GE

Measurement & Control Solutions

Gas Analysis

FGA 300V(X)

Vertical Flue Gas Analyzer

User's Manual

imagination at work

910-105 Rev. F
August 2011

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Information Paragraphs

- **Note** paragraphs provide information that provides a deeper understanding of the situation, but is not essential to the proper completion of the instructions.
- **Important** paragraphs provide information that emphasizes instructions that are essential to proper setup of the equipment. Failure to follow these instructions carefully may cause unreliable performance.
- **Caution!** paragraphs provide information that alerts the operator to a hazardous situation that can cause damage to property or equipment.
- **Warning!** paragraphs provide information that alerts the operator to a hazardous situation that can cause injury to personnel. Cautionary information is also included, when applicable.

Safety Issues

WARNING! It is the responsibility of the user to make sure all local, county, state and national codes, regulations, rules and laws related to safety and safe operating conditions are met for each installation.

Auxiliary Equipment

Local Safety Standards

The user must make sure that he operates all auxiliary equipment in accordance with local codes, standards, regulations, or laws applicable to safety.

Working Area

WARNING! Auxiliary equipment may have both manual and automatic modes of operation. As equipment can move suddenly and without warning, do not enter the work cell of this equipment during automatic operation, and do not enter the work envelope of this equipment during manual operation. If you do, serious injury can result.

WARNING! Make sure that power to the auxiliary equipment is turned OFF and locked out before you perform maintenance procedures on the equipment.

Qualification of Personnel

Make sure that all personnel have manufacturer-approved training applicable to the auxiliary equipment.

Personal Safety Equipment

Make sure that operators and maintenance personnel have all safety equipment applicable to the auxiliary equipment. Examples include safety glasses, protective headgear, safety shoes, etc.

Unauthorized Operation

Make sure that unauthorized personnel cannot gain access to the operation of the equipment.

Environmental Compliance

Waste Electrical and Electronic Equipment (WEEE) Directive

GE Measurement & Control Solutions is an active participant in Europe's *Waste Electrical and Electronic Equipment* (WEEE) take-back initiative, directive 2002/96/EC.

The equipment that you bought has required the extraction and use of natural resources for its production. It may contain hazardous substances that could impact health and the environment.

In order to avoid the dissemination of those substances in our environment and to diminish the pressure on the natural resources, we encourage you to use the appropriate take-back systems. Those systems will reuse or recycle most of the materials of your end life equipment in a sound way.

The crossed-out wheeled bin symbol invites you to use those systems.

If you need more information on the collection, reuse and recycling systems, please contact your local or regional waste administration.

Visit **http://www.ge-mcs.com/en/about-us/environmental-health-and-safety/1741-weee-req.html** for take-back instructions and more information about this initiative.

Chapter 4. Calibration

Chapter 5. Troubleshooting

Chapter 6. Parts Replacement

Chapter 7. Specifications

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Chapter 1. General Information

1.1 Overview

Process plant managers are usually looking for ways to reduce expense and increase profitability. When combustibles are burned as part of the operation, and that combustion is incomplete (allowing unburned fuel to escape), costs go up and profits go down.

A reliable system for analyzing flue gas can provide the necessary information to:

- adjust the flow of oxygen,
- increase the efficiency of the combustion, and
- result in huge cost savings for the overall operation.

To meet these specific needs, GE the *FGA 300V(X) Flue Gas Analyzer* which monitors the efficiency of a furnace or boiler by measuring excess oxygen and/or ppm_v unburned combustibles in the flue gases.

To measure these two parameters, the FGA 300V(X) uses:

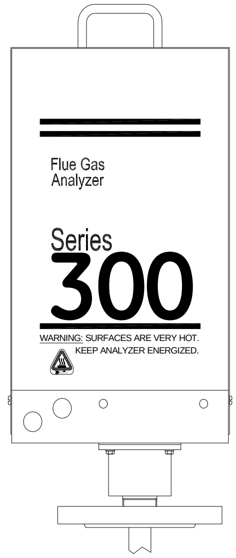
- a zirconium oxide (zirconia) *oxygen* sensor
- a platinum-catalyst *combustibles* detector

The oxygen sensor measures excess oxygen or, in a fuel rich environment, equivalent combustibles. The combustibles detector monitors partially combusted fuel, only in the presence of excess oxygen (i.e. there must be enough oxygen present to burn the fuel). Each FGA 300V(X) analyzer may be equipped with one or both of these devices.

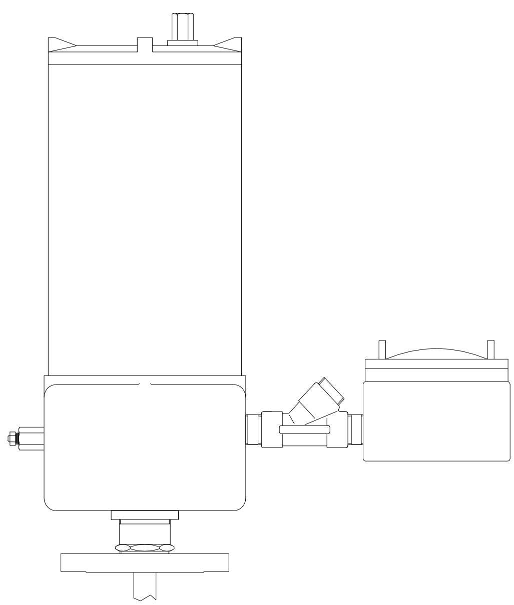
The FGA 300V(X) Vertical Flue Gas Analyzer is available in both the *standard (weatherproof) FGA 300V* and the optional *explosion-proof (flameproof) FGA 300VX*. Physically, the FGA 300V(X) standard and explosion-proof versions look very different from each other. However, the internal components and operation are the same for both versions. See Figure 1 on page 2 for illustrations of the standard and explosion-proof models of the main analyzer unit.

Both versions of the FGA 300V(X) consist of at least two enclosures: the larger of the two is the *Main Analyzer Unit* and the smaller enclosure is the remote *Furnace Temperature Control (FTC) Box*. In addition, a *Display Electronics Console* may be included in the system.

Overview (cont.)



Standard (Weatherproof) Model 300V - Front View



Explosion-Proof (Flameproof) Model 300VX - Side View

Figure 1: Main Analyzer Unit

1.2 Description of System

The Main Analyzer Unit houses the *sample system*, which consists of the components shown in Figure 2. The functions of the sample system components are as follows:

- a *heater block* with removable *thermostat* and *cartridge heaters* to prevent acid components of the flue gas from condensing in the sample system and causing corrosion
- a zirconium oxide (zirconia) *oxygen sensor*
- a platinum-catalyst *combustibles detector* to monitor imperfect combustion of the fuel by burning it in the presence of excess oxygen
- a temperature-controlled *sensor furnace* to maintain the oxygen sensor at a stable operating temperature and to act as the engine for convective sampling
- a *convection loop* to circulate the sample gases through the sample system

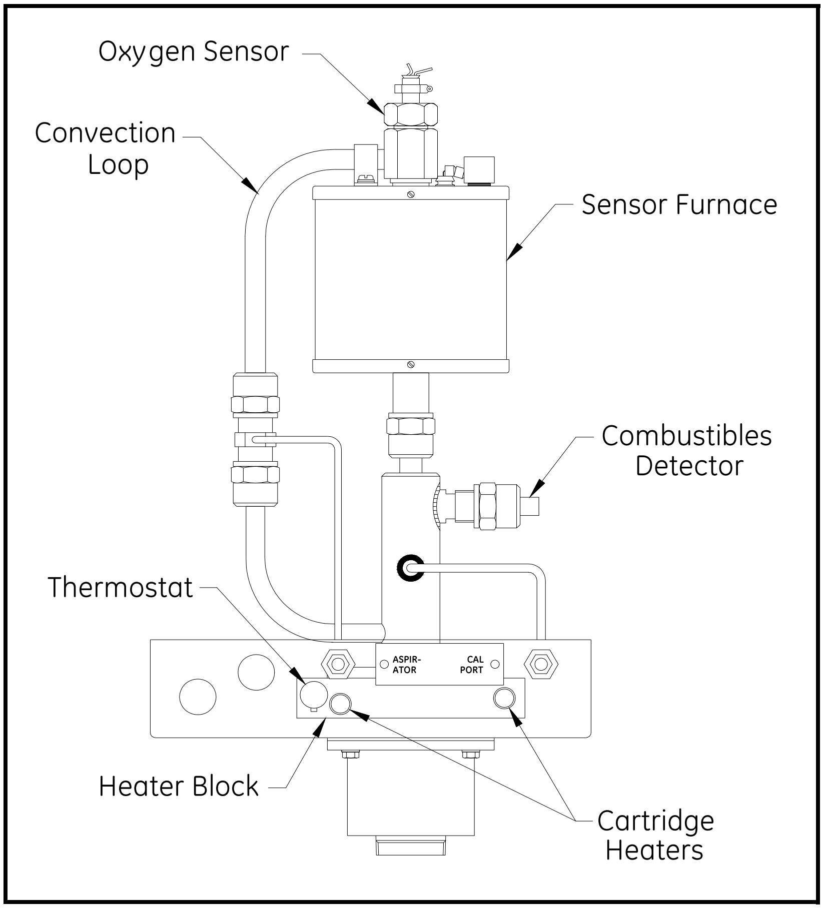
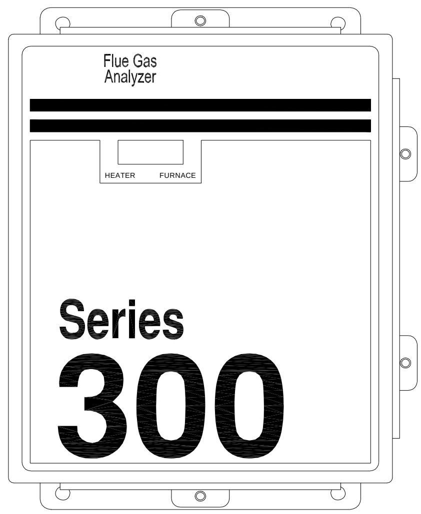


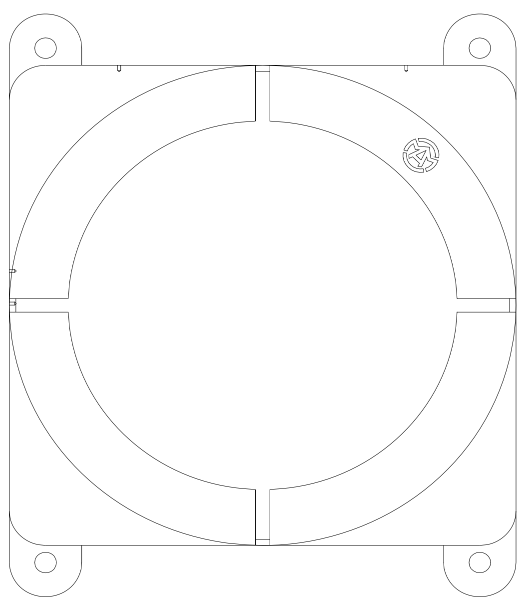
Figure 2: Sample System

1.2 Description of System (cont.)

The FTC Box contains a furnace temperature control board to maintain a constant sensor furnace temperature. This temperature stability improves the accuracy of oxygen analysis and extends the life of the oxygen sensor. Locate the FTC Box as close to the Main Analyzer Unit as possible, as long as the ambient temperatures is –25° to 70°C (–13° to 158°F). The FTC Box can also be ordered as either a standard (weatherproof) model or an explosion-proof (flameproof) model, as shown in Figure 3.



Standard (Weatherproof) Model



Explosion-Proof (Flameproof) Model

Figure 3: FTC Box Enclosures

1.2 Description of System (cont.)

The 300D *Display Electronics Console* is available for use with the FGA 300V(X). The Display Console can display a variety of system parameters. Figure 4 shows a Display Console with both oxygen and combustibles outputs.

Note: *A Display Console is required for any FGA 300V(X) analyzer equipped with a combustibles detector.*

The Display Console performs the following functions:

- amplifies the oxygen sensor and combustibles detector outputs
- linearizes the oxygen signal
- shows percent oxygen on a four digit LED display
- shows ppm_V combustibles on a 4 1/2 digit LED display
- provides a stoichiometric interlock at 100 ppm O_2 (optional)

Note: *This device triggers an alarm if the excess oxygen level drops below 100 ppm_v or the combustibles exceeds 20,000 ppm_v.*

- provides an indication of oxygen sensor resistance
- provides an indication of convection loop plugging/blockages
- provides an indication of oxygen sensor aging.

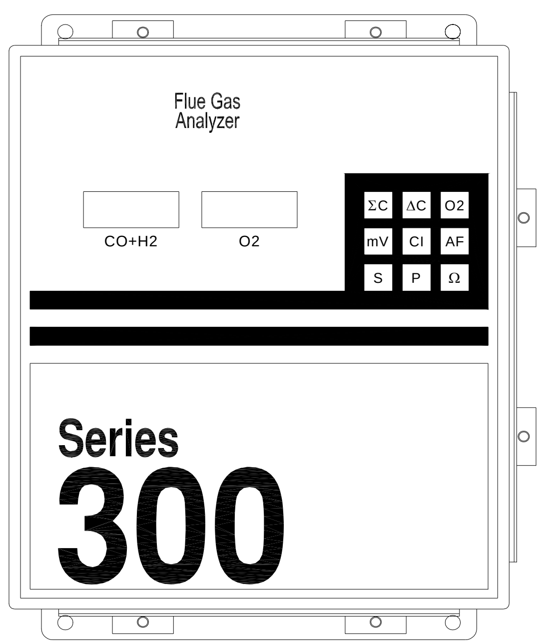


Figure 4: Display Console with O_2 & Combustibles

1.3 Principles of Operation

Ideally, every furnace/burner should mix a precise ratio of air to fuel, and the mixture should burn efficiently to yield only heat, water vapor and carbon dioxide. However, because of burner aging, imperfect air to fuel mixtures and changing firing rates, this rarely happens. Monitoring the actual efficiency of the combustion process is easily accomplished with the FGA 300V(X).

A flue gas sample is drawn into the probe by gaseous diffusion and a gentle convective flow. The sample passes through the probe and into the sample system, where it is maintained at a temperature above 200°C (392°F) by the heater block. In the presence of oxygen, this sample temperature is high enough to burn any partial combustion products that reach the active (platinum-coated) element of the combustibles detector. The resulting temperature differential between the two combustibles detector elements is related to the concentration of partial combustion products in the test sample.

Note: *The sampled gas is maintained above 200°C (392°F) to prevent flue gas acids from condensing in the analyzer and causing corrosion.*

The sample then passes into the sensor furnace, which heats the sample gas and the oxygen sensor to either 770°C (1,418°F) or 812°C (1,494°F) [a temperature above 650°C (1,202°F) is required for proper operation of the oxygen sensor]. The oxygen sensor is covered with a platinum catalyst that burns all remaining combustibles, enabling the sensor to measure the excess oxygen (or equivalent combustibles) in the flue gas.

Note: *A sensor furnace temperature of either 770°C (1,418°F) or 812°C (1,494°F) is standard for the FGA 300V(X). Consult with a GE engineer to determine which temperature is best suited to your situation.*

The sensor furnace also generates the convective flow that circulates the sample gas through the sample system. The hot sample gas in the sensor furnace rises out of the furnace and cools, as it is pushed from behind by the hot gases still in the furnace. The cooled sample gases then drop down the other branch of the convection loop and into the annular space between the probe and probe sleeve, where they are carried away by the gas flow in the flue.

1.3.1 The Zirconia Oxygen Sensor

The inside and outside of the zirconia oxygen sensor (see Figure 5) are coated with porous platinum, forming two electrodes. The sample gas flows past the outside of the sensor, while atmospheric air circulates freely on the inside of the sensor. This atmospheric air is used as the reference gas for making oxygen measurements. See Figure 6 on page 7.

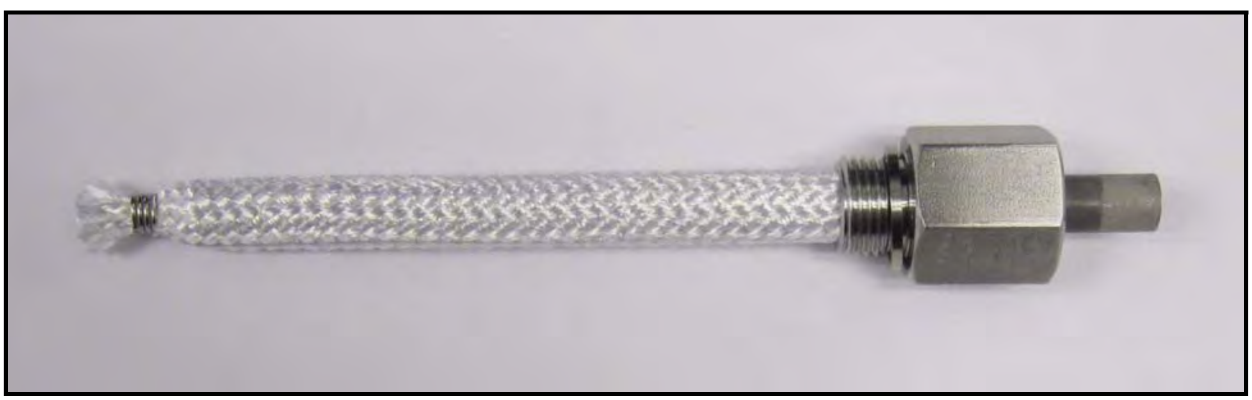


Figure 5: Zirconia Oxygen Sensor

1.3.1 The Zirconia Oxygen Sensor (cont.)

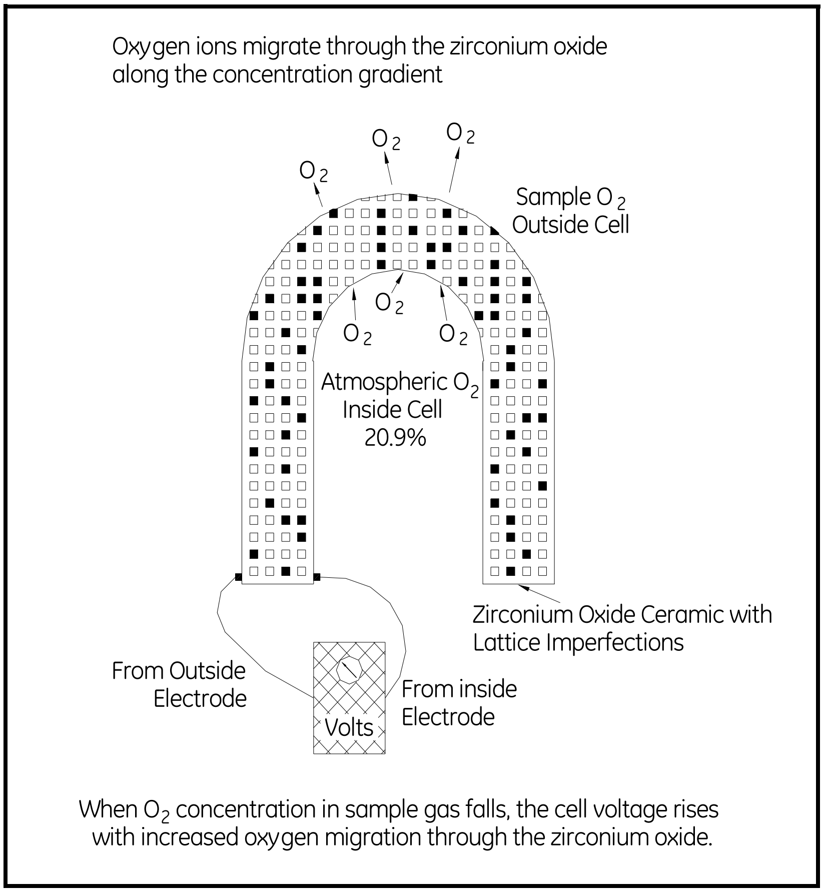


Figure 6: Oxygen Migration in the Zirconia Sensor

At the operating temperature of the oxygen sensor, the atmospheric reference oxygen is electrochemically reduced at the inner electrode, and the resulting oxygen ions seek to equalize with the lower oxygen concentration on the sample side of the cell by migrating through the porous ceramic toward the outer electrode. At the outer electrode they give up electrons to become oxygen molecules again, and are swept away by the sample gas flow.

The lower the concentration of oxygen in the flue gas sample, the greater the rate of ion migration through the ceramic, and the higher the cell voltage due to electron exchange at the electrodes. The cell voltage rises logarithmically as the amount of oxygen in the flue gas falls, allowing the accurate measurement of very low levels of excess oxygen in the flue gas.

1.3.2 Platinum-Catalyst Combustibles Detector

The combustibles detector consists of two platinum thermistors mounted side by side in the sample stream. One thermistor, the *active element*, is used to detect/react partial combustion products, while the other thermistor, the *reference element*, provides a baseline. The active element is coated with a black platinum catalyst and the reference element has a white inert surface. As the sample gas passes over the active element, the platinum catalyst causes any combustibles to burn (in the presence of excess oxygen), thereby raising the temperature of the active element above that of the reference element. See Figure 7.

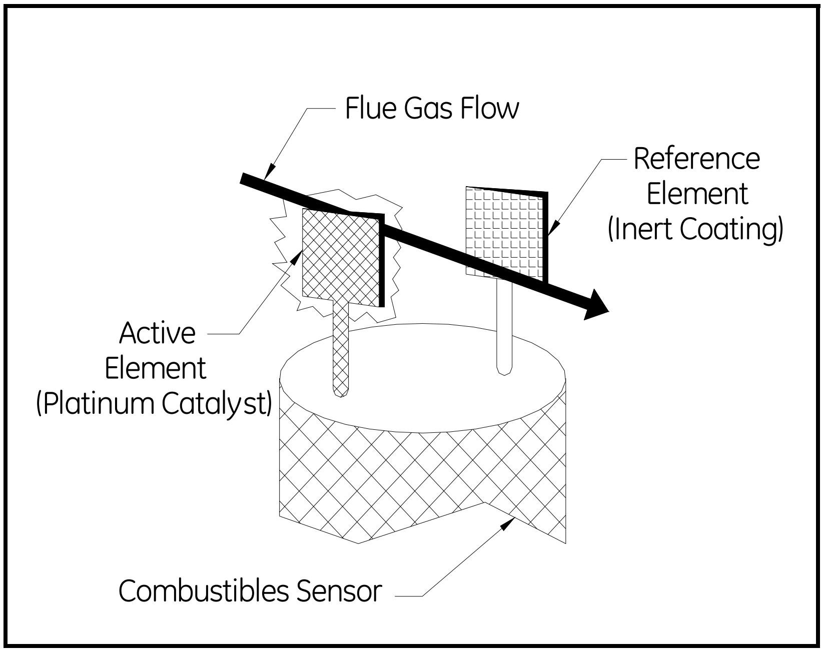


Figure 7: Combustibles Detector Elements

The resulting temperature differential between the active and reference elements is proportional to the concentration of combustibles in the sample, and a corresponding resistance change is then converted into a reading of parts per million by volume (ppm_V) of combustibles.

Chapter 2. Installation

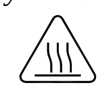
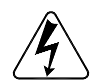
2.1 Overview

This chapter provides a general description of the standard (weatherproof) FGA 300V and explosion-proof (flameproof) FGA 300VX, and gives directions on how to install, wire, and set up each model for operation.

Note: *If more than one analyzer system is being installed, be aware that each system is a matched set (i.e., each Remote FTC Box, probe, probe sleeve and Display Console must be matched to a specific analyzer). Refer to tags on the box, probes, sleeves, displays and analyzers in order to match the units correctly.*

IMPORTANT: *For compliance with the European Union's Low Voltage Directive (73/23/EEC), the standard 300V requires an external power disconnect device such as a switch or circuit breaker. The disconnect device must be marked as such, clearly visible, directly accessible, and located within 1.8 m (6 ft) of the unit. Because the sensor furnace power feed in the remote FTC Box must also be interrupted, a 4-pole disconnect device is required. This does not apply to the flameproof 300VX.*

IMPORTANT: *These symbols indicate Caution - dangerously hot surfaces and risk of electric shock, respectively.*

WARNING! Power up the FGA 300V(X) as quickly as possible after installation. If the analyzer is left installed without power, the unit's components become susceptible to acid condensation that will cause corrosion.

Be sure to observe all installation limits and precautions described in this chapter. Pay particular attention to the temperature limitations for the Furnace Temperature Control (FTC) Box.

WARNING! To ensure safe operation of the FGA 300V(X), the unit must be installed and operated as described in this manual. Also, be sure to follow all applicable local safety codes and regulations for installing electrical equipment.

All procedures should be performed by trained service personnel.

2.2 Physical Description

2.2.1 Standard (Weatherproof) Enclosure

The standard (weatherproof) configuration consists of two separate boxes. The larger box is the Main Analyzer Unit, which contains the manifold and the sample system (see Figure 8).

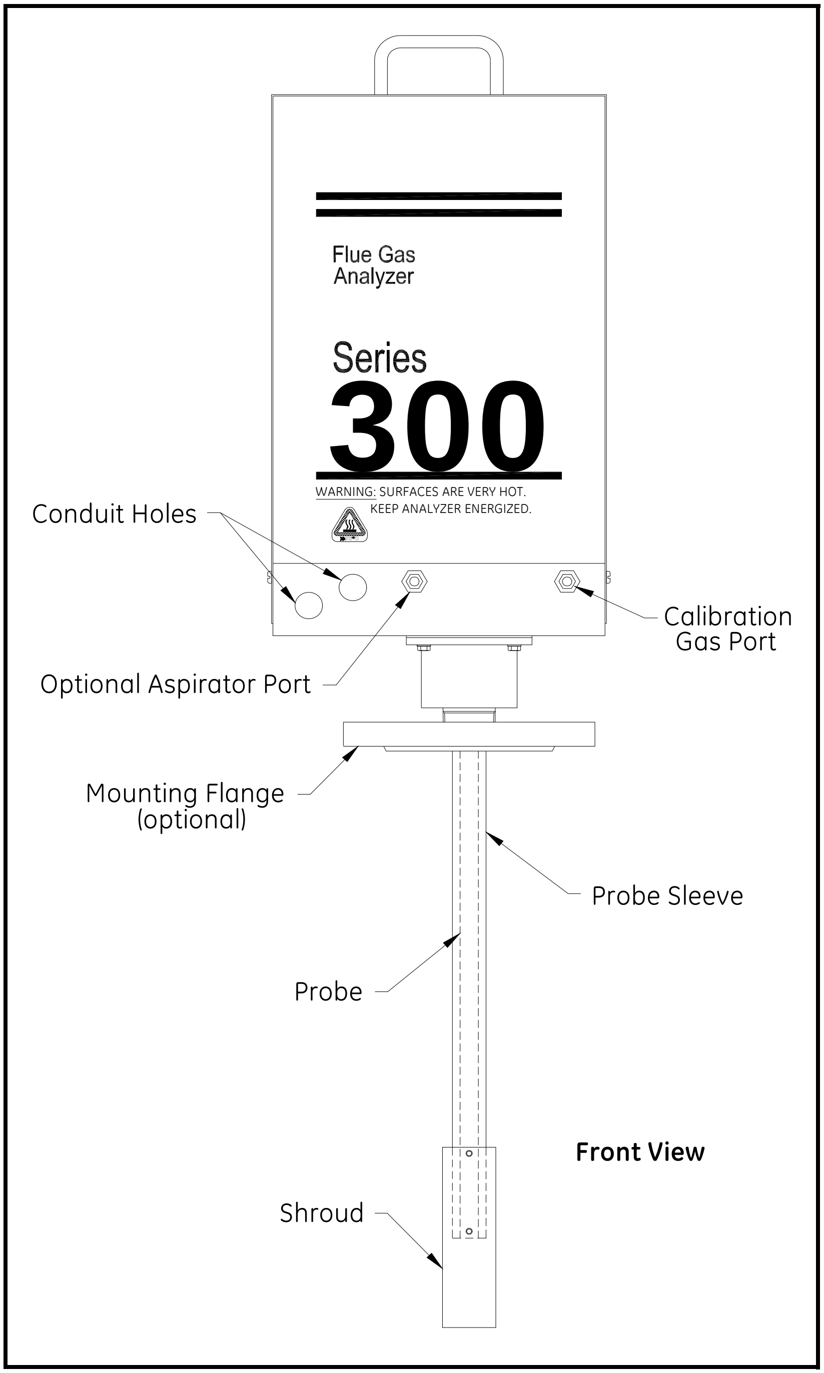


Figure 8: Standard (Weatherproof) Model

2.2.2 Standard Sample System

The sample system consists of a sampling inlet tube, a heater block with thermostat, an oxygen sensor, a sensor furnace, a convection loop to circulate the sample gas, and, if ordered, a combustibles detector (see Figure 9).

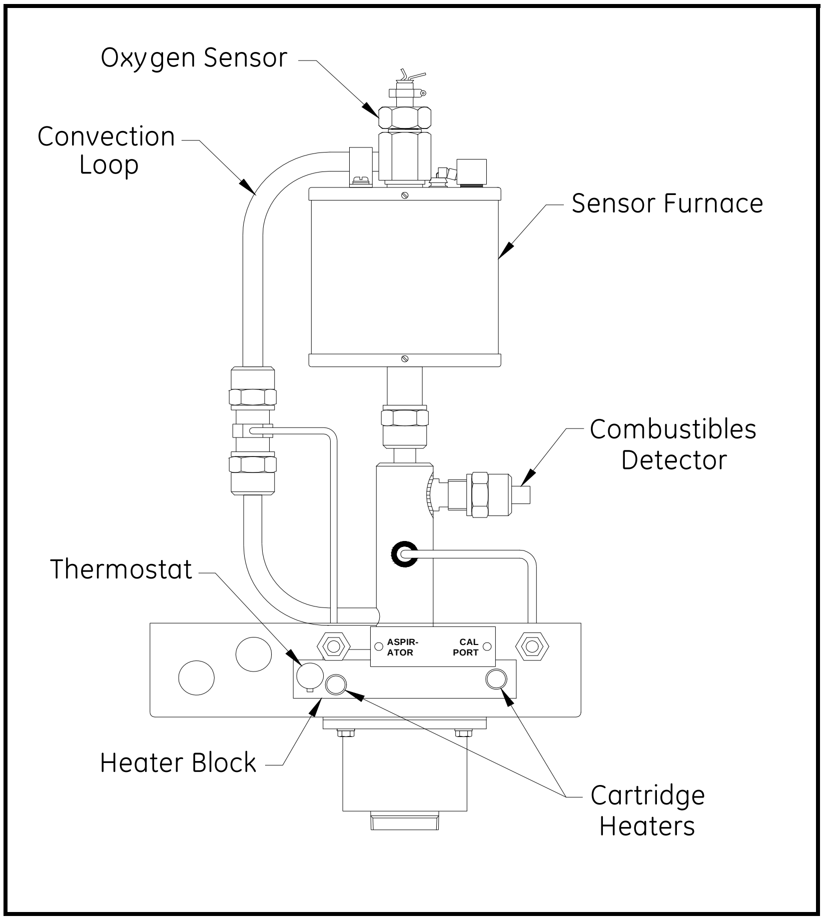
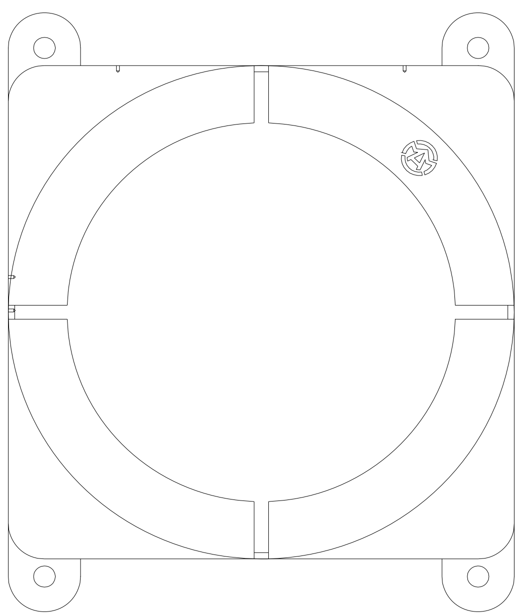


Figure 9: Standard Sample System

2.2.3 Remote FTC Box

The other enclosure is the Remote FTC Box. It is mounted separately from the Main Analyzer Unit and contains the furnace temperature control (FTC) board (see Figure 10). The FTC Box can be ordered in either a standard (weatherproof) or explosion-proof (flameproof) enclosure.

Standard (Weatherproof) Model



Explosion-Proof (Flameproof) Model

Figure 10: FTC Box Enclosures

2.2.4 Explosion-Proof (Flameproof) Enclosure

The explosion-proof (flameproof) FGA 300VX consists of two attached boxes: a large Main Analyzer Unit that contains the manifold assembly and the sample system; and a smaller Accessory Box (mounted behind the Main Analyzer Unit) that contains the analyzer terminal block. See Figure 11. The Remote FTC Box (shown in Figure 10 on page 12) is also included as part of the explosion-proof (flameproof) system configuration.

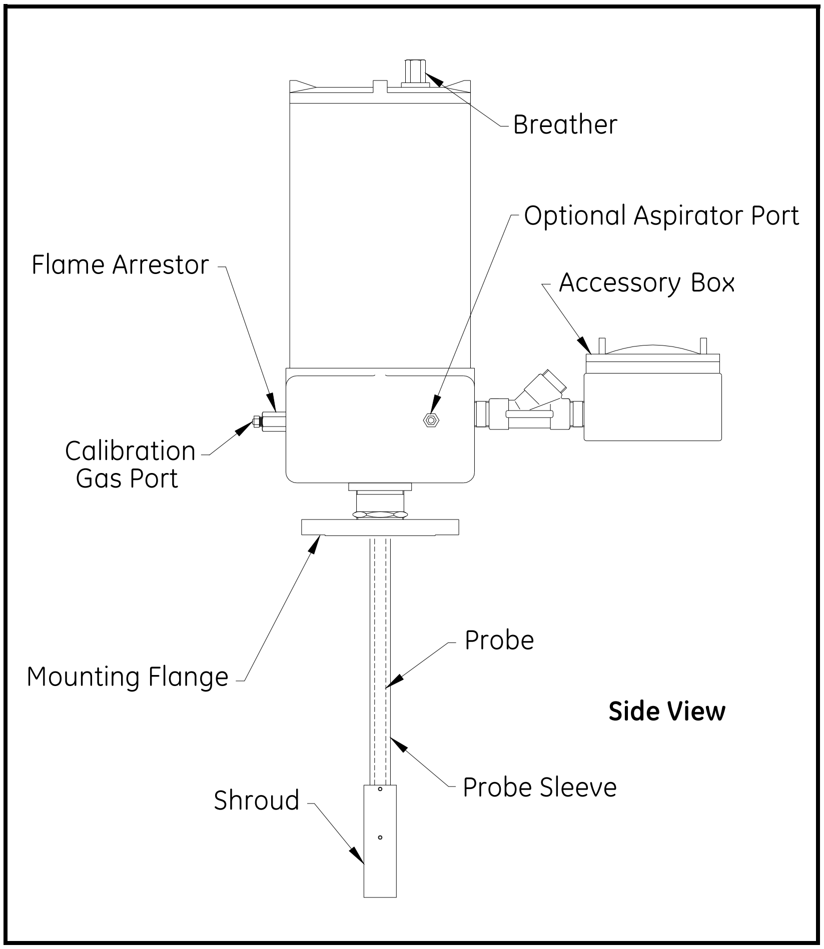


Figure 11: Explosion-Proof (Flameproof) Model

2.2 Physical Description (cont.)

Included as part of the analyzer are the 1/4” NPT probe and the 3/4” NPT probe sleeve. The probe and probe sleeve carry the sample gas into and out of the analyzer (see Figure 12).300V(X) units intended for operation at temperatures below 950°C (1,742°F) include a 1-1/4” shroud attached to the end of the probe sleeve.

WARNING! **Never attempt to attach a shroud to any unit with a non-metallic probe assembly.**

Note: *A short section of pipe (for the furnace or boiler wall), two flanges (one for the mounting site and one for the analyzer), studs, nuts, plus a suitable gasket are required for mounting.*

WARNING! **Gas flow must be perpendicular to the probe sleeve or, at worst, angled downward and away from the open end of the probe sleeve. Never angle the gas flow into the open end of the probe sleeve (see Figure 12).**

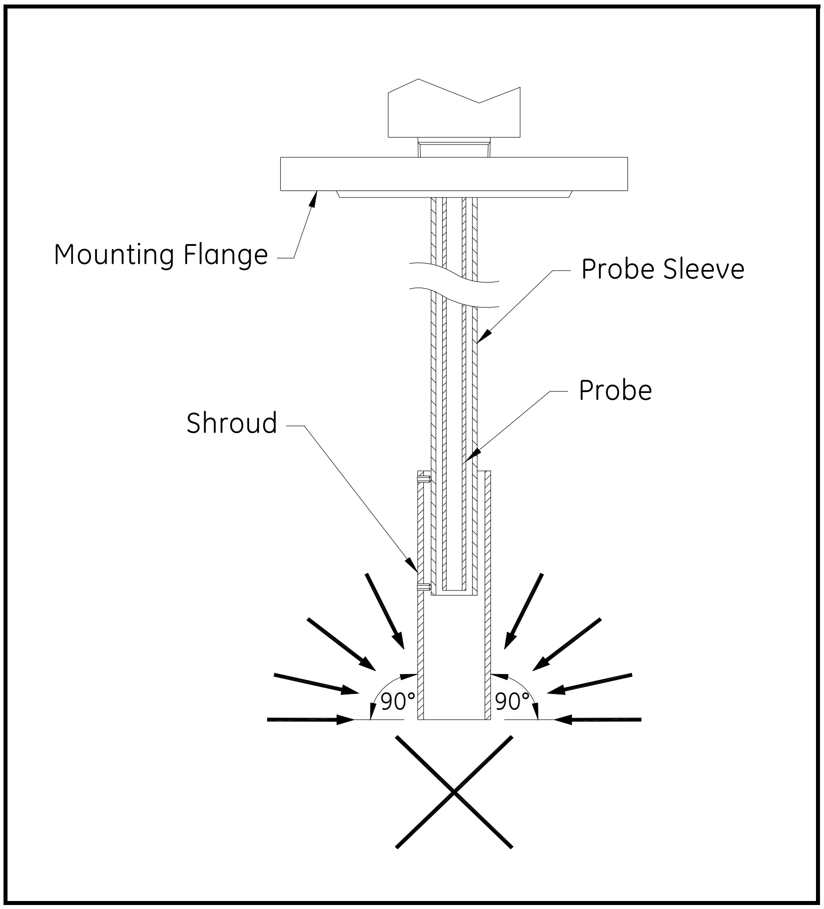


Figure 12: Permitted Gas Flow Angles

2.2 Physical Description (cont.)

The standard (weatherproof) FGA 300V is equipped with a short section of 1-1/2” NPTM threaded pipe projecting from the manifold assembly at the bottom of the analyzer (see Figure 13). On the explosion-proof (flameproof) FGA 300VX the pipe is 2” NPTM. Use this pipe to attach a user-supplied flange or fixing-plate, or to install the analyzer using one of the flanges available from the factory.

Note: *On request, the factory can supply the analyzer as a flange mounted unit. Standard available options are 3”-300 lb ANSI, 4”-150 lb ANSI and DN80 PN16 flanges.*

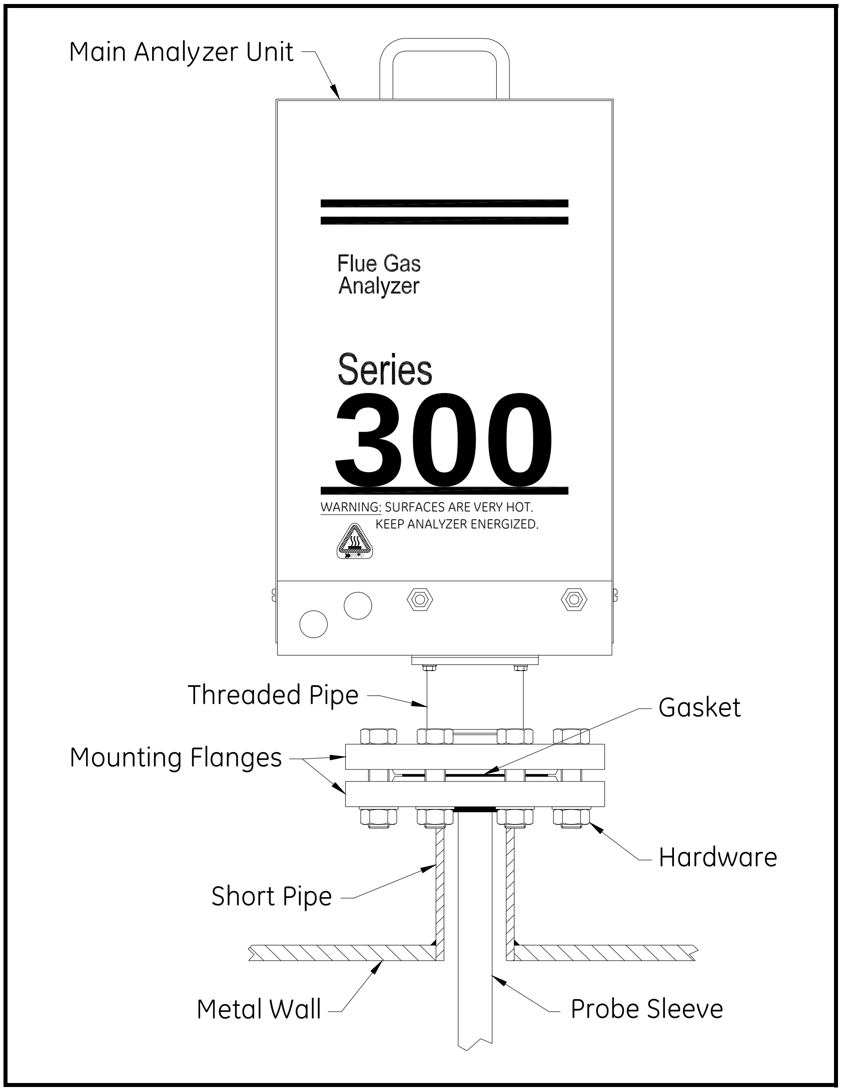


Figure 13: A Typical Flange-Mounted Unit

2.2 Physical Description (cont.)

The FGA 300V(X) is wired at the factory for one of four possible operation voltages:

- 100 VAC
- 110/120 VAC
- 220 VAC
- 240 VAC

Note: *Be sure that the line voltage at the intended installation site corresponds to the factory preset voltage setting.*

CAUTION! **To change the voltage setting, contact the factory for instructions and parts. DO NOT make this adjustment on site without first contacting the factory.**

2.3 Installation Site

Install the Main Analyzer Unit in the furnace or boiler ceiling or in the top of a horizontal flue duct.

