OPERATING INSTRUCTIONS FOR

MODEL 3000ZA2G

Trace Oxygen Analyzer

P/N M86303
06/18/2013

DANGER

Toxic gases and or flammable liquids may be present in this monitoring system.

Personal protective equipment may be required when servicing this instrument.

Hazardous voltages exist on certain components internally which may persist for a time even after the power is turned off and disconnected.

Only a trained service technician should open the front door of this instrument.

Only a trained service technician should conduct maintenance and/or servicing. Before conducting any maintenance or servicing, consult with authorized supervisor/manager.

Declaration of Conformity

Application of Council Directives:
2004/108/EC and 2006/95/EC

Standards To Which Conformity Is Declared:	**EN61010-1: 2010 (LVD)** **EN61326: 2006 (EMC)** **EN55011 Class A Group 1** **EN61000-4-2** **EN61000-4-3** **EN61000-4-4** **EN61000-4-5** **EN61000-4-6** **EN61000-4-8** **EN61000-4-11**
Manufacturer's Name:	**Teledyne Analytical Instruments**
Manufacturer's Address:	**16830 Chestnut Street** **City of Industry, CA 91748** **626-934-1500**
Equipment Description:	**19" Rack-Mount Unit**
Equipment Class:	**Process Control Equipment:** **Industrial Environment** **Insulation Class I**
Model Number:	**3000ZA2G**

I the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).

Company: Teledyne Analytical Instruments

Signature: [signature] 9-7-12

Full Name: Angel Alegria

Position: Electrical Engineer

Warranty

This equipment is sold subject to the mutual agreement that it is warranted by us free from defects of material and of construction, and that our liability shall be limited to replacing or repairing at our factory (without charge, except for transportation), or at customer plant at our option, any material or construction in which defects become apparent within one year from the date of shipment, except in cases where quotations or acknowledgements provide for a shorter period. Components manufactured by others bear the warranty of their manufacturer. This warranty does not cover defects caused by wear, accident, misuse, neglect or repairs other than those performed by Teledyne Analytical Instruments or an authorized service center. We assume no liability for direct or indirect damages of any kind and the purchaser by the acceptance of the equipment will assume all liability for any damage which may result from its use or misuse.

We reserve the right to employ any suitable material in the manufacture of our apparatus, and to make any alterations in the dimensions, shape or weight of any parts, in so far as such alterations do not adversely affect our warranty.

Important Notice

This instrument provides measurement readings to its user, and serves as a tool by which valuable data can be gathered. The information provided by the instrument may assist the user in eliminating potential hazards caused by his process; however, it is essential that all personnel involved in the use of the instrument or its interface, with the process being measured, be properly trained in the process itself, as well as all instrumentation related to it.

The safety of personnel is ultimately the responsibility of those who control process conditions. While this instrument may be able to provide early warning of imminent danger, it has no control over process conditions, and it can be misused. In particular, any alarm or control systems installed must be tested and understood, both as to how they operate and as to how they can be defeated. Any safeguards required such as locks, labels, or redundancy, must be provided by the user or specifically requested of Teledyne Analytical Instruments at the time the order is placed.

Therefore, the purchaser must be aware of the hazardous process conditions. The purchaser is responsible for the training of personnel, for providing hazard warning methods and instrumentation per the appropriate standards, and for ensuring that hazard warning devices and instrumentation are maintained and operated properly.

Teledyne Analytical Instruments, the manufacturer of this instrument, cannot accept responsibility for conditions beyond its knowledge and control. No statement expressed or implied by this document or any information disseminated by the manufacturer or its agents, is to be construed as a warranty of adequate safety control under the user's process conditions.

Specific Model Information

The instrument for which this manual was supplied may incorporate one or more options not supplied in the standard instrument. Commonly available options are listed below, with check boxes. Any that are incorporated in the instrument for which this manual is supplied are indicated by a check mark in the box.

Instrument Serial Number: ________________________

Options Included in the Instrument with the Above Serial Number:

- ❑ **Auto Calibration:** The Auto Cal option includes a manifold with separate ports for sample in, zero and span gases with solenoid control valves. The internal valves are entirely under the control of the 3000ZA2G electronics and can be used to automatically switch between gases in synchronization with the analyzer's operation.
- ❑ **4-20 mA Range ID:** This option provides an additional analog output for range identification in the form of a 4-20 mA current.

Important Notice

Model 3000ZA2G complies with all of the requirements of the Commonwealth of Europe (CE) for Radio Frequency Interference, Electromagnetic Interference (RFI/EMI), and Low Voltage Directive (LVD).

