procedure.

5.1. Electrical Zero Adjustments

a) Disconnect the plug (P3) from J3 on the printed circuit board (PCB) (P3 is on the end of the cable assembly coming from the oxygen sensor).

b) Connect a millivolt generator between pin no. 1 (-) and pin no. 2 (+) at J3 on the PCB.

c) Adjust simulator for 000.00 mv ± 0.01 mv input as measured at TP-8 (+) and common (-).

d) Adjust Front panel zero potentiometer for 000.00 mv ± 0.01 mv as measured between TP-9 and common.

e) Set front-panel range switch to Range 1.

f) Adjust R8 for 000.00 mv ± 0.01 mv as measured at TP-4.

g) Adjust R12 for 0.000 VDC ± 0.001 VDC as measured between the 0-10 VDC (+) output terminal and common.

h) Adjust R20 for 4 mA ± 0.01 mA across the 4-20 mA output terminals.

i) Verify O_2 display reads 000.0 for all ranges.

j) Repeat steps a) through j) until no further adjustment is required.

5.2. Electrical Span Adjustments

Note: Electrical zero adjustments must be made before electrical span adjustments.

a) Adjust the millivolt generator and the front-panel span potentiometer (as necessary) for exactly 50.00 mv as measured between TP-9 and common.

b) Set front-panel range switch to range 1.

c) Set O_2 display selector switch (SW2) to percent (%) O_2 mode. Display should read 5.0.

d) Adjust R4 for 1.000 VDC ± 0.001 VDC as measured at TP-4.

e) Set range switch to Range 2 and adjust R3 for 0.500 VDC ± 0.001 VDC at TP-4.

f) Set range switch to Range 3 and adjust R32 for 0.200 VDC ± 0.001 VDC at TP-4.

g) Set range selector to range 1 and verify 1.000 VDC ± 0.001 VDC at TP-4.

h) Adjust R33 for 10.00 VDC ± 0.01 VDC as measured across the 0-10 VDC output terminals.

i) Adjust R24 for 20 mA ± 0.01 mA as measured between the 4-20 mA output terminals at TP-4.

j) Repeat steps a) through j) until no further adjustment is required.

Note: the voltages given in steps e) and f) assume the analyzer is configured for the standard ranges of 0-5, 10, and 25% O_2. Consult the factory for the correct voltages required for other non-standard range configurations.

5.3. The Oxygen Sensor

a) Lift the cover from the analyzer by first removing the retaining screws that secure the cover to the chassis.

b) Adjust the front panel potentiometer to its mid-setting. The span dial should indicate 5.0.

c) Flow N_2 into the analyzer at a flow rate of 1 L/min (± 0.5). After the reading stabilizes, adjust the front panel zero potentiometer for an indication of 0.0% O_2.

d) Flow an oxygen span gas into the analyzer at a flow rate of 1.0 L/min (± 0.5).

Locate R27 on the printed circuit board and adjust it as required to obtain (obtain what?) The output of the oxygen sensor is a DC output of approximately –10 millivolts at 20.9 % O2. As the sensor is consumed, it gradually becomes consumed and its voltage output slowly diminishes toward 0 millivolts. Periodic zero and span calibration should be preformed to ensure accurate oxygen measurement over the sensor's life span. When the front-panel span potentiometer runs out of adjustment-capability, it will be necessary to perform a coarse-span-adjustment.

Coarse-Span- Adjustment: A digital display that is equivalent to the value of the span gas being used

5.3.1. Sensor Checks

a) Connect a DC voltmeter to TP-8 (+) and TP-2 common.

b) Introduce a span gas of 21%.

c) The measured voltage at TP-8 should be between –3 mv and –13 mv.

d) Whenever the measured voltage is less than –3 mv (or whenever the signal stability diminishes) the sensor should be replaced.

Note: A new sensor has a specification of –10 mv (± 3 mv) when measuring 21% O^2 at sea level. A correction factor (cf) must be applied to this specification whenever the measuring site is at higher elevations.

$$Corrected\ output = -10mv \times cf \quad Where: cf = \frac{site\ barometric\ pressure\ ("hg)}{30"hg}$$