2.3.1 Selecting The Site

Ideally, the probe and probe sleeve should extend approximately 1 ft (30.5 cm) into the flue. Also, the flue gas flow direction should be perpendicular to the probe sleeve or, at worst, angled downward and away from the open end of the probe sleeve (see Figure 12 on page 14).

WARNING! Never allow the flue gas flow to be angled upward and directly into the open end of the probe sleeve.

- *Furnaces:* Locate the analyzer close to the combustion zone, typically within the radiant section and always before the convection section. Because of the high temperatures in such a location, probe material selection should be a primary concern.

Note: *If the ambient temperature near the probe can exceed 950°C (1,750°F), a high temperature probe assembly is required.*

- *Boilers:* The analyzer is best located downstream of the main heater and just before the economizer air heater, if there is one. The analyzer should not be placed downstream of any air heater because of possible air leaks, which will cause inaccurate readings.

In general, the sample point should be in an area of *high turbulence*, which will ensure a good homogeneous mixture of the flue gases. Conditions to be avoided would include *air leaks* upstream of the sample point and *dead spaces* in the vicinity of the sample point.

2.3.2 Preparing the Site

Preparation of the installation site should include the following steps (see Figure 14 on page 18):

1. At the chosen analyzer location on the furnace or boiler ceiling or on top of a horizontal flue duct, drill a hole of the proper diameter to accommodate a short length of pipe having at least a 1.875 in. (4.8 cm) inside diameter. A length of 2 in. diameter Schedule 80 pipe is recommended for this purpose.
2. Weld the short pipe into the hole. The pipe should be long enough to provide at least a 4 in. (10 cm) clearance between the mounting surface and the mating flange installed in the next step.

Note: *For installation in a masonry wall, the short pipe should extend through the wall to prevent the probe and sleeve from becoming trapped, if the wall should crumble.*

2.3.2 Preparing the Site (cont.)

3. Weld a mating flange onto the pipe section. This flange, as well as a mounting flange for the Main Analyzer Unit and a suitable flange gasket, may be ordered with the FGA 300V(X) to ensure a proper match of the mounting components.

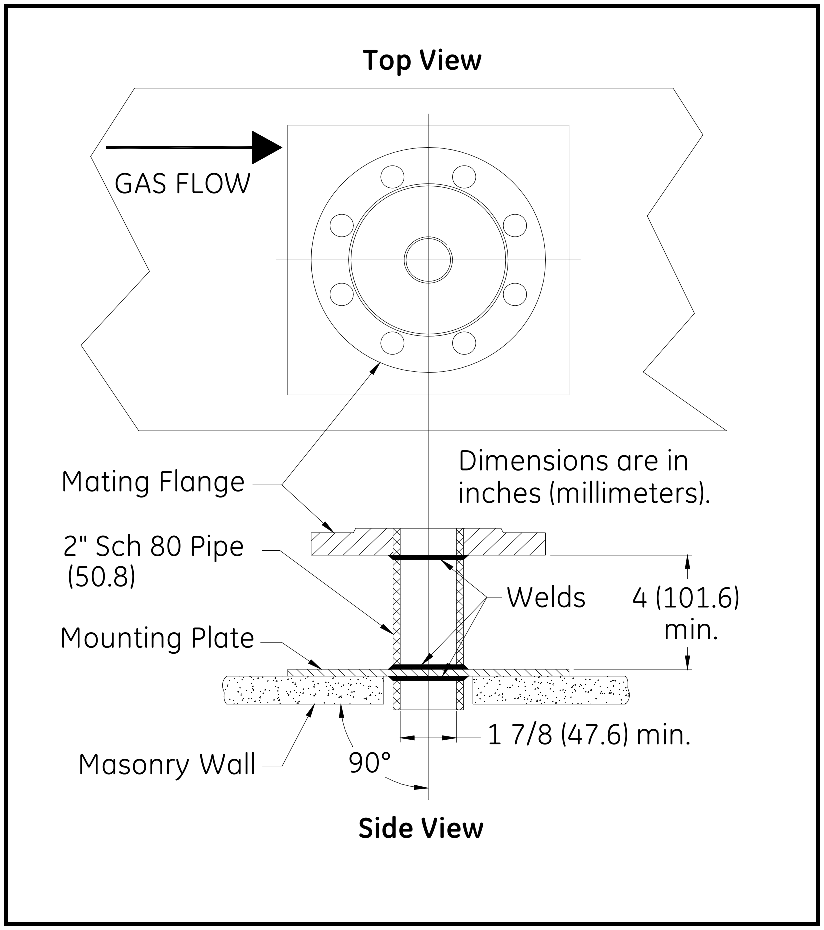


Figure 14: Installed Pipe and Mating Flange

Although the rotation of the Main Analyzer Unit with respect to the gas flow direction is not critical, if the unit is ordered with an installed mounting flange, the mating flange orientation shown in Figure 14 will ensure that the analyzer is square to the duct. In addition, make certain that the mating flange is mounted so that the analyzer is vertical (and not tilted) when it is bolted in place.

CAUTION! **The mounting flange on a standard FGA 300V may be rotated readily, but rotating the flange on an explosion-proof (flameproof) FGA 300VX may cause the manifold to rotate inside the case. Take extreme care to avoid this, as the damage so caused to the internal piping is NOT covered under the warranty.**

2.4 Preventing Common Problems

Because of the complex techniques required to monitor flue gases, some basic precautions must be observed. Failure to observe these simple procedures is often the cause of some common problems with the FGA 300V(X) operation. Compliance with the following instructions will help to eliminate such problems:

1. Do not use any thread sealant on the threads of the probe components or on any joints in the sample flow path. Teflon tape will melt at the normal probe operating temperature, and other thread sealants give off combustible vapors that can cause reading errors.
2. Do not handle the oxygen sensor or combustibles detector with bare hands. Although some scratches on the platinum coating can be tolerated, rubbing the coating should be avoided.
3. If the analyzer contains a combustibles detector, do not use silicon-based sealers or lubricants on any part of the analyzer. The presence of silicon in the analyzer will damage the combustibles detector.
4. Do not install a cold probe and/or sleeve into a hot manifold, as the threads will expand and seize upon warming. If such a situation is unavoidable, thread the components loosely into the manifold and allow to warm for a few minutes before fully tightening.

2.5 Installing the Probe and Probe Sleeve

For optimum performance, the probe sleeve should extend approximately 1/3 of the way across the flue duct. If possible, the insertion distance should not be less than 30 cm (1 ft).

Confirm that the probe and sleeve are the correct lengths. Then, refer to Figure 15 on page 20 and complete the following steps:

1. As shown in Figure 15 on page 20, attach a flange or fixing-plate to the bottom of the Main Analyzer Unit. Orient the flange mounting holes to coincide with the holes in the existing mating flange (see Figure 14 on page 18).
2. Thread the probe and then the probe sleeve into the manifold assembly located in the bottom of the analyzer. When properly installed, the probe sleeve should extend approximately 3 mm beyond the end of the probe.

Note: *As it is unnecessary to make the sample probe threading leak-tight, do not use a thread sealant on the threads. However, a dry, high-temperature, graphite-based lubricant may be used.*

2.5 Installing the Probe and Probe Sleeve (cont.)

3. Units intended for operation at temperatures below 950°C (1,750°F) include a 1-1/4” shroud attached to the end of the probe sleeve. Secure the shroud to the end of the probe sleeve by tightening the six (6) set screws.

IMPORTANT: *Never attempt to install a shroud on a non-metallic probe assembly, as the probe sleeve will crack.*

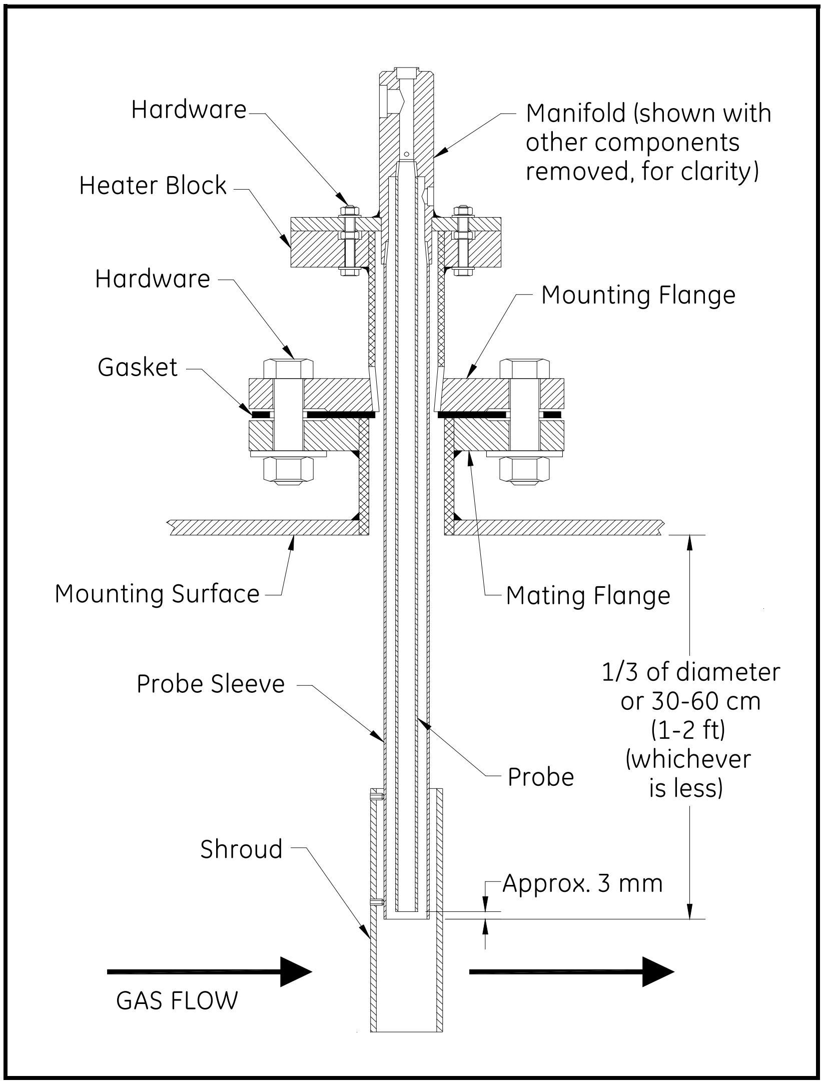


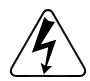
Figure 15: Sample Probe Assembly

2.6 Installing the System

Note: *If more than one analyzer system is being installed, be aware that each system is a matched set (i.e., each Remote FTC Box, probe, probe sleeve and Display Console <u>must</u> be matched to a specific analyzer). Refer to tags on the box, probes, sleeves, displays and analyzers in order to match the units correctly.*

IMPORTANT: *For compliance with the European Union's Low Voltage Directive (73/23/EEC), the standard 300V requires an external power disconnect device such as a switch or circuit breaker. The disconnect device must be marked as such, clearly visible, directly accessible, and located within 1.8 m (6 ft) of the unit. Because the sensor furnace power feed in a remote FTC Box must also be interrupted, a 4-pole disconnect device is required for units so equipped. This does not apply to the flameproof 300VX.*

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



2.6.1 Mounting the Analyzer

After installing the probe and probe sleeve into the analyzer as described in the previous section, mount the analyzer as follows:

1. Slide a suitable high-temperature gasket over the probe assembly so that it rests against the mounting flange on the bottom of the main analyzer assembly.

Note: *If the mating flange was purchased with the analyzer, an appropriate gasket is included.*

2. Insert the probe and sleeve into the hole in the furnace/boiler ceiling until the gasket is sandwiched between the two flanges.

3. Secure the analyzer in place by fitting bolts into the matching flange holes and fastening the bolts with washers and nuts. Upon insertion, the two flanges should fit together with the gasket clamped between them (see Figure 15 on page 20).

<u>CAUTION!</u> **To prevent corrosion, the analyzer must be powered up immediately after mounting and the power must remain on at all times. If the power must be removed for more than thirty minutes, purge the analyzer through the calibration port with a continuous flow of instrument air at a minimum rate of 150 cc/min (0.3 SCFH).**

2.6.1 Mounting the Analyzer (cont.)

4. An explosion-proof (flameproof) analyzer requires a constant reference air flow. Connect a 50 cc/min atmospheric air line (20.9% oxygen) to the purge connection (see Figure 16).

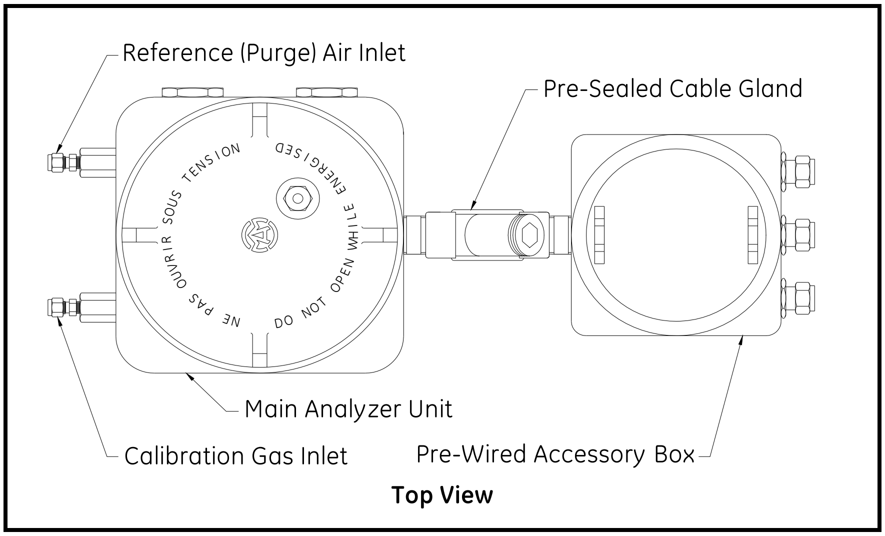


Figure 16: Explosion-Proof (Flameproof) Enclosure

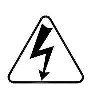
2.6.2 Mounting the Remote FTC Box

In addition to the *Main Analyzer Unit* and the attached *Accessory Box*, the FGA 300V(X) system includes a separate *Remote FTC Box*. Mount the FTC Box as close to the analyzer as possible, and connect it to the Accessory Box with 0.75 mm^2 (or18 awg) cable, for distances up to 25 m (80 ft).

Note: *The remote FTC Box may be located up to 40 m (110 ft) from the Accessory Box, if 1 mm^2 (or 16 awg) cable is used.*

The ambient temperature of the mounting location should not exceed 70°C (160°F). If the ambient temperature at the proposed location is expected to exceed 70°C (160°F), the enclosure should be located where the temperature will be within the remote FTC's specified temperature limits of -25° to 70°C (-15° to 160°F). Refer to Appendix B, *Mounting Dimensions and Drawings,* for the Main Analyzer Unit and Remote FTC Box mounting dimensions.

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



2.6.3 Mounting the Display Electronics Console

Ideally, the 300D *Display Electronics Console* should be located within 5 m (15 ft) of the FTC Box. However, the use of shielded cable permits distances up to 150 m (500 ft), for units equipped with both the oxygen sensor and combustibles detector. If a greater distance is required, contact the factory for assistance. See Appendix B, *Mounting Dimensions and Drawings,* for the Display Console mounting dimensions.

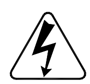
Note: *For units without the optional combustibles detector, the Display Console may be located up to 600 m (2,000 ft) from the FTC Box without significant signal degradation, if shielded cable is used.*

The Display Console has four rotary switches located on its printed circuit board which are used to set:

- fuel type (Switch 1)
- display parameter (Switch 2)
- analog output range (Switch 3)
- alarm level (Switch 4)

These switches have been pre-set at the factory according to the customer’s specifications; however, they can be reset as required. To reset the rotary switches, see Appendix A, *Rotary Switch Settings*.

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



WARNING! The above electric shock symbol is also applied next to screws that secure components essential to the double insulation requirements of the EN61010 standard.
Removal of these screws and/or components may result in a safety hazard.

2.6.4 Making Wiring Connections

Wiring for the FGA 300V(X) involves three steps:

- Wire the Main Analyzer Unit to the Remote FTC Box
- Wire the Display Console to the Remote FTC Box
- Connect power to the Display Console and the Remote FTC Box

Additional connections for optional recorders and alarms are shown later in this section. Refer to Appendix D, *Wiring Diagrams and Circuit Boards*, or Appendix F, *Previous Configurations*, (whichever applies to your setup) for a wiring diagram of the FGA 300V(X).

WARNING! **In order to meet CE Mark requirements, all cables must installed as described in Appendix F, *CE Mark Compliance*.**

IMPORTANT: *For compliance with the European Union's Low Voltage Directive (73/23/EEC), the standard 300V requires an external power disconnect device such as a switch or circuit breaker. The disconnect device must be marked as such, clearly visible, directly accessible, and located within 1.8 m (6 ft) of the unit. Because the sensor furnace power feed in the remote FTC Box must also be interrupted, a 4-pole disconnect device is required. This does not apply to the flameproof 300VX.*

WARNING! **To ensure safe operation, the FGA 300V(X) must be installed and operated as described in this manual. Also, be sure to follow all local safety codes and regulations for installing electrical equipment which apply. All procedures should be performed by trained service personnel.**

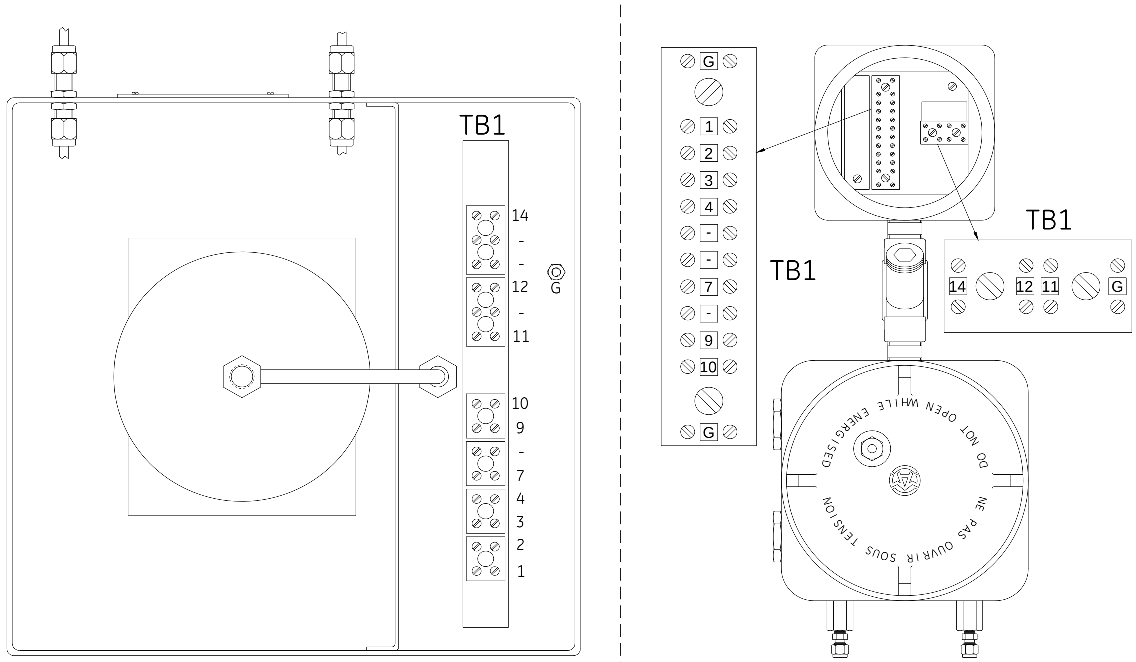
2.6.4a Connecting the Analyzer to the Remote FTC Box

Make wiring connections from terminal block TB1 in the remote *FTC box* to terminal block TB1 in the *main analyzer unit*. For an explosion-proof (flameproof) main analyzer unit, connect the remote *FTC box* to terminal block TB1 in the *accessory box* (the smaller box attached to the main analyzer unit). Refer to Table 1 and Figure 17 on page 25 and Figure 18 on page 26 for the terminal block locations and the proper pin connections. An Interconnection Diagram, Figure 20 on page 29, has been included for help in making the proper connections. Wiring diagrams can be found in Figure 59 on page 137 and Figure 64 on page 150.

2.6.4a Connecting the Analyzer to the Remote FTC Box (cont.)

Table 1: Main Analyzer Unit to FTC Box Connections

Connect:	From: Main Analyzer (TB1)	To: FTC Box (TB1)
Oxygen Sensor	1	1
	2	2
Temperature Sensor	3	3
	4	4
Combustibles - Active	7	7
Combustibles - Common	9	9
Combustibles - Reference	10	10
Heater - Live	11	11
Neutral	12	12
Furnace - Live	14	14
Ground	G	G



Standard (Weatherproof) Model | **Explosion-Proof (Flameproof) Model**

Figure 17: Main Analyzer Unit (Top View) TB1 Location

2.6.4a Connecting the Analyzer to the Remote FTC Box (cont.)

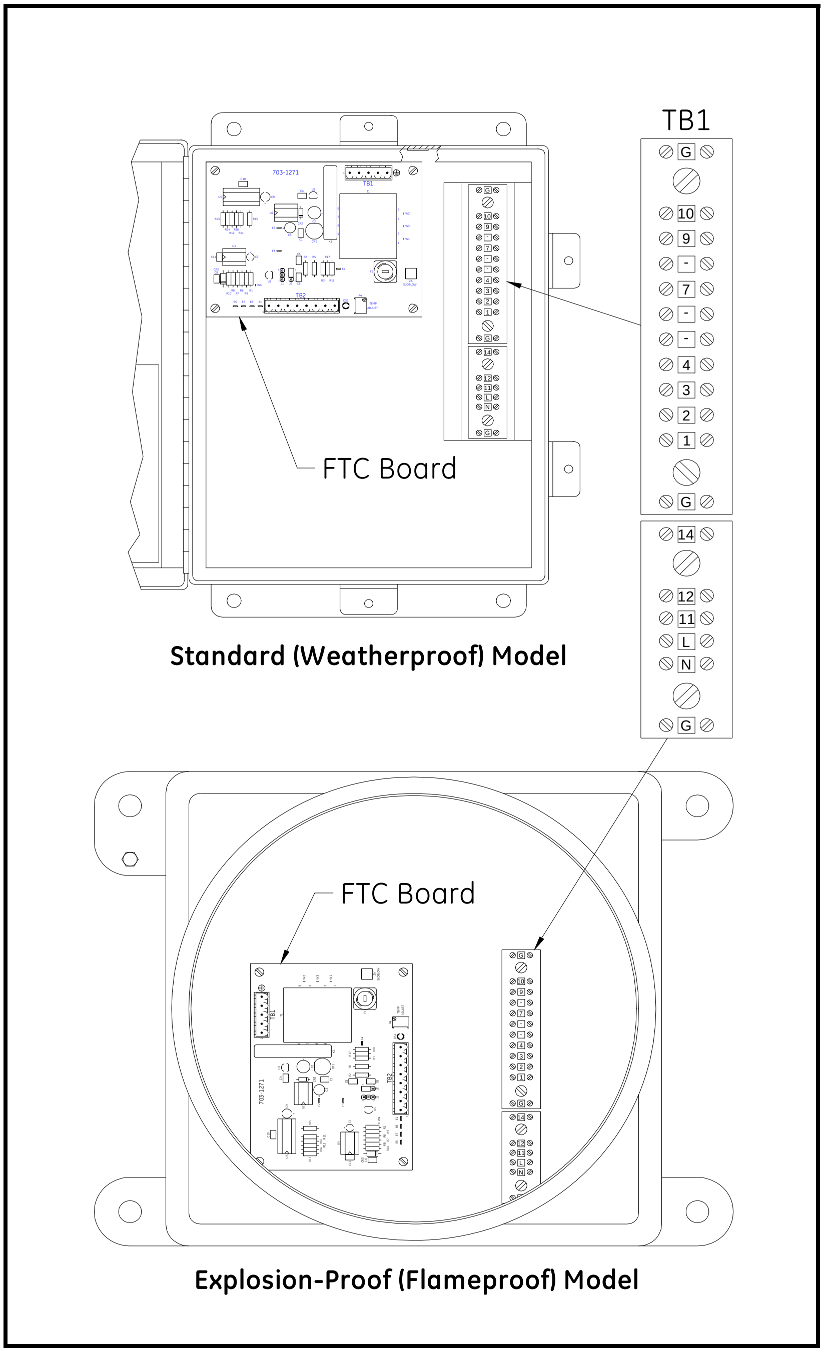


Figure 18: Remote FTC Box (Top View) TB1 Location

 = Protective Conductor Terminal

2.6.4b Connecting the Display

Make wiring connections from terminal block TB1 in the 300D Display Console to terminal block TB1 in the Remote FTC Box. Refer to Figure 18 on page 26, Figure 19 on page 28, and Table 2 for the terminal block locations and the proper pin connections.

Table 2: Display to FTC Box Connections

Connect:	From: 300D Display TB1	To: FTC Box TB1
Oxygen Sensor (+)	2	1
Oxygen Sensor (-)	3	2
Combustibles Detector (Reference)	5	10
Combustibles Detector (Common)	6	9
Combustibles Detector (Active)	7	7
Display Screen	1, 4, 8	Ground

Note: *For units fitted with the previous version of the 300D printed circuit board. See Appendix F,* Previous Configurations, *for the layout of this circuit board.*

2.6.4c Connecting the Power

Power must be connected to both the Display Console (TB4) and the Remote FTC Box (TB1). Refer to Figure 18 on page 26, Figure 19 on page 28, and Table 3 for the terminal block locations and the proper pin connections.

Note: *Be sure that the line voltage at the intended installation site corresponds to the factory preset voltage setting.*

Table 3: Power Connections

From: Voltage Supply	To: 300D Display (TB4)	To: FTC Box (TB1)
Live (+)	L	L
Neutral (-)	N	N
Ground (⏚)	(chassis)	G

⏚ = Protective Conductor Terminal

2.6.4 Making Wiring Connections (cont.)

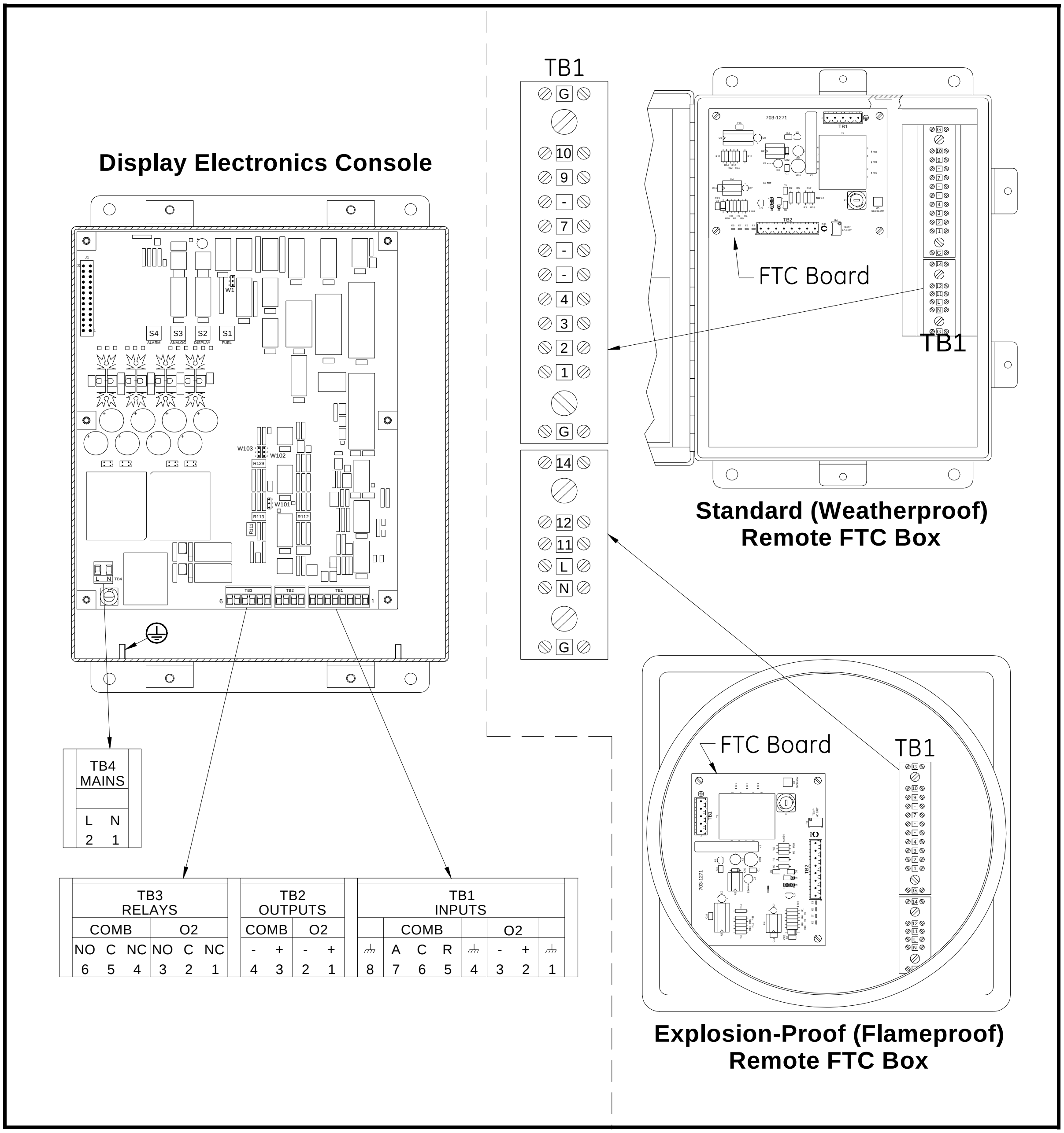


Figure 19: Standard Display Console and Remote FTC - Terminal Block Locations

= Protective Conductor Terminal

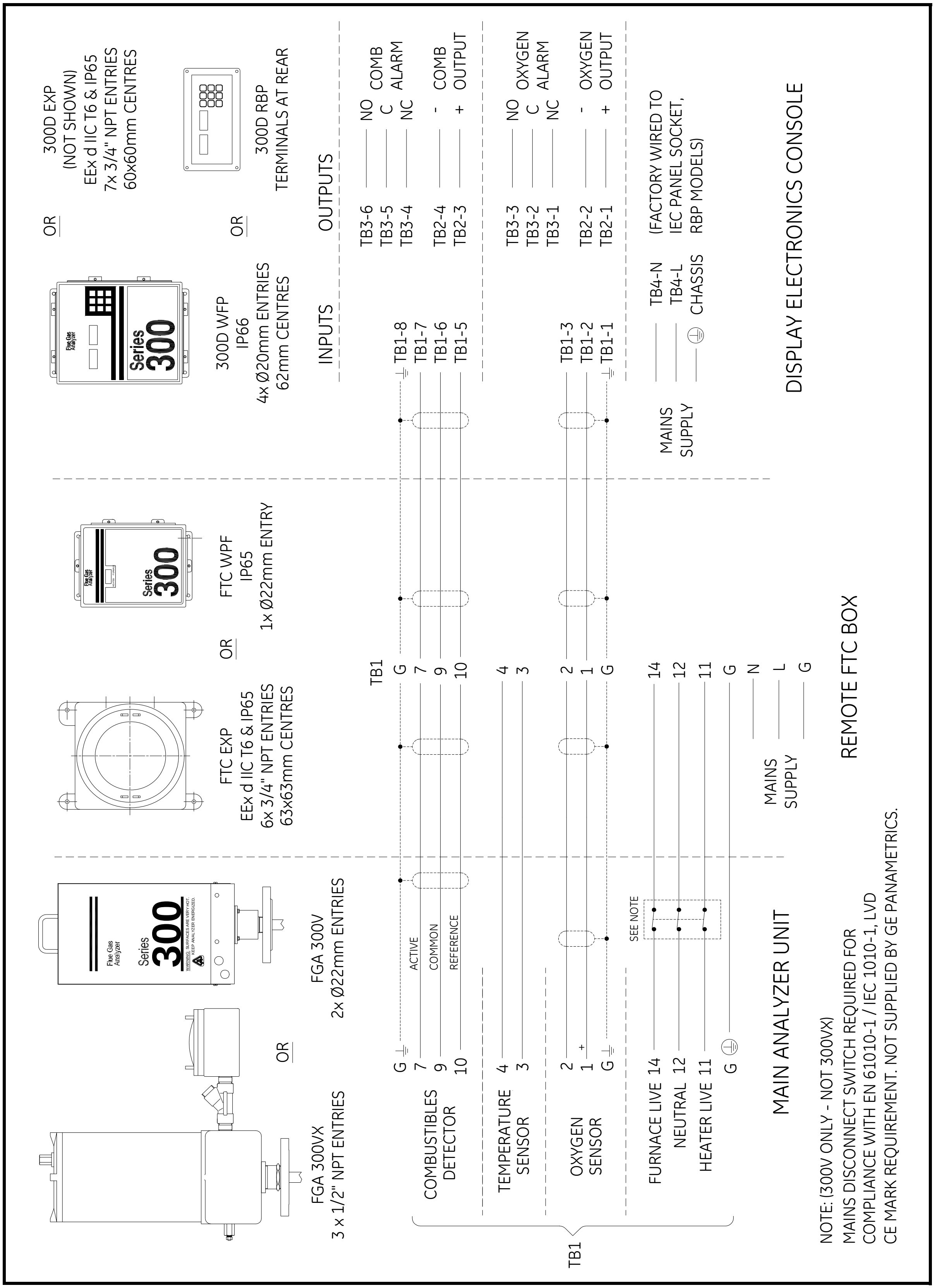


Figure 20: Interconnection Diagram

2.6.5 Connecting Recorders

The 300D Display Console provides a pair of outputs for connecting a recorder to the system. Make the connections to terminal block TB2 on the 300D Display circuit board. The recorder output mode is set to either current or voltage at the factory, prior to shipment. Use Table 4 to make the proper connections, and refer to Figure 19 on page 28 for the terminal block location on the 300D Display circuit board.

Table 4: Recorder Connections

Output Variable	300D Display (TB2)
Oxygen +	1
Oxygen -	2
Combustibles +	3
Combustibles -	4

The scale for outputs is either a zero-based linear output (0-20 mA/0-10 V) or an offset linear output (4-20 mA/2-10 V), as specified when ordered. To change the preset output range see Appendix A, *Rotary Switch Settings*.

2.6.6 Connecting Alarms

There is one alarm for the oxygen channel and one for the combustibles channel. Once the alarms are connected, the alarm trip points must be set. Refer to Table 5 and Figure 19 on page 28 to make the proper connections.

Table 5: Alarm Connections

Alarm Output	300D Display (TB3)
Oxygen - NC	1
Oxygen - C	2
Oxygen - NO	3
Combustibles - NC	4
Combustibles - C	5
Combustibles - NO	6

The next step before using the alarms is setting the alarm trip points for both the oxygen and combustibles channels. Proceed to the appropriate section below to set the desired alarm trip points.

2.7 Setting Alarms

The instructions in this section describe the steps required to properly set the oxygen and combustibles alarms. To set the oxygen alarm:

- Set the alarm trip point to the desired oxygen percentage
- Set the oxygen alarm as either a high or low type (see page 33).

2.7.1 Setting the Oxygen Alarm Trip Point

1. Locate switch S4 on the 300D Display printed circuit board. Each position on switch S4 represents a percentage of the recorder's full analog output range, which is set at the factory using switch S3.
2. Use the following formula to determine the correct analog output trip point.

$$\text{Trip Point \%} = \frac{\text{Trip Point O2 \%}}{\text{Full Scale O2 \%}} \times 100$$

3. Adjust switch S4 to the required position (refer to the Table 6 and Figure 21 on page 32).

For example, if an alarm trip point of **6% oxygen** is desired with a unit set for a full scale reading of 10% oxygen, use the above equation to find the trip point (60% of full scale range), $\text{Trip Point \%} = \frac{6\ \%}{10\ \%} \times 100 = 60\,\%$, and set Switch S4 to **position 6**.

Table 6: Rotary Switch S4 Settings

Switch Position	Alarm Trip Point (as % of Full Scale Range)
0	0%
1	10%
2	20%
3	30%
4	40%
5	50%
6	60%
7	70%
8	80%
9	90%
10	100%
11	110%
12	120%

2.7.1 Setting the Oxygen Alarm Trip Point (cont.)

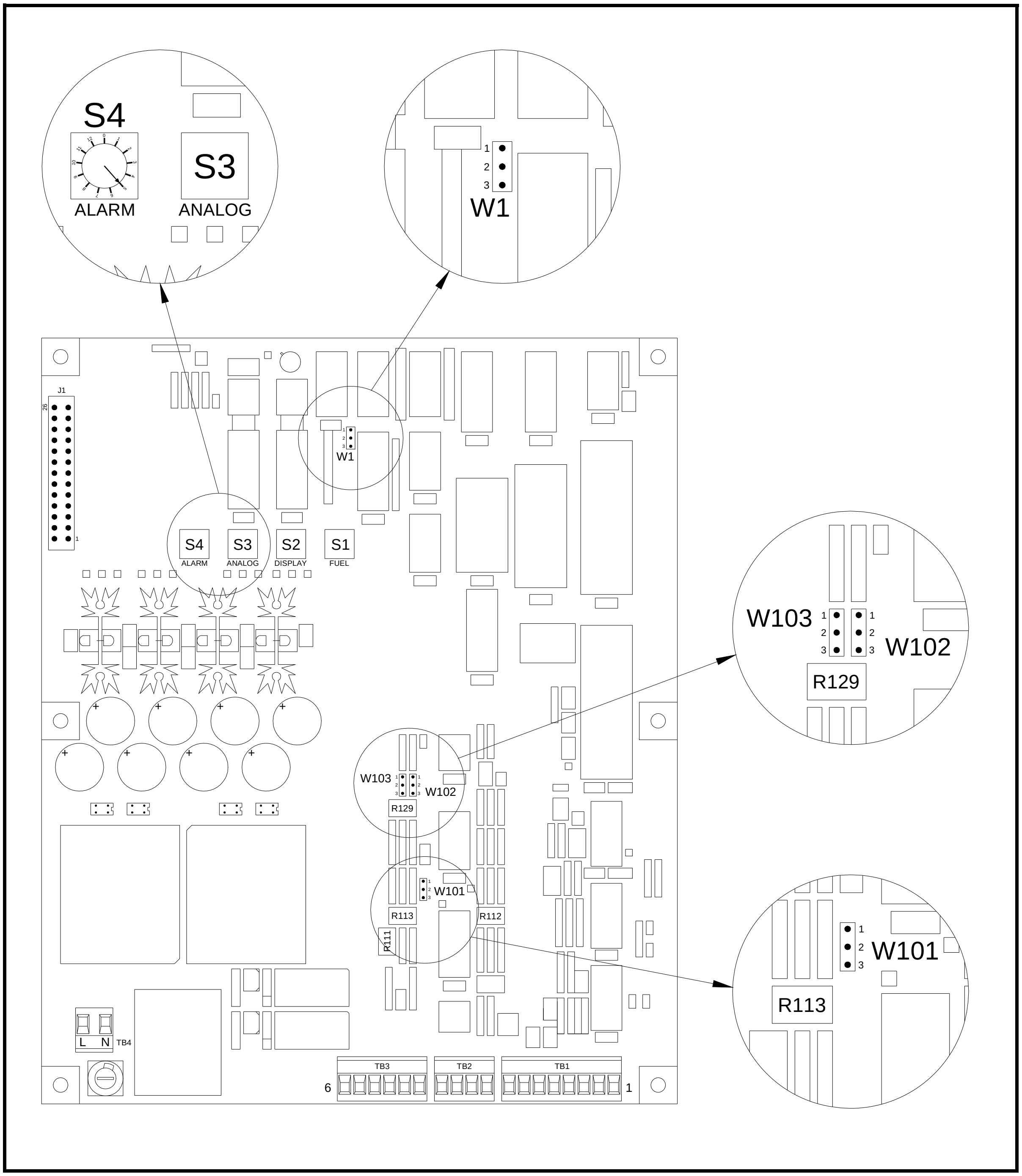


Figure 21: 300D Display Circuit Board

Note: *For units fitted with the previous version of the 300D printed circuit board, see Appendix F,* Previous Configurations, *for the layout of this circuit board.*

2.7.2 Setting the Alarm Trigger Mode

After setting the alarm trip point, the alarm trigger mode must be set. The oxygen alarm can be set for either high or low operation.

To set the alarm trigger mode:

1. Locate jumper W1 on the 300D Display printed circuit board. See Figure 21 on page 32.

2. Set jumper W1 to either of the following settings for the desired alarm trigger mode:

- Low Alarm - install jumper in 1/2 position
- High Alarm - install jumper in 2/3 position

A high alarm will activate when the oxygen measurement goes over the alarm trip point and a low alarm will activate when the oxygen measurement goes below the alarm trip point.

2.7.3 Setting the Combustibles Alarm Trip Point

The combustibles alarm trip point is set by using the jumpers and potentiometers on the 300D Display printed circuit board. Complete the following steps and refer to Figure 21 on page 32 to set the combustibles alarm trip point.

1. Move the jumper at location W101 from its original 1/2 position to position 2/3.

2. Adjust potentiometer R113 until the desired alarm trip point, in combustibles PPM_V, appears on the digital display.

3. Set the jumper at location W102 to either of the following settings for the desired alarm mode:

- Low Alarm - install jumper W102 in the 1/2 position
- High Alarm - install jumper W102 in the 2/3 position

A high alarm will activate when the combustibles measurement goes over the alarm trip point and a low alarm will activate when the combustibles measurement goes below the alarm trip point.

4. Move the jumper at location W101 from the 2/3 position back to its original 1/2 position.

2.8 Installing Additional Components

The typical FGA 300V(X) Vertical Flue Gas Analyzer supplied by GE, consists of three major components:

- Main Analyzer Unit/Accessory Box
- Remote FTC Box
- Display Electronics Console

The instructions in this chapter have explained how to install and wire these primary components. However, some additional user-supplied items are recommended to enhance the system. Specifically, the following components may make the system more user-friendly and improve the overall efficiency and reliability of the system:

- Flowmeters
- Pressure Gauges
- Needle Valves
- Piping and Fittings

Since no two installations are identical, it is not possible to provide exact instructions and specifications for this ancillary equipment. However, the system shown in Figure 22 on page 35 should serve as a good general guideline for most situations. The all-inclusive diagram in Figure 22 on page 35 is not intended to imply that all of the components shown are required in every situation. Only those items deemed appropriate for the intended application need be considered.