The following International Symbols are used throughout the Instruction Manual. These symbols are visual indicators of important and immediate warnings and when you must exercise CAUTION while operating the instrument. See also the Safety Information on the next page.

STAND-BY: Instrument is on Stand-by, but circuit is active

GROUND: Protective Earth

CAUTION: The operator needs to refer to the manual for further information. Failure to do so may compromise the safe operation of the equipment.

CAUTION: Risk of Electrical Shock

Safety Messages

Your safety and the safety of others are very important. We have provided many important safety messages in this manual. Please read these messages carefully.

A safety message alerts you to potential hazards that could hurt you or others. Each safety message is associated with a safety alert symbol. These symbols are found in the manual and inside the instrument. The definition of these symbols is described below:

GENERAL WARNING/CAUTION: Refer to the instructions for details on the specific danger. These cautions warn of specific procedures which if not followed could cause bodily Injury and/or damage the instrument.

CAUTION: HOT SURFACE WARNING: This warning is specific to heated components within the instrument. Failure to heed the warning could result in serious burns to skin and underlying tissue.

WARNING: ELECTRICAL SHOCK HAZARD: Dangerous voltages appear within this instrument. This warning is specific to an electrical hazard existing at or nearby the component or procedure under discussion. Failure to heed this warning could result in injury and/or death from electrocution.

Technician Symbol: All operations marked with this symbol are to be performed by qualified maintenance personnel only.

No Symbol

NOTE: Additional information and comments regarding a specific component or procedure are highlighted in the form of a note.

CAUTION: THE ANALYZER SHOULD ONLY BE USED FOR THE PURPOSE AND IN THE MANNER DESCRIBED IN THIS MANUAL.

IF YOU USE THE ANALYZER IN A MANNER OTHER THAN THAT FOR WHICH IT WAS INTENDED, UNPREDICTABLE BEHAVIOR COULD RESULT POSSIBLY ACCOMPANIED WITH HAZARDOUS CONSEQUENCES.

This manual provides information designed to guide you through the installation, calibration and operation of your new analyzer. Please read this manual and keep it available.

Occasionally, some instruments are customized for a particular application or features and/or options added per customer requests. Please check the front of this manual for any additional information in the form of an Addendum which discusses specific information, procedures, cautions and warnings that may be peculiar to your instrument.

Manuals do get lost. Additional manuals can be obtained from Teledyne Analytical Instruments at the address given in the Appendix. Some of our manuals are available in electronic form via the internet. Please visit our website at: www.teledyne-ai.com.

DANGER

COMBUSTIBLE GAS USAGE WARNING

This is a general purpose instrument designed for use in a non-hazardous area. It is the customer's responsibility to ensure safety especially when combustible gases are being analyzed since the potential of gas leaks always exist.

The customer should ensure that the principles of operation of this equipment are well understood by the user. Misuse of this product in any manner, tampering with its components, or unauthorized substitution of any component may adversely affect the safety of this instrument.

Since the use of this instrument is beyond the control of Teledyne Analytical Instruments, no responsibility by Teledyne Analytical Instruments, its affiliates, and agents for damage or injury from misuse or neglect of this equipment is implied or assumed.

Table of Contents

List of Figures

List of Tables

Introduction

1.1 Overview

The Teledyne Analytical Instruments Model 3000ZA2G Trace Oxygen Analyzer is a versatile microprocessor-based instrument for detecting oxygen from parts-per-million (ppm) level to 25% oxygen in background gases consistent with the zirconium oxide sensor. This manual covers the Model 3000ZA2G 19” rack-mount units with CE mark. These units are for indoor use in a non-hazardous environment.

1.2 Typical Applications

A few typical applications of the Model 3000ZA2G are:

- Monitoring inert gas blanketing
- Air separation and liquefaction
- Chemical reaction monitoring
- Semiconductor manufacturing
- Petrochemical process control
- Quality assurance
- Gas analysis certification.

1.3 Main Features of the Analyzer

The Model 3000ZA2G Trace Oxygen Analyzer is sophisticated yet simple to use. The main features of the analyzer include:

- A 2-line alphanumeric display screen, driven by microprocessor electronics that continuously prompts and informs the operator.
- High resolution, accurate readings of oxygen content for low ppm levels. Large, bright, meter readout.