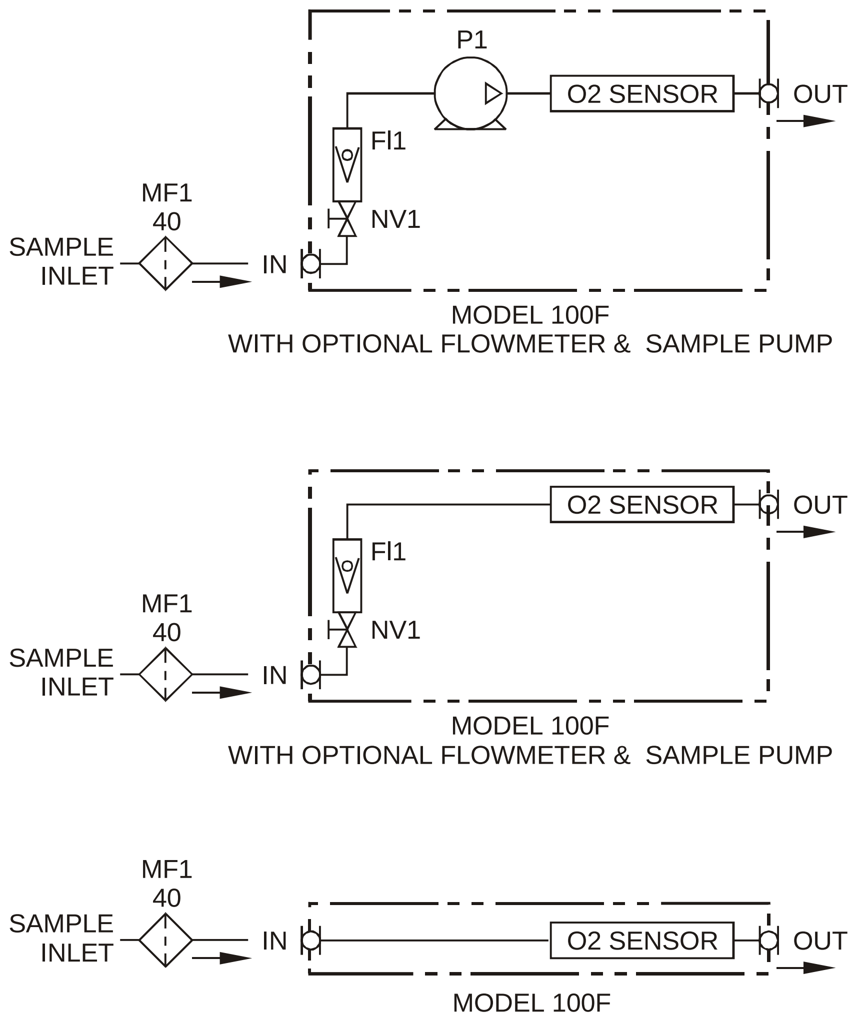
$$Where\ "hg = inches\ of\ mercury$$

5.3.2. Sensor Replacement

a) Refer to section 2.4 of this manual for selection of the proper type of replacement sensor.

b) After replacing the sensor it will be necessary to perform a "coarse span adjustment" (refer to paragraph 5.3.1).

6. Mechanical & Electrical Drawings



4. IN-LINE FILTER (MF1) CUSTOMER SUPPLIED.

3. INLET & OUTLET CONNECTIONS ARE 1/4" OD TUBE.

2. SAMPLE FLOW RATE: 0.5 L/min to 2.0 L/min.

1. SAMPLE PRESSURE: 1-5 PSIG (NOT REQUIRED WITH OPTIONAL SAMPLE PUMP).

NOTES: UNLESS OTHERWISE SPECIFIED.