Note: *Figure 22 shows a system with a 300VX explosion-proof (flameproof) unit and remote FTC Box and a standard Display Console. Although other combinations of standard and flameproof enclosures for these components are possible, the fundamental connections shown in Figure 22 remain unchanged.*

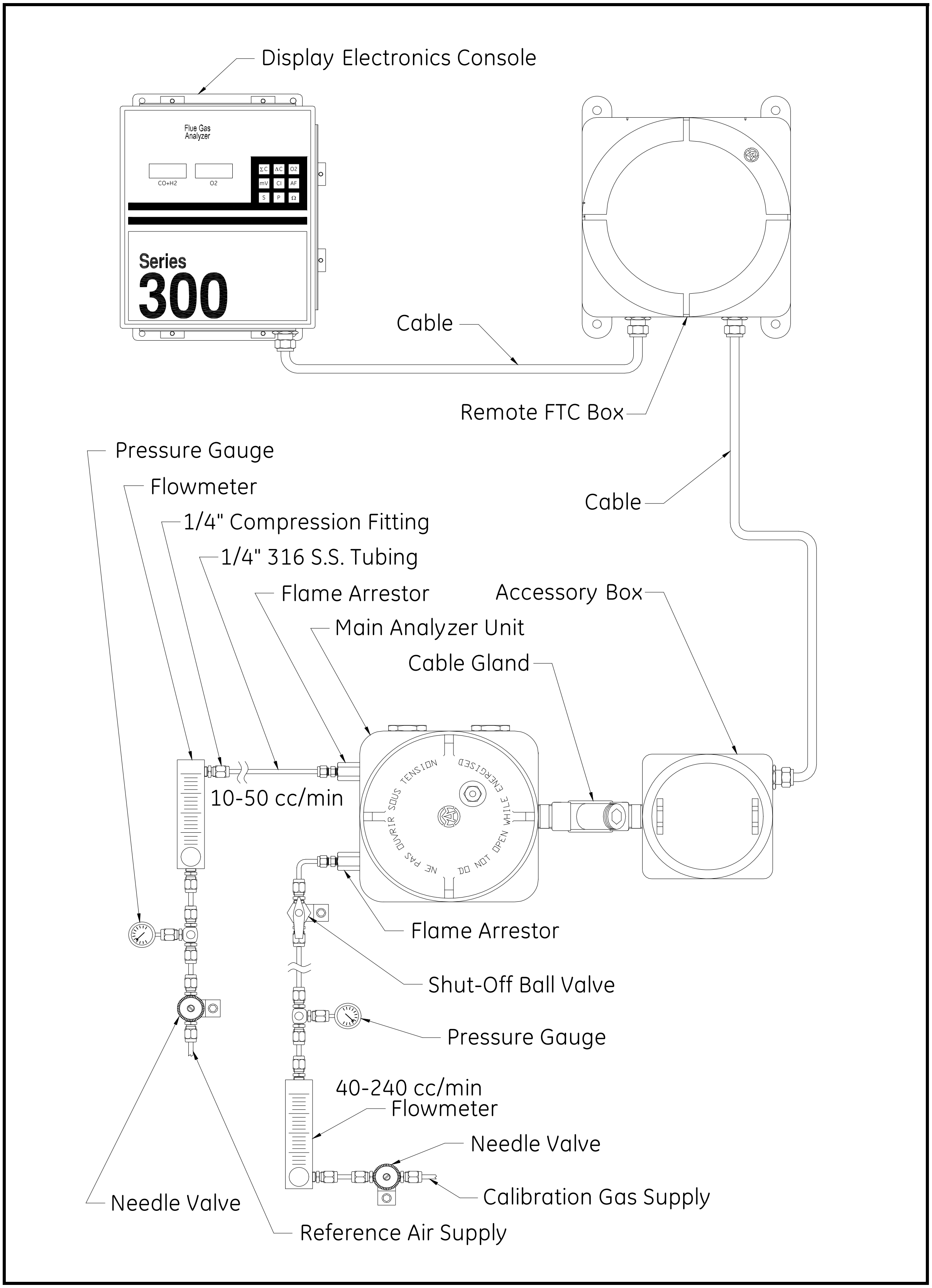


Figure 22: A Complete FGA 300VX System

[no content intended for this page]

Chapter 3. Operation

3.1 Overview

The FGA 300V(X) is an easily operated monitoring device. However, before using the analyzer, allow it to warm-up for at least one hour (three hours if possible). In addition, make sure all electrical and mechanical connections have been completed before power is applied. This chapter includes discussions of the following topics:

- Powering Up the System
- Taking Measurements
- Using the Display and Keypad

WARNING! To ensure safe operation of the FGA 300V(X), it must be installed and operated as described in this manual. In addition, be sure to follow all applicable local safety codes and regulations for installing electrical equipment.

3.2 Powering Up the System

After checking the wiring connections, apply power to the analyzer. The FGA 300V does not have its own ON/OFF switch. Thus, power is applied to the unit as soon as the external disconnect device is energized. Allow the analyzer to warm up for at least one hour (three hours if possible), before taking measurements.

WARNING! To prevent corrosion, the analyzer must be powered up immediately after installation. If the analyzer is left installed without power, the unit's components become susceptible to acid condensation that will cause corrosion.

If the power must be removed for more than thirty minutes, purge the analyzer through the calibration port with a continuous flow of instrument air at a minimum rate of 150 cc/min (0.3 SCFH).

IMPORTANT: *For compliance with the European Union's Low Voltage Directive (73/23/EEC), the standard 300V requires an external power disconnect device such as a switch or circuit breaker. The disconnect device must be marked as such, clearly visible, directly accessible, and located within 1.8 m (6 ft) of the unit. Because the sensor furnace power feed in the remote FTC Box must also be interrupted, a 4-pole disconnect device is required. This does not apply to the flameproof 300VX.*

3.3 Taking Measurements

Allow the FGA 300V(X) to warm up sufficiently before taking any measurements. Readings are output to the Display Console in percent oxygen (or other ordered parameter) and/or ppm_V combustibles. Other parameters can be displayed using the keypad.

If the Display Console is not included in the system, use the graphs in Appendix C, *The Nernst Equation*, to convert the analog output reading into percent oxygen. For a more precise mV to % oxygen conversion, use one of the following formulas, depending on which standard temperature has been selected for your particular system:

if 770°C (1,418°F), use

$$E_{770}\ (\text{mV}) = 51.745 \times \log\left\{\frac{20.9}{\%\ O2\ \text{in Sample Gas}}\right\}$$

if 812°C (1,494°F), use

$$E_{812}\ (\text{mV}) = 53.829 \times \log\left\{\frac{20.9}{\%\ O2\ \text{in Sample Gas}}\right\}$$

See Appendix C, *The Nernst Equation*, for more details on how to perform similar calculations at other operating temperatures.

Although percent oxygen can still be measured without the Display Console, the measurement of combustibles can **NOT** be accomplished without the Display Console.

3.4 Using the Display and Keypad

The front panel of the Display Console shows both the oxygen reading and the combustibles reading (when applicable). The combustibles display shows total combustibles, which is normally a combination of CO and H_2. The oxygen display is factory set to show the ordered parameter. However, the keypad may be used to display all other available parameters, which are listed in Table 7 along with their corresponding keys.

All of the parameters listed in Table 7 can be displayed by pressing the appropriate key on the keypad. The selected parameter is displayed until the key is released.

Note: *These parameters may be selected as the default display using the internal rotary switch (S2). See Appendix A, page 113, for more details.*

Table 7: FGA 300V(X) Keypad Parameters

Key	Parameter	Description
ΣC	Equivalent Combustibles	This parameter, with respect to the total flue gas volume, supplements the combustibles measurement in excess fuel situations.
ΔC	Excess Fuel	This parameter, with respect to fuel only, detects poor combustion or controls conditions when fuel is deliberately in excess, such as in reducing atmospheres.
O_2	Percent Oxygen	This key displays the amount of oxygen in excess of the stoichiometric quantity. This is the only accurate method for properly setting the air/fuel ratio.
mV	Oxygen Sensor Millivolts	This key displays the raw oxygen sensor millivolt output, which indicates the condition of the oxygen sensor.
C.I.	Combustibility Index	This parameter indicates the combustion air requirement index [$CI = 14.02 - (0.67) \times (\%O_2)$].
A.F.	Air Factor	This parameter indicates the proportion of air supplied for stoichiometric combustion. Air factor is often the preferred parameter to control furnaces that are operating from reducing through oxidizing conditions.
S	Not Used	Not Used
P	Not Used	Not Used
Ω	Oxygen Sensor Test	This key tests the operating condition of the sensor and warns in advance that sensor replacement is necessary.

[no content intended for this page]

Chapter 4. Calibration

4.1 Overview

Generally, changes in calibration result from sensor/detector aging. Within limits, reading errors can usually be compensated for by making minor calibration adjustments.

Calibration of the analyzer should be checked once or twice a week for the first month of operation and then once every two or three months. Units with combustibles detectors need more frequent checking than those with oxygen sensors only.

The oxygen sensor should be calibrated every three months, and the combustibles detector should be calibrated upon power up and once a month thereafter. Since the oxygen sensor and combustibles detector are calibrated differently, be sure to proceed to the appropriate section to perform the calibration properly.

WARNING! To ensure safe operation of the FGA 300V(X), it must be installed and operated as described in this manual. In addition, be sure to follow all applicable local safety codes and regulations for installing electrical equipment.

All procedures should be performed by trained service personnel.

4.2 Recommended Calibration Gases

To properly calibrate the oxygen sensor and combustibles detector, a calibration gas of known composition must be used. The following calibration gases are recommended by GE:

1. 5% O_2 + 95% N_2:

   a. calibration gas for oxygen sensor (all ranges)

   b. zero gas for combustibles

   c. this gas should read 32.1 mV at 770°C (1,292°F) or 33.4 mV at 812°C (1,494°F)

Note: *This gas must be combustibles free, even if the analyzer is not fitted with a combustibles detector.*

2. 1000 PPMV CO + 500 PPMV H_2 + 1% O2 + Balance N_2:

   a. span gas for combustibles

   b. this mixture should read 1500 ppm_v combustibles

Note: *The presence of the 1500 ppm_v combustibles will cause the O_2 to read low by 750 ppm_v.*

4.2 Recommended Calibration Gases (cont.)

IMPORTANT: *A calibration gas containing only CO is not recommended, since the analyzer will not respond correctly to dry calibration gases that do not contain H_2.*

IMPORTANT: *The gas cylinders must be certified as to the exact composition of the calibration gas.*

The uncertainty in the oxygen content of the calibration gas is the largest source of error in the calibration process. A standard certificate of analysis has an uncertainty in the smaller component of ±5%. For the oxygen calibration gas, this means an oxygen range of 4.75–5.25%, and the corresponding potential calibration errors shown in Table 8 are introduced.

Table 8: Calibration Uncertainty

%O_2	T(°C)	mV	ΔmV	%Error
4.75	812	34.67	+1.20	+3.59
5.00		33.47	0.00	0.00
5.25		32.33	–1.14	–3.41
4.75	770	33.33	+1.15	+3.57
5.00		32.18	0.00	0.00
5.25		31.08	–1.10	–3.42

As shown in Table 8, a calibration uncertainty of about ±3.5% is introduced by the calibration gas uncertainty alone.

4.3 Calibrating the Oxygen Sensor

To calibrate the oxygen sensor, introduce the chosen calibration gas through the sample system. Because the sensors can be cooled by a high flow rate, the flow rate of the calibration gas must be regulated. After the calibration gas flow rate is adjusted to the proper value, a calibration check can be performed.

4.3.1 Regulating the Calibration Gas Flow Rate

A temporary connection is usually made for calibration. A blank (plug) is supplied with the FGA 300V(X) to seal the calibration gas inlet when not in use. However, if a permanent connection is preferred, it should be as short as possible with an isolation valve right at the calibration gas inlet on the analyzer.

Each analyzer is tagged with its optimum calibration gas flow rate, based on the analyzer and sampling probe/sleeve combination. Typically, this value will be 80-100 cc/min (0.15-0.2 SCFH).

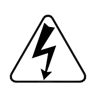
To set up for calibration complete the following steps:

1. Remove the blank (plug) from the calibration gas inlet port. Refer to Figure 23 on page 44 for the location of the calibration inlet port on the Main Analyzer Unit.
2. Connect the calibration gas and a flowmeter to the calibration gas inlet port. If the calibration gas supply does not come with its own regulator, a needle valve will also need to be installed.
3. Using the flowmeter and the regulator (or needle valve), set the calibration gas flow rate to the tagged value.

CAUTION! **Make sure the calibration gas flow rate does not exceed 500 cc/min (1.0 SCFH). Higher flow rates may cool the oxygen sensor below the normal operating temperature and affect the accuracy of measurements or even cause damage to the oxygen sensor.**

If the analyzer does not respond correctly at the tagged calibration gas flow rate (i.e. the oxygen sensor millivolt output reading is more than 5% in error), the problem is probably due to improper siting of the unit. Contact your GE representative for recommendations and/or additional hardware.

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



4.3.1 Regulating the Calibration Gas Flow Rate (cont.)

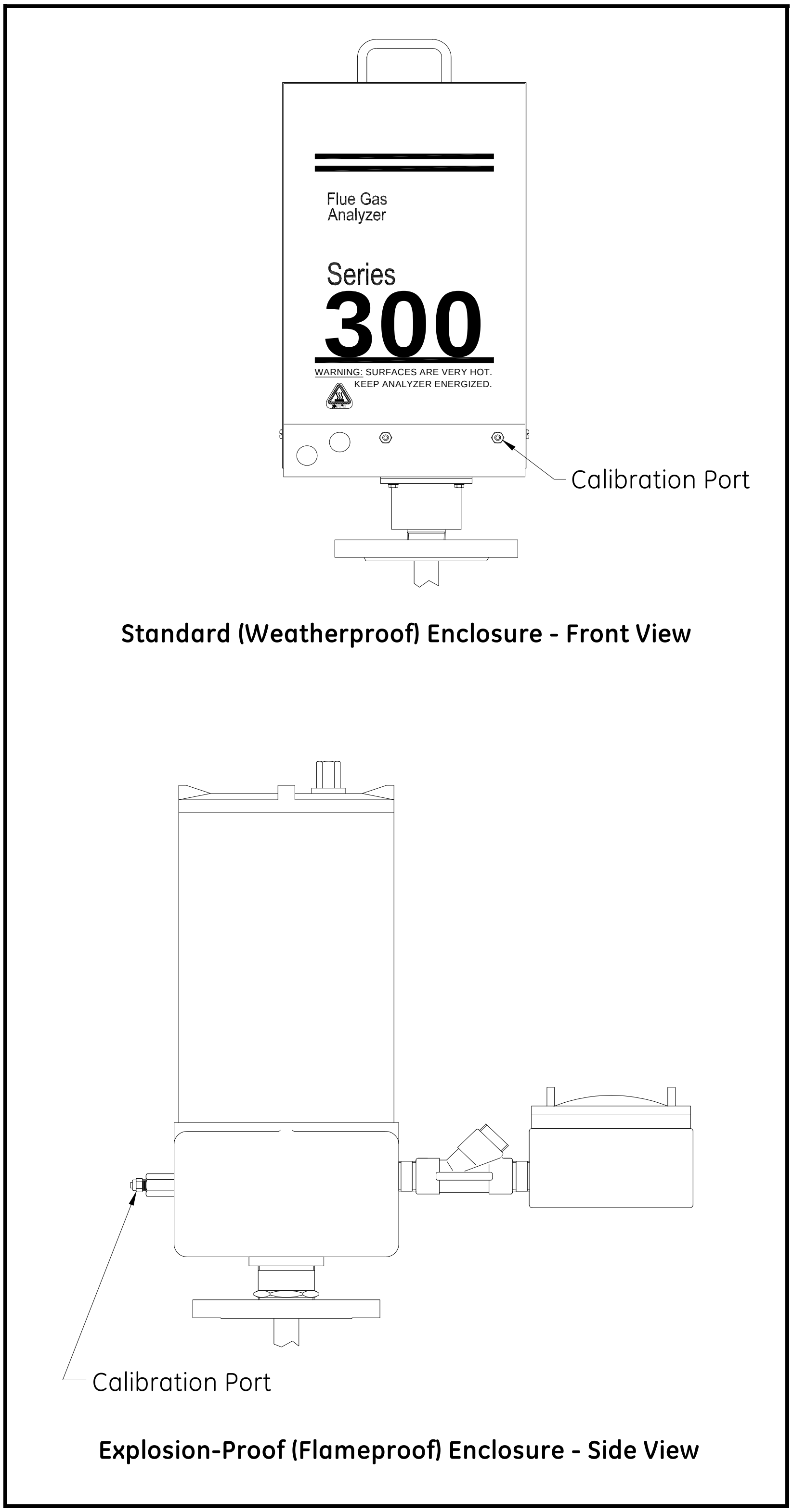


Figure 23: Calibration Port Location

4.3.2 Calibration Check

A calibration check is started by introducing the calibration gas to the oxygen sensor. GE recommends using a calibration gas consisting of 5% O_2 and 95% N_2, as described on page 41.

Note: *Explosion-proof (flameproof) analyzers require a constant 10–50 cc/min air flow into the reference air purge connection. The idea is to maintain a flow rate that is high enough to be verifiable, but not so high as to create a backpressure greater than 1 psi.*

To calibrate the oxygen sensor, complete the following steps:

1. Introduce a calibration gas mixture, containing a known amount of oxygen, at the tagged flow rate to the Main Analyzer Unit. Refer to Figure 23 on page 44 for the location of the calibration gas inlet port.

2. Read the voltage in one of three places:

- press the mV key on the Display Console keypad (if one is included in the system), or
- using a voltmeter, measure across pins 1 and 2 on terminal block TB1 in the Remote FTC Box, or
- using a voltmeter, measure across pins 1 and 2 on terminal block TB1 in the Main Analyzer Unit.

See Figure 24 on page 46 for the location of the terminal blocks.

4.3.2 Calibration Check (cont.)

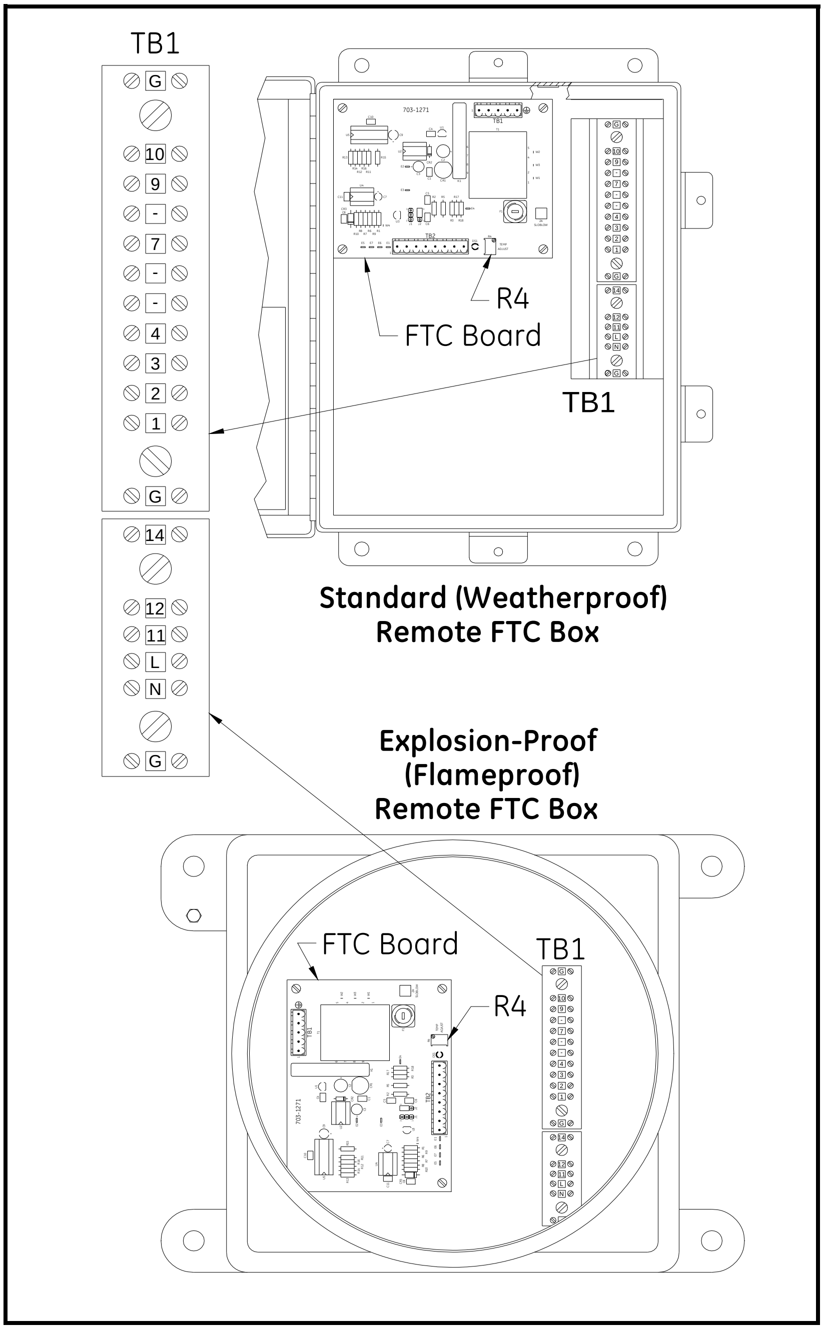


Figure 24: FTC Board (R4) and TB1 Locations

4.3.2 Calibration Check (cont.)

3. Calculate the expected oxygen sensor voltage output with one of the following equations:

Note: *Be sure to use the first equation for units operating at 770°C and the second equation for units operating at 812°C.*

$$E_{770}\,(mV) = 51.745 \times \log\left\{\frac{20.9}{\%\ O2\ \text{in Cal. Gas}}\right\}$$

$$E_{812}\,(mV) = 53.829 \times \log\left\{\frac{20.9}{\%\ O2\ \text{in Cal. Gas}}\right\}$$

When using the recommended calibration gas (5% O_2 + 95% N_2), the oxygen sensor output voltage should be **32.14 ± 0.2 mV at 770°C** or **33.44 ± 0.2 mV at 812°C**.

Note: *For an FGA 300V(X) analyzer operating at any other temperature, refer to Appendix C,* The Nernst Equation, *for details on converting the known oxygen concentration into the expected oxygen sensor millivolt output reading.*

4. If necessary, adjust the sensor furnace *operating temperature* using potentiometer R4 on the FTC board in the following manner (see Figure 24 on page 46 for the location of R4):

Note: *For units fitted with previous versions of the FTC circuit board, the location and designation of the temperature adjustment potentiometer is different. Refer to Appendix F,* Previous Configurations, *for the correct information.*

- Turn R4 clockwise to increase the sensor furnace temperature and reduce the percent oxygen reading, or
- Turn R4 counterclockwise to reduce the sensor furnace temperature and increase the percent oxygen reading.

Each 360° turn of potentiometer R4 will change the reading by about 0.15% oxygen (assuming an oxygen level of about 5%), which equates to about 3% of the full scale setting. Due to thermal inertia of the sensor furnace, the change in output will not immediately follow the change made to R4. Therefore, make the adjustments in small increments and allow several minutes for each new reading to stabilize.

IMPORTANT: *According to the Nernst equation, a 5% error in the mV output reading from the oxygen sensor would require a temperature adjustment of approximately 50°C. As the FTC setting is unlikely to be the source of such a large error, if the measurement error is greater than 5% of the reading, contact the factory for assistance in tracing the source of the problem.*

4.4 Calibrating the Combustibles Detector

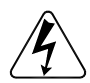
In order to properly calibrate the combustibles detector, the following three steps must be performed:

- check the operating temperature of the combustibles detector
- perform a zero check
- perform a span check

4.4.1 Checking the Operating Temperature

Before beginning the calibration, the operating temperature of the combustibles detector should be checked. The operating temperature of the combustibles detector is controlled by the cartridge heaters in the heater block. The heaters maintain the combustibles detector at a steady temperature, to ensure consistent measurements. Do not proceed with the calibration if the operating temperature is incorrect. At the normal operating temperature of 225°C, the resistance of the combustibles detector’s active and reference elements should measure between 1800 and 1900 ohms. Furthermore, the resistances of the two elements should be within 50 ohms of each other, while reading the sample gas. If these conditions are not met, consult the factory for assistance.

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



To check the resistances, complete the following steps:

1. Locate terminal block TB1 in the Display Console (see Figure 25 on page 49).

Note: *For units fitted with the previous version of the 300D printed circuit board. See Appendix F,* Previous Configurations*, for the layout of this circuit board.*

2. Disconnect the wire from pin 6 of terminal block TB1.
3. Attach one lead of a multimeter to the disconnected pin 6 wire.
4. Attach the other lead of the multimeter to pin 5 of terminal block TB1 and record the resistance value.
5. Move the multimeter lead from pin 5 to pin 7 of terminal block TB1 and record the resistance value.
6. Both readings should be between 1800 and 1900 ohms, and the difference between them should not exceed 50 ohms. If this is not the case, contact the factory for assistance.
7. Disconnect the multimeter and immediately reconnect the wire to pin 6 of terminal block TB1.

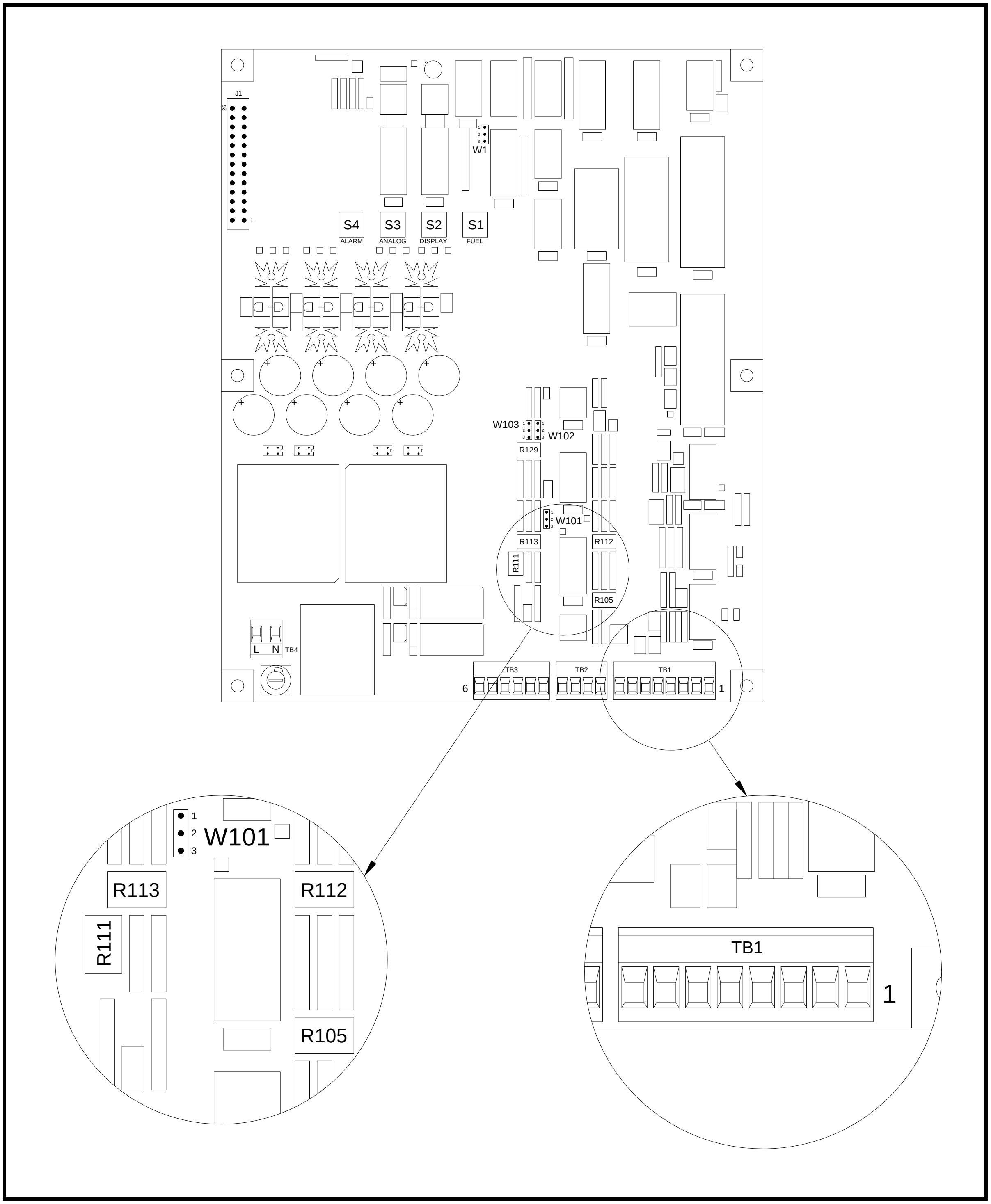


Figure 25: Display Electronics Console Circuit Board (Top View)

4.4.2 Zero Check

The oxygen span gas, which consists of 5% O_2 and 95% N_2, may also be used for the zero combustibles gas. This reduces the number of gas cylinders required to calibrate the analyzer and the two adjustments may be made simultaneously.

To perform a zero check, complete the following steps:

1. Introduce the zero combustibles gas into the calibration gas inlet port on the Main Analyzer Unit.

Note: *See Figure 23 on page 44 for the location of the calibration gas port and refer to* Regulating the Calibration Gas Flow Rate *on page 43 for the correct flow rate.*

2. Verify that the 300D Display reads 0 ppm_V.

If the 300D Display does not read 0 ppm_V, adjust the trimmer potentiometer R111 on the 300D Display printed circuit board. Since R111 is very sensitive, adjustments should be made in small increments. Refer to Figure 25 on page 49 for the location of R111, and adjust it in the appropriate direction:

- Turn R111 clockwise to increase the ppm_V reading, or
- Turn R111 counterclockwise to reduce the ppm_V reading.

If the 300D Display can not be adjusted to read 0 ppm_V, the combustibles detector must be replaced.

4.4.3 Span Check

A span calibration gas consisting of 1000 ppm_V CO + 500 ppm_V H_2 + 1% O_2 + balance N_2 is recommended.

To perform a span check, complete the following steps:

1. Introduce the span calibration gas.

2. The combustibles reading should be approximately 1500 ppm_V for the gas specified in the previous step.

Note: *During this procedure, the oxygen reading will be low because the oxygen sensor measures excess oxygen and the combustion of the span calibration gas consumes 750 ppm_V of the oxygen.*

If the reading is incorrect, adjust trimmer potentiometer R105 on the 300D Display printed circuit board. This adjustment is not as sensitive as the zero adjustment with R111, and the R105 adjustments may be made in larger increments. Refer to Figure 25 on page 49 for the location of R105, and adjust it in the appropriate direction:

- Turn R105 clockwise to increase the ppm_V reading, or
- Turn R105 counterclockwise to reduce the ppm_V reading.

This completes the calibration of the combustibles detector.

Chapter 5. Troubleshooting

5.1 Overview

The FGA 300V(X) has been designed to overcome most of the problems commonly associated with monitoring flue gases. However, because of the corrosive and extreme conditions under which the instrument must operate, some difficulties may still be encountered. The procedures for resolving many of these situations are discussed in this chapter. If the information provided in this chapter is not sufficient, please consult the factory for assistance.

The FGA 300V(X) analyzer has two sets of error indicators that can occur:

- oxygen measurement errors
- combustibles measurement errors

Each error indicator appears on the corresponding readout of the 300D Display Console. Thus, if there is an oxygen measurement error, the error indicator will appear on the oxygen readout.

Refer to Table 9 on page 52 to troubleshoot the FGA 300V(X) analyzer.

WARNING! To ensure safe operation of the FGA 300V(X), it must be installed and operated as described in this manual. In addition, be sure to follow all applicable local safety codes and regulations for installing electrical equipment.

All procedures should be performed by trained service personnel.

Table 9: Troubleshooting Guide

Error Indicator	System Response	Description	Go To:
Possible Oxygen Error Indicators			
Blinking “--.--” * (error code E1)	1. alarm relay activated 2. analog output shows a lack of oxygen on all ranges 3. stoichiometric interlock is activated	1. sensor signal exceeds full scale input (1000 mV) 2. possible open circuit 3. possible cold furnace	page 53
“PP.PP” and Normal Reading Alternate	1. alarm relay activated	the sensor signal has not changed in 15 minutes - the probe may be plugged	page 62
Blinking Reading	no response	sensor impedance is high - the sensor may need replacement	page 63
Oxygen Concentration Reads Constant 20.9%	no response	1. sensor or its wiring shorted 2. severe air leak (i.e. cal. port open, sample system not sealed, etc.)	page 65
Oxygen Reading Above 20.9% (error code E4 or reading of 55.35)	no response	sensor wiring reversed	page 67
Oxygen Reading Too Low	no response	1. combustibles in the sample 2. sensor out of calibration	page 67
Oxygen Reading Too High	no response	1. poor quality reference air 2. air leak 3. sensor too cold 4. high sample pressure	page 68
Possible Combustibles Error Indicators			
“1 0” Out-Of-Range Indicator	alarms activated	combustibles level is greater than 20,000 PPM_V	page 69
“–12340” Negative Reading	no response	1. combustibles channel is out of calibration 2. wiring of element reversed	page 70
“1 0” Negative Out-Of-Range Indicator	no response	1. reference element open or active element shorted 2. combustibles channel severely out of calibration 3. detector incorrectly wired	page 71
Low Combustibles Reading, but Correct Oxygen Reading	no response	1. detector physically damaged or improperly installed 2. detector aging 3. calibration flow too low	page 72

* a “1   0” error indicator also appears on the combustibles display (see first O_2 error).

Note: *Although the E2 (sensor aging) and E3 (probe plugging) error codes have been defined, they have not yet been implemented.*

5.2 Oxygen Errors

This section discusses each of the possible oxygen errors listed in Table 9 on page 52. If an error other than those listed should occur, contact the factory for assistance.

5.2.1 Blinking “--.--”

An oxygen display that alternates between a blank screen and a “--.--” reading indicates an open circuit error and can be caused by one of the following conditions:

Note: *Before proceeding, make sure the unit is not still warming up. This condition may also be indicated by an* E1 *error code.*

- faulty wiring
- faulty oxygen sensor
- faulty RTD/TC temperature sensor
- faulty sensor furnace
- faulty furnace temperature control (FTC) board

When the FGA 300V(X) detects this error:

- alarms are activated
- analog outputs indicate a lack of oxygen on all ranges
- the stoichiometric interlock is activated, which produces a “1 0” reading on the combustibles display.

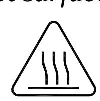
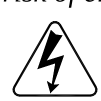
To correct this error, refer to the flow diagram in Figure 26 on page 54 and perform the following checks in the order given.

5.2.1a Check the Wiring

The most common reason for the open circuit error is incorrect or loose wiring. Complete the two checks listed below to correct any wiring problems.

WARNING! Be careful when tightening the terminal block electrical connections. Full line voltage is present on some terminals in the Main Analyzer Unit, the FTC Box and the Display Console.

IMPORTANT: *These symbols indicate Caution - dangerously hot surfaces and risk of electric shock, respectively:*

5.2.1a Check the Wiring (cont.)

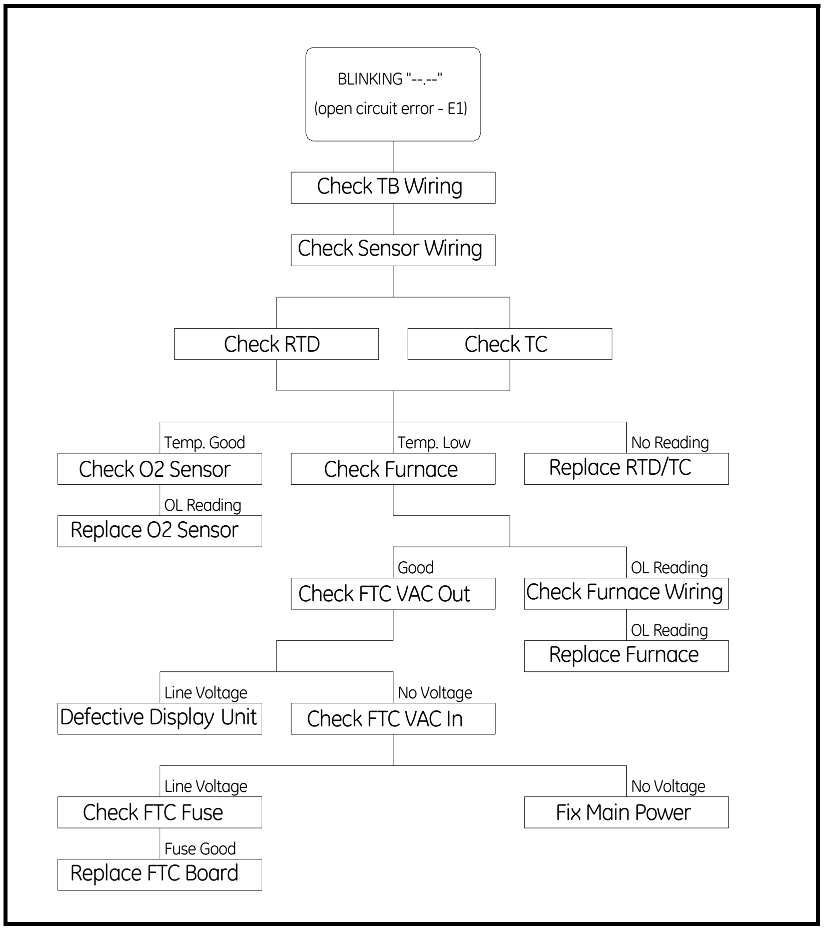


Figure 26: Blinking "--.--" Flow Diagram

1. Check all wiring, including the factory wiring, on the terminal blocks in the Main Analyzer Unit, remote Furnace Temperature Control (FTC) Box, and Display Console. Refer to the wiring instructions in Chapter 2, *Installation*, and the wiring diagram in Figure 59 on page 137 to make sure that all wires are attached to the correct pins. If any connections are loose, turn the screws clockwise with a small screwdriver to secure the connections.
2. Locate the oxygen sensor clips (see Figure 27 on page 55, which shows the sample system with the analyzer enclosure removed) and short them together with a jumper. The oxygen display should read 20.9% (or 0 mV by pressing the mV key).

If the wiring is good and a 20.9% oxygen reading is obtained with the shorted clips, **remove the jumper** and proceed to the sensor furnace temperature check.

Note: *If an open loop (OL) is measured at the oxygen sensor clips, recheck the wiring and try again. If the OL reading repeats, contact the factory for assistance.*

5.2.1a Check the Wiring (cont.)

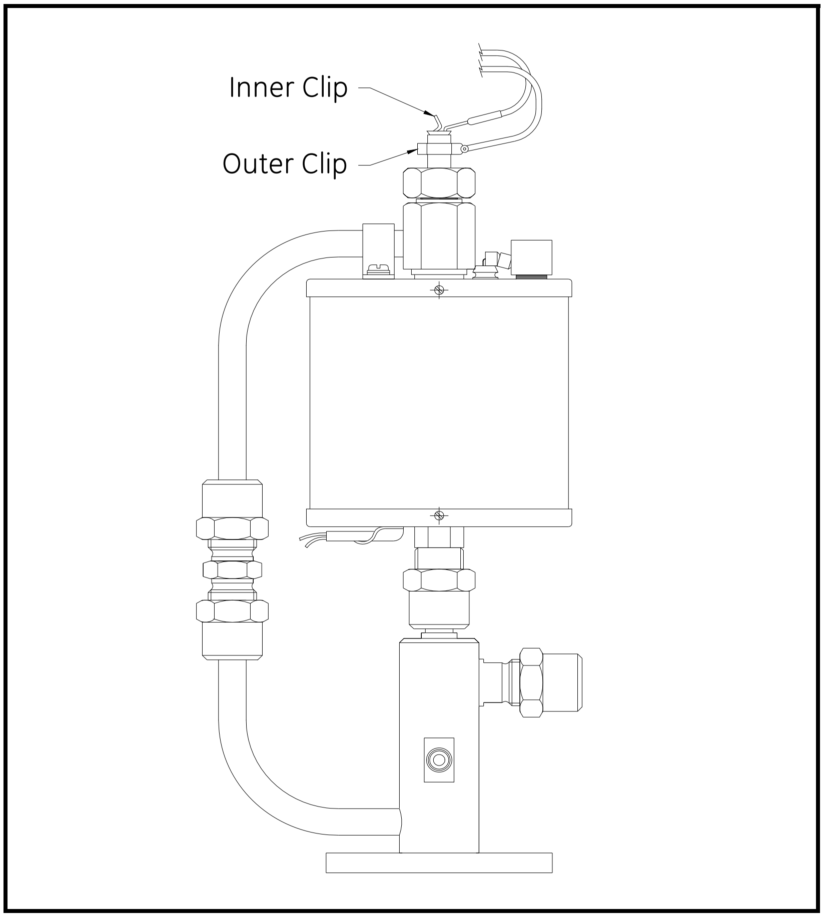


Figure 27: Oxygen Sensor Clips

5.2.1b Check the Temperature Sensor

If the FGA 300V(X) is fitted with an **RTD** temperature sensor, follow the steps listed below. If the FGA 300V(X) is fitted with an optional thermocouple (**TC**) temperature sensor, follow the steps on page 57.

WARNING! There are very hot surfaces in the Main Analyzer Unit. Touching any of these surfaces without heat resistant gloves will result in serious burns.

Checking Units with an RTD Temperature Sensor

1. Disconnect the Main Analyzer Unit RTD leads from pins 3 and 4 of terminal block TB1 in the Remote FTC Box.
2. Using a digital multimeter, measure the resistance across the disconnected RTD leads. One of the conditions listed in Table 10 on page 56 should occur.
3. Complete the action recommended in Table 10 on page 56.

5.2.1b Check the Temperature Sensor (cont.)

Table 10: RTD Resistance Readings

Resistance Reading	Recommended Action
about 365-385 ohms (770°C) or about 375-395 ohms (812°C)	The temperature is good - proceed to the oxygen sensor check on page 59.
about 105-140 ohms (either 770°C or 812°C)	The temperature is low - proceed to the sensor furnace check on page 59.
open loop (OL) (either 770°C or 812°C)	The RTD is defective and must be replaced - see *Replacing the Temperature Sensor* on page 84.

Note: *If a resistance reading other than those listed above is obtained, refer to Table 11 to determine the operating temperature of the sensor furnace. A standard FGA 300V(X) operates at a temperature of either 770°C or 812°C.*

Table 11: RTD Resistance vs. Temperature

Resistance vs. Temperature for 100Ω Platinum RTD Sensor

Example:
An RTD resistance of 200 ohms indicates a sensor furnace operating temperature of about 270°C: First, find the resistance value in the table (201.30) that best matches the measured value. Then, add the values of the column label (200) and the row label (70) together to determine the operating temperature of the sensor furnace (270).