- Zirconium oxide sensor to provide complete range of analysis from 0-10 ppm to 0-25%.
- Can be used without a flowing reference with only a marginal performance impact.
- Versatile analysis over a wide range of applications.
- Microprocessor based electronics: 8-bit CMOS microprocessor with 32 kB RAM and 128 kB ROM.
- Three user definable output ranges (from 0-10 ppm through 0-25%) allow best match to the end user's process and equipment.
- Auto ranging allows analyzer to automatically select the proper preset range for a given measurement. Manual override allows the user to lock onto a specific range of interest.
- Two adjustable concentration alarms and a system failure alarm.
- Extensive self-diagnostic testing at startup and on demand with continuous power-supply monitoring.
- CE compliance
- RS-232 serial digital port for use with a computer or other digital communication device.
- A 0-1 VDC analog output for concentration plus a 0-1 VDC output for range identification.
- Convenient and versatile with standard 19" rack-mount analyzer with slide-out electronics drawer.

1.4 Front Panel

The standard 3000ZA2G is housed in a rugged metal case designed for installation into a standard 19" equipment rack. All controls and displays are accessible from the front panel. See Figure 1-1. The front panel has thirteen buttons for operating the analyzer, a digital meter, an alphanumeric display, a flowmeter, and sample flow control valve.

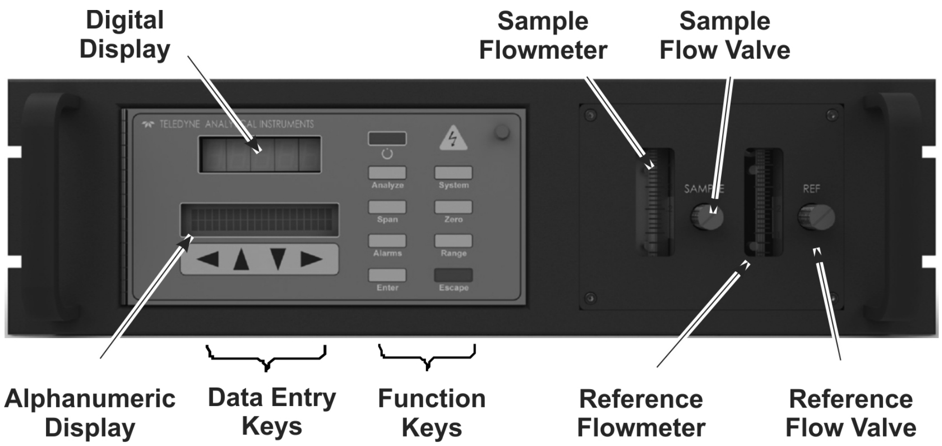


Figure 1-1: Model 3000ZA2G Front Panel

Function Keys:
Six touch-sensitive membrane switches are used to change the specific function performed by the analyzer:

- **Analyze** Perform analysis for oxygen content of a sample gas.
- **System** Perform system-related tasks (described in detail in chapter 4, *Operation.*).
- **Span** Span calibrate the analyzer.
- **Zero** Zero calibrate the analyzer.
- **Alarms** Set the alarm setpoints and attributes.
- **Range** Set up the 3 user definable ranges for the instrument.

Data Entry Keys:
Six touch-sensitive membrane switches are used to input data to the instrument via the alphanumeric VFD display:

- **Left & Right Arrows:** Select between functions currently displayed on the VFD screen.
- **Up & Down Arrows:** Increment or decrement values of functions currently displayed.

- **Enter:** Advances VFD display to the next screen in a series or returns to the *Analyze* screen if none remain.
- **Escape:** Backs VFD display to the previous screen in a series or returns to the *Analyze* screen if none remain.

Digital Meter Display:
The meter display is a Light Emitting Diode (LED) device that produces large, bright, 7-segment numbers that are legible in any lighting. It produces a continuous readout from which is accurate across all analysis ranges without the discontinuity inherent in analog range switching.

Alphanumeric Interface Screen:
The alphanumeric screen is a vacuum fluorescent display (VFD) screen with an easy-to-use interface. It displays values, options, and messages that give the operator immediate feedback.

Flowmeter:
Monitors the flow of gas past the sensor. Readout is 0.1 to 0.5 standard liters per minute (SLPM).

Reference Flowmeter:
Monitors the flow of reference gas past the sensor. Readout is 0.1 to 0.5 standard liters per minute (SLPM).

Note: It is possible to use the analyzer without a flowing reference but doing so will incur a marginal degradation in performance. See Section 3.3.1. TAI recommends using a flowing reference for best results.

Flow Control Valve:
The sample control valve allows precise adjustment over sample or calibration gas flow to the analyzer.