Figure 6-1 Chemical fuel cell sample flow

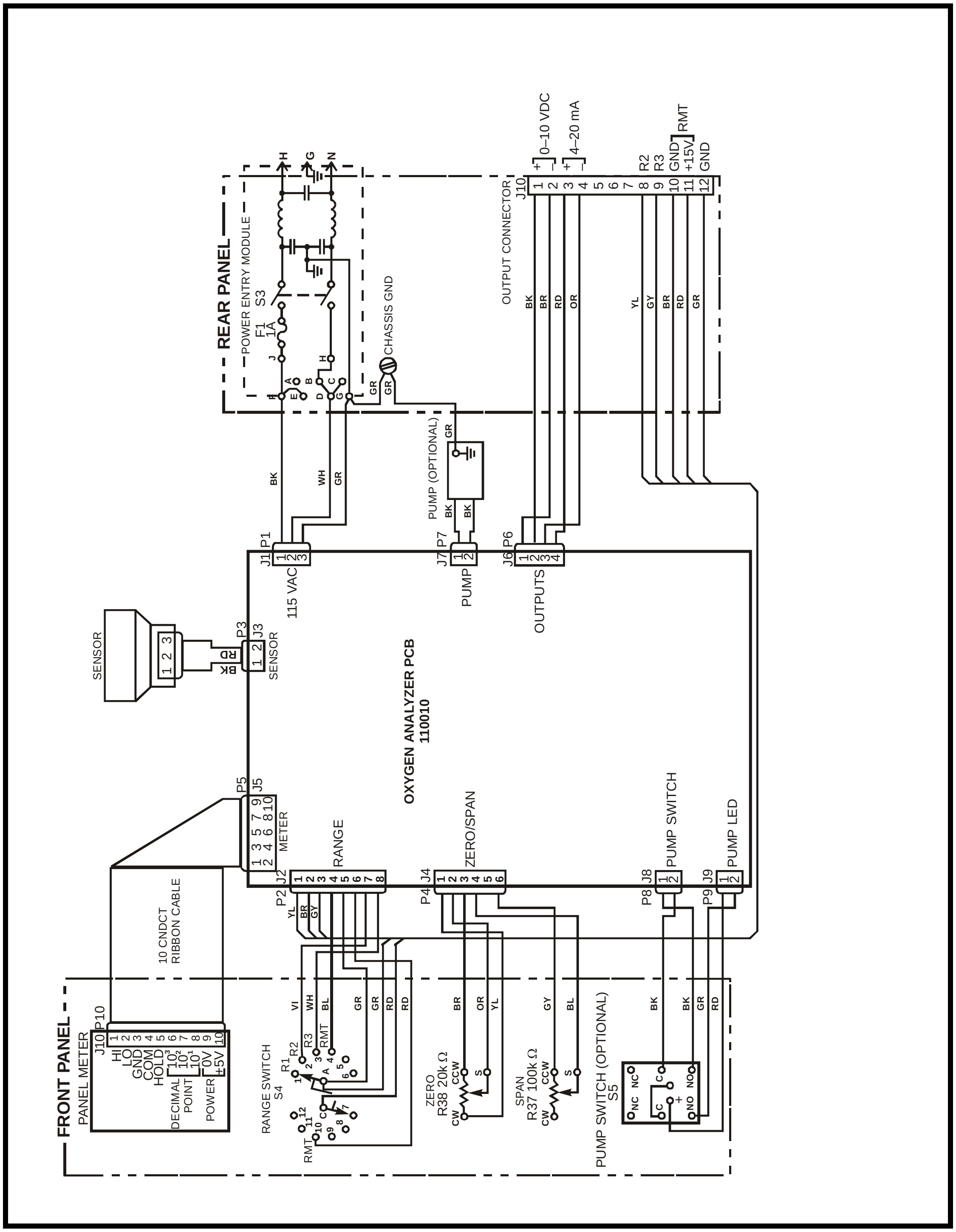


Figure 6-2 Fuel cell wiring diagram

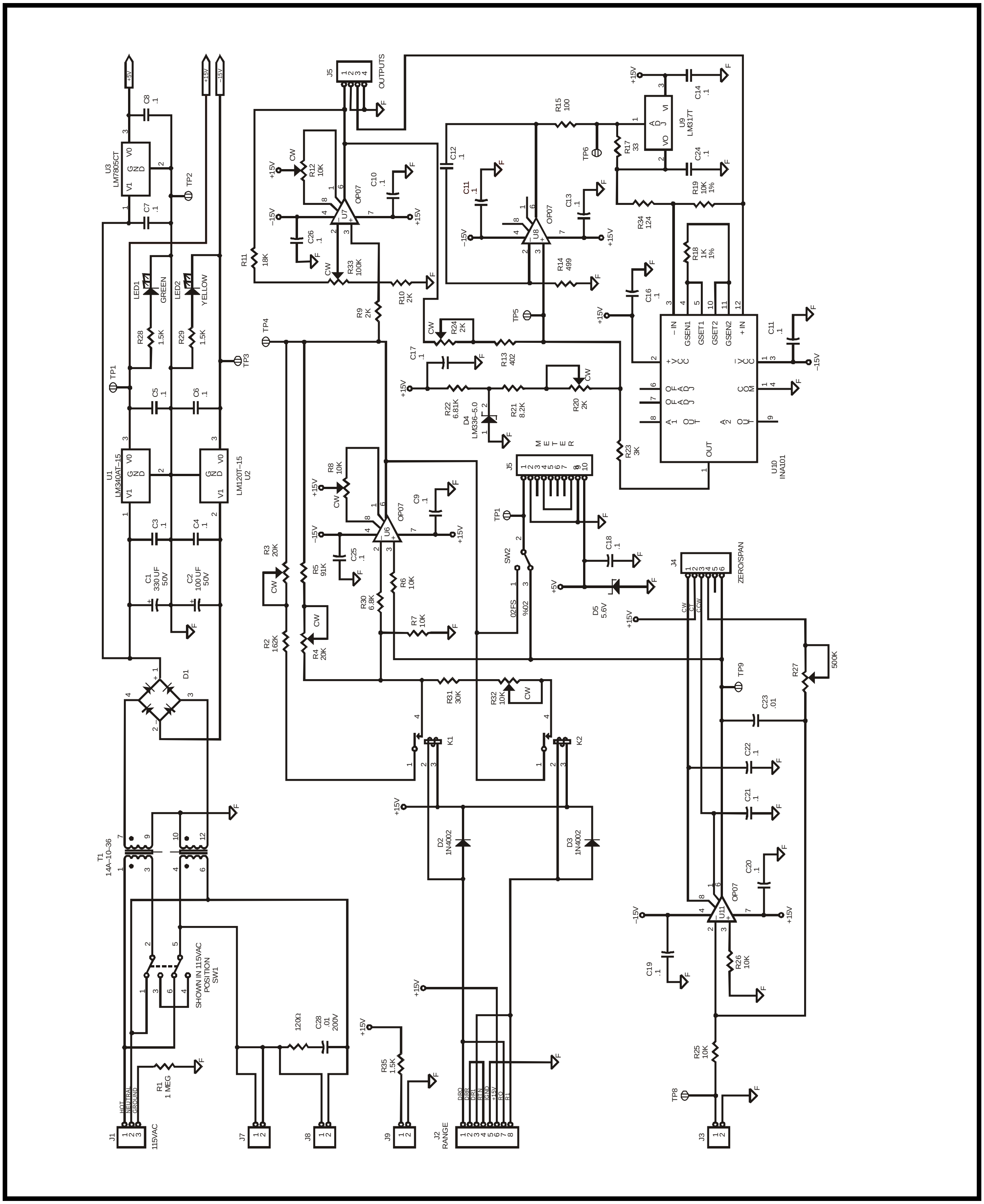