	0	100	200	300	400	500	600	700	800
0	100.00	138.50	175.84	212.03	247.06	280.93	313.65	345.21	375.61
10	103.90	142.28	179.51	215.58	250.50	284.26	316.86	348.30	378.59
20	107.79	146.06	183.17	219.13	253.93	287.57	320.05	351.38	381.55
30	112.16	149.82	186.82	222.69	257.34	290.87	323.24	354.45	384.50
40	115.54	153.57	190.46	226.18	260.50	294.16	326.41	357.51	387.45
50	119.40	157.32	194.08	229.69	264.14	297.43	329.57	360.55	390.38
60	123.24	161.04	197.70	233.19	267.52	300.70	332.72	363.59	------
70	127.07	164.76	201.30	236.67	270.89	303.95	335.86	366.61	------
80	130.89	168.47	204.88	240.15	274.25	307.20	338.99	369.62	------
90	134.70	172.16	208.46	243.61	277.60	310.43	342.10	372.62	------
100	138.50	175.84	212.03	247.06	280.93	313.65	345.21	375.61	------
W/°C	0.385	0.373	0.361	0.350	0.338	0.327	0.315	0.304	0.295

5.2.1b Check the Temperature Sensor (cont.)

Checking Units with a Thermocouple Temperature Sensor

1. Locate the Main Analyzer Unit TC leads at pins 3 and 4 of terminal block TB1 in the Remote FTC Box.

2. Using a digital multimeter, measure the voltage across the TC terminals. One of the conditions listed in Table 12 should occur.

3. Complete the action recommended in Table 12.

Table 12: TC Voltage Readings

Voltage Reading	Recommended Action
about 30-33 mV (770°C) or about 32-35 mV (812°C)	The temperature is good - proceed to the oxygen sensor check on page 59.
about 0-3.5 mV (either 770°C or 812°C)	The temperature is low - proceed to the sensor furnace check on page 59.
0 mV reading (either 770°C or 812°C)	The TC is defective and must be replaced - see *Replacing the Temperature Sensor* on page 84.

Note: *If a voltage reading other than those listed above is obtained, refer to Figure 28 or Table 13 on page 58 to determine the operating temperature of the sensor furnace. A standard FGA 300V(X) operates at a temperature of either 770°C. or 812°C.*

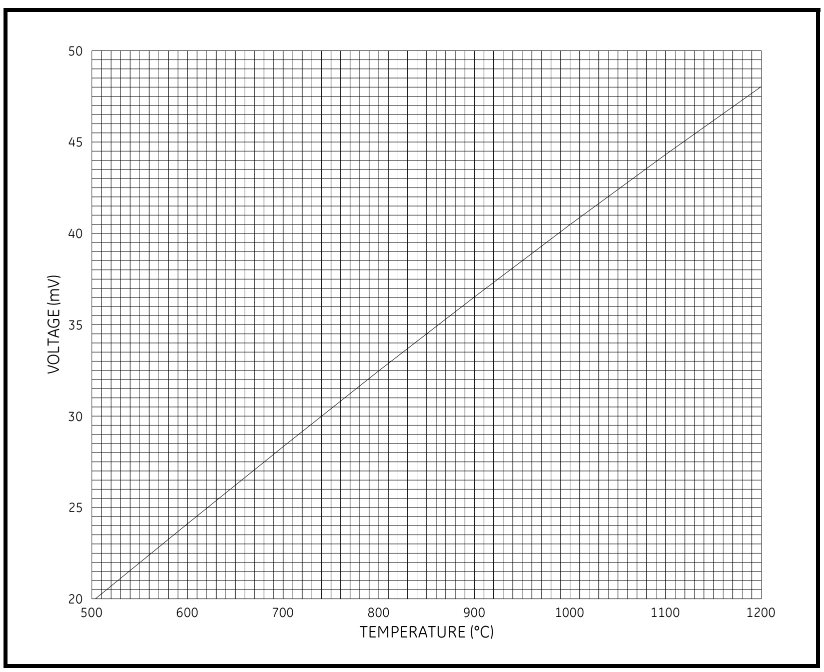


Figure 28: Thermocouple Voltage vs. Temperature

5.2.1b Check the Temperature Sensor (cont.)

Table 13: Thermocouple Voltage vs. Temperature

Temp.(°C)	E(mV)	Temp.(°C)	E(mV)
20	(0.7981)	740	30.0002
500	19.8462	750	30.4153
510	20.2725	760	30.8296
520	20.6990	770	31.2429
530	21.1254	780	31.6553
540	21.5519	790	32.0668
550	21.9783	800	32.4773
560	22.4046	810	32.8868
570	22.8307	812	32.9686
580	23.2565	820	33.2953
590	23.6821	830	33.7029
600	24.1073	840	34.1094
610	24.5322	850	34.5150
620	24.9566	860	34.9196
630	25.3805	870	35.3231
640	25.8039	880	35.7257
650	26.2267	890	36.1272
660	26.6489	900	36.5278
670	27.0705	910	36.9273
680	27.4914	920	37.3259
690	27.9115	930	37.7234
700	28.3309	940	38.1199
710	28.7494	950	38.5154
720	29.1672	960	38.9099
730	29.5841	970	39.3033

5.2.1c Check the Oxygen Sensor

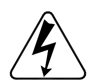
If the sensor furnace operating temperature was within the normal range, the troubleshooting sequence should resume here.

1. Disconnect the Main Analyzer Unit leads from pins 1 and 2 (oxygen sensor connections) of terminal block TB1 in the Remote FTC Box.
2. Using a digital multimeter, measure the resistance between the two oxygen sensor clips. Place the positive lead of the multimeter on the inner clip (the clip inside the base of the oxygen sensor) as close to the oxygen sensor as possible without touching it. Place the negative lead of the multimeter on the outer clip (the clip around the base of the oxygen sensor). See Figure 27 on page 55 for the location of the clips.
3. If the measurement indicates an open loop (OL), adjust the clips to make certain they are making good contact with the oxygen sensor and take another reading. If an open loop is still measured, the oxygen sensor is defective and must be replaced.

5.2.1d Check the Sensor Furnace

If the sensor furnace operating temperature was too low, the troubleshooting sequence should resume here.

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



1. Disconnect the sensor furnace leads from pins 12 and 14 of terminal block TB1 in the Main Analyzer Unit.
2. Using a digital multimeter, measure the resistance across the disconnected sensor furnace leads. One of the conditions listed in Table 14 should occur.

Table 14: Sensor Furnace Resistance Readings

Resistance Reading	Recommended Action
63-70 ohms	The sensor furnace is good - proceed to the FTC board check on page 61.
open loop (OL)	Check the wires from terminal block TB1 to the ceramic block to see if they are broken or loose. If the wiring is good, the sensor furnace is defective and must be replaced (refer to *Replacing the Sensor Furnace* on page 86).

5.2.1d Check the Sensor Furnace (cont.)

3. Reconnect the sensor furnace leads to pins 12 and 14 of terminal block TB1 in the Main Analyzer Unit.

4. Complete the action recommended in Table 15.

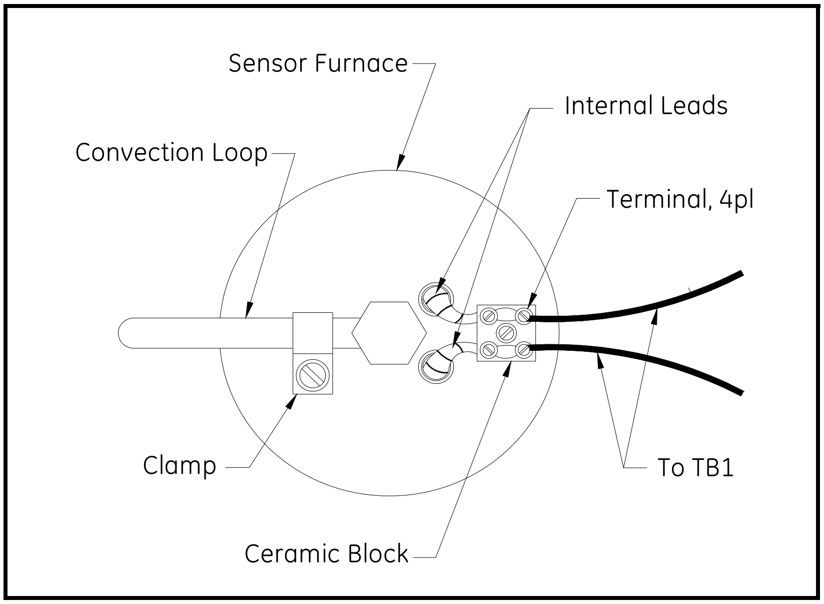


Figure 29: Top View of Furnace

Table 15: Sensor Furnace Resistance Readings

Resistance Reading	Recommended Action
63-70 ohms	There is a bad connection on the ceramic block. Make sure the wires are fed all the way through the ceramic block and exit on the opposite side from which they were inserted. Tighten down all four screws and verify continuity across the ceramic block (see Figure 29).
open loop (OL)	Check the wires from terminal block TB1 to the ceramic block to see if they are broken or loose. If the wiring is good, the sensor furnace is defective and must be replaced (refer to *Replacing the Sensor Furnace* on page 86).

5.2.1e Check the FTC Board

1. Using a digital multimeter, measure the FTC board's AC output voltage to the sensor furnace across pins 12 and 14 on terminal block TB1 in the Remote FTC Box and across pins 3 and 4 of terminal block TB1 on the FTC board. See Figure 30 for the terminal block locations, and record the two voltage readings.

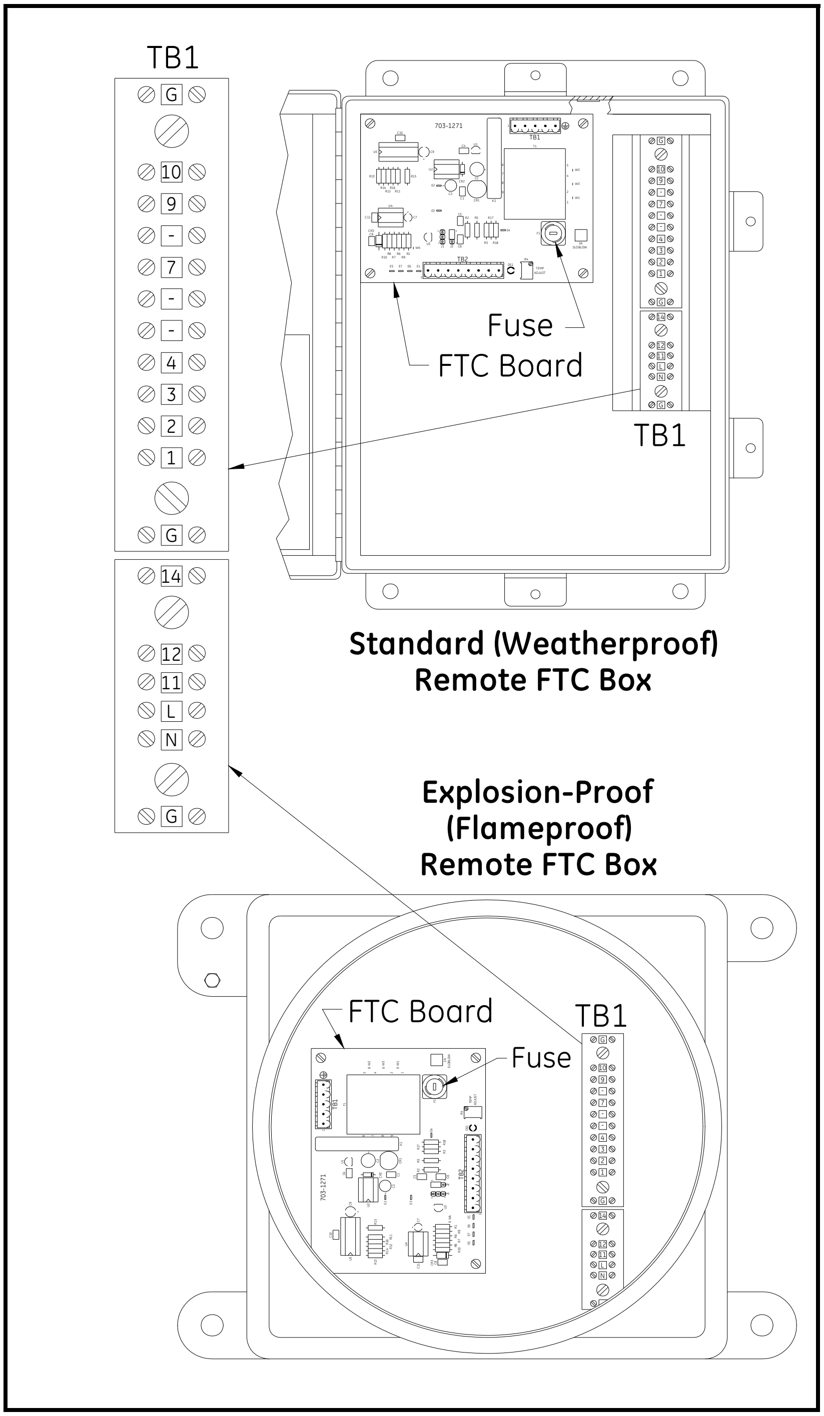


Figure 30: FTC Board (Fuse) and TB1 Locations

5.2.1e Check the FTC Board (cont.)

2. The voltages at the two terminal blocks should be the same. If they are not, check the wiring between the terminal blocks (see Figure 59 on page 137, *Wiring Diagrams and Circuit Boards*). Then, one of the conditions listed in Table 16 should occur.

Table 16: FTC Output Voltage Readings

Voltage Reading	Recommended Action
approximately full line voltage	The FTC board is good. The Display Electronics Console may be defective - contact the factory for assistance.
voltage greater than 0 but less than full line voltage	The FTC board is defective and must be replaced. See Chapter 6, *Parts Replacement*.
no voltage present	Proceed with the remaining steps in this section.

3. Using a digital multimeter, measure the FTC board's AC input voltage across pins 1 and 2 of terminal block TB1 on the FTC board. See Figure 30 on page 61 for the location of TB1. One of the conditions listed in Table 17 should occur.

Table 17: FTC Output Voltage Readings

Voltage Reading	Recommended Action
approximately full line voltage	Continue with the next step in this section.
no voltage present	There is no power reaching the FTC box - check the power source.

4. Remove the FTC board fuse (see Figure 30 on page 61) and check it for continuity. If the fuse is blown, replace it with a new fuse of the size and type listed in Chapter 7, *Specifications*.

5. If the FTC board fuse is good, the FTC board is defective and must be replaced. See Chapter 6, *Parts Replacement*, for instructions.

If the display continues to blink "--.--", contact the factory for assistance.

Note: *Older FGA 300V(X) analyzers may have a different FTC board and/or a sensor furnace power transformer. For units so equipped, refer to Appendix F,* Previous Configurations, *for troubleshooting instructions.*

5.2.2 "PP.PP" and Normal Reading Alternate

This oxygen display condition indicates that the signal from the oxygen sensor has changed less than 0.2 mV in 15 minutes. Such a situation can indicate either that the probe is plugged or that the process is unusually stable.

When this error condition occurs:

- the alarm relay is activated
- the analog outputs are not affected

Plugging of the probe usually occurs in very dirty applications. If the problem is a plugged probe, use a blowback system (contact the factory for details) to unplug the analyzer. If the flue gas composition is really that stable, this warning may be ignored.

5.2.3 Blinking Reading

A blinking reading on the oxygen display is usually caused by either of two conditions:

- the oxygen sensor has exceeded its useful lifetime
- the sensor furnace is not at the proper temperature

To correct this condition refer to the flow diagram in Figure 31 on page 64 and perform the following tests:

5.2.3a Check the Oxygen Sensor

Every two hours, the FGA 300V(X) automatically measures the impedance of the oxygen sensor. If the impedance is above the acceptable range, the oxygen display reading blinks. This means the oxygen sensor is aging and should be replaced. To test the oxygen sensor impedance manually, complete the following steps:

1. Press the mV key located on the keypad of the Display Console and record the voltage reading.
2. Simultaneously press the Ω and mV keys, located on the keypad of the Display Console, and record the voltage reading.
3. If the voltage reading from Step 2 is more than 50% below the voltage reading from in Step 1, replace the oxygen sensor (refer to *Replacing the Oxygen Sensor* on page 79).

IMPORTANT: *The oxygen sensor will continue to take accurate readings for a while after the* Blinking Reading *error condition occurs, but the oxygen sensor should still be replaced as soon as possible.*

5.2.3b Check the Remaining Components

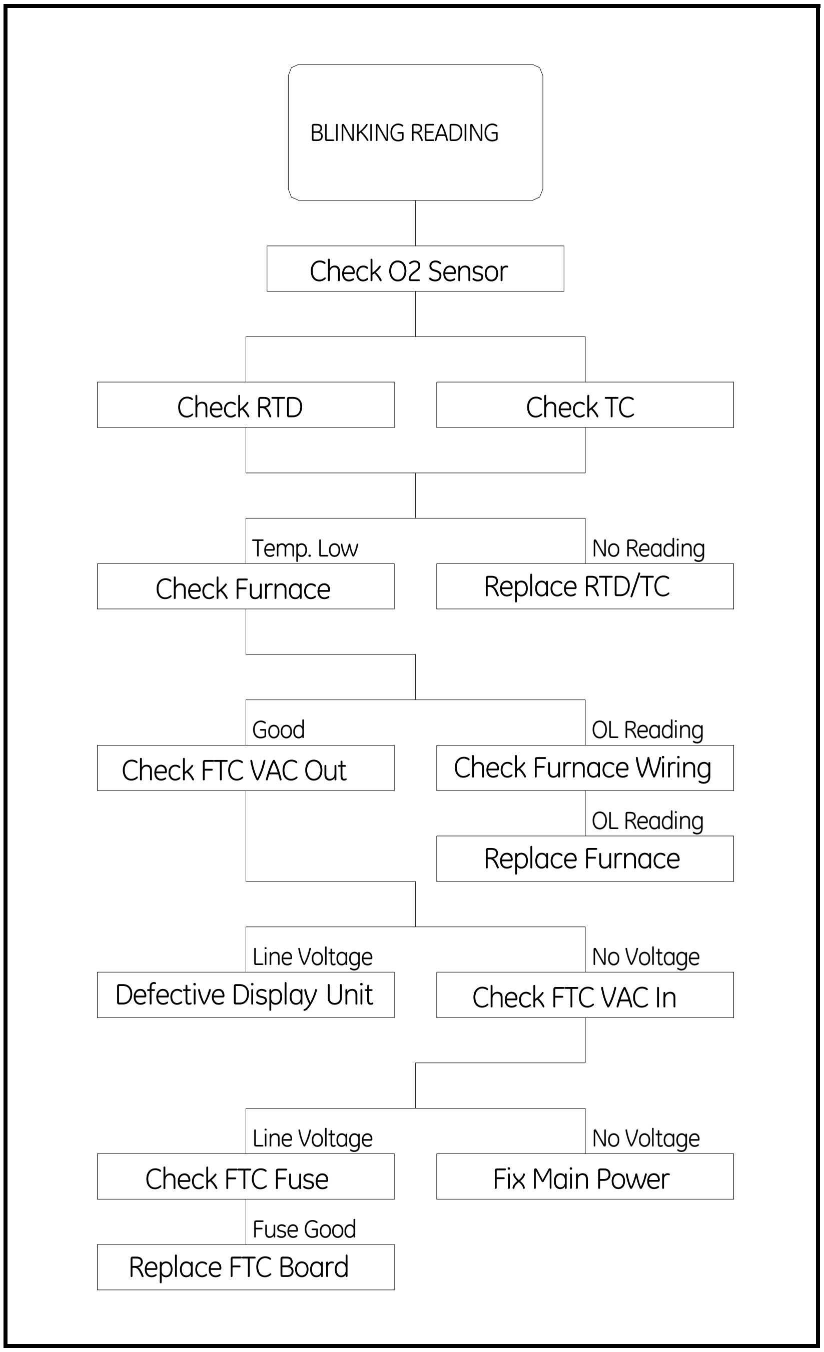


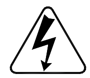
Figure 31: Blinking Reading Flow Diagram

5.2.4 Oxygen Concentration Reads Constant 20.9%

This condition is unusual and is likely to be caused either by a short in the oxygen sensor wiring, a severe air leak in the plumbing or a defective Display Console. A brief description of how to remedy this problem is presented below.

WARNING! The main analyzer enclosure is hot. Use heat-resistant gloves when handling the enclosure.

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



5.2.4a Check the Oxygen Sensor Wiring

Refer to Figure 27 on page 55 for the location of the oxygen sensor clips, and check for a short circuit in the contact clip wiring (two wires touching). If this does not correct the problem, proceed to the next section.

5.2.4b Check for Plumbing Leaks

A plumbing leak permits cross-contamination of the reference air and the flue gas sample. Use the following steps to remedy the problem:

1. Make sure that the calibration gas port on the Main Analyzer Unit has not been left open. This would admit atmospheric air into the sample system and force a 20.9% reading.
2. Remove the Main Analyzer Unit cover and check all sample system plumbing connections for leaks. Make sure that the oxygen sensor and combustibles detector ports are properly sealed.

When the reference air is contaminated by the same gases that are being measured, the oxygen sensor generates a 0.00 mV analog output signal and a 20.9% oxygen reading. Removing the cover permits uncontaminated reference air to enter the unit.

3. If the oxygen reading drops, ensure that all fittings are tight and replace the Main Analyzer Unit cover. If the oxygen reading gradually returns to 20.9%, try tightening the fittings an additional 1/8 turn. If the problem persists, contact the factory for assistance.

CAUTION! Do not tighten fittings more than 1/8 turn at a time.

5.2.4c Check the Display Electronics Console

If the shorted wiring and plumbing leak checks have not corrected the problem, complete the following steps:

1. Disconnect the oxygen sensor leads from pins 2 and 3 of terminal block TB1 in the Display Console. See Figure 32 for the location of TB1.

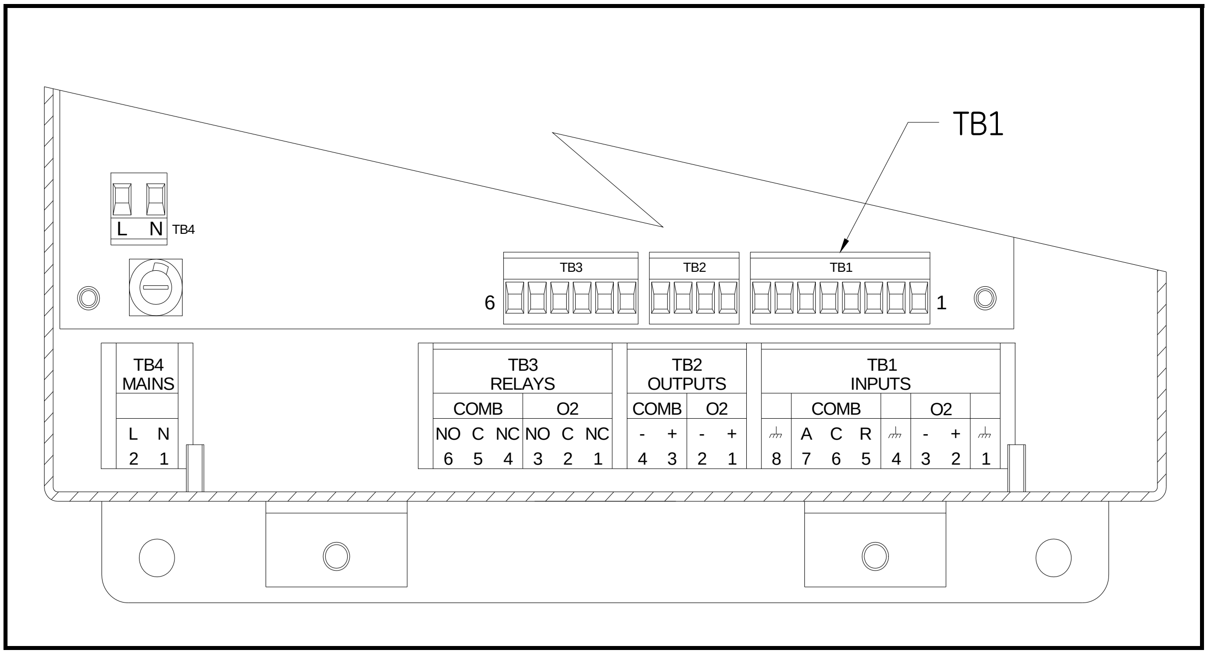


Figure 32: Display Electronics Console - TB1

2. Connect the positive lead of a digital voltmeter to the wire removed from pin 2 and connect the negative voltmeter lead to the wire removed from pin 3.

IMPORTANT: *The oxygen sensor leads must be removed from the terminal block for this test. If the leads are not disconnected, a short on the Display Console circuit board could result in a false 0.00 mV reading.*

3. A voltage reading of 0.00 mV should be obtained, to correspond with the 20.9% oxygen reading. If any voltage other than 0.00 mV is measured, the Display Console is defective. Contact the factory for assistance.

Note: *For units fitted with the previous version of the 300D printed circuit board. See Appendix F,* Previous Configurations, *for the layout of this circuit board.*

5.2.5 Oxygen Reading Above 20.9%

An oxygen display reading greater than 20.9%, which may also be indicated by a display reading of 55.35 or the error code E4, is almost always caused by reversed wiring of the oxygen sensor. For example, 5% oxygen at 812°C would generate an oxygen sensor output of +33.47 mV. However, reversed oxygen sensor wiring would cause this reading to be –33.47 mV. The Nernst equation calculation would then convert this voltage to an oxygen display of 87.61%!

To correct this problem, check the oxygen sensor wiring at TB1 in the Main Analyzer Unit, TB1 in the remote FTC Box and TB1 in the Display Console for the correct polarity (refer to Figure 59 on page 137, *Wiring Diagrams and Circuit Boards*).

5.2.6 Oxygen Reading Too Low

This condition is usually caused by combustibles in the sample gas, but it may also be the result of the oxygen sensor being out of calibration. To correct the condition, complete the following steps:

1. The sample gas may be contaminated with combustibles from the following common sources:

- grease or oil in the sensor plumbing
- silicon-based plumbing tape
- excess fuel in the burner

The oxygen sensor will cause combustibles such as CO, H_2, or hydrocarbons in the sample to react with oxygen, thus depleting the oxygen in the sample gas. This will give a reading that may be less than the expected amount of oxygen. To fix the problem, remove the source of the contamination.

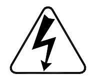
2. If the sample gas is not contaminated with hydrocarbons, recalibrate the oxygen sensor. See Chapter 4, *Calibration*, for the correct procedure.

5.2.7 Oxygen Reading Too High

This condition is most likely caused either by poor quality reference air, a leak in the plumbing or an oxygen sensor that is too cool. A brief description of possible solutions to this problem is presented below.

WARNING! The main analyzer enclosure is hot. Use heat-resistant gloves when handling the enclosure.

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



5.2.7a Check for Plumbing Leaks

A plumbing leak permits contamination of the reference air by the flue gas sample. The resulting reduction in the ratio of the oxygen partial pressures reduces the mV output from the oxygen sensor and yields a percent oxygen reading that is higher than expected. Use the following steps to remedy the problem:

1. Remove the Main Analyzer Unit cover, in order to allow uncontaminated reference air to enter the unit.
2. If the oxygen reading drops, tighten all fittings by 1/8 turn and replace the Main Analyzer Unit cover. If the oxygen reading gradually increases, repeat Step 1 and then replace the cover.

CAUTION! Do not tighten fittings more than 1/8 turn at a time.

5.2.7b Check the Oxygen Sensor Temperature

If the oxygen sensor is its normal operating temperature, the mV output will be too low and the percent oxygen reading will be higher than expected.

The easiest way to check the sensor temperature is to calibrate the oxygen sensor as described in Chapter 4, *Calibration*. The calibration procedure includes instructions for adjusting the sensor furnace temperature, if necessary.

If the problem has not been resolved by performing the checks above, contact the factory for assistance.

5.3 Combustibles Errors

The following is a list of the possible combustibles error indicators. If an unlisted error occurs, contact the factory for assistance.

5.3.1 "1   0" Out-Of-Range Indicator

The out-of-range error indicator is usually caused by one of the following conditions:

- the stoichiometric interlock is activated
- faulty combustibles detector or wiring
- combustibles channel is out of calibration.
- insufficient excess oxygen to support burning of the combustibles
- combustibles level is greater than 19,990 ppm_V

To correct this error, perform the following checks until the problem is remedied:

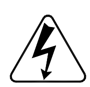
5.3.1a Check Oxygen Channel

The "1   0" combustibles error indicator can be caused by the detection of an open circuit in the oxygen channel, which activates the stoichiometric interlock. If a blinking "--.--" error indicator also appears on the oxygen display, refer to the *Blinking "--.--"* section on page 53 to correct both of these errors. If the error is not oxygen related, proceed to the next section.

5.3.1b Check the Combustibles Detector

The out-of-range combustibles error may also be caused by a faulty or incorrectly wired combustibles detector. To check this possibility, complete the following steps:

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



1. Refer to Figure 59 on page 137, *Wiring Diagrams and Circuit Boards*, and verify that the combustibles detector is correctly wired at terminal blocks TB1 in the Main Analyzer Unit, the remote FTC Box and the Display Electronics Console. Make sure that none of the wires interconnecting the three terminal blocks are loose or broken.
2. In the Main Analyzer Unit, disconnect the common wire from pin 9 of terminal block TB1, and attach one lead of a multimeter to the disconnected wire.

5.3.1b Check the Combustibles Detector (cont.)

3. Attach the other lead of the multimeter to pin 10 of terminal block TB1, record the resistance of the reference element, and do one of the following:

- If the resistance is between 1800 and 1900 ohms, proceed to step 4.
- If the element is shorted (0 ohms) or open (OL), the combustibles detector is defective and must be replaced (refer to *Replacing the Combustibles Detector* on page 81).

4. Move the multimeter lead from pin 10 to pin 7 of terminal block TB1, record the resistance of the active element, and do the following:

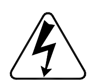
- If both readings are between 1800 and 1900 ohms, and the difference between them does not exceed 50 ohms, disconnect the multimeter and reconnect the common wire to pin 9 of terminal block TB1. The combustibles channel may be out of calibration (refer to *Calibrating the Combustibles Detector* on page 48).
- If the element is shorted (0 ohms) or open (OL), the combustibles detector is defective and must be replaced (refer to *Replacing the Combustibles Detector* on page 81.

If the steps in this section do not correct the “1   0” combustibles error, consult the factory for assistance.

5.3.2 “–12340” Negative Reading

A negative reading on the combustibles display can be caused by incorrect wiring of the combustibles detector or the combustibles circuitry being out of calibration. To correct the problem, complete the following steps:

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



1. Refer to Figure 59 on page 137 and verify that the combustibles detector is correctly wired at terminal blocks TB1 in the Main Analyzer Unit, the remote FTC Box and the Display Electronics Console.

2. If the combustibles detector wiring is correct, the combustibles circuitry may be out of calibration. Refer to Chapter 4, *Calibration*, for instructions on calibrating the combustibles detector.

If the steps in this section do not correct the “–12340” combustibles error, consult the factory for assistance.

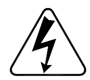
5.3.3 "-1 0" Negative Out-Of-Range Indicator

The negative out-of-range error indicator is usually caused by one of the following conditions:

- faulty combustibles detector or wiring
- combustibles circuitry is out of calibration.

To correct this error, perform the following checks until the problem is remedied:

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



1. Refer to Figure 59 on page 137 and verify that the combustibles detector is correctly wired at terminal blocks TB1 in the Main Analyzer Unit, the remote FTC Box and the Display Console. Make sure that none of the wires interconnecting the three terminal blocks is loose or broken.
2. In the Main Analyzer Unit, disconnect the common wire from pin 9 of terminal block TB1, and attach one lead of a multimeter to the disconnected wire.
3. Attach the other lead of the multimeter to pin 10 of terminal block TB1, record the resistance of the reference element, and do one of the following:
   - If the resistance is 1800-1900 ohms, proceed to step 4.
   - If the element is shorted (0 ohms) or open (OL), the combustibles detector is defective and must be replaced (refer to *Replacing the Combustibles Detector* on page 81).
4. Move the multimeter lead from pin 10 to pin 7 of terminal block TB1, record the resistance of the active element, and do the following:
   - If both readings are 1800-1900 ohms, and the difference between them does not exceed 50 ohms, disconnect the multimeter and reconnect the common wire to pin 9 of terminal block TB1. The combustibles channel may be out of calibration (refer to *Replacing the Combustibles Detector* on page 81).
   - If the element is shorted (0 ohms) or open (OL), the combustibles detector is defective and must be replaced (refer to *Replacing the Combustibles Detector* on page 81).

If the steps in this section do not correct the "-1 0" combustibles error, consult the factory for assistance.

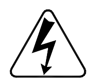
5.3.4 Low Combustibles Reading, but Correct Oxygen Reading

If the *"Low Combustibles Reading"* error condition occurs, check the following possible causes:

- the combustibles detector was improperly installed or is physically damaged
- the combustibles detector has lost sensitivity due to aging
- the combustibles detector was calibrated at too low a flow rate.

To correct this error condition, complete the following steps:

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



1. Remove the cover from the Main Analyzer Unit and inspect the installation of the combustibles detector. Verify that the serial number label on the detector is in the 9 o'clock position, which indicates that the two elements are positioned with the active element above the reference element. Refer to *Replacing the Combustibles Detector* on page 81, and to Figure 35 on page 82 and Figure 36 on page 83, for detailed installation instructions for the combustibles detector.
2. Remove the combustibles detector and inspect the two elements. The active and reference elements should be parallel to each other and approximately 5/32 in. (4 mm) apart. If the elements are too close together, heat will transfer from the active element to the reference element and lower the output signal. If the active element is bent outward, some of its heat may be transferred to the manifold structure and lower the output signal.
3. Reinstall the combustibles detector as described in *Replacing the Combustibles Detector* on page 81. Test the combustibles detector by completing the following steps:
   a. In the Main Analyzer Unit, disconnect the common wire from pin 9 of terminal block TB1, and attach one lead of a multimeter to the disconnected wire.
   b. Attach the other lead of the multimeter to pin 10 of terminal block TB1 and record the resistance of the reference element.
   c. Move the multimeter lead from pin 10 to pin 7 of terminal block TB1 and record the resistance of the active element.
   d. Both readings should be between 1800 and 1900 ohms, and the difference between them should not exceed 50 ohms. Disconnect the multimeter and reconnect the common wires to pin 9 of terminal block TB1. If the proper readings are obtained, skip to Step 4 below.
   e. If the resistance readings are outside the acceptable range, the combustibles detector has lost sensitivity and should be replaced. See Chapter 6, *Parts Replacement*, for instructions.
4. Recalibrate the combustibles detector using the procedures described in Chapter 4, *Calibration*. Be sure to calibrate the detector at the tagged flow rate. If the calibration tag is unreadable or has been lost, contact the factory for assistance.

If the steps in this section do not correct the *"Low Combustibles Reading"* error, consult the factory for assistance.

5.4 Calibration Responses

Chapter 4, *Calibration*, describes the procedures for calibrating the FGA 300V(X) in great detail. However, the response of the unit to the calibration procedures can provide valuable clues to potential problems with the installation. The three most common situations are described in this section.

5.4.1 Everything Is Fine

Calibration of the analyzer at the tagged calibration gas flow rate has been successfully completed. Upon switching off the calibration gas, the analyzer quickly returns to monitoring and displaying the flue gas concentrations accurately. This indicates that proper operating conditions have been achieved and the analyzer can be expected to perform reliably.

5.4.2 Forced Flow Problem

If a flow rate higher than the tagged calibration gas flow rate is required to calibrate the analyzer, either the flue gas velocity is too high or the probe is not perpendicular to the flue gas flow direction.

Under such conditions, the sample is not entering the probe by diffusion only, but it is being forced into the probe instead. In addition to the calibration problem, sensor/detector life may be shortened and analyzer plugging may occur. If forced flow is confirmed as the problem, refer to Chapter 2, *Installation*, for instructions on proper orientation of the analyzer.

5.4.3 Dead Space Problem

The analyzer was successfully calibrated at the tagged calibration gas flow rate, and the analyzer responded quickly to the calibration gas. However, there is a significant delay in reading the correct flue gas concentrations, after turning off the calibration gas.

When this problem occurs, it is very likely that the probe tip is located in a dead space. After the analyzer is correctly reading the flue gas concentration, switch on the calibration gas just long enough to get the correct reading. As soon as the analyzer reads the correct value, quickly shut off the calibration gas. One of two responses should occur:

1. If the recovery time is still too long, *plugging* may be the problem. Use of a blowback system (contact the factory for assistance) should clear the analyzer and restore proper operation.
2. If the analyzer reading recovers promptly, *dead space* is the likely problem. Furnace internal structures can cause dead spaces that are not evident from an external examination. Often, the installation of a longer probe may solve a dead space problem. However, it may sometimes be necessary to relocate the analyzer to a more suitable installation site.

If any situations not covered in this chapter are encountered, contact the factory for assistance.

[no content intended for this page]

Chapter 6. Parts Replacement

6.1 Overview

The FGA 300V(X) is designed to enable easy and quick servicing, if necessary. This chapter describes the replacement of major and minor components of the FGA 300V(X). However, before actually replacing any component, carefully read the complete instructions to become familiar with the procedures.

Each section of this chapter gives a list of the equipment needed to complete the component replacement. Please make sure that any necessary replacement parts are on hand before dismantling the analyzer. In addition, the first paragraph of each section gives a description of the function and location of the part to be replaced.

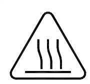
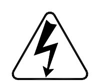
IMPORTANT: *If the power must be disconnected to replace a part, perform the replacement as quickly as possible. The FGA 300V(X) is susceptible to corrosion from acid condensation, if it remains without power for more than about thirty minutes.*

If service procedures not covered in this chapter become necessary, please contact the factory for assistance.

WARNING! **To ensure safe operation of the FGA 300V(X), it must be installed and operated as described in this manual. In addition, be sure to follow all applicable local safety codes and regulations for installing electrical equipment.**

All procedures should be performed by trained service personnel.

IMPORTANT: *These symbols indicate Caution - dangerously hot surfaces and risk of electric shock, respectively.*

6.2 Preventing Common Problems

Because of the complex techniques required to monitor flue gases, some basic precautions must be observed. Failure to observe these simple procedures is often the cause of some common problems with the FGA 300V(X) operation. Compliance with the following instructions will help to eliminate such problems:

1. Do not use any thread sealant on the threads of probe components or on any joints in the sample flow path. Teflon tape will melt at the normal probe operating temperature, and other thread sealants give off combustible vapors that can cause reading errors.
2. Do not handle the oxygen sensor or combustibles detector with bare hands. Although some scratches on the platinum coating can be tolerated, rubbing the coating should be avoided.

6.2 Preventing Common Problems (cont.)

3. Scrubbing an oxygen sensor or washing a hot sensor in cold water can damage or destroy it. Clean a sensor only by rinsing it with clean water, after the sensor has cooled.

4. Do not install a cold probe and/or sleeve into a hot manifold, as the threads will expand and seize upon warming. If such a situation is unavoidable, thread the components loosely into the manifold and allow to warm for a few minutes before fully tightening.

6.3 The Main Analyzer Unit

Those components associated with the basic sample system are located in the Main Analyzer Unit. This section describes the proper procedures for replacing these parts.

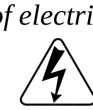
6.3.1 Removing the Cover

In order to access the sample system components, the cover must first be removed from the Main Analyzer Unit:

- Standard (weatherproof) FGA 300V:
  - **a.** Remove the two (2) screws on each side of the cover, near the base of the Main Analyzer Unit.
  - **b.** Lift the cover straight up and off the base, with the handle provided.
- Explosion-proof (flameproof) FGA 300VX:
  - **a.** Loosen the locking set screw on top of the Main Analyzer Unit and, using a long screwdriver across the slots provided, unscrew the cover from the enclosure.
  - **b.** Loosen the locking set screw on the side of the Main Analyzer Unit (near the bottom) and unscrew the enclosure from the base of the unit.
  - **c.** Loosen the locking set screw on top of the Accessory Box and, using a long screwdriver across the slots provided, unscrew the cover from the enclosure.

WARNING! There are extremely hot surfaces in the analyzer. If these surfaces are touched, serious burns could result. Use heat-resistant gloves when working within the Main Analyzer Unit.

IMPORTANT: *These symbols indicate Caution - dangerously hot surfaces and risk of electric shock, respectively.*



6.3.2 Replacing the Oxygen Sensor Clips

The oxygen sensor is connected to the electronics via two contact clips located at the base of the sensor. The *inner clip*, is inserted into the end of the oxygen sensor, while the outer clip simply snaps around the base of the sensor.

The following tools are needed to replace the oxygen sensor clips:

- pliers
- wire cutters
- wire strippers
- crimping tool

Power should remain on while replacing the oxygen sensor clips. Refer to Figure 33 while completing the following steps:

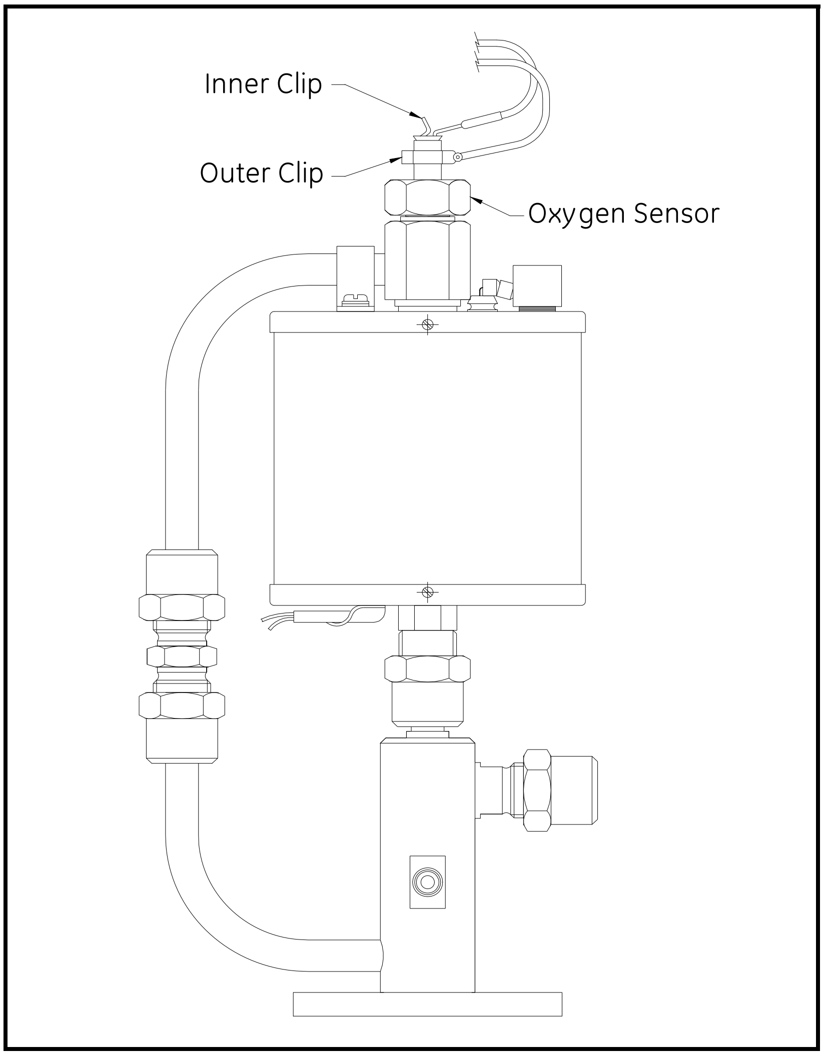


Figure 33: Oxygen Sensor Clips

6.3.2a Removing the Old Sensor Clips

1. Remove the main analyzer unit cover, as described in the *"Removing the Cover"* section on page 76.
2. Disconnect the oxygen sensor leads from pins 1 and 2 of terminal block TB1 in the Main Analyzer Unit.
3. Locate the oxygen sensor and the oxygen sensor clips (see Figure 33 on page 77).
4. Use pliers to remove the inner and outer clips from the oxygen sensor. To remove the inner clip, pinch the ends together and pull the clip out of the oxygen sensor. The outer clip is easily removed by pulling it away from the oxygen sensor body.
5. Making sure you do not cut off too much of the wire, cut off the old inner clip. The remaining wire should be left as long as possible.