Reference Flow Control Valve:
Control valve for the reference flow through the analyzer.

Standby Button ⏻:
The Standby turns off the display and outputs but circuitry is still operating.

CAUTION: **THE POWER ENTRY SWITCH ON THE REAR OF THE INSTRUMENT MUST BE TURNED OFF TO FULLY DISCONNECT POWER FROM THE INSTRUMENT. WHEN CHASSIS IS EXPOSED OR WHEN ACCESS**

DOOR IS OPEN AND POWER CABLE IS CONNECTED, USE EXTRA CARE TO AVOID CONTACT WITH LIVE ELECTRICAL CIRCUITS AND HOT SURFACES. ONLY A TRAINED SERVICE TECHNICIAN SHOULD OPEN THE FRONT DOOR.

Access Door:
For inspection of the instrument by a trained service technician , the front panel swings open when the latch in the upper right corner of the analyzer panel is pressed all the way in with a narrow gauge tool. Accessing the main circuit board requires unfastening rear panel screws and sliding the unit out of the case.

1.5 Rear Panel (Equipment Interface)

The rear panel, shown in Figure 1-2, contains the gas and electrical connectors for external inlets and outlets. Some of those depicted are optional and may not appear on your instrument. The connectors are described briefly here and in detail in Chapter 3 *Installation*.

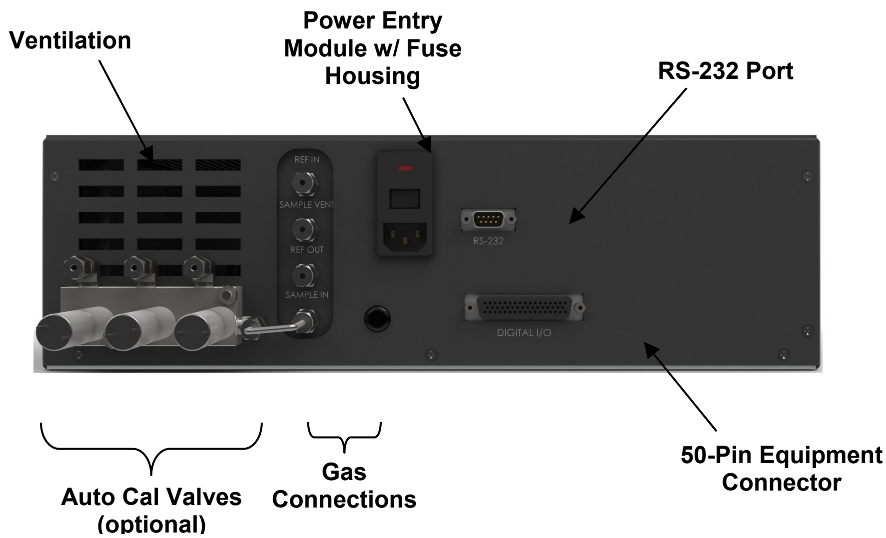


Figure 1-2: Model 3000ZA2G Rear Panel

- **Power Connection** Factory configured for either 115 VAC or 230 VAC operation , 50/60 Hz.

- **Sample Inlet and Outlet:** One inlet (must be externally valved) and one exhaust. Three inlets when auto calibration option is present.
- **Reference Inlet and Outlet:** Flowing air reference inlet and exhaust.
- **9-Pin RS-232 Port:** Serial digital concentration signal output and control input.
- **50-Pin Equipment Interface Port:**

  Analog Outputs: 0–1 VDC oxygen concentration plus 0-1 VDC range ID

  Alarm Connections: 2 concentration alarms and 1 system alarm.

  Remote Valve: Used in the 3000ZA2G for controlling external solenoid valves only.

  Remote Span/Zero: Digital inputs allow external control of analyzer calibration.

  Calibration Contact: To notify external equipment that instrument is being calibrated and readings are not monitoring sample.

  Range ID Contacts: Four separate, dedicated, range relay contacts. Low, Medium, High, Cal.

  Network I/O: Serial digital communications for local network access. For future expansion. Not currently implemented.

Optional

- **Calibration Gas Ports:** Separate fittings for zero, span, and sample gas input, internal valves for automatic gas switching.
- **Current Signal Output:** Isolated 4–20 mA DC plus optional 4–20 mA DC range ID.