Figure 6-3 Fuel Cell O2 PCB Schematic Diagram

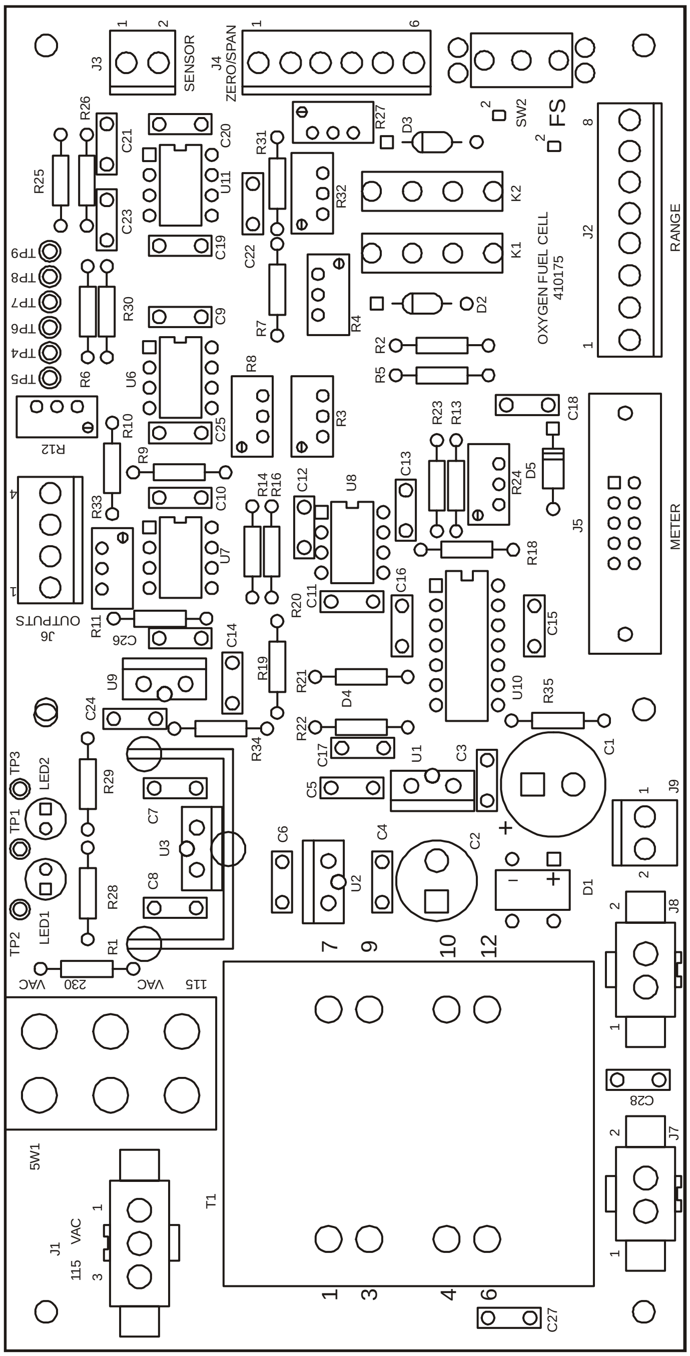


Figure 6-4 Model 100F component locator