6.3.2b Installing the New Sensor Clips

1. Strip 13mm (1/2") of insulation off the inner clip wire.
2. Slide the new inner clip over the stripped wire.
3. Using a crimping tool, crimp the new inner clip onto the inner clip wire.
4. Repeat steps 4 through 7 to install the new outer clip. Reinstall both clips onto the oxygen sensor.
5. Reconnect the oxygen sensor leads to pins 1 and 2 of terminal block TB1 in the Main Analyzer Unit.
6. Install the Main Analyzer Unit cover by completing the steps in the *"Removing the Cover"* section on page 76 in reverse order.
7. Recalibrate the oxygen sensor as described in Chapter 4, *Calibration*.

This completes the replacement of the oxygen sensor clips.

6.3.3 Replacing the Oxygen Sensor

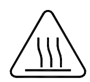
The oxygen sensor is mounted on top of the furnace and is readily accessible for quick and easy replacement. The following items are needed to replace the oxygen sensor:

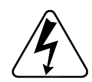
- open-end wrench
- torque wrench
- Molykote® High-Temperature, Non-Silicone Lubricant
- pliers

Note: *When replacing the oxygen sensor, handle the sensor only by the fitting at its base.*

The oxygen sensor can be replaced with the sensor furnace either hot or cool. However, the procedures are slightly different, and particular attention should be paid to the noted variations in the following steps:

IMPORTANT: *These symbols indicate Caution - dangerously hot surfaces and risk of electric shock, respectively.*





If replacing the oxygen sensor with a hot furnace, the power should remain on during the process and the following warning should be observed:

WARNING! **There are extremely hot surfaces in the analyzer. Touching these surfaces will result in serious burns. Use heat-resistant gloves while replacing the oxygen sensor.**

6.3.3a Removing the Old Oxygen Sensor

1. Remove the main analyzer unit cover, as described in the *“Removing the Cover”* section on page 76.
2. Locate the oxygen sensor and the oxygen sensor clips (see Figure 34). Use pliers to remove the inner and outer clips from the oxygen sensor. To remove the inner clip, pinch the ends together and pull the clip out of the oxygen sensor. The outer clip is easily removed by pulling it away from the oxygen sensor body.

IMPORTANT: *Do not remove the oxygen sensor from the sensor furnace at this time.*

3. While wearing heat resistant gloves, slowly unscrew the fitting nut until it is completely free of its fitting. Carefully lift the oxygen sensor up and out of the sensor furnace. Figure 34 shows an oxygen sensor that has been partially lifted out of the sensor furnace. Make sure that the sensor does not hit the sides of the sensor furnace during its removal.

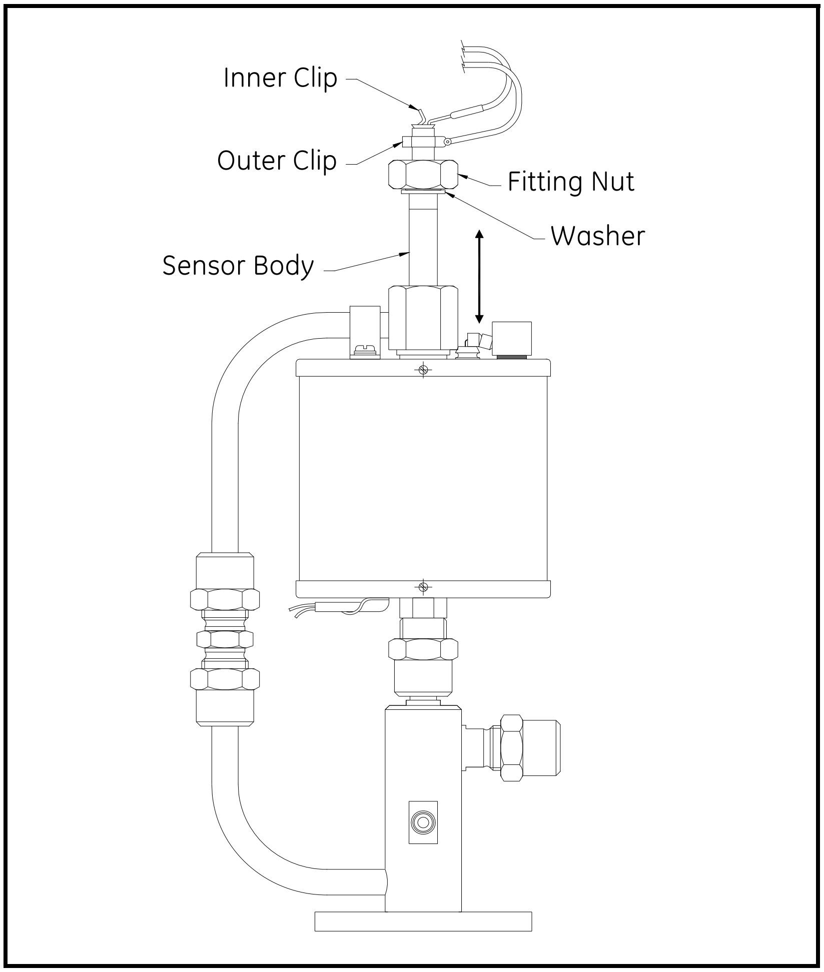


Figure 34: Partially Removed Oxygen Sensor

6.3.3b Installing the New Oxygen Sensor

1. Lubricate the threads of the new oxygen sensor. GE recommends the use of Molykote® High-Temperature, Non-Silicon Lubricant for this purpose.
2. When replacing the oxygen sensor, handle it only by the fitting at its base. Carefully insert the new sensor into the top of the sensor furnace, being careful not to allow it to touch the sides of the furnace.

CAUTION! If the sensor furnace is hot, insert the new oxygen sensor slowly. Take 45-60 seconds to fully insert the sensor into the furnace. If the sensor is inserted too quickly, it will crack.

3. After positioning the titanium washer against the sensor nut (bottom nut), finger tighten the oxygen sensor into its fitting on top of the sensor furnace.

IMPORTANT: *If the sensor furnace is hot, allow the oxygen sensor to stand for at least two minutes before proceeding.*

4. Turn the fitting nut clockwise, as viewed from above the oxygen sensor, to securely tighten the oxygen sensor. Use a torque wrench set at 56 N-m (480 in-lb) for this purpose.

IMPORTANT: *If the sensor furnace is hot, set the torque wrench at 70 N-m (600 lb-in.).*

5. Reinstall the inner and outer clips onto the oxygen sensor body.
6. Install the Main Analyzer Unit cover by completing the steps in the *"Removing the Cover"* section on page 76 in reverse order.
7. Calibrate the new oxygen sensor as described in Chapter 4, *Calibration*.

This completes the replacement of the oxygen sensor.

6.3.4 Replacing the Combustibles Detector

The combustibles detector is located on the side of the manifold, below the sensor furnace. The combustibles detector unscrews easily from the manifold and slips out of its housing.

CAUTION! The combustibles detector is very fragile. Handle it with great care.

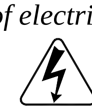
The following tools are needed for this procedure:

- open-end wrench
- torque wrench

To replace the combustibles detector, carefully complete the following steps:

WARNING! There are extremely hot surfaces in the Main Analyzer Unit. Touching these surfaces could result in serious burns. Use heat-resistant gloves while replacing the combustibles sensor.

IMPORTANT: *These symbols indicate Caution - dangerously hot surfaces and risk of electric shock, respectively.*



6.3.4a Removing the Old Combustibles Detector

1. Remove the Main Analyzer Unit cover, as described in the *"Removing the Cover"* section on page 76, and locate the combustibles detector on the side of the manifold.
2. Disconnect the four combustibles detector leads from pins 7, 9, and 10 of terminal block TB1 in the Main Analyzer Unit (there is also a jumper between pins 8 and 9).
3. Use a wrench to turn the retaining nut counterclockwise, as viewed from the end of the combustibles detector, until it comes loose from its fitting (see Figure 35).
4. Slide the combustibles detector out of its housing.

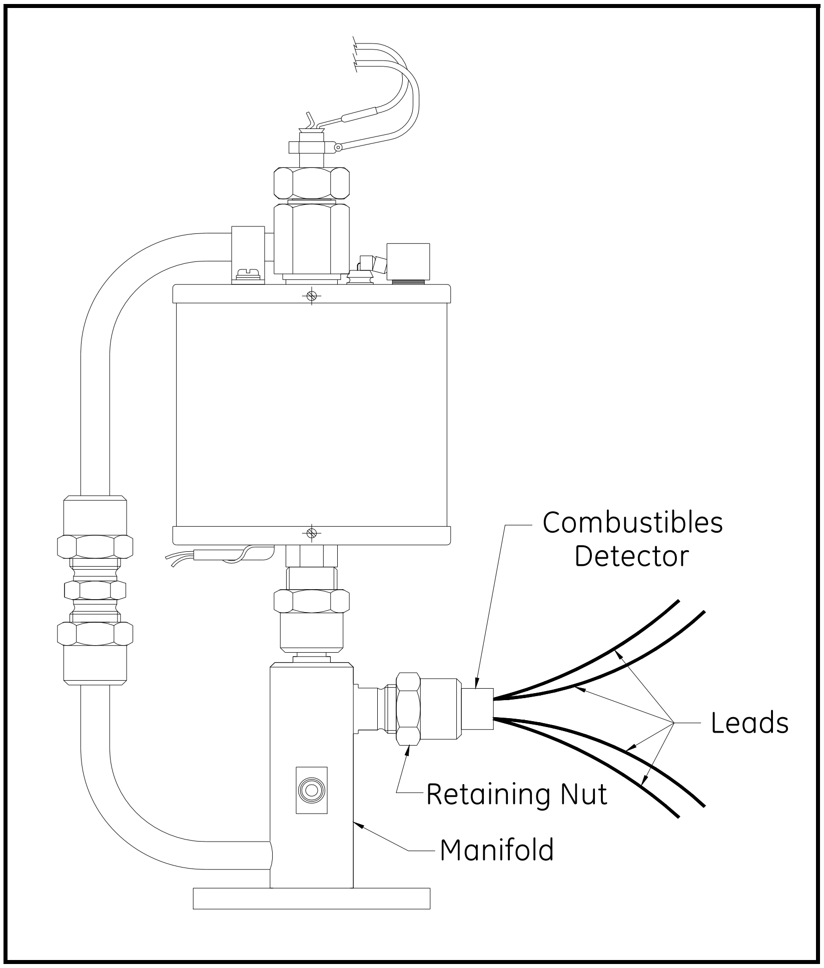


Figure 35: Combustibles Detector Location

6.3.4b Installing the New Combustibles Detector

1. Thread the wires of the new combustibles detector through the retaining nut, so that the threaded end of the nut is facing the combustibles detector body.
2. Remove the protective plastic cover from the new combustibles detector. The two sensing elements on the end of the combustibles detector should not be touched.
3. Insert the new combustibles detector into its housing, being careful not to damage the two sensing elements, and tighten the retaining nut finger tight.
4. Orient the new combustibles detector with the active element above the reference element and the serial number label facing out, as shown in Figure 36. Using a torque wrench set at 70 N-m (600 in-lb), securely tighten the retaining nut by turning it clockwise, as viewed from the end of the combustibles detector.

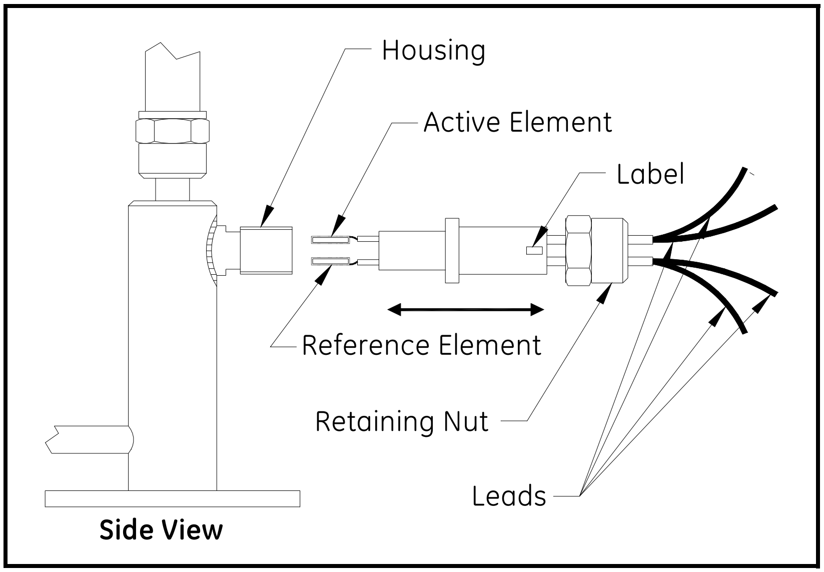


Figure 36: Combustibles Detector Orientation

5. Thread the four (4) combustibles detector leads to the location of terminal block TB1 in the Main Analyzer Unit.
6. Connect the new combustibles detector leads to the appropriate pins on terminal block TB1 in the Main Analyzer Unit or Accessory Box, as follows:
   - active element leads to pins 7 and 9
   - reference element leads to pins 9 and 10
   - jumper between pins 8 and 9

Note: *The reference element leads are clearly marked with an "R" on bands located near the ends of the wires.*

6.3.4b Installing the New Combustibles Detector (cont.)

7. Install the Main Analyzer Unit cover by completing the steps in the *"Removing the Cover"* section on page 76 in reverse order.

8. Calibrate the new combustibles detector as described in Chapter 4, *Calibration*.

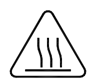
This completes the replacement of the combustibles detector.

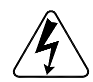
6.3.5 Replacing the Temperature Sensor

The temperature sensor maintains the sensor furnace at a constant temperature. Either a resistance temperature detector (RTD) or a type K thermocouple (TC), as specified at the time of purchase, may be used for this purpose. The temperature sensor is mounted on the bottom of the sensor furnace and extends approximately 2" into the sensor furnace. The temperature sensor is fragile and easily damaged, and therefore, it must be handled with great care.

CAUTION! **To replace the temperature sensor, the power to the FGA 300V(X) must be disconnected. Therefore, replace the temperature sensor and reconnect the power as quickly as possible to prevent corrosion of the analyzer components due to acid condensation.**

IMPORTANT: *These symbols indicate Caution - dangerously hot surfaces and risk of electric shock, respectively.*





A standard screwdriver is the only tool needed for replacement of the temperature sensor. Complete the following steps, in the order shown, to replace a defective temperature sensor:

6.3.5a Removing the Old Temperature Sensor

1. Disconnect the main power to the FGA 300V(X).
2. Remove the Main Analyzer Unit cover, as described in the *"Removing the Cover"* section on page 76.
3. Disconnect the temperature sensor leads from pins 3 and 4 on terminal block TB1 in the Main Analyzer Unit.
4. Loosen the clamp that holds the temperature sensor to the bottom of the sensor furnace.
5. Extract the temperature sensor from the bottom of the sensor furnace. See Figure 37, which shows a partially removed RTD type temperature sensor (the TC type temperature sensor is mounted and removed in a similar manner).

IMPORTANT: *Although the RTD and TC type temperature sensors are mounted and wired in the same manner, they are electrically different.* ***DO NOT*** *substitute one type in a unit configured for the other type.*

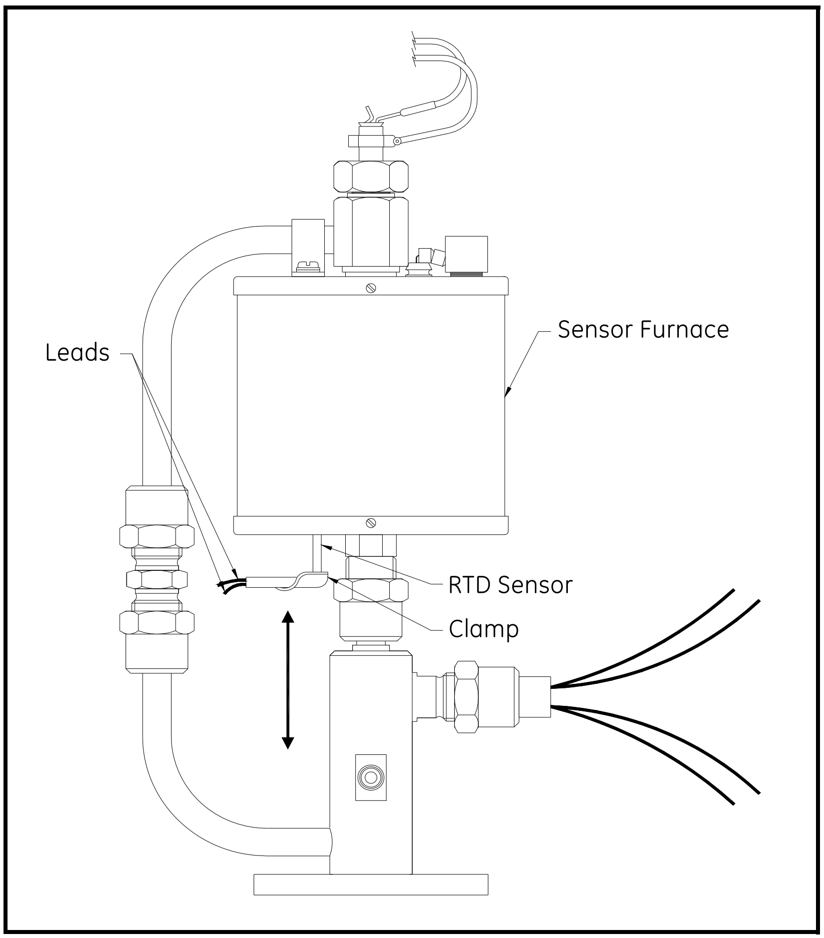


Figure 37: Temperature Sensor Location

6.3.5b Installing the New Temperature Sensor

1. Insert the new temperature sensor into the sensor furnace, being careful not to strike it against the heating element or the pipe wall inside the sensor furnace.
2. Tighten the clamp to secure the new temperature sensor to the bottom of the sensor furnace.
3. Thread the temperature sensor wires to the location of terminal block TB1 in the Main Analyzer Unit.
4. Connect the temperature sensor wire leads to pins 3 and 4 of terminal block TB1. Polarity is not important for an RTD type sensor, but the TC type must have the positive (yellow) lead connected to pin 3 and the negative (red) lead connected to pin 4.
5. Install the Main Analyzer Unit cover by completing the steps in the *"Removing the Cover"* section on page 76 in reverse order.
6. Reconnect the main power to the unit and recalibrate the oxygen sensor as described in Chapter 4, *Calibration*.

6.3.6 Replacing the Sensor Furnace

The sensor furnace maintains the oxygen sensor at a stable temperature, to ensure the accuracy of the percent oxygen readings and to extend the useful life of the oxygen sensor. The sensor furnace is located in the Main Analyzer Unit and is easily replaceable. Replacement of the sensor furnace requires the following tools:

- two open-end wrenches
- torque wrench
- screwdriver
- digital multimeter

CAUTION! To replace the sensor furnace, the power to the FGA 300V(X) must be disconnected. Therefore, replace the sensor furnace and reconnect the power as quickly as possible to prevent corrosion of the analyzer components due to acid condensation.

IMPORTANT: *These symbols indicate Caution - dangerously hot surfaces and risk of electric shock, respectively:*

6.3.6a Removing the Old Sensor Furnace

Complete the following steps in the order given to remove the old sensor furnace:

1. Disconnect the main power to the FGA 300V(X).
2. Remove the Main Analyzer Unit cover, as described in the *"Removing the Cover"* section on page 76.
3. Disconnect the sensor furnace power wires from TB1 pins 12 and 14 in the Main Analyzer Unit.
4. Remove the temperature sensor located on the bottom of the sensor furnace, as described in the *"Replacing the Temperature Sensor"* section on page 84. Place the temperature sensor aside, for later reinstallation.

6.3.6a Removing the Old Sensor Furnace (cont.)

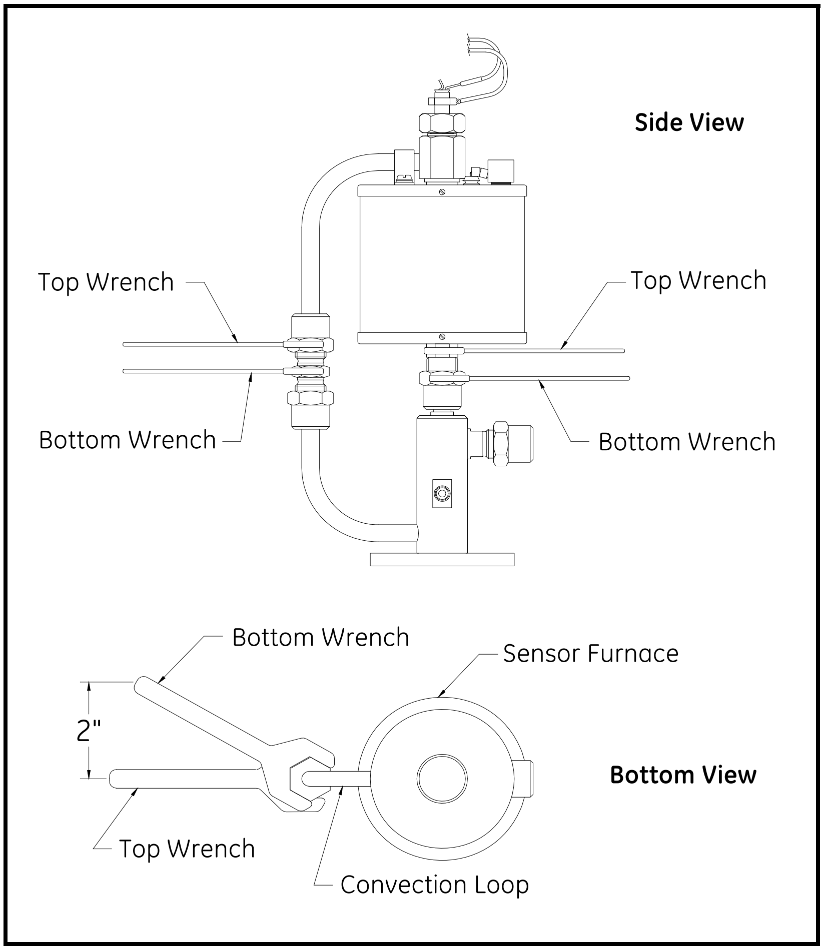


Figure 38: Wrench Positions

5. Place one open-end wrench on the flat surface machined into the piping just below the sensor furnace. Place a second open-end wrench on the nut directly below the first wrench.

Note: *The wrenches should be parallel to each other, but the bottom wrench should be positioned with its end rotated about 2 in. in a counterclockwise direction from the upper wrench. Refer to Figure 38 for a view of the wrenches from both the side and the bottom of the manifold assembly.*

6. While holding the top wrench steady, turn the bottom wrench two inches toward the top wrench so that the two wrenches are aligned with each other.

Note: *Do not attempt to move the top wrench during the above step. Be sure to hold it in its original position.*

7. Repeat steps 5 and 6 to loosen the upper nut in the center of the convection loop (see Figure 38).

6.3.6a Removing the Old Sensor Furnace (cont.)

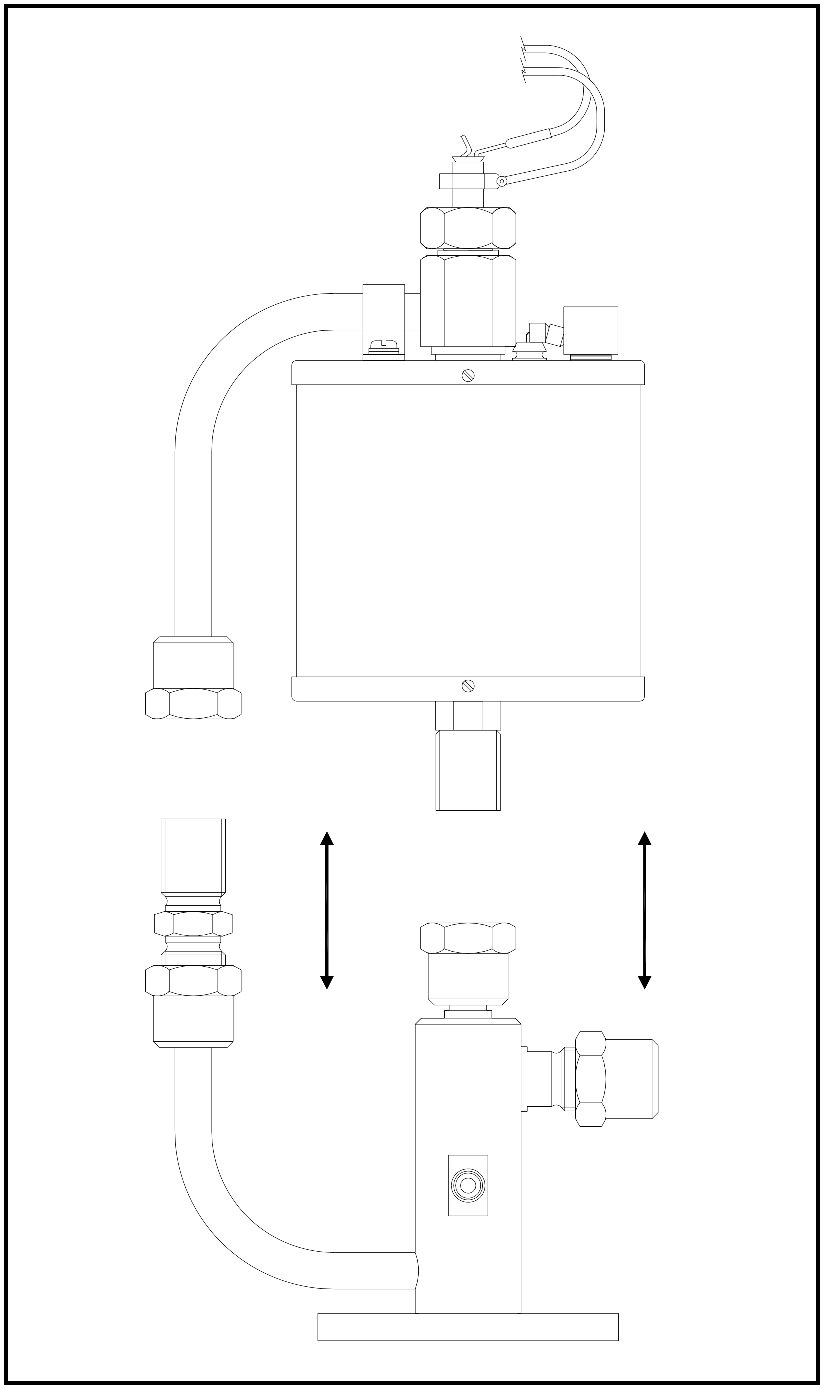


Figure 39: Removal of Sensor Furnace

8. Unscrew both loosened nuts completely and lift the sensor furnace off the manifold, with the upper portion of the convection loop still attached (see Figure 39).

6.3.6a Removing the Old Sensor Furnace (cont.)

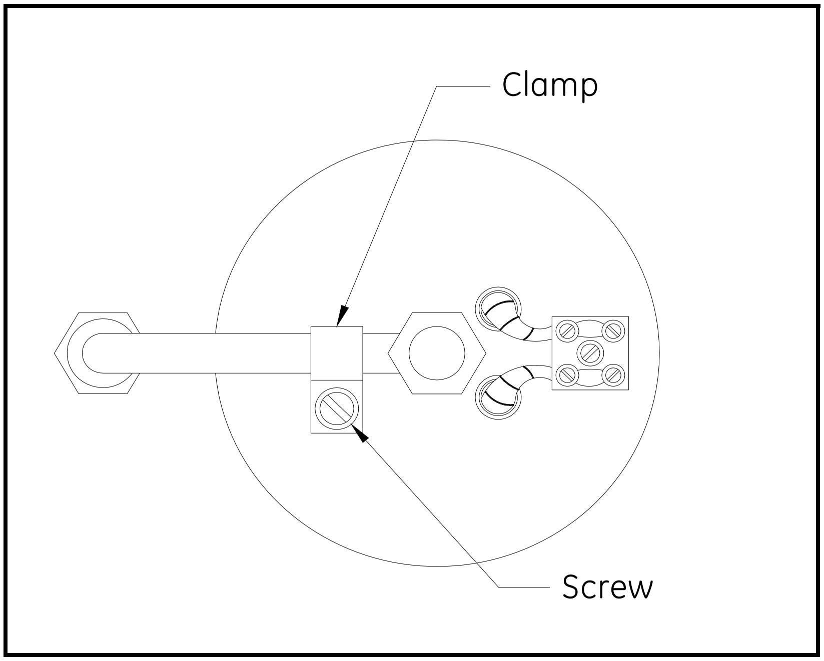


Figure 40: Convection Loop Clamp Location

9. Use a screwdriver to remove the clamp on top of the sensor furnace. **DO NOT** allow the sensor furnace to fall off the convection loop/oxygen sensor assembly as the clamp is being removed (see Figure 40).

WARNING! The sensor furnace may still be hot. Always use heat-resistant gloves when handling it.

10. Lift the convection loop/oxygen sensor assembly straight up and out of the sensor furnace.

This completes the removal of the old sensor furnace. Install the new sensor furnace immediately, by completing the instructions in the next section.

6.3.6b Installing the New Sensor Furnace

1. Locate the ceramic power block on the top surface of the new sensor furnace.

2. Slide the removed convection loop/oxygen sensor assembly into the top of the new sensor furnace. Position the furnace so that the mounting hole in the top of the furnace lines up with the clamp.

3. Secure the convection loop to the top of the sensor furnace with the clamp and screw that were previously removed.

4. Position the sensor furnace/convection loop assembly over the manifold, as shown in Figure 39 on page 88.

5. Finger tighten the nut on top of the manifold to the fitting beneath the sensor furnace. Also, finger tighten the nut on the upper section of the convection loop to the fitting on the lower section of the convection loop (see Figure 38 on page 87).

6. Place a wrench on the flat surface of the piping at the connection just below the sensor furnace (see Figure 38 on page 87).

7. Using a torque wrench set to 70 N-m (600 in-lb), tighten the nut while holding the first wrench steady.

8. Repeat steps 6 and 7 to tighten the nut on the convection loop, but set the torque wrench to 63 N-m (540 in-lb).

9. Reinstall the temperature sensor, as described in the *"Replacing the Temperature Sensor"* section on page 84.

10. Reconnect the two previously removed wires to pins 12 and 14 on TB1 in the Main Analyzer Unit.

11. Using a digital multimeter, check the resistance of the sensor furnace heating element. Specific instructions may be found in Chapter 5, *Troubleshooting*.

Assuming that the correct resistance reading was obtained in Step 11 above, replacement of the sensor furnace has been successfully completed. Complete the procedure as follows:

12. Install the Main Analyzer Unit cover by completing the steps in the *"Removing the Cover"* section on page 76 in reverse order.

13. Reconnect the main power to the unit and recalibrate the oxygen sensor as described in Chapter 4, *Calibration*.

6.3.7 Replacing the Cartridge Heaters

A heater block is mounted on the bottom of the Main Analyzer Unit. The cartridge heaters, which are approximately 3-1/2” long cylinders, and a thermostat are located inside this heater block (see Figure 41).

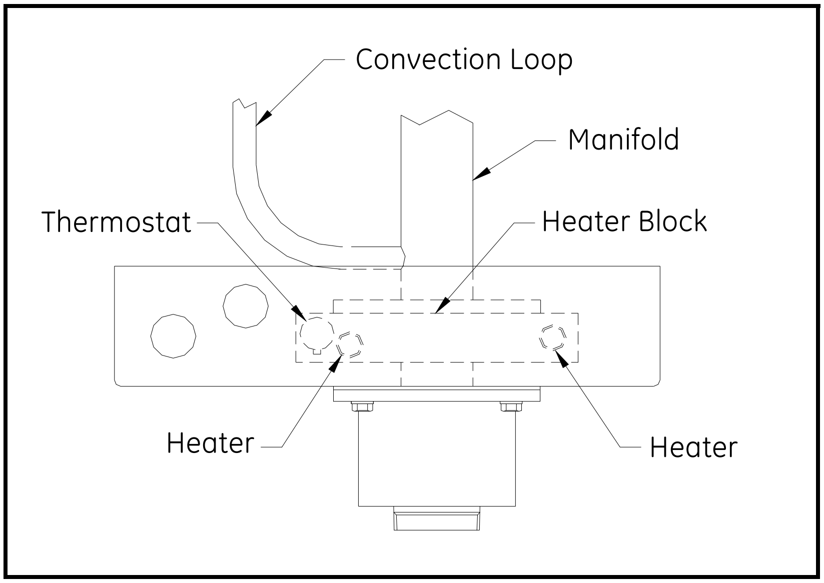


Figure 41: Thermostat and Heater Locations

The following items are required to replace the cartridge heaters:

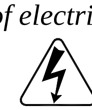
- wire cutters
- wire strippers
- Watlube® Heat Transfer and Release Agent

CAUTION! **To replace the cartridge heaters, the power to the FGA 300V(X) must be disconnected. Therefore, replace the cartridge heaters and reconnect the power as quickly as possible to prevent corrosion of the analyzer components due to acid condensation.**

WARNING! **There are extremely hot surfaces in the Main Analyzer Unit. If they are touched, serious burns could result. Always use heat-resistant gloves when replacing the cartridge heaters.**

To replace the cartridge heaters, complete the following steps:

IMPORTANT: *These symbols indicate Caution - dangerously hot surfaces and risk of electric shock, respectively.*

6.3.7a Removing the Old Cartridge Heaters

1. Disconnect the main power to the FGA 300V(X).

2. Remove the Main Analyzer Unit cover, as described in the *"Removing the Cover"* section on page 76.

3. Locate the cartridge heaters in the heater block on the bottom of the Main Analyzer Unit. The cartridge heater wires come out the side of the heater block near terminal block TB1 (the side opposite the combustibles detector).

4. Trace the four wires from the cartridge heaters to pins 11 (2 wires), 12 and 14 on terminal block TB1 in the Main Analyzer Unit.

5. Disconnect **ONLY** the cartridge heater wires at pins 11 (2 wires), 12 and 14 on terminal block TB1.

IMPORTANT: *Do not disconnect any of the other leads at these terminals.*

6. Push on one of the cartridge heaters from the end without the wires, while pulling the same cartridge heater out the other side of the heater block.

6.3.7b Installing the New Cartridge Heaters

1. Brush a thin coat of a heat transfer agent on one of the new cartridge heater. GE recommends Watlube® Heat Transfer and Release Agent.

2. Slide the new cartridge heater into the heater block, and feed the wires to terminal block TB1.

3. Strip the ends of both cartridge heater wires.

4. Repeat steps 6, 1, 2 and 3 to install the other cartridge heater.

5. Connect one wire from each of the cartridge heaters to pin 11 on terminal block TB1. Connect the two remaining wires, one from each cartridge heater, to pins 12 and 14 on terminal block TB1.

6. Install the Main Analyzer Unit cover by completing the steps in the *"Removing the Cover"* section on page 76 in reverse order, and reconnect the main power to the unit.

This completes the replacement of the cartridge heaters.

6.3.8 Replacing the Thermostat

The thermostat, which is approximately the same length as the heater block, is located in the heater block on the bottom of the Main Analyzer Unit. The thermostat regulates the temperature of the heater block to approximately 225°C. If the thermostat is defective or it is removed, the heater block will quickly cool down.

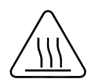
The following items are needed to replace the thermostat:

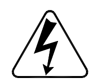
- wire cutters
- wire strippers
- Watlube® Heat Transfer and Release Agent

CAUTION! **To replace the thermostat, the power to the FGA 300V(X) must be disconnected. Therefore, replace the thermostat and reconnect the power as quickly as possible to prevent corrosion of the analyzer components due to acid condensation.**

WARNING! **There are extremely hot surfaces in the Main Analyzer Unit. If they are touched, serious burns could result. Always use heat-resistant gloves when replacing the thermostat.**

IMPORTANT: *These symbols indicate Caution - dangerously hot surfaces and risk of electric shock, respectively.*





6.3.8 Replacing the Thermostat (cont.)

Use the procedures below and refer to Figure 41 on page 91 to complete the thermostat replacement:

6.3.8a Removing the Old Thermostat

1. Disconnect the main power to the FGA 300V(X).
2. Remove the Main Analyzer Unit cover, as described in the *"Removing the Cover"* section on page 76.
3. The thermostat is located next to one of the cartridge heaters, in the heater block on the bottom of the Main Analyzer Unit. The thermostat wires come out the side of the heater block near terminal block TB1 (the side opposite the combustibles detector).
4. Trace the thermostat wires from the end of the thermostat to pins 12 and 14 on terminal block TB1 in the Main Analyzer Unit.
5. Disconnect **ONLY** the thermostat wires at pins 12 and 14 on terminal block TB1.

IMPORTANT: *Do not disconnect any other leads at these terminals.*

6. Remove the old thermostat by pulling it out of the heater block.

6.3.8b Installing the New Thermostat

1. Brush a thin coat of a heat transfer agent, such as Watlube® Heat Transfer and Release Agent, on the new thermostat.
2. Slide the new thermostat into the heater block.
3. Strip the ends of the two new thermostat wires.
4. Insert the new thermostat leads into pins 12 and 14 on terminal block TB1 and tighten the screws securely. Polarity is not important.
5. Install the Main Analyzer Unit cover by completing the steps in the *"Removing the Cover"* section on page 76 in reverse order, and reconnect the main power to the unit.

This completes the replacement of the thermostat.

6.4 FTC Board

The major component associated with the operation of the sensor furnace is the Furnace Temperature (FTC) control board, which is located in the Remote FTC Box.

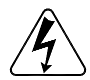
Note: *Some older units also have a* transformer *in the FTC box to supply the 80 VAC required by previous FTC board designs. See Appendix F,* Previous Configurations, *for additional information on these units.*

6.4.1 Replacing the FTC Board Fuse

The Furnace Temperature Control (FTC) board fuse is located on the FTC board, in the remote FTC Box.

CAUTION! **To replace the FTC board fuse, the power to the FGA 300V(X) must be disconnected. Therefore, replace the FTC board fuse and reconnect the power as quickly as possible to prevent corrosion of the analyzer components due to acid condensation.**

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



The only tool needed to replace the FTC board fuse is a small screwdriver. Refer to Figure 43 on page 98 and complete the following steps to replace the FTC board fuse:

1. Disconnect the main power to the FGA 300V(X).
2. Open the hinged cover on the standard (weatherproof) FTC box. For an explosion-proof (flameproof) FTC box, loosen the locking set screw on top of the FTC box and, using a long screwdriver across the slots provided, unscrew the cover from the enclosure.
3. Locate the fuseholder on the FTC board. Using a small screwdriver, remove the spring-loaded cover from the fuseholder and discard the old fuse.
4. Install a new fuse of the same type and size (see the label near the fuseholder or Chapter 7, *Specifications*), and reinstall the fuseholder cover.
5. Close the cover on the remote FTC Box and reconnect the main power to the system.

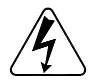
The system may now be placed back into service.

6.4.2 Replacing the FTC Board

The Furnace Temperature Control (FTC) board is located in the Remote FTC box. The FTC board is a 3.5 x 4.7 in. (90 x 120 mm) rectangular printed circuit board that maintains a steady sensor furnace temperature in order to ensure accurate operation of the oxygen sensor.

CAUTION! **To replace the FTC board, the power to the FGA 300V(X) must be disconnected. Therefore, replace the FTC board and reconnect the power as quickly as possible to prevent corrosion of the analyzer components due to acid condensation.**

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



The only tool needed to replace the FTC board is a nutdriver or similar tool. Refer to Figure 42 on page 97 and complete the following steps to replace the FTC board:

6.4.2a Removing the Old FTC Board

1. Disconnect the main power to the FGA 300V(X).
2. Open the hinged cover on the standard (weatherproof) FTC box. For an explosion-proof (flameproof) FTC box, loosen the locking set screw on top of the FTC box and, using a long screwdriver across the slots provided, unscrew the cover from the enclosure.
3. Remove the connectors from the 5-pin terminal block (TB1) and the 8-pin terminal block (TB2) on the FTC board.
4. Remove the four hex nuts and washers located in the corners of the old FTC board, and lift the FTC board out of the enclosure.

6.4.2b Installing the New FTC Board

Note: *Install the new board in the same orientation as the old board. The line voltage and temperature sensor type for the new FTC board are factory set, based on the unit's serial number.*

1. Locate the new FTC board over the standoffs in the enclosure. Make sure that the new FTC board is in the same orientation as the old board and not rotated by 180°.
2. Replace the four hex nuts and washers in the corners of the new FTC board, and tighten the nuts securely.

6.4.2b Installing the New FTC Board (cont.)