Note: *If you require highly accurate Auto-Cal timing, use external Auto-Cal control where possible. The internal clock in the Model 3000ZA2G is accurate to 2-3 %. Accordingly, internally scheduled calibrations can vary 30-45 minutes per day.*

Operational Theory

2.1 Introduction

The analyzer is composed of three subsystems:

1. The zirconium oxide (ZrO_2) sensor with a 0-25% analysis range
2. Sample System
3. Electronic Signal Processing, Display and Control

The sample system is designed to accept the sample gas and transport it through the analyzer without contaminating or altering the sample prior to analysis. The ZrO_2 sensor is a device that translates the amount of oxygen present in the sample into a voltage output. The electronic signal processing, display and control subsystem simplifies operation of the analyzer and accurately processes the sampled data. The microprocessor controls all signal processing, input/output and display functions for the analyzer.

2.2 ZrO_2 Sensor

The zirconium oxide (ZrO_2) sensor is a solid state sensor. It is a voltage device with a logarithmic response. The sensor uses a stabilized zirconia disc as an electrolyte with a sensing electrode (the cathode) and a counter electrode (the anode) on each side of the disc and contains a thermocouple. The sensor is designed to have a small sample of the unknown gas passed inside the sensor tube. Air (20.95% oxygen) surrounds the outside of the tube. A heater is mounted around the sensor to keep the sensor hot. The sensor construction is shown in Figure 2.1.

CAUTION: **THE SENSOR IS HOT. DO NOT TOUCH THE SENSOR OR ALLOW FLAMMABLE MATERIAL TO COME IN CONTACT WITH THE ASSEMBLY.**

THE SENSOR ASSEMBLY REMAINS HOT EVEN IN STANDBY MODE. REMOVE POWER FROM THE INSTRUMENT AND ALLOW SENSOR TO COOL FOR

TWO HOURS BEFORE PERFORMING ANY MAINTENANCE ON THE SENSOR.

The heater control is a time proportioning temperature controller that maintains the thermocouple junction at the sensor operating temperature of 575°C (1070°F).

When exposed to different oxygen partial pressures at the outside and inside of the sensor, an EMF (E) is developed which obeys the Nernst equation:

$$E(\mathrm{mV}) = \frac{RT}{4F}\log_e\left(\frac{(\mathrm{P_{O2}})\,\mathrm{Inside}}{(\mathrm{P_{O2}})\,\mathrm{Ouside}}\right)$$

Where T is the temperature (K) at the zirconia disc, R is the gas constant, F is the Faraday constant and (P_{O2}) Inside and (P_{O2}) Outside are the oxygen partial pressures at the inner and outer electrodes, respectively, with the higher oxygen partial pressure electrode being positive.

When dry air at atmospheric pressure, (21% oxygen) is used as a reference gas at the inner electrode, the following equations are obtained:

$$E(\mathrm{mV}) = 2.154x10^{-2}\,T\log_e\left(\frac{0.21}{(\mathrm{P_{O2}})\,\mathrm{Ouside}}\right)$$

Transposing this equation:

$$(\%\mathrm{O_2})\,\mathrm{Outside}\,(\mathrm{Atm}) = 0.21\exp\frac{-46.421E}{T}$$

The analyzer solves this equation, which is valid above the minimum operating temperature.

The oxygen sensor assembly provides a means of exposing the zirconia sensor to the atmosphere to be measured on the inside of the sensor while maintaining air as a reference gas at atmospheric pressure on the outside of the sensor.

The sensor offset voltage changes with sample flowrate as shown in Figure 2-1. Assuming that the environment remains constant and within the specifications of the sensor, the difference in offset voltage between a flowing reference gas at 200 ml/min and at 0 ml/min is nearly constant over the operating range of sample flowrates (100-300 ml/min). This offset is removed during calibration assuming that the sample flowrate used in calibration is the same as the process flow. Hence the analyzer can be used without a flowing reference gas during operation with only a marginal degradation in performance. For best performance, a flowing reference should be used.