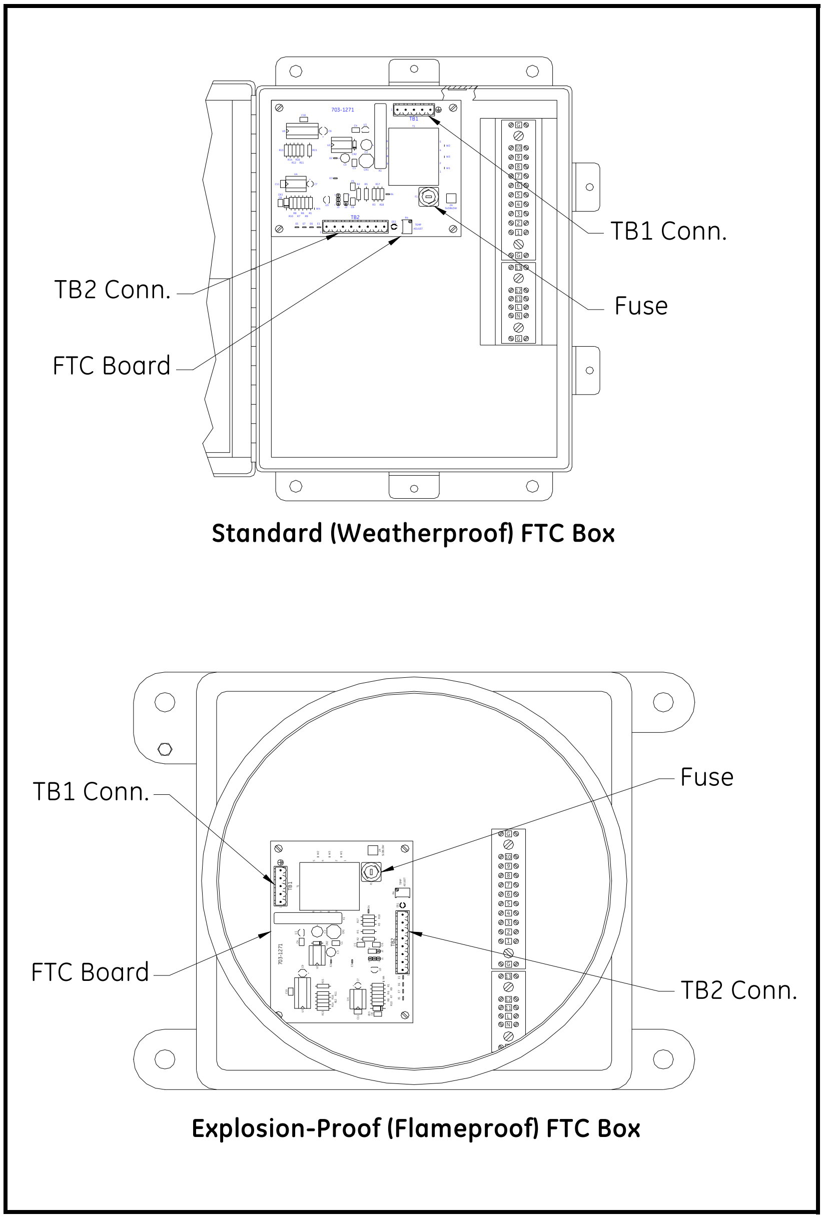


Figure 42: FTC Board Location

3. Reconnect the connectors to the 5-pin terminal block (TB1) and the 8-pin terminal block (TB2) on the new FTC board.
4. Close the cover on the remote FTC Box and reconnect the main power to the system.
5. Refer to Chapter 4, *Calibration*, and recalibrate the oxygen sensor and the combustibles detector.

This completes the replacement of the FTC board.

6.5 Display Electronics Console

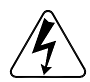
There are no user-serviceable components in the Display Console, except for the fuse on the display board. Refer to Chapter 7, *Specifications*, for the size and type of the display board fuse.

6.5.1 Replacing the Display Board Fuse

The display board fuse is located on the digital display printed circuit board, in the 300D Display Console.

CAUTION! **To replace the display board fuse, the power to the FGA 300V(X) must be disconnected. Therefore, replace the display board fuse and reconnect the power as quickly as possible to prevent corrosion of the analyzer components due to acid condensation.**

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



The only tool needed to replace the display board fuse is a screwdriver. Refer to Figure 43 and complete the following steps to replace the display board fuse:

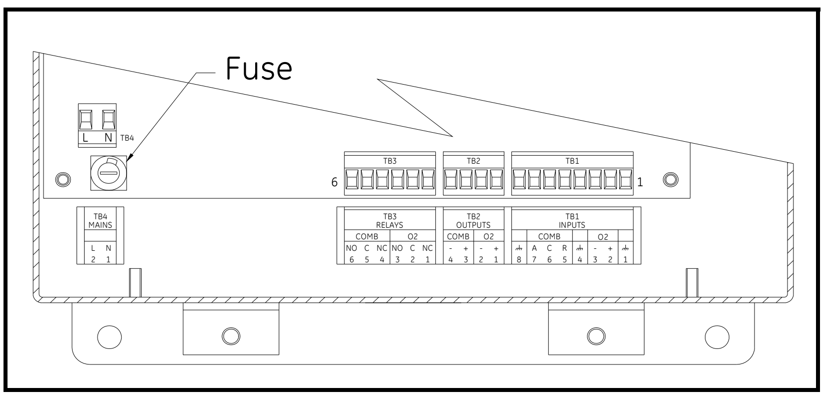


Figure 43: Display Board Fuse

1. Disconnect the main power to the FGA 300V(X).
2. Open the hinged cover on the standard Display Console. For the panel mount, bench mount or rack mount versions, the fuseholder is accessible through the back panel.
3. Locate the fuseholder on the display board. Using a screwdriver, remove the spring-loaded cover from the fuseholder and discard the old fuse.
4. Install a new fuse of the same type and size (see the label near the fuseholder or Chapter 7, *Specifications*), and reinstall the fuseholder cover.
5. Close/replace the cover on the Display Console and reconnect the main power to the system.

There are no other user-serviceable components in the Display Console. If it is suspected that this unit is defective, please contact the factory for assistance.

6.6 Spare Parts

To perform the service procedures described in this chapter, the required spare parts must be purchased from GE.

WARNING! The use of unauthorized spare parts will void the warranty. Non-factory parts may cause damage to the instrument and/or may present a serious safety hazard to the operator.

For convenience, the most commonly needed spare parts for the 300D Digital Display are listed in Table 18, and for the FGA 300V(X), in Table 19 on page 100. To purchase any parts, whether listed or not, contact the factory for assistance.

Table 18: Spare Parts List - 300D Digital Display

Part Number	Qty	Description
1703-011-XXX	1	Linear Board (refer to Table 20 on page 101 for ordering information)
1703-002-02	1	Display Board, Oxygen Channel
1703-002-03	1	Display Board, Combustibles Channel
1703-002-04	1	Display Board, Oxygen & Combustibles Channel
1193-504	5	Fuse - 200mA
1193-503	5	Fuse - 100mA (for 220VAC units)

6.6 Spare Parts (cont.)

Table 19: Spare Parts List - FGA 300V(X)

Part Number	Qty	Description
1214-511	1	Inner Oxygen Sensor Clip
1214-510	2	Outer Oxygen Sensor Clip
1705-533	2	Combustibles Detector Assembly
1705-534	1	RTD Assembly
1190-505-01	1	Thermostat and Leads
1227-502-01	2	Cartridge Heater 150W, 115VAC
1227-502-02	2	Cartridge Heater 150W, 220VAC
1227-505-01	2	Cartridge Heater, 75W, 115VAC
1227-505-02	2	Cartridge Heater, 75W, 220VAC
1420-520-01	1	Heater Block, 300H, 300V
1420-520-02	1	Heater Block, 300HX, 300V
1410-502	1	Gasket, Hi Temp
1705-546	1	Thermocouple (K-Type) Temperature Detector Assembly
1193-501	5	Fuse, 2.5A
1705-526-01	1	Oxygen Sensor Assembly - Std. Gases
1705-526-02	1	Oxygen Sensor Assembly - Stoichiometric Combustion (CO)
1703-1271-XX	1	Temperature Control Board (See Table 21 on page 101 for ordering information.)
1705-552-03	1	Furnace Assembly with bracket
1705-549-02	1	Cal Port Flowmeter
1781-505	1	Plug, 8mm, Serto
1420-619	1	Flow Shield
1781-527	1	Internal Calibration Tubing
1781-511	1	Calibration Stub, 6mm
1781-504	1	Bulkhead Fitting - Cal Port

6.7 Ordering Information

The information below shows how the 300D Digital Display Linear Board Part Number is configured from the options specified.

	B	C	D
1703-011-			

Table 20: 300D Linear Board Ordering Information

LTR	CATEGORY	OPTIONS
B	Package	**1** = Rack, Bench or Panel **2** = Weatherproof or Explosion-Proof
C	Configuration	**2** = Oxygen only, 115 VAC **3** = Oxygen only, 220 VAC **4** = Combustibles only, 115 VAC **5** = Combustibles only, 220 VAC **6** = Oxygen and Combustibles, 115 VAC **7** = Oxygen and Combustibles, 220 VAC
D	Alarms	**0** = Single Oxygen and Single Combustibles Alarm **1** = Dual Oxygen Alarms **2** = Dual Combustibles Alarms
Please specify the Serial number and Model number of the FGA 300V(X) when ordering.		

The information below shows how the FGA 300V(X) Temperature Control Board Part Number is configured from the options specified.

	B	C
1703-1271-		

Table 21: FGA Temperature Control Board Ordering Information

LTR	CATEGORY	OPTIONS
B	Thermocouple/ RTD	**2** = Thermocouple, 110 VAC **3** = Thermocouple, 220 VAC **4** = RTD, 110 VAC **5** = RTD, 220 VAC
C	FTC Location	**1** = Remote **2** = Local
Please specify the Serial number and Model number of the FGA 300V(X) when ordering.		

[no content intended for this page]

Chapter 7. Specifications

7.1 General Specifications

Response Time:

20 seconds to within 90% of a step change

Sample Probe Length:

Standard: 0.6 m (24 in.) high temperature resistant steel

Optional: 1.0 m (39 in.), 1.4 m (55 in.), or special lengths

Sample Dew Point:

180°C (356°F) maximum (higher dew point version available)

Ambient Temperature:

Analyzer: -25° to 70°C (-13° to 158°F) (higher temperature version available)

Digital Display Unit: -10° to 50°C (14° to 122°F)

Power Requirement:

Maximum on Start-up (±10%): 420W @115/230 VAC, 560W @120/240 VAC

Fuses:

Anti-Surge, T-Type, 5x20 mm

FTC Board: 2.5 A @115 VAC, 1.25 A @230 VAC

Digital Display Board: 200 mA @115 VAC, 100 mA @230 VAC

Warm-Up Time:

Meets specified accuracy within one hour

Area Classification for FGA 300VX:

II 2 G, Ex d IIC T4, ISSep04ATEX078X

Note: *As a special consideration for certification, the flue gas can not generate an explosive atmosphere. After removing power, wait 5 minutes before opening.*

European Compliance:

The unit complies with EMC Directive 2004/108/EC and the 2006/95/EC Low Voltage Directive (Installation Category II, Pollution Degree 2). For EN 61000-4-3, the FGA 300V(X) meets Performance Criterion A, except at a limited number of frequencies, Criterion B, per EN 61326.

7.2 Oxygen Specifications

Sensor:

Stabilized zirconium oxide (zirconia) ceramic

Accuracy:

Logarithmic Output: ±1% of reading

Linear Output: ±1% of full scale

Repeatability:

Logarithmic Output: ±0.2% of reading

Linear Output: ±0.5% of full scale

Drift:

Less than 0.1% of sensor output per month

Sample Temperature:

950°C (1,742°F) maximum (higher sample temperature version available)

Calibration:

Through calibration port using a certified mixture of O_2 in N_2

7.3 Combustibles Specifications

Detector:

Catalytic combustion platinum resistance thermometer

Accuracy:

±5% of reading

Repeatability:

±1% of full scale

Drift:

Less than 2% of full scale per month

Sample Dew Point:

180°C (356°F) maximum (higher dew point version available)

Calibration:

Through calibration port using a certified mixture of CO and H_2 in N_2 with O_2

7.4 Available Options

Some of the available options for the 300V(X) Flue Gas Analyzer are listed below:

- Remote logarithmic meter
- Dual alarm contacts for combustibles
- Flameproof analyzer: CENELEC EEx d IIB T3 ISSEP cert. #01E.103.1315 X

Note: *As a special consideration for certification, the flue gas can not generate an explosive atmosphere.*

- Sample probe lengths up to 1.5 m
- Analyzers for sampling at flue gas temperatures up to 1700°C (3,092°F) and/or flue gas acid dew points higher than 180°C (356°F)
- Analyzers for ambient temperatures higher than 70°C (158°F)

Consult the factory for additional information.

7.5 Ordering Information

The information below shows how the FGA 300V Part Number is configured from the options specified.

	B	C	-	D	E	-	F	G	-	H	J	-	K
FGA300V-	☐	☐	-	☐	☐	-	☐	☐	-	☐	☐	-	☐

Table 22: FGA 300V Weatherproof Ordering Information

LTR	CATEGORY	OPTIONS
B	**Oxygen Sensor**	**0 =** None **1 =** Standard oxygen sensor (type 1) **2** = Oxygen sensor for stoichiometric combustion (type 2)
C	**Combustibles Detector**	**0** = None **1** = Standard combustibles detector with flowmeter
D	**Power**	**1** = 100 VAC **2** = 110 / 120 VAC **3** = 220 VAC **4** = 240 VAC
E	**Furnace Controller Enclosure**	**0** = No furnace temperature control card (Spares orders only) **3** = Remote Weatherproof FTC enclosure (IP65) **5** = 304 SS remote Weatherproof FTC enclosure (IP65) **S** = Special
F	**Mounting**	**1** = 1-1/2" male NPT thread mounting **2** = DN80 PN16 flange C.S. mounting **3** = ANSI 3" 300 lb flange C.S. mounting **4** = Two flanges with gasket - DN80 PN16 C.S. for mounting **5** = Two flanges with gasket - ANSI 3" 300 lb C.S. for mounting **6** = ANSI 4" 150 lb flange C.S. mounting **7** = Two flanges with gasket - ANSI 4" 150 lb C.S. for mounting **S** = Special
G	**Aspirator**	**0** = Diffusion / convection based sampling **1** = Aspirator included **S** = Special
H	**External Port Connections**	**0** = 6mm external port connections **1** = 1/4" external port connections
J	**Special**	**0** = None **1** = Flowmeter and valve for calibration port **2** = Tropicalized electronics **S** = Special
K	**Temperature Control Setting**	**0** = Standard temperature setting: 812°C **S** = Special temperature setting: (700°/770°C - please specify)
Note: *Option J=1 is not required for units with combustibles detectors, as the flowmeter is supplied with option B=1. Option J=1 is available for "Oxygen only" units.*		
Note: *Oxygen sensor types: Type 1 is a plasma-sprayed cell and is the standard cell. Type 2 is a coated plasma-sprayed cell intended for applications where percent levels of CO are expected.*		

7.5 Ordering Information (cont.)

The information below shows how the FGA 300VX Part Number is configured from the options specified.

	B	C	-	D	E	-	F	G	-	H	J	-	K
FGA300VX-	☐	☐	-	☐	☐	-	☐	☐	-	☐	☐	-	☐

Table 23: FGA 300VX Explosion-Proof Ordering Information

LTR	CATEGORY	OPTIONS
B	**Oxygen Sensor**	**0 =** None **1 =** Standard oxygen sensor (type 1) **2** = Oxygen sensor for stoichiometric combustion (type 2)
C	**Combustibles Detector**	**0** = None **1** = Standard combustibles detector with flowmeter
D	**Power**	**1** = 100 VAC **2** = 110 / 120 VAC **3** = 220 VAC **4** = 240 VAC
E	**Furnace Controller Enclosure**	**0** = None **3** = Remote Weatherproof FTC enclosure (IP65) **4** = Remote Flameproof FTC enclosure (Ex d IIC) **5** = 304 SS remote Weatherproof FTC enclosure (IP65) **6** = Display unit **S** = Special
F	**Mounting**	**2** = DN80 PN16 flange C.S. mounting **3** = ANSI 3" 300 lb flange C.S. mounting **4** = Two flanges with gasket - DN80 PN16 C.S. for mounting **5** = Two flanges with gasket - ANSI 3" 300 lb C.S. for mounting **6** = ANSI 4" 150 lb flange C.S. mounting **7** = Two flanges with gasket - ANSI 4" 150 lb C.S. for mounting **S** = Special
G	**Aspirator**	**0** = Diffusion / convection based sampling **1** = Aspirator included **S** = Special
H	**External Port Connections**	**0** = 6mm external port connections **1** = 1/4" external port connections
J	**Special**	**0** = None **1** = Flowmeter and valve for calibration port **2** = Tropicalized electronics **S** = Special
K	**Temperature Control Setting**	**0** = Standard temperature setting: 812°C **S** = Special temperature setting: (700°/770°C - please specify)

Note: *Option J=1 is not required for units with combustibles detectors, as the flowmeter is supplied with option B=1. Option J=1 is available for "Oxygen only" units.*

Note: *Oxygen sensor types: Type 1 is a plasma-sprayed cell and is the standard cell. Type 2 is a coated plasma-sprayed cell intended for applications where percent levels of CO are expected.*

7.5 Ordering Information (cont.)

The information below shows how the FGA 300D Part Number is configured from the options specified.

	B	C	-	D	-	E	F	-	G	H	-	J
300D-	☐	☐	-	☐	-	☐	☐	-	☐	☐	-	☐

Table 24: FGA 300D Digital Display Ordering Information

LTR	CATEGORY	OPTIONS
B	**Package**	**0 =** No enclosure (OEM) **1 =** Weatherproof enclosure (IP65) **2** = Rack mount **3** = Bench mount **4** = Panel mount **7** = Flameproof enclosure (EEx d IIC T6) **8** = Flameproof enclosure with FTC (EEx d IIC T6) **9** = 304SS Weatherproof enclosure (IP65) **S** = Special
C	**Power**	**1** = 100 VAC **2** = 110 / 120 VAC **3** = 220 VAC **4** = 240 VAC
D	**Analog Output Format**	**1** = 0-20mA output **2** = 4-20mA output **3** = 0-10 VDC output **S** = Special
E	**Zirconia Range** *Specify fuel and range	**0** = None **1** = 0-5% Oxygen **2** = 0-10% Oxygen **3** = 0-20% Oxygen **4** = 0-25% Oxygen **5** = 0-1000mV - Cell mV **6** = 0.8-1.2/0.8-2.0 Air factor* **7** = 5/10/20/25% Excess fuel* **8** = 5/10/20/25% Equivalent combustibles* **S** = Special*
F	**Combustibles Range CO + H2**	**0** = None **1** = 0-2,000 ppm_v combustibles **2** = 0-5,000 ppm_v combustibles **3** = 0-10,000 ppm_v combustibles **4** = 0-2.00% combustibles **S** = Special
G	**Alarms**	**0** = Single oxygen and single combustibles alarm (standard configuration) **1** = Dual oxygen alarms **2** = Dual combustibles alarms
H	**Special**	**0** = None **2** = Tropicalized **S** = Special
J	**Temperature Control Setting****	**2** = 812°C (standard for 300V and 300VX) **S** = Special (please specify) **Temperature must match analyzer

7.5 Ordering Information (cont.)

The information below shows how the FGA Current Output Board Part Number is configured from the options specified.

	B	C	-	D	E	-	F
FGACB-	☐	☐	-	☐	☐	-	☐

Table 25: FGA Current Output Board Ordering Information

LTR	CATEGORY	OPTIONS
B	Voltage	**1** = 100 VAC **2** = 110 VAC **3** = 220 VAC **4** = 240 VAC
C	Location	**1** = Supplied loose **2** = Mounted with furnace temperature control card **3** = Mounted in separate Weatherproof (IP65) enclosure **4** = Mounted in separate Explosion-Proof enclosure **S** = Special
D	Range	**1** = 0-1% Oxygen **2** = 0-5% Oxygen **3** = 0-10% Oxygen **4** = 0-20.9% Oxygen **5** = 0-25% Oxygen **S** = Special
E	Special	**0** = None **1** = 0-1V Output **2** = Tropicalized **S** = Special
F	Temperature Control Setting*	**0** = Factory selected option *Temperature must match analyzer

7.5 Ordering Information (cont.)

The information below shows how the FGA 300 Probe and Probe Sleeve Part Number is configured from the options specified.

	B	C	D
FGAPS-			

Table 26: FGA Probe and Probe Sleeve Ordering Information

LTR	CATEGORY	OPTIONS
B	**Temperature Range**	**1** = below 650°C **2** = 650° to 950°C **3** = 950° to 1600°C **4** = above 1600°C
C	**Sampling Method**	**1** = Standard sampling method **3** = Aspirated sampling method **S** = Special sampling method
D	**Nominal Length**	**1** = 0.6m long **2** = 1.0m long **4** = 1.4m long (see note) **S** = Special
Note: *The 1.4m length is normally only available for temperatures over 950°C (where* **B = 3** *or* **4***).*		
Note: *If the unit has an aspirator, choose* Sampling Method *option* **C = 3**, Aspirated.		

Appendix A. Rotary Switch Settings

A.1 Overview

The *Display Electronics Console* for the FGA 300V(X) analyzer is completely configured at the factory to meet the specified requirements. However, the instructions in this appendix may be used to complete the following adjustments:

- Selecting the Fuel Type
- Selecting the Display Parameter
- Adjusting the Oxygen Channel
- Adjusting the Combustibles Channel

CAUTION! The display circuitry is factory set and should only be adjusted in the field by a fully qualified electronics technician. This appendix should be used as a reference for field personnel to make such adjustments.

To make the first three above adjustments, use rotary switches S1, S2 and S3 on the upper portion of the 300D display printed circuit board. To access these switches, open the Display Console and refer to Figure 44 on page 112 to locate the switches.

Note: *For units fitted with the previous version of the 300D printed circuit board. See Appendix F,* Previous Configurations*, for the layout of this circuit board.*

For reconfiguration information not covered in this appendix, contact GE for assistance.

A.1 Overview (cont.)

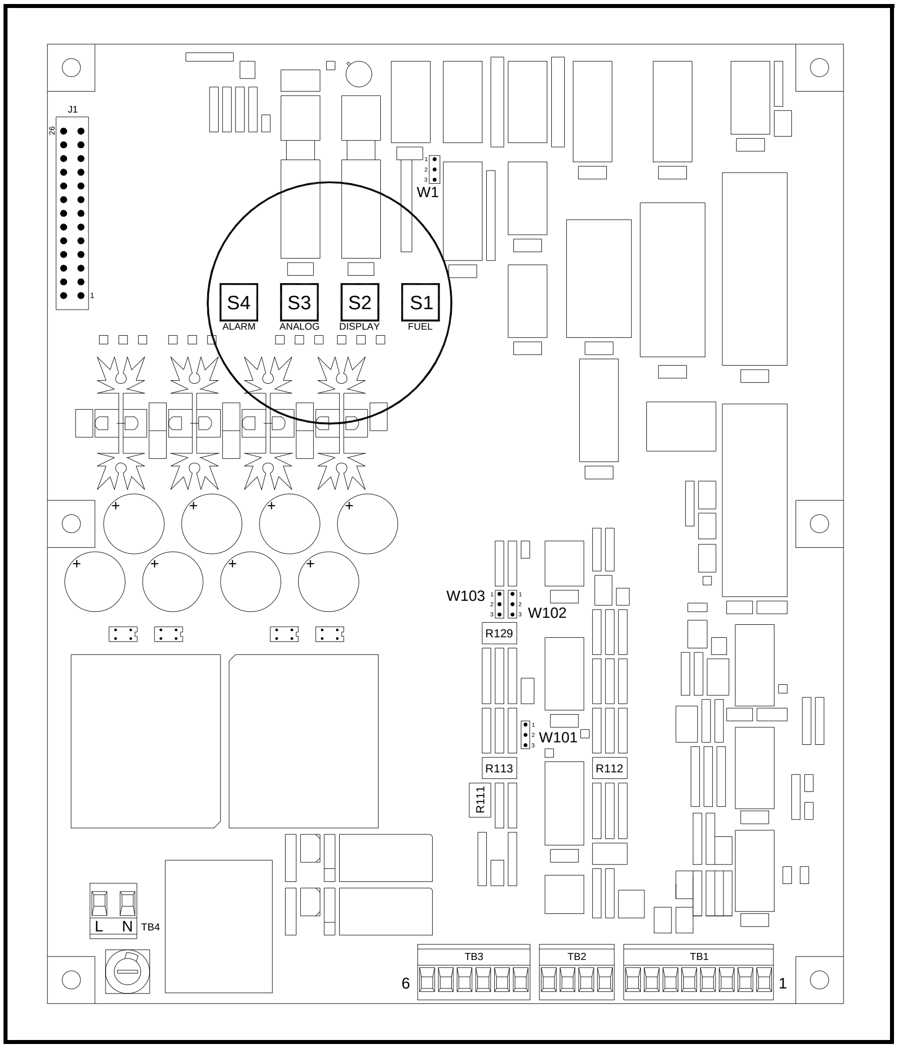


Figure 44: Rotary Switch Locations

A.2 Selecting the Display Parameter

Switch S2 allows the selection of the combustion process parameter to be automatically displayed.

Note: *The 300D Display can automatically display only one parameter at a time. Therefore, only the display parameter selected with switch S2 is automatically displayed.*

Refer to Table 27 and use switch S2 to select the preferred automatic display parameter.

Table 27: Rotary Switch S2 Settings

Position	Default Display Parameter
0	% Oxygen
1	% Excess Fuel
2	% Equivalent Combustibles
3	Air Factor
4	Combustibles Index
5	Sensor mV

A.3 Selecting the Fuel Type

Switch S1 allows the selection of the appropriate fuel type for the installation. However, switch S1 is used in conjunction with switch S2, and applies only to the following three display parameters (as chosen with switch S2):

- % Excess Fuel
- % Equivalent Combustibles
- Air Factor

If switch S2 is used to automatically display any other parameter, switch S1 has no effect. Use Table 28 to determine the correct setting for switch S1.

Table 28: Rotary Switch S1 Settings

Position	Fuel Type
0	Coal
1	Oil
2	Propane/Butane
3	Natural Gas
4	Coke Oven Gas

A.4 Adjusting the Oxygen Channel

While switch S2 is used to select the parameter displayed, switch S3 permits selection of the analog output range for the parameter being displayed. Since switch S3 is used in conjunction with switch S2, the analog output range is determined by the S2/S3 combination chosen.

Note: *The analog output range may only be adjusted for the oxygen channel, not the combustibles channel.*

To better understand the interaction between switches S2 and S3, consider the following two examples:

- **switch S2=0 and switch S3=1:**
  The S2 setting causes percent oxygen to be displayed and the S3 setting specifies an offset analog output of 4-20 mA/2-10 V to represent an oxygen range of 0-5% (see Table 30 on page 115).
- **switch S2=3 and switch S3=1:**
  The S2 setting causes air factor to be displayed and the S3 setting specifies an offset analog output of 4-20 mA/2-10 V to represent an air factor of 0.8-2.0 (see Table 31 on page 115).

For other S2/S3 combinations, refer to Figure 44 on page 112 and follow the directions in Table 29 to set the oxygen channel analog output range (either zero-based or offset) with switch S3.

Table 29: Switch S2 Settings

If Switch S2 =:	Go To:
Position 0 (% oxygen)	Table 30
Position 1 (% excess Fuel)	Table 30
Position 2 (% equivalent combustibles)	Table 30
Position 3 (air factor)	Table 31
Position 4 (combustibles index)	Table 32
Position 5 (sensor mV)	Table 33

A.4 Adjusting the Oxygen Channel (cont.)

Use Table 30 to determine the switch S3 setting, if switch S2 is set to position 0, 1 or 2.

Table 30: Switch S3 Settings (S2=0, 1, 2)

Position	Analog Output Range
0	0-5% (0-20 mA/0-10 V)
1	0-5% (4-20 mA/2-10 V)
2	0-10% (0-20 mA/0-10 V)
3	0-10% (4-20 mA/2-10 V)
4	0-15% (0-20 mA/0-10 V)
5	0-15% (4-20 mA/2-10 V)
6	0-20% (0-20 mA/0-10 V)
7	0-20% (4-20 mA/2-10 V)
8	0-25% (0-20 mA/0-10 V)
9	0-25% (4-20 mA/2-10 V)

Use Table 31 to determine the switch S3 setting, if switch S2 is set to position 3.

Table 31: Switch S3 Settings (S2=3)

Position	Analog Output Range
0	0.8-2.0 (0-20 mA/0-10 V)
1	0.8-2.0 (4-20 mA/2-10 V)

Use Table 32 to determine the switch S3 setting, if switch S2 is set to position 4.

Table 32: Switch S3 Settings (S2=4)

Position	Analog Output Range
0	7.0-14.1 (0-20 mA/0-10 V)
1	7.0-14.1 (4-20 mA/2-10 V)

Use Table 33 to determine the switch S3 setting, if switch S2 is set to position 5.

Table 33: Switch S3 Settings (S2=5)

Position	Analog Output Range
0	0-1000 mV (0-20 mA/0-10 V)
1	0-1000 mV (4-20 mA/2-10 V)

A.5 Adjusting the Combustibles Channel

The following two adjustments can be made to the combustibles channel of the Display Console:

- Setting the scale type (zero-based or offset)
- Setting the Zero and Full Scale Values

A.5.1 Setting the Scale Type

Each unit is shipped with the analog outputs set up as specified at the time of purchase. However, the analog outputs can be changed to be either a zero-based or offset scale, using the following procedures:

Note: *The zero and full scale analog output values must be set after selecting a linear or offset scale.*

Specify the desired scale type by installing jumper W103 in one of the following positions (see Figure 45 on page 117):

- position 1/2 for a linear scale (0-20 mA or 0-10 V), or
- position 2/3 for an offset scale (4-20 mA or 2-10 V)

A.5.2 Setting the Zero and Full Scale Values

Setting the zero and full scale values is the second step in setting up the analog outputs. Please keep in mind that the scale type (zero-based or offset) should be selected before setting the zero and full scale values. Since the procedures for the two scale types are different, proceed to the appropriate section to set the output values (refer to Figure 45 on page 117).

A.5.2a A Linear Scale

To set the zero and full scale values for a linear scale, complete the following steps (see Figure 45 on page 117):

1. Connect two identical resistors of between 1800 and 2000 ohms across terminal block TB1 pins 5-6 and pins 6-7.
2. Install a jumper on pins 1 and 2 of W103.
3. Adjust potentiometer R111 for the desired full scale value, as read on the front panel display.
4. Adjust potentiometer R129 until the analog output corresponds to the value on the front panel display.
5. Remove the resistors from TB1 and the jumper from W103.

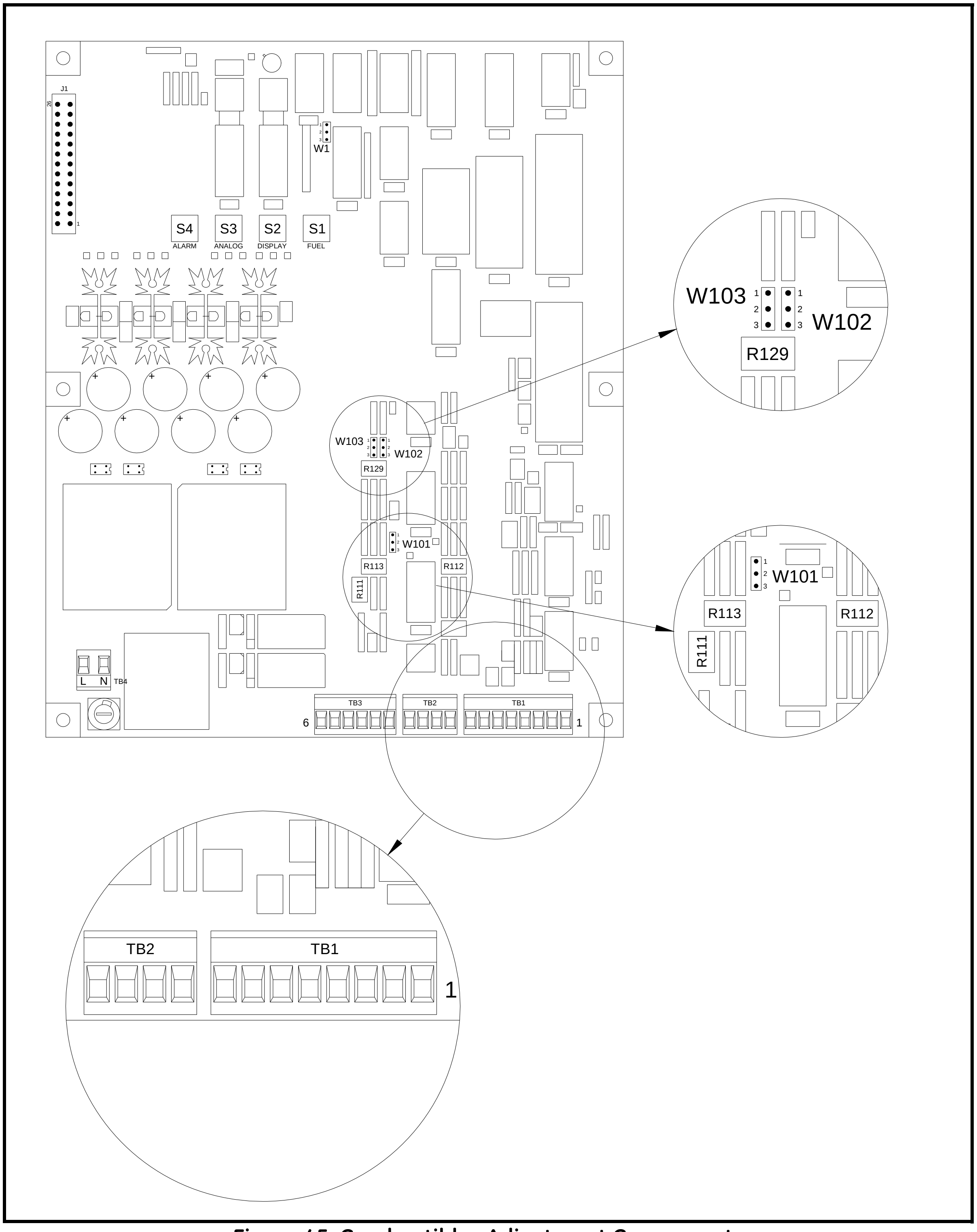


Figure 45: Combustibles Adjustment Components

Note: *For units fitted with the previous version of the 300D printed circuit board. See Appendix F,* Previous Configurations, *for the layout of this circuit board.*

A.5.2b An Offset Scale

To set the zero and full scale values for an offset scale, complete the following steps (see Figure 45 on page 117):

1. Connect two identical resistors of between 1800 and 2000 ohms across terminal block TB1 pins 5-6 and pins 6-7.
2. Install a jumper on pins 2 and 3 of W103.
3. Adjust potentiometer R111 for a zero value, as read on the front panel display.
4. Attach the positive (+) lead of a multimeter to pin 3 of terminal block TB2 and attach the negative (-) lead of the multimeter to pin 4 of terminal block TB2. Then, adjust potentiometer R112 until a reading of 4 mA (or 2 V) is obtained.
5. Adjust potentiometer R111 for the desired full scale value, as read on the front panel display.
6. Adjust potentiometer R129 until the analog output corresponds to the value on the front panel display.
7. Remove the resistors from TB1 and the jumper from W103.

Appendix B. Outline and Mounting Dimensions

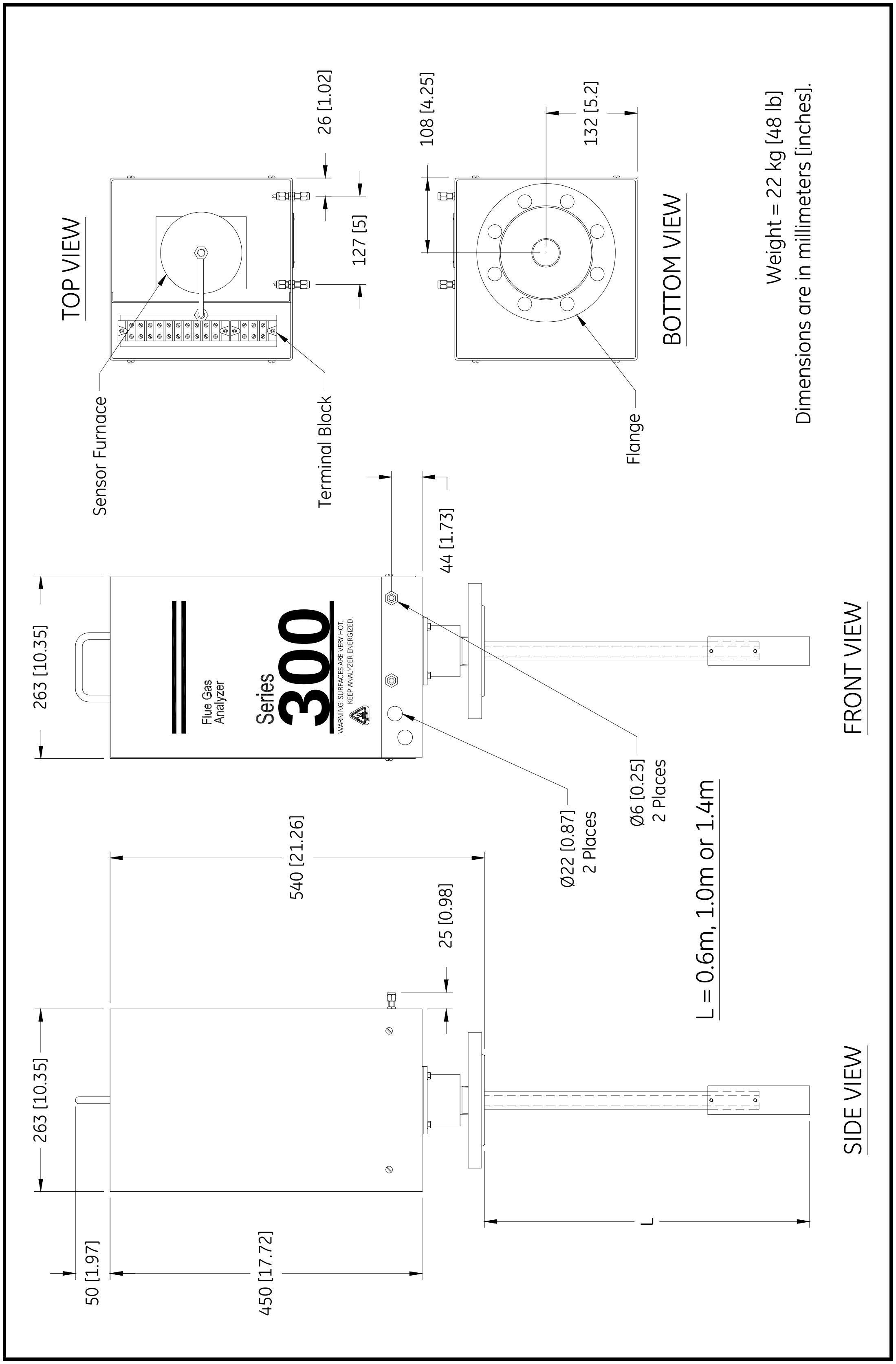


Figure 46: Main Analyzer Unit - Standard (Weatherproof)

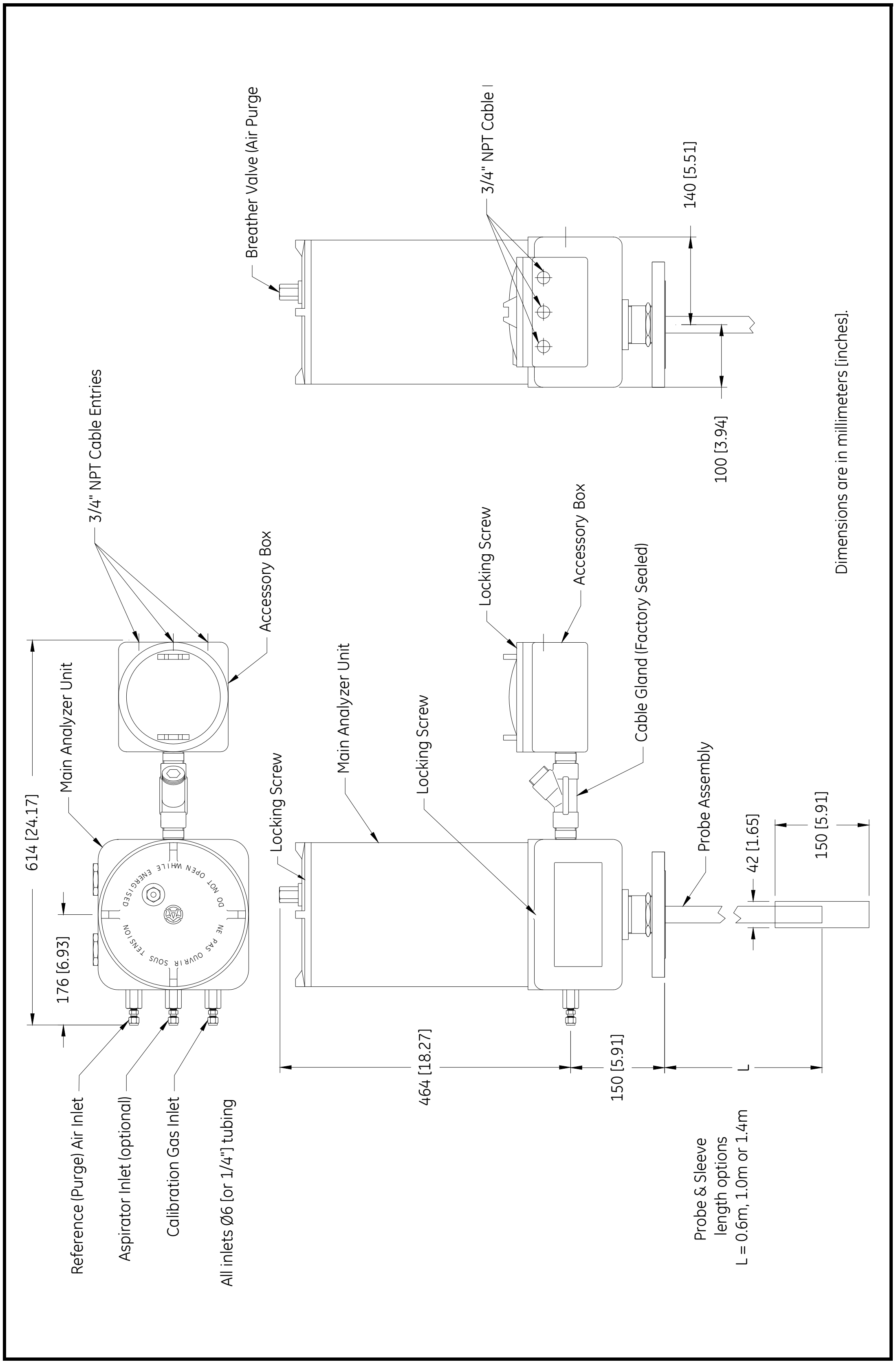


Figure 47: Main Analyzer Unit (1 of 2) - Explosion-Proof (Flameproof)

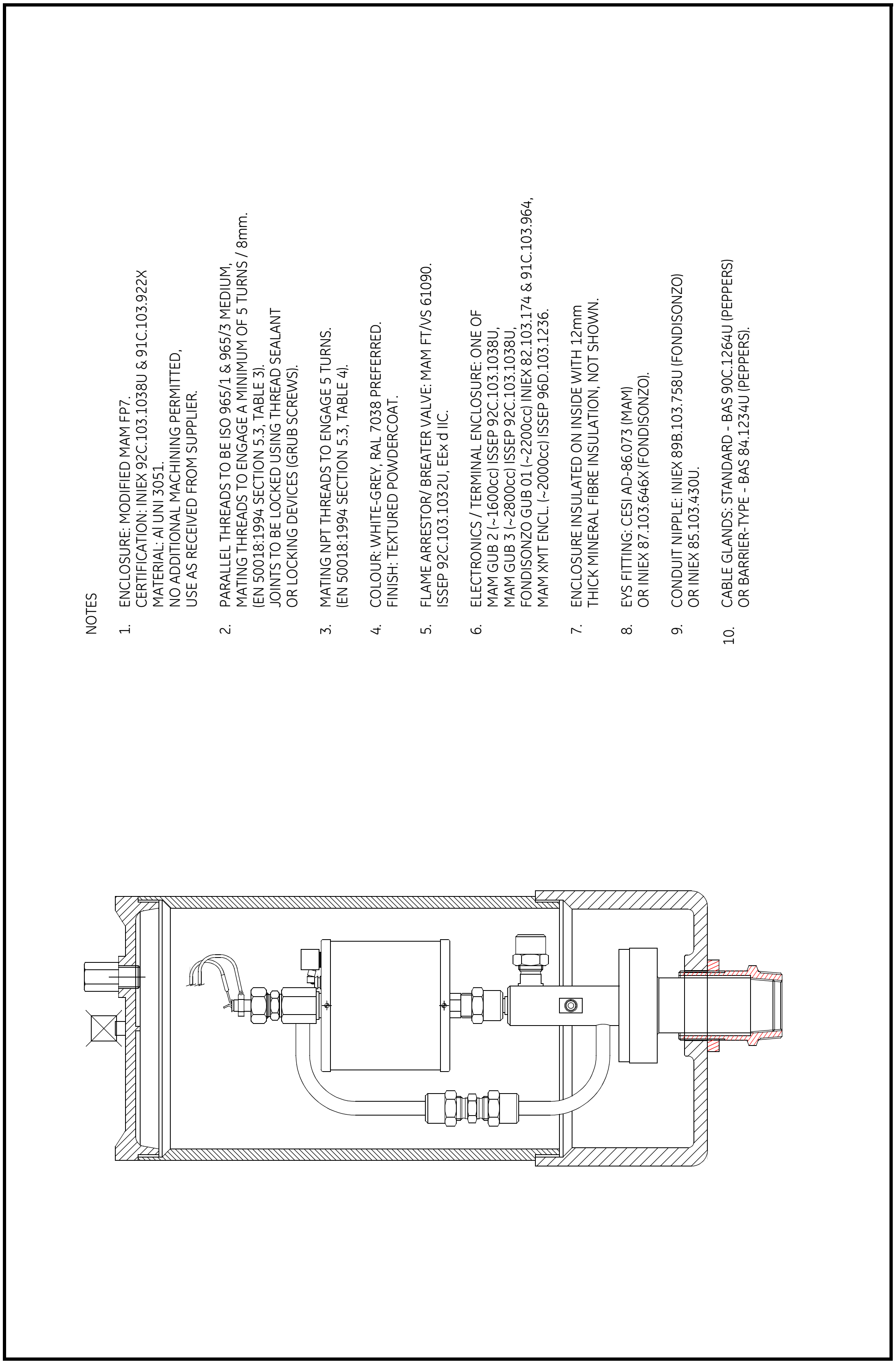


Figure 48: Main Analyzer Unit (2 of 2) - Explosion-Proof (Flameproof)

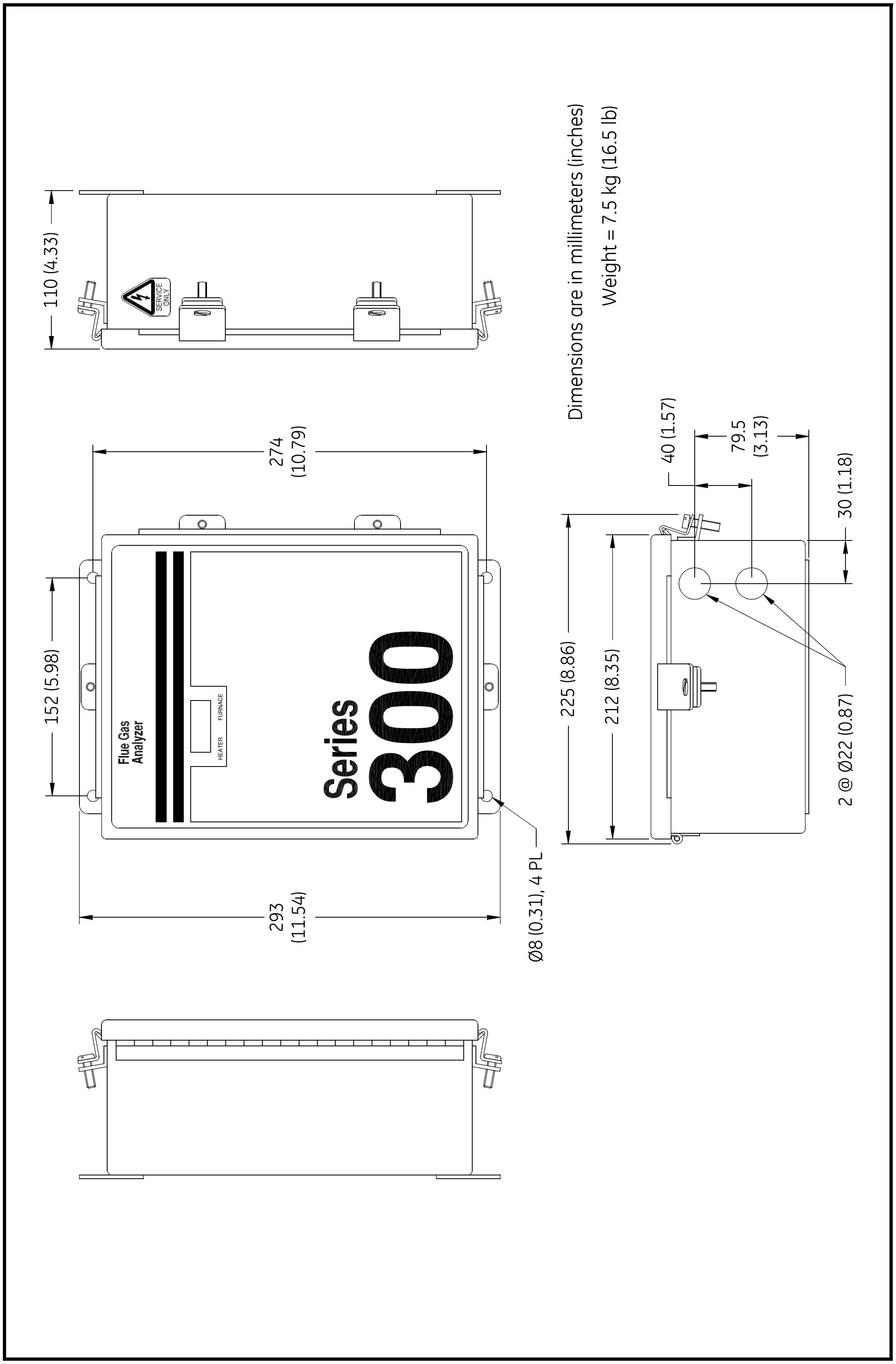


Figure 49: Remote FTC Box - Standard (Weatherproof)

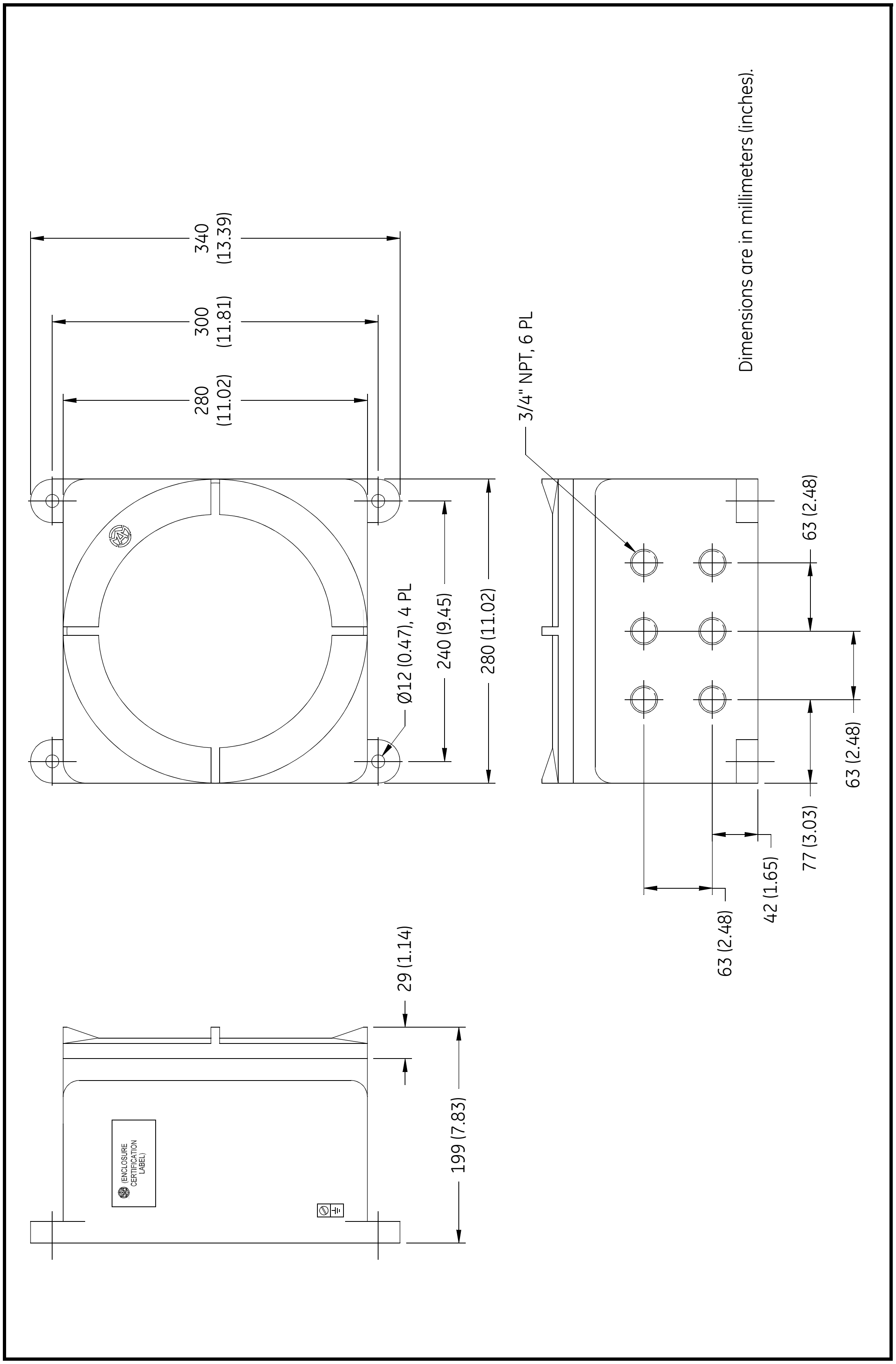


Figure 50: Remote FTC Box - Explosion-Proof (Flameproof)

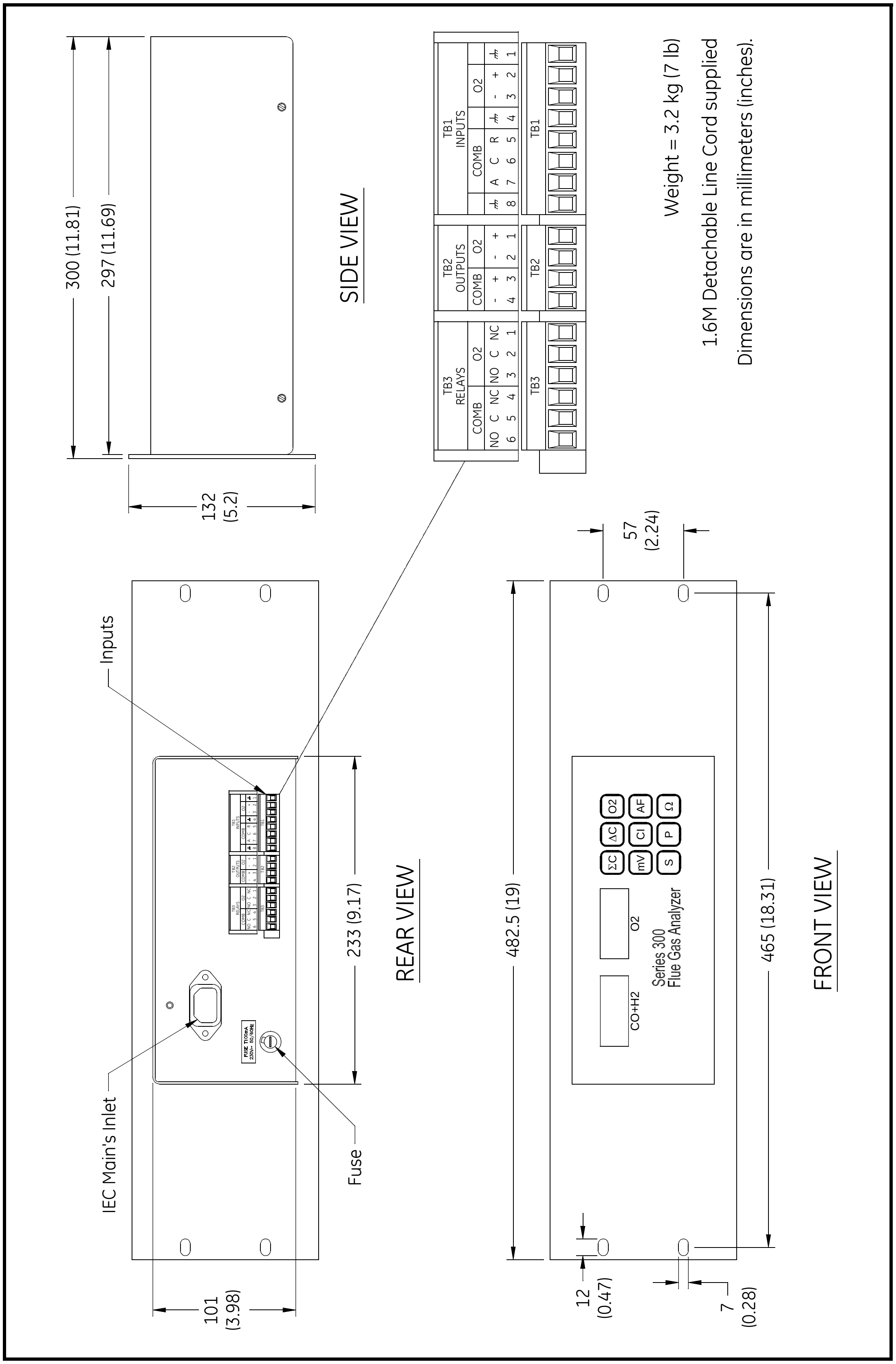


Figure 51: 300D Display - Rack Mount

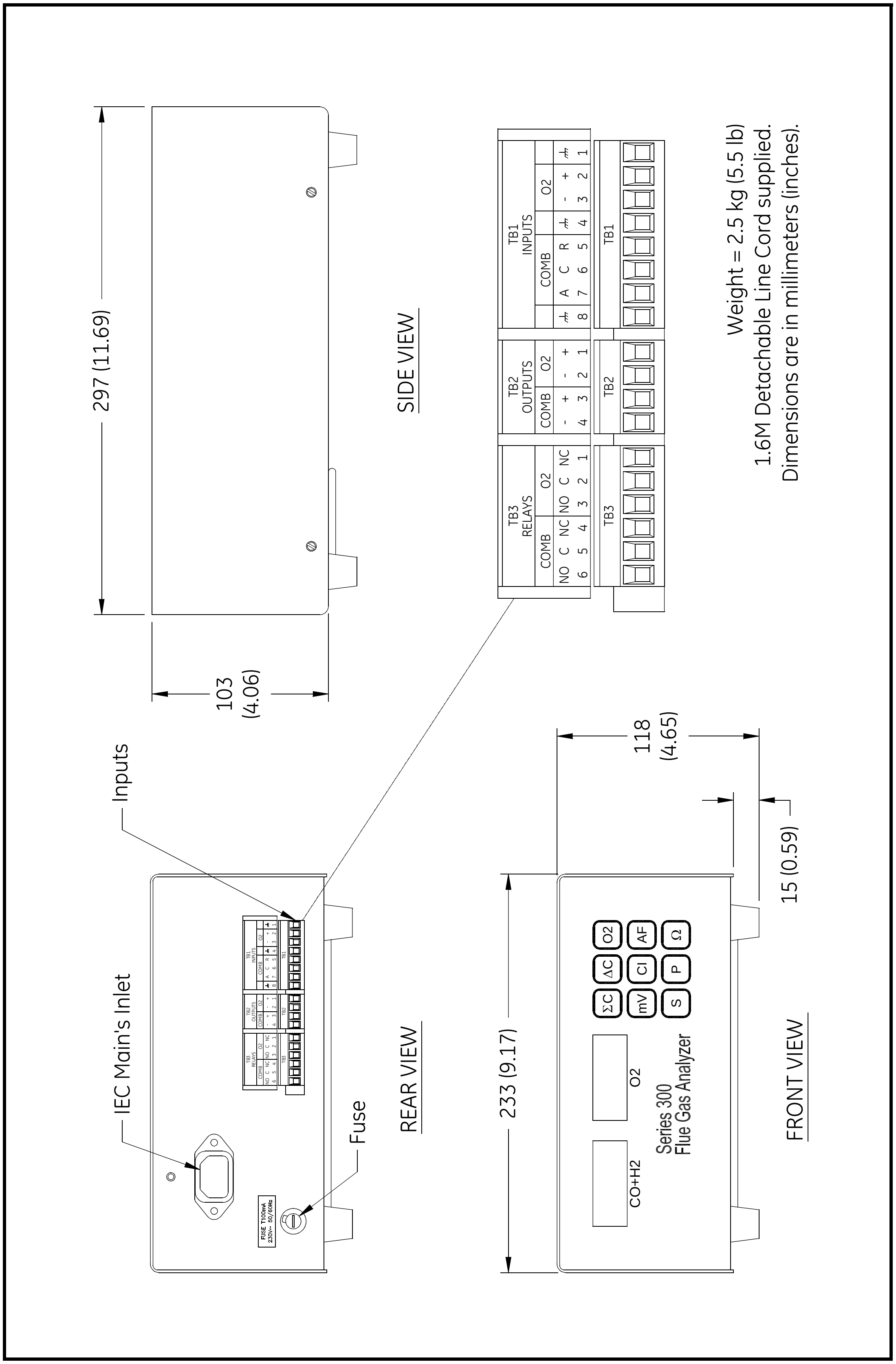


Figure 52: 300D Display - Bench Mount

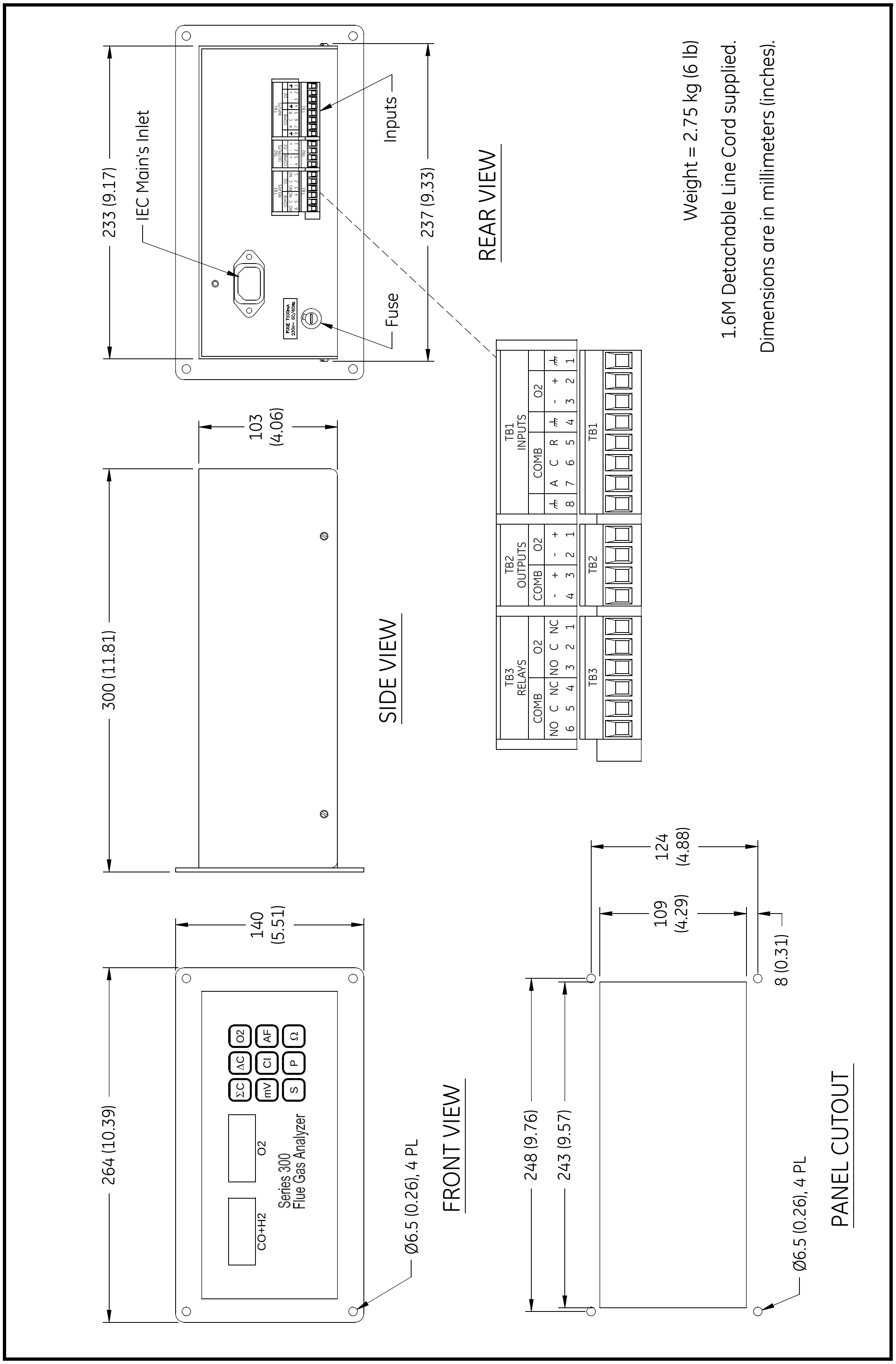


Figure 53: 300D Display - Panel Mount

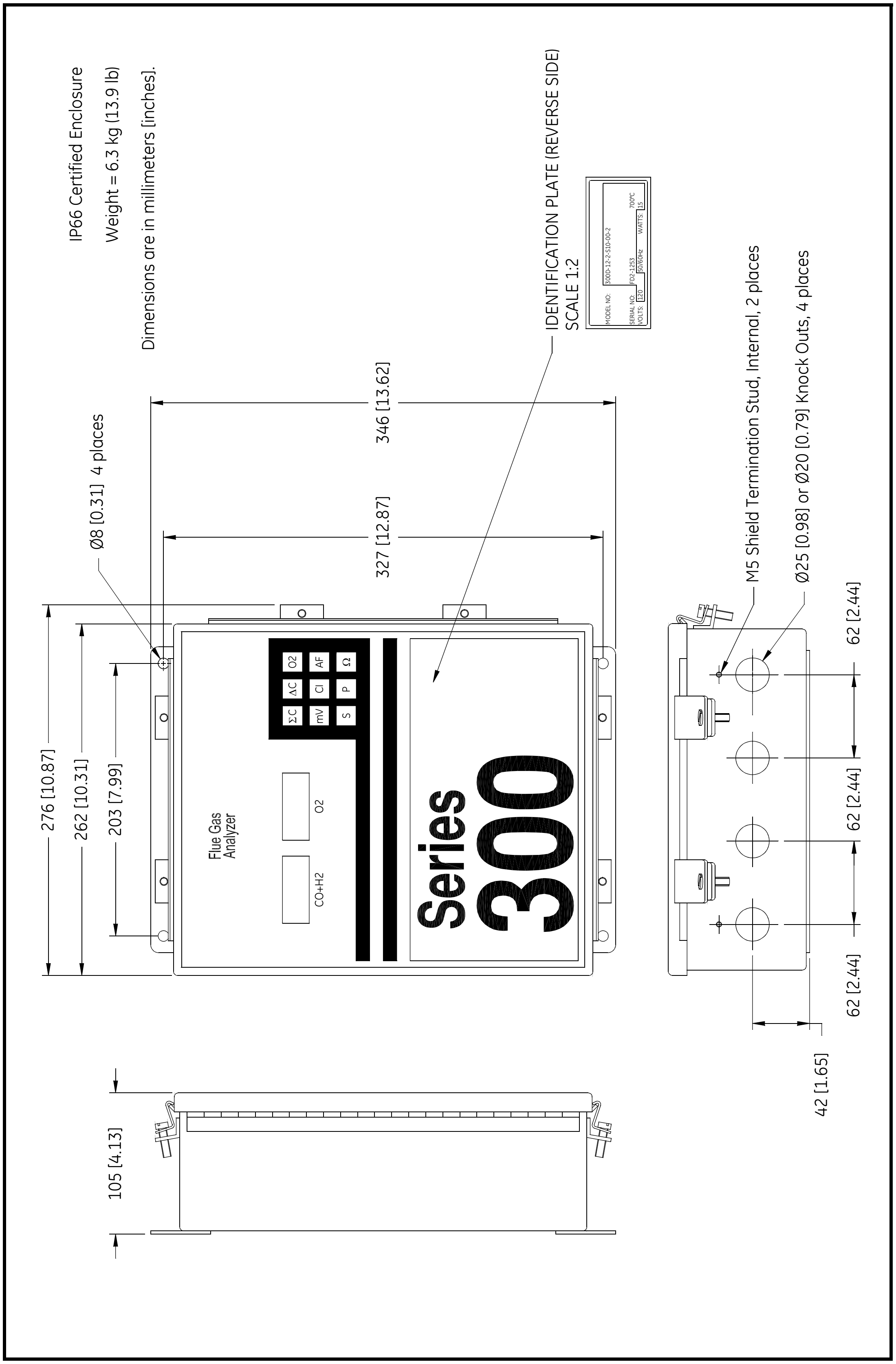


Figure 54: 300D Display - Standard (Weatherproof)

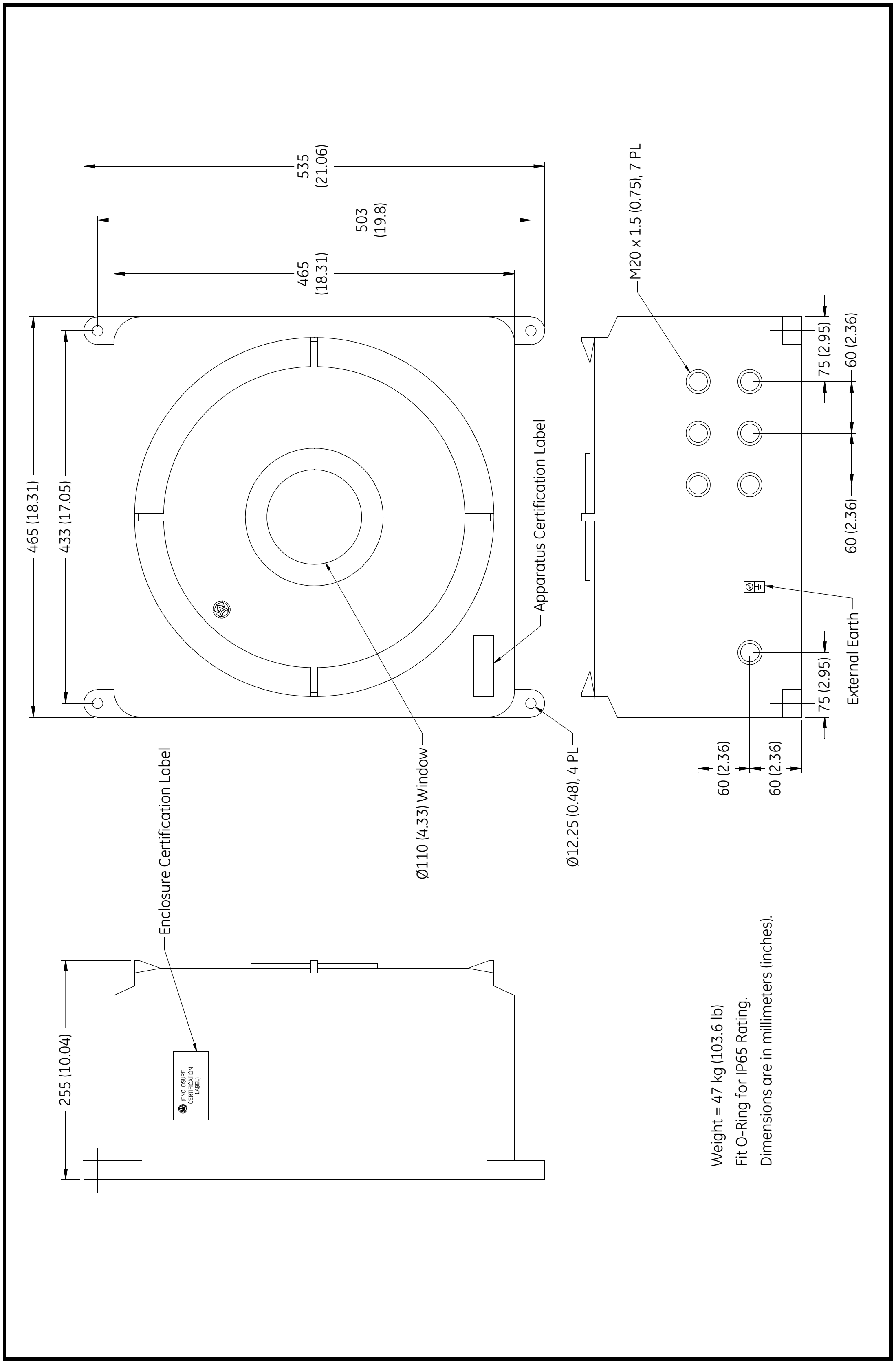


Figure 55: 300D Display - Bench Mount

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Appendix C. The Nernst Equation

C.1 Overview

The FGA 300V(X) Flue Gas Analyzer uses the *Nernst Equation* to calculate the oxygen content of the flue gas. When a Yttrium-doped zirconium oxide ceramic is heated to a temperature above 650°C, it becomes an electrolytic conductor, as vacancies in the crystal lattice permit oxygen ions to diffuse into the ceramic.

If there are different oxygen partial pressures on the two sides of the ceramic cell, oxygen ions will migrate along the resulting *concentration gradient*. This constitutes a transfer of electrons from one face of the ceramic to the other. If the transferred charge is allowed to accumulate, it gives rise to a *potential gradient* acting in the opposite direction, thus tending to oppose further diffusion.

C.2 Equilibrium Conditions

Under equilibrium conditions, the potential gradient exactly balances the concentration gradient. Porous coatings of a platinum catalyst on both surfaces of the ceramic cell serve as electrodes, while still allowing the oxygen molecules to penetrate the coating and diffuse into the ceramic. The measured voltage drop across the cell can be directly related to the ratio of the two oxygen partial pressures by means of the *Nernst Equation*:

$$E_{12} = \frac{RT}{nF} \bullet \ln\left[\frac{p_1}{p_2}\right]$$

where,

F = the Faraday = 96,484.56 coulombs

T = absolute temperature = °K (°K = °C + 273.15°)

R = gas constant = 8.31441 volt-coulomb/mole-°K

n = # electrons transferred per molecule = 4/mole

ln = natural logarithm = 2.303 $\log_{10}$

p_1 = O_2 partial pressure on reference gas side = 0.209

p_2 = O_2 partial pressure on flue gas side

E_{12} = voltage on reference face with respect to the flue gas face

C.3 The FGA 300V(X) Equations

The Nernst Equation specifically applicable to the FGA 300V(X) analyzer is obtained by substituting the above values into the general equation, converting the natural logarithm to the common logarithm (base 10) and converting the units for E_{12} to millivolts. This results in the following equation:

$$E_{12}(mV) = 0.049605 \bullet T \bullet \log\left[\frac{0.209}{p_2}\right]$$

The FGA 300V(X) uses one of two standard oxygen sensor operating temperatures (Consult with a GE Panametrics engineer to determine which temperature is best suited to your situation.):

if 770°C, the equation above becomes

$$E_{12}(mV) = 51.745 \bullet \log\left[\frac{0.209}{p_2}\right]$$

if 812°C, the equation becomes

$$E_{12}(mV) = 53.829 \bullet \log\left[\frac{0.209}{p_2}\right]$$

The voltage drop across the zirconium oxide sensor, as calculated from the Nernst equation, is then sent to the linearizer circuit. The circuit produces a linear analog output that represents the percentage of oxygen in the flue gas, and this signal is available as a recorder output at pins 1 and 2 of terminal block TB2 on the Display Console circuit board.

For convenience, the standard Nernst equations for the FGA 300V(X) Flue Gas Analyzer above have been converted into a graphical format. Use these graphs (see Figure 56 on page 133 and Figure 57 on page 134) to quickly correlate the analog output voltage reading with the corresponding oxygen percentage, at the operating temperature of the unit.

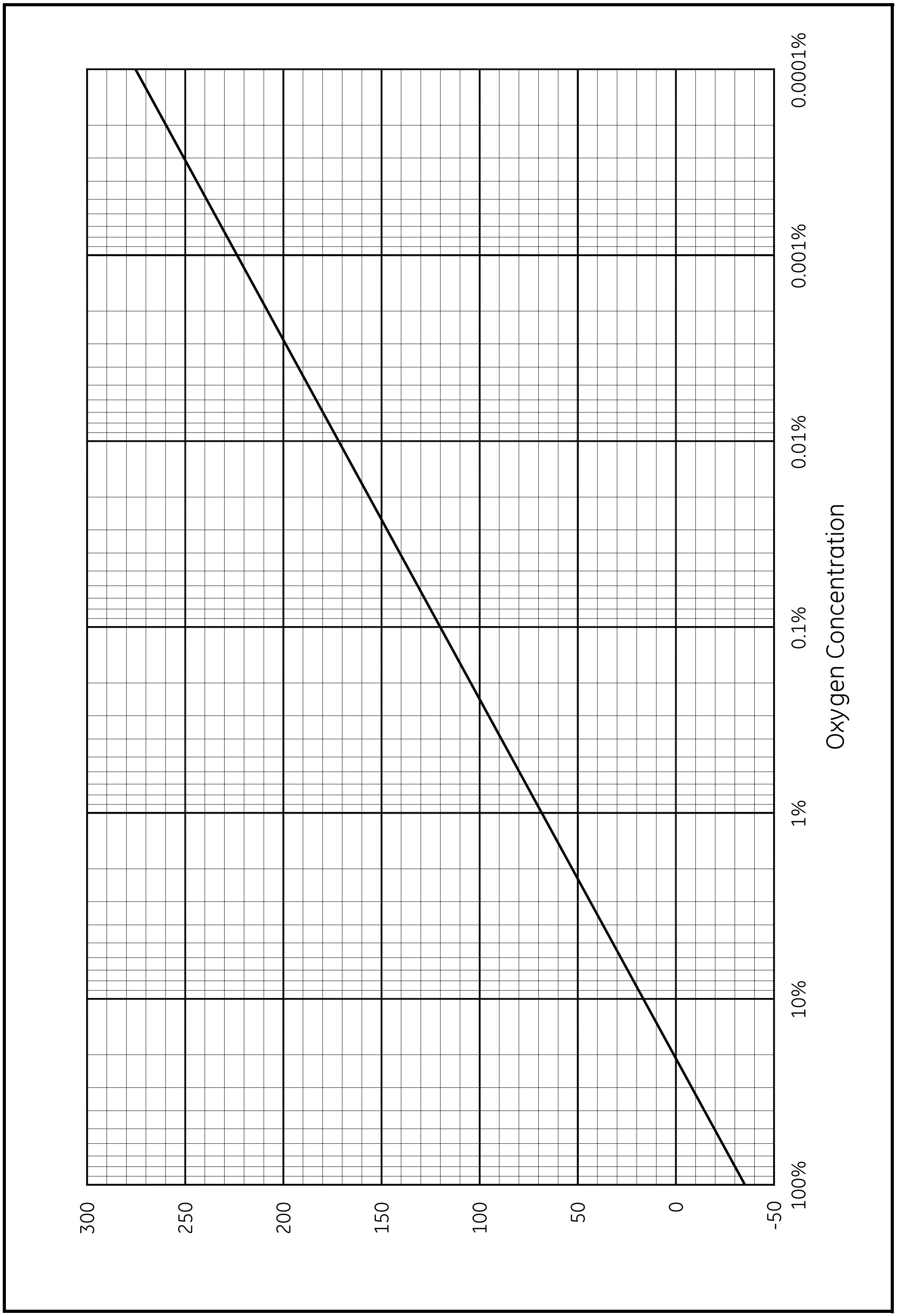


Figure 56: Oxygen Sensor Output at 770°C

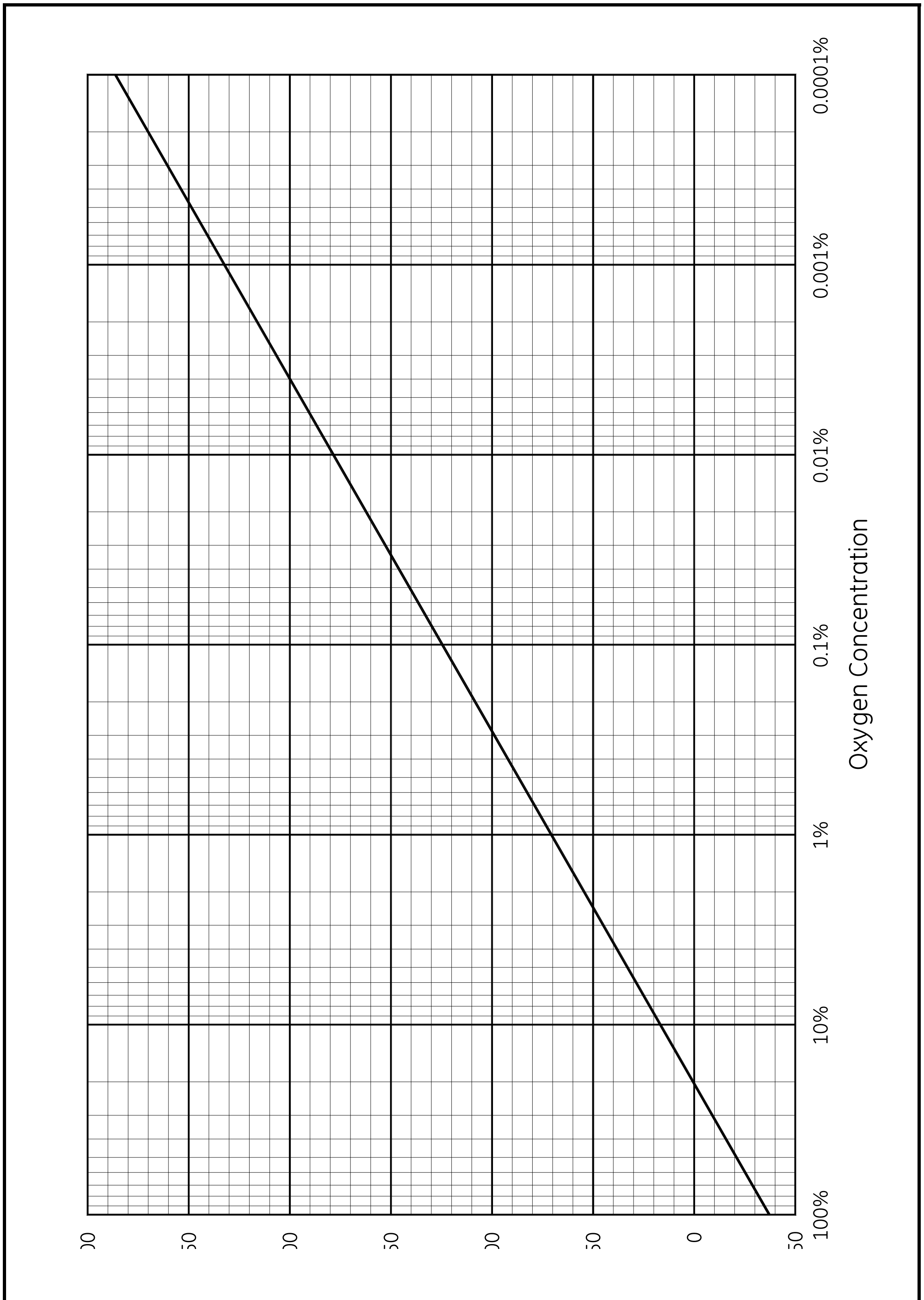


Figure 57: Oxygen Sensor Output at 812°C

Appendix D. Wiring Diagrams and Circuit Boards

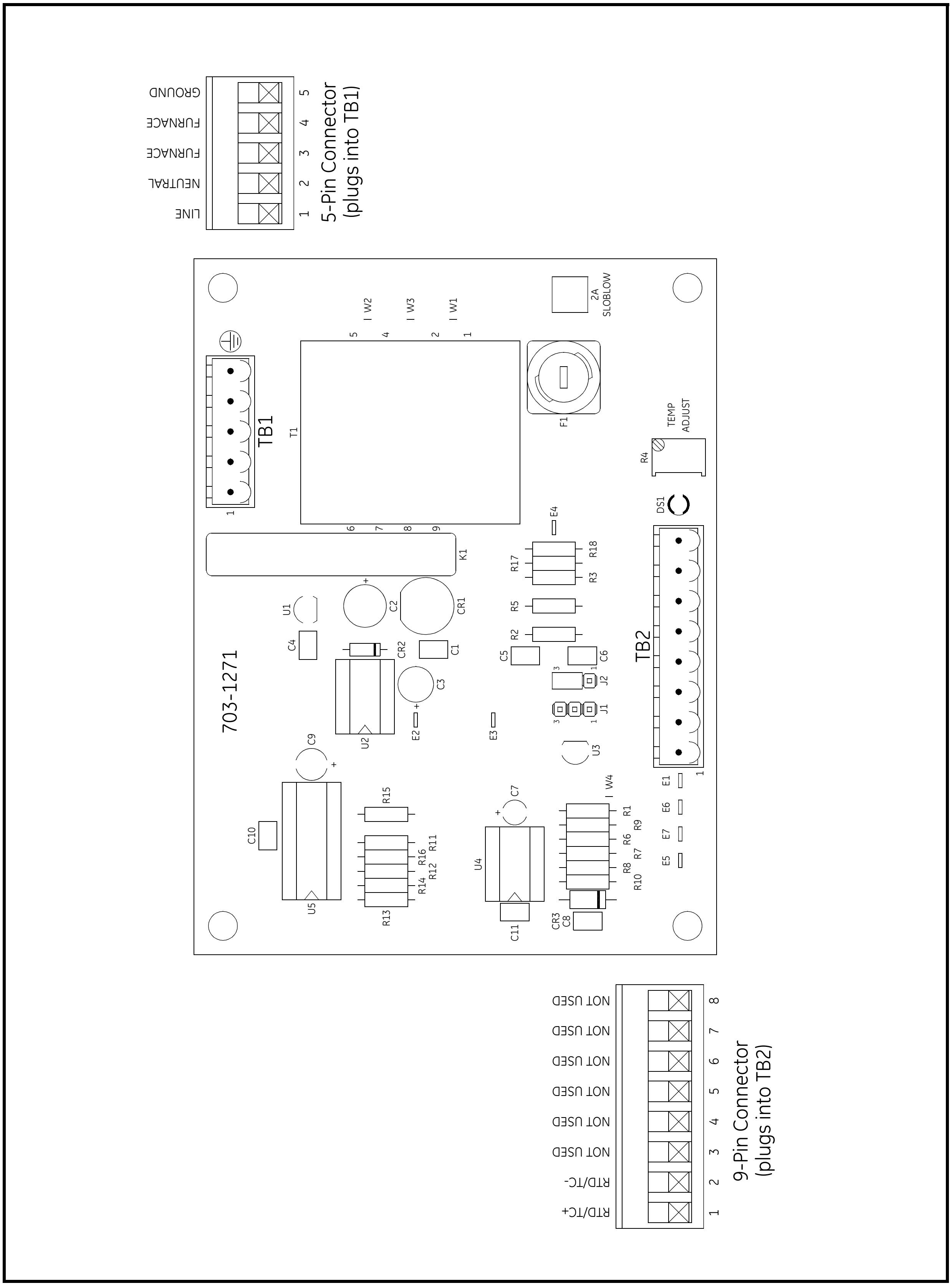


Figure 58: FTC Circuit Board - Current (ref. dwg #703-1271)

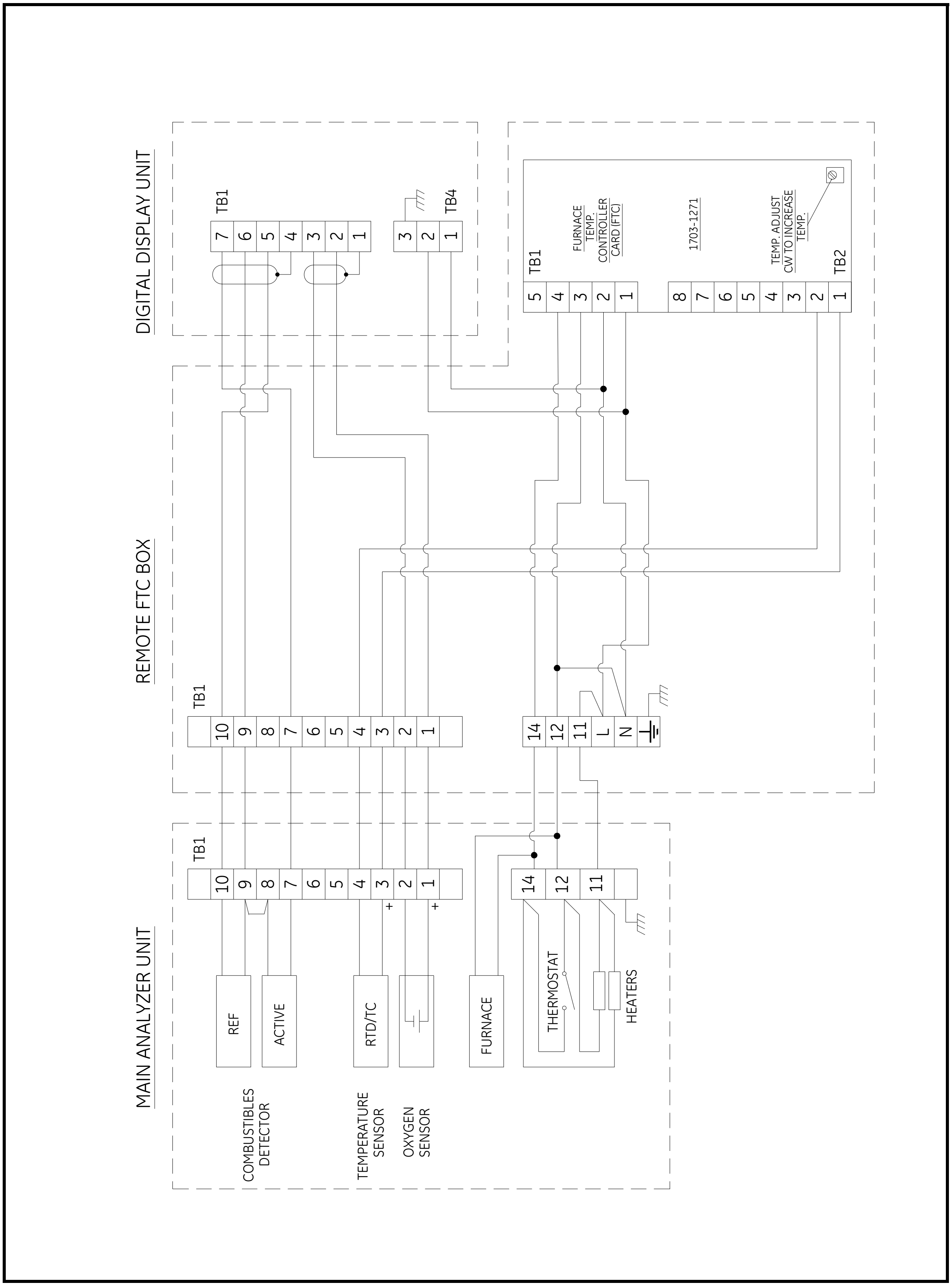


Figure 59: Wiring Diagram - Current (Drawing #1442-517, Rev. F)

TB1 - INPUTS

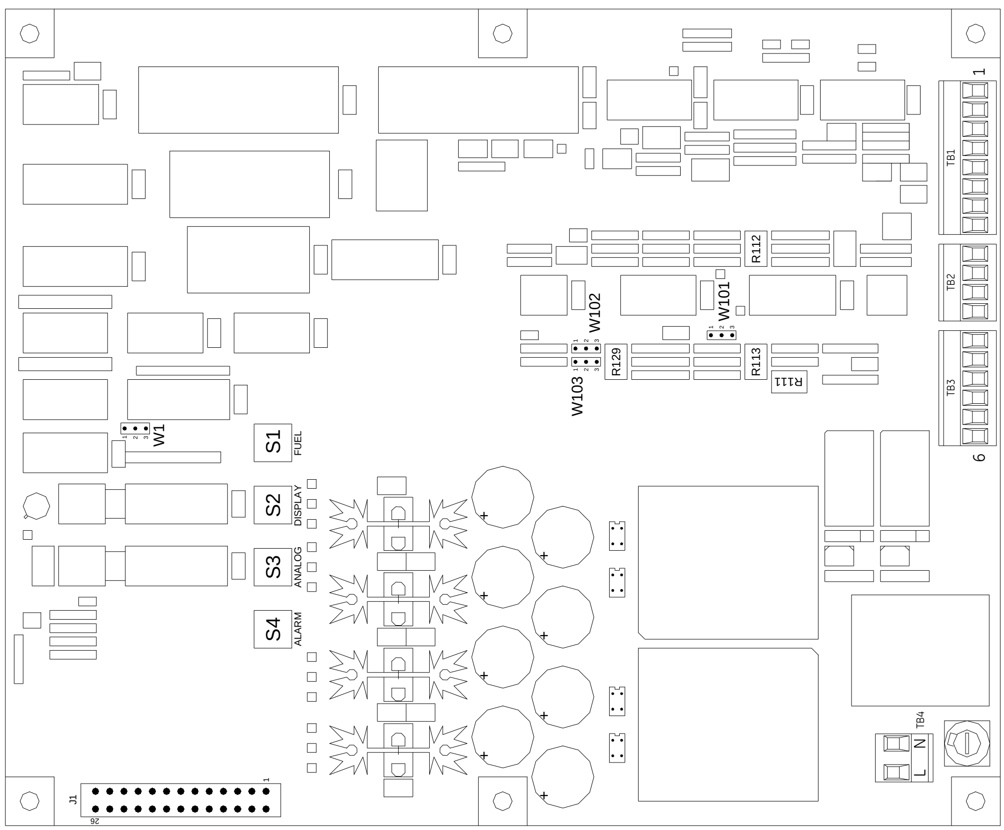
Pin #	Label	Description
1	⏚	Ground
2	+	Oxygen Sensor +
3	-	Oxygen Sensor -
4	⏚	Ground
5	R	Combustibles Reference
6	C	Combustibles Common
7	A	Combustibles Active
8	⏚	Ground

TB2 - OUTPUTS

Pin #	Label	Description
1	+	Oxygen Sensor +
2	-	Oxygen Sensor -
3	+	Combustibles Detector +
4	-	Combustibles Detector -

TB3 - RELAYS

Pin #	Label	Description
1	NC	Oxygen Alarm Normally Closed
2	C	Oxygen Alarm Common
3	NO	Oxygen Alarm Normally Open
4	NC	Combustibles Alarm Normally Closed
5	C	Combustibles Alarm Common
6	NO	Combustibles Alarm Normally Open



TB4 - MAINS

Pin #	Label	Description
1	N	Neutral (-)
2	L	Line (+)

Figure 60: Display Circuit Board - Current (Drawing #1703-011)

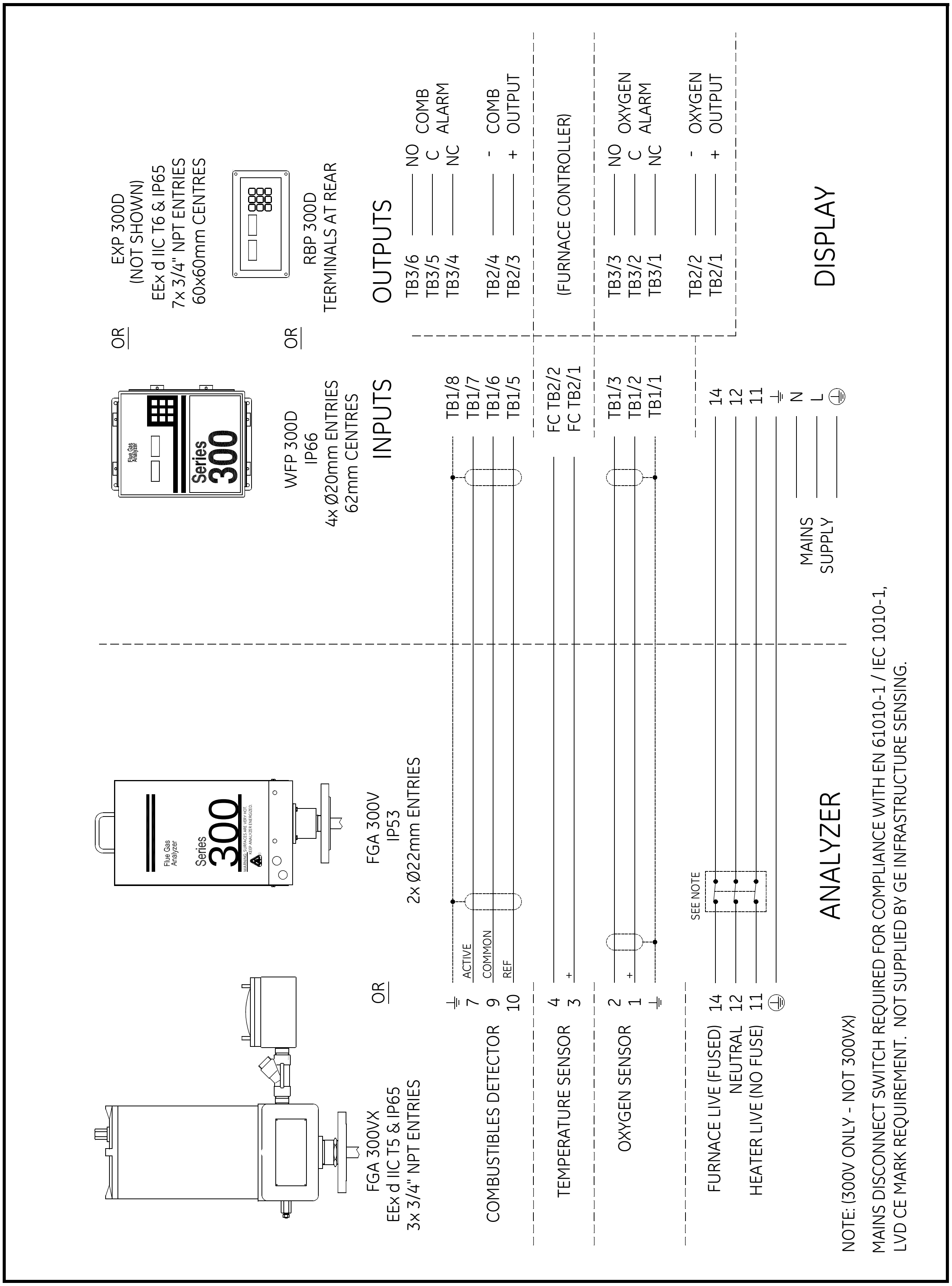


Figure 61: Interconnection Diagram with FTC Board in Display Enclosure

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Appendix E. Default Settings

E.1 Overview

For CE Mark compliance, the FGA 300**V** must meet both the *EMC* and *LVD* directives. The FGA 300**HX** must meet only the *EMC* directive.

IMPORTANT: *CE Mark compliance is required only for units used in EEA countries.*

IMPORTANT: *For EN 61000-4-3, the FGA 300V(X) meets Performance Criterion A, except at a limited number of frequencies, Criterion B, per EN 61326.*

E.2 EMC Compliance

For *EMC* compliance, the electrical connections must be shielded and grounded as shown in Table 34. After all the necessary electrical connections have been made, seal any unused cable entry holes with standard conduit plugs or equivalent.

Note: *If the instructions in this appendix are followed, the unit will comply with the EMC Directive 2004/108/EC.*

Table 34: Wiring Modifications for EMC Compliance

Connection	Wiring Modification
Power	1. Use shielded* cable to connect power to the FGA 300V(X). 2. Select the cable entry closest to the chassis ground. 3. Connect the power line ground wire and the shield* to the nearest chassis ground terminal.
Input/Output	1. Use shielded* cable to interconnect the FGA 300V(X) with any external input/output devices. 2. Connect the shields* to the nearest chassis ground terminal.
*Wires installed in properly grounded metal conduit are not required to have their own shield.	

E.3 LVD Compliance

For compliance with the European Union’s Low Voltage Directive (2006/95/EC), the analyzer requires an external power disconnect device such as a switch or circuit breaker. The disconnect device must be marked as such, clearly visible, directly accessible, and located within 1.8 m (6 ft) of the FGA 300V. Because the sensor furnace power feed in the remote FTC Box must also be interrupted, a 4-pole disconnect device is required.

Note: *If the instructions in this appendix are followed, the unit will comply with the Low Voltage Directive (2006/95/EC).*

[no content intended for this page]

Appendix F. Previous Configurations

F.1 Overview

Over the years, feedback from field installations and advancements in technology have led to refinements in the furnace temperature control (FTC) circuitry of the FGA 300V(X) analyzer. Specifically, the following components within the remote FTC Box have evolved:

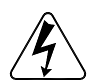
- FTC printed circuit board
- sensor furnace power transformer

Because of the reliability of the FGA 300V(X), many units with the previous FTC circuitry designs are still in use. Therefore, troubleshooting and replacement procedures for FTC units fitted with a transformer or a previous version of the FTC circuit board are presented in this appendix.

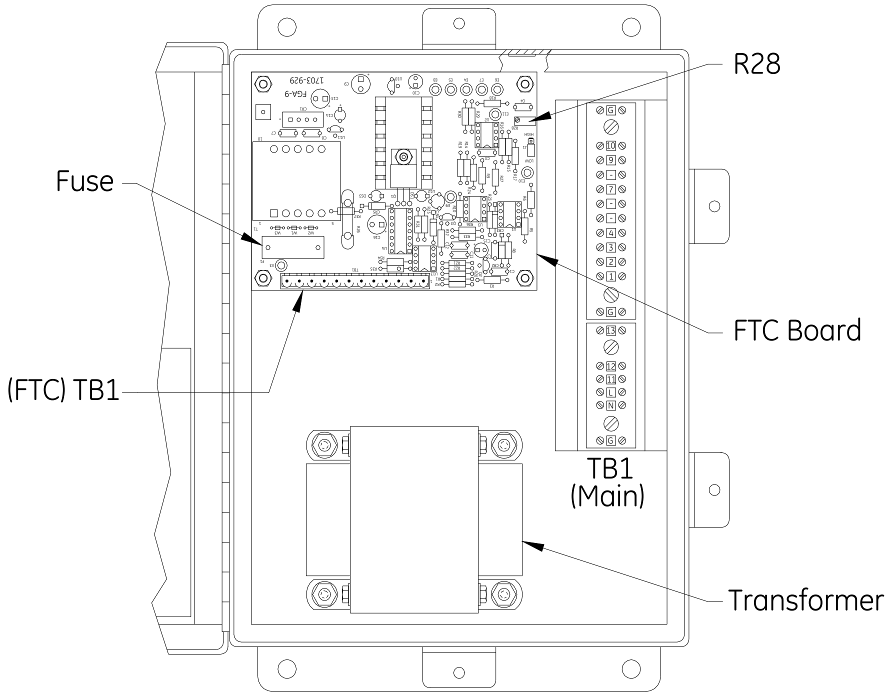
F.2 Testing the FTC Board and Transformer

If the standard testing procedures in Chapter 5, *Troubleshooting*, reaches the point where the FTC circuit board must be checked, refer to Figure 62 on page 144 and complete the following steps:

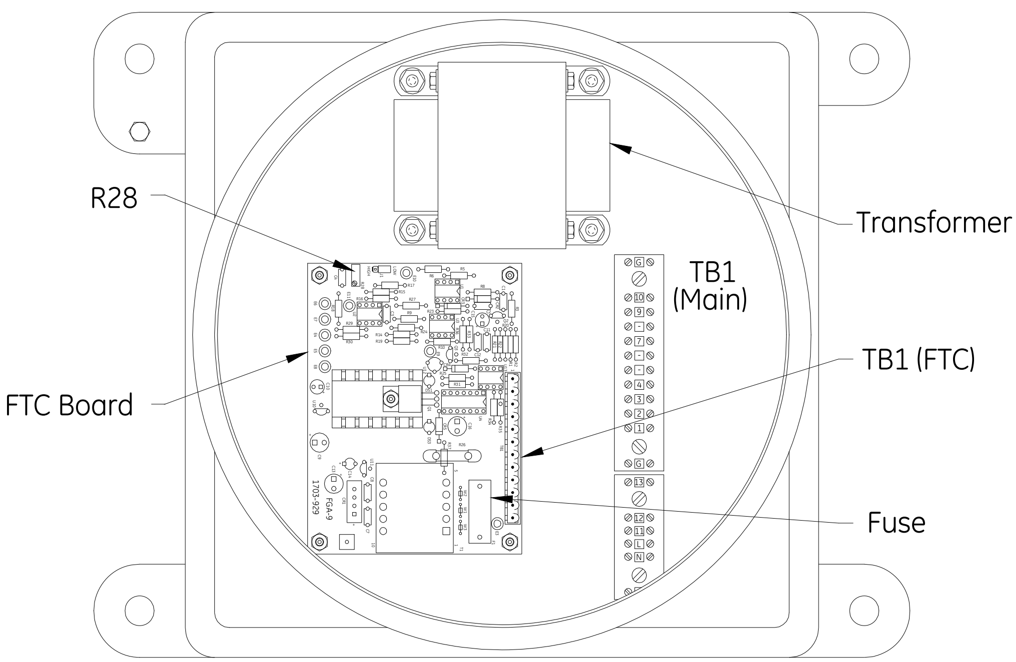
IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



3. Using a digital multimeter, measure the voltage across pins 5 and 6 on terminal block TB1 in the remote FTC Box (**NOT** on the FTC board). If the reading is approximately 80 VAC, the FTC board and the transformer are functioning properly. If the reading is not approximately 80 VAC, proceed to the next step.
4. Measure the voltage across pins 10 and 11 on the FTC circuit board (**NOT** on TB1 of the FTC Box). If the reading is not approximately line voltage, check the main power, as there is no power reaching the remote FTC Box. If the reading is approximately line voltage, proceed to the next step.
5. Measure the voltage across pins 8 and 9 on the FTC board (transformer input). If the reading is approximately line voltage proceed to the next step. If the reading is not approximately line voltage, replace the fuse on the FTC board (see the instructions later in this appendix).
6. Measure the voltage across pins 6 and 7 on the FTC board (transformer output). If the reading is approximately 80 VAC, the FTC board is defective and must be replaced. If the voltage is not approximately 80 VAC, the transformer is defective and must be replaced. (Refer to the instructions later in this appendix for the correct replacement procedures.)



Standard (Weatherproof) FTC Box



Explosion-Proof (Flameproof) FTC Box

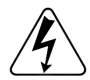
Figure 62: FTC Board & Transformer Locations

F.3 Replacing the FTC Board Fuse

The Furnace Temperature Control (FTC) board fuse is located on the FTC board, in the remote FTC Box.

CAUTION! **To replace the FTC board fuse, the power to the FGA 300V(X) must be disconnected. Therefore, replace the FTC board fuse and reconnect the power as quickly as possible to prevent corrosion of the analyzer components due to acid condensation.**

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



The only tool needed to replace the FTC board fuse is a small screwdriver. Refer to Figure 62 on page 144 and complete the following steps to replace the FTC board fuse:

1. Disconnect the main power to the FGA 300V(X).
2. Open the hinged cover on the standard (weatherproof) FTC box. For an explosion-proof (flameproof) FTC box, loosen the locking set screw on top of the FTC box and, using a long screwdriver across the slots provided, unscrew the cover from the enclosure.
3. Locate the fuseholder on the FTC board. Using a small screwdriver, remove the spring-loaded cover from the fuseholder and discard the old fuse.
4. Install a new fuse of the same type and size (see Chapter 7, *Specifications*), and reinstall the fuseholder cover.
5. Close the cover on the remote FTC Box and reconnect the main power to the system.

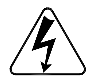
The system may now be placed back into service.

F.4 Replacing the FTC Board

The Furnace Temperature Control (FTC) board is located in the Remote FTC box. The FTC board is a 3.5 x 4.7 in. (90 x 120 mm) rectangular printed circuit board that maintains a steady sensor furnace temperature in order to ensure accurate operation of the oxygen sensor.

CAUTION! To replace the FTC board, the power to the FGA 300V(X) must be disconnected. Therefore, replace the FTC board and reconnect the power as quickly as possible to prevent corrosion of the analyzer components due to acid condensation.

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



The only tool needed to replace the FTC board is a nutdriver or similar tool. Refer to Figure 62 on page 144 and complete the following steps to replace the FTC board:

1. Disconnect the main power to the FGA 300V(X).
2. Open the hinged cover on the standard (weatherproof) FTC box. For an explosion-proof (flameproof) FTC box, loosen the locking set screw on top of the FTC box and, using a long screwdriver across the slots provided, unscrew the cover from the enclosure.
3. Remove the connector from the 12-pin terminal block (TB1) on the FTC circuit board.
4. Remove the four hex nuts and washers located in the corners of the old FTC board, and lift the FTC board out of the enclosure.

Note: *Install the new FTC board in the same orientation as the old FTC board. The line voltage for the new FTC board is factory set, based on the unit's serial number.*

5. Locate the new FTC board over the standoffs in the enclosure. Make sure that the new FTC board is in the same orientation as the old board and not rotated by 180°.
6. Replace the four hex nuts and washers in the corners of the new FTC board, and tighten the nuts securely.
7. Reconnect the connector to the 12-pin terminal block (TB1) on the new FTC circuit board.
8. Close the cover on the remote FTC Box and reconnect the main power to the system.
9. Refer to Chapter 4, *Calibration*, and recalibrate the oxygen sensor and the combustibles detector.

This completes the replacement of the FTC board.

F.5 Replacing the Transformer

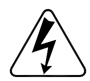
The sensor furnace power transformer is located near the FTC board in the remote FTC Box. Its purpose is to convert the line voltage to the 80 VAC required for proper operation of the sensor furnace.

CAUTION! **To replace the transformer, the power to the FGA 300V(X) must be disconnected. Therefore, replace the transformer and reconnect the power as quickly as possible to prevent corrosion of the analyzer components due to acid condensation.**

The following items are needed to replace the transformer:

- A nutdriver (or similar tool)
- a digital multimeter

IMPORTANT: *This symbol indicates Caution - risk of electric shock.*



Refer to Figure 62 on page 144 and complete the following steps to replace the transformer:

1. Disconnect the main power to the FGA 300V(X).
2. Open the hinged cover on the standard (weatherproof) FTC box. For an explosion-proof (flameproof) FTC box, loosen the locking set screw on top of the FTC box and, using a long screwdriver across the slots provided, unscrew the cover from the enclosure.
3. Remove the four hex nuts and washers from the old transformer.
4. Move the old transformer aside (do not disconnect any wires yet) and place the new transformer into the remote FTC Box.
5. Disconnect the leads from the old transformer, one at a time, and connect the corresponding lead from the new transformer in its place, until all of the new leads have been connected.
6. Verify that the new transformer leads are properly connected by referring to Figure 64 on page 150.
7. Remove and discard the old transformer.
8. Secure the new transformer in place with the four hex nuts and washers that were previously removed.
9. Reconnect the main power to the system.
10. Using a digital multimeter, measure the sensor furnace voltage across pins 5 and 6 of terminal block TB1 in the remote FTC Box. If the measured voltage is approximately 80 VAC, the new transformer is working properly. Close the cover on the remote FTC Box.

This completes the replacement of the transformer.

F.6 Adjusting the Sensor Furnace Temperature

In Chapter 4, *Calibration*, instructions are given for adjusting the operating temperature of the sensor furnace via a potentiometer on the FTC circuit board. For units fitted with the previous version of the FTC circuit board (1703-92), this potentiometer is designated as R28 and is located as shown in Figure 62 on page 144. The calibration instructions are otherwise identical.

F.7 Previous Wiring Diagrams and Circuit Boards

The following drawings are included for reference to previous versions of the FGA 300V(X). They include:

- FTC Circuit Board layout
- Wiring Diagram with transformer
- Display Circuit Board layout

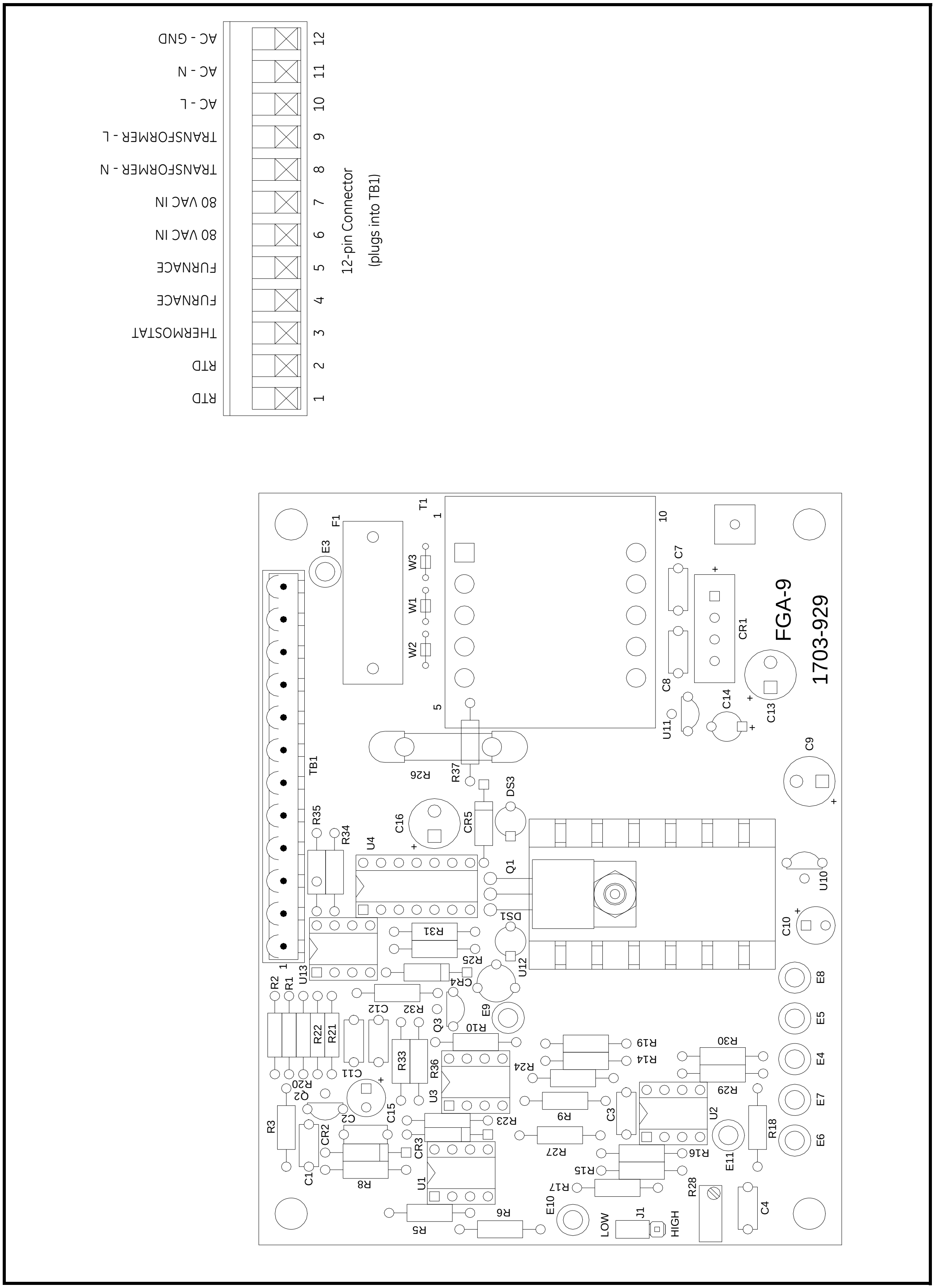


Figure 63: FTC Circuit Board - Previous (Drawing #1703-929)

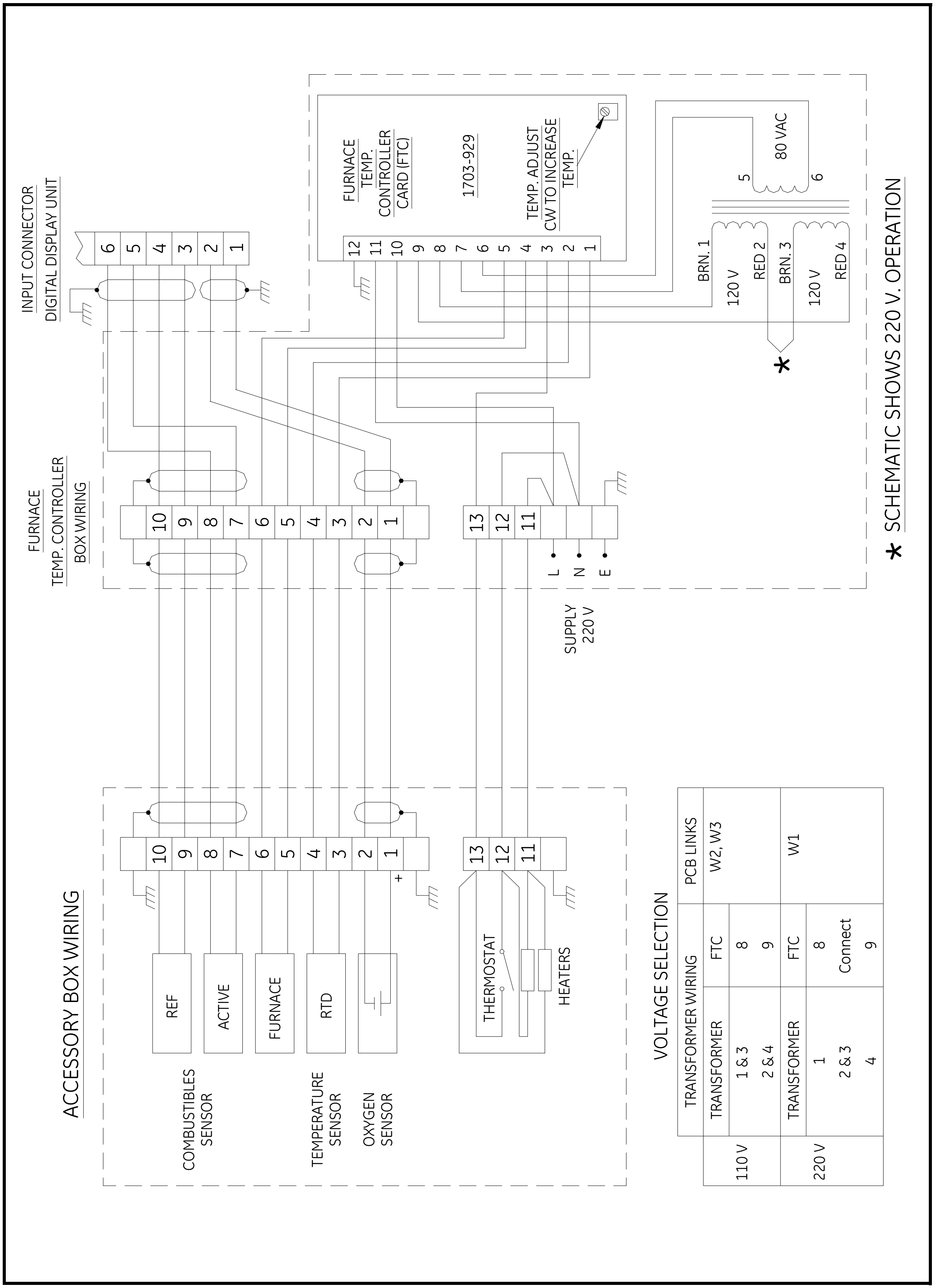
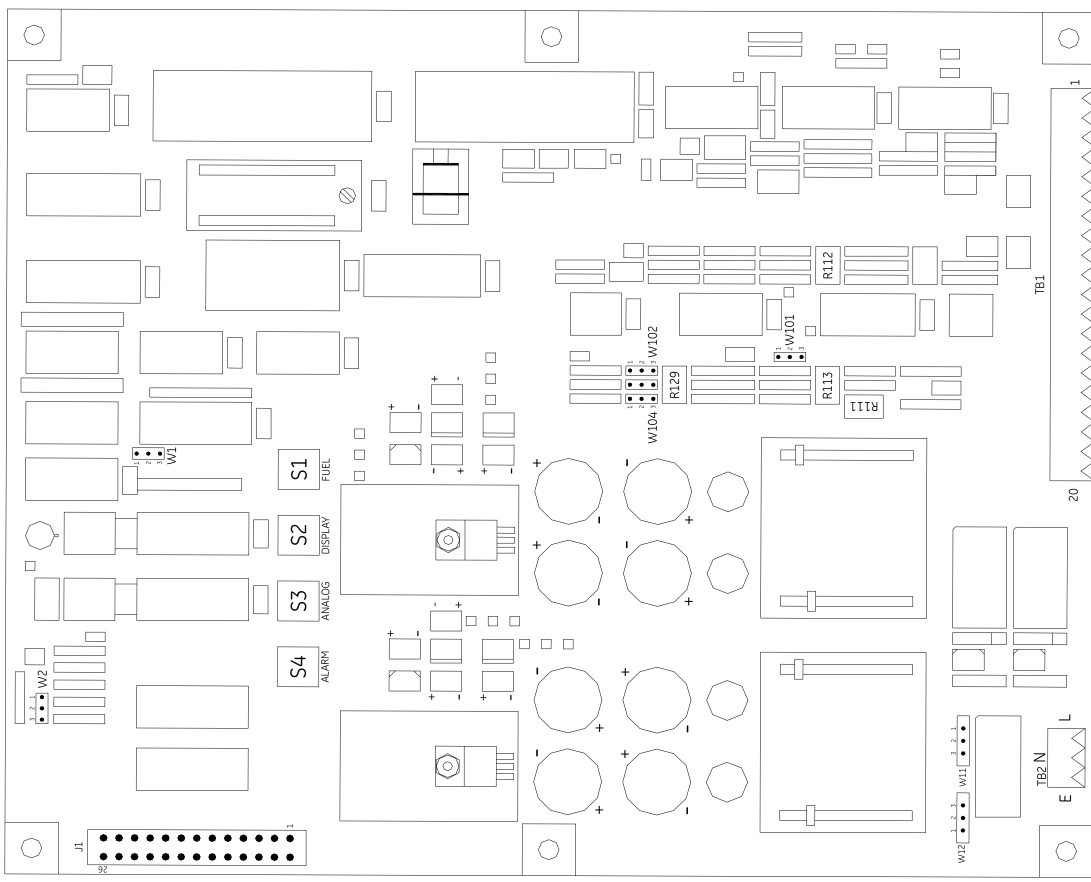


Figure 64: Wiring Diagram - Previous (Drawing #1442-517, Rev. E)

TB1

Pin #	Label	Description
1	O+	Oxygen Sensor +
2	O1	Oxygen Sensor -
3	R2	Combustibles Reference
4	R1	Combustibles Reference
5	A2	Combustibles Active
6	A1	Combustibles Active
7	V+	Oxygen Voltage Output +
8	V-	Oxygen Voltage Output -
9	I+	Oxygen Current Output +
10	I-	Oxygen Current Output -
11	V+	Combustibles Voltage Output +
12	V-	Combustibles Voltage Output -
13	I+	Combustibles Current Output +
14	I-	Combustibles Current Output -
15	NC1	Oxygen Alarm Normally Closed
16	A1	Oxygen Alarm Common
17	NO1	Oxygen Alarm Normally Open
18	NO2	Combustibles Alarm Normally Open
19	A2	Combustibles Alarm Common
20	NC2	Combustibles Alarm Normally Closed



TB2

Pin #	Label	Description
1	L	Line
2	N	Neutral
3	E	Ground

Figure 65: Display Circuit Board - Previous (Drawing #1703-001)

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T

V

W

[no content intended for this page]

Warranty

Each instrument manufactured by GE Sensing is warranted to be free from defects in material and workmanship. Liability under this warranty is limited to restoring the instrument to normal operation or replacing the instrument, at the sole discretion of GE Sensing. Fuses and batteries are specifically excluded from any liability. This warranty is effective from the date of delivery to the original purchaser. If GE Sensing determines that the equipment was defective, the warranty period is:

- one year from delivery for electronic or mechanical failures
- one year from delivery for sensor shelf life

If GE Sensing determines that the equipment was damaged by misuse, improper installation, the use of unauthorized replacement parts, or operating conditions outside the guidelines specified by GE Sensing, the repairs are not covered under this warranty.

The warranties set forth herein are exclusive and are in lieu of all other warranties whether statutory, express or implied (including warranties or merchantability and fitness for a particular purpose, and warranties arising from course of dealing or usage or trade).

Return Policy

If a GE Sensing instrument malfunctions within the warranty period, the following procedure must be completed:

1. Notify GE Sensing, giving full details of the problem, and provide the model number and serial number of the instrument. If the nature of the problem indicates the need for factory service, GE Sensing will issue a RETURN AUTHORIZATION NUMBER (RAN), and shipping instructions for the return of the instrument to a service center will be provided.
2. If GE Sensing instructs you to send your instrument to a service center, it must be shipped prepaid to the authorized repair station indicated in the shipping instructions.
3. Upon receipt, GE Sensing will evaluate the instrument to determine the cause of the malfunction.

Then, one of the following courses of action will then be taken:

- If the damage is covered under the terms of the warranty, the instrument will be repaired at no cost to the owner and returned.
- If GE Sensing determines that the damage is not covered under the terms of the warranty, or if the warranty has expired, an estimate for the cost of the repairs at standard rates will be provided. Upon receipt of the owner’s approval to proceed, the instrument will be repaired and returned.

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GE
Sensing

DECLARATION OF CONFORMITY

DOC-0035, Rev. A

We,

GE Sensing
1100 Technology Park Drive
Billerica, MA 01821
USA

declare under our sole responsibility that the

FGA300H and FGA300HX Horizontal Flue Gas Analyzers
FGA300V and FGA300VX Vertical Flue Gas Analyzers
FGA300D Display Unit
FGA311 In Situ Flue Gas Oxygen Analyzer

to which this declaration relates, are in conformity with the following standards:

- EN 61326-1: 2006, Class A, Table 2, Industrial Locations
- EN 61326-2-3: 2006
- EN 61010-1: 2001, Overvoltage Category II, Pollution Degree 2

following the provisions of the 2004/108/EC EMC and 2006/95/EC Low Voltage Directives.

The units listed above and any ancillary equipment supplied with them do not bear CE marking for the Pressure Equipment Directive, as they are supplied in accordance with Article 3, Section 3 (sound engineering practices and codes of good workmanship) of the Pressure Equipment Directive 97/23/EC for DN<25.

Billerica - August 2010
Issued

Gary Kozinski

Mr. Gary Kozinski
Certification & Standards, Lead Engineer

Customer Support Centers

U.S.A.
The Boston Center
1100 Technology Park Drive
Billerica, MA 01821
U.S.A.
Tel: 800 833 9438 (toll-free)
978 437 1000
E-mail: sensing@ge.com

Ireland
Sensing House
Shannon Free Zone East
Shannon, County Clare
Ireland
Tel: +353 (0)61 470291
E-mail: gesensingsnnservices@ge.com

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