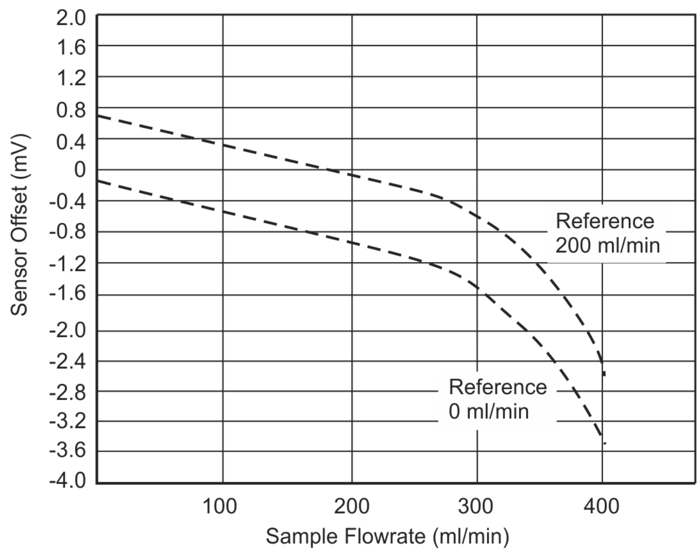


Figure 2-1: Sensor Offset Voltage

The sensor assembly also provides the means of maintaining the sensor operating temperature by surrounding the sensor tube with a heater element, and measuring the temperature of the zirconia disc with a thermocouple inside the sensor. (See Figure 2.2).

The logarithmic output of the sensor depends therefore on the partial pressure of the oxygen in the sample gas.

The non-linear output is linearized by the system software and a linear output signal is generated and used by the DAC circuit to produce the requisite output signals.

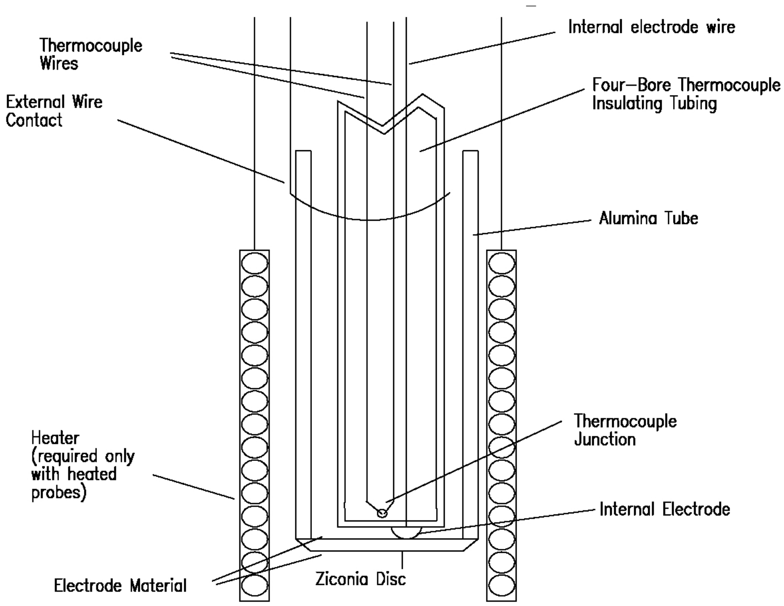


Figure 2-2: Zirconia Sensor Assembly

Stability and repeatability of the sensor are dependent on temperature control, flow and reference oxygen stability as well as other operational variables. Flow rates should be kept constant to minimize flow errors. The recommended flow rates are as follows:

Sample flow rate:	100-300 ml/min
Reference flow rate:	100-200 ml/min
Maximum flow rate:	500 ml/min

In addition, the flow rate differential between the sample and reference flows must be less than 200 ml/min. The maximum pressure applied to the sensor cell is 5 psig.

2.3 Sample System

The sample system delivers gases to the ZrO_2 sensor from the analyzer rear panel inlet. Depending on the mode of operation either sample or calibration gas is delivered.

The Model 3000ZA2G sample system is designed and fabricated to ensure that the oxygen concentration of the gas is not altered as it travels through the sample system.

The sample system for the standard instrument incorporates 1/8" tube fittings for sample inlet and outlet at the rear panel. The sample or calibration gas that flows through the system is monitored by a flowmeter downstream from the cell.

Figure 2-3 shows the flow diagram with an optional gas manifold. In the standard instrument, calibration gases can be connected directly to the Sample In port by teeing to the port with appropriate valves.

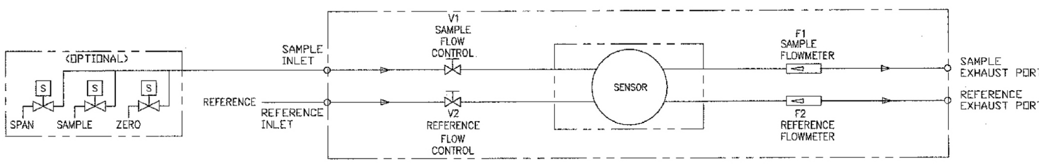


Figure 2-3: Flow Diagram

2.4 Zirconium Oxide Sensor Application Notes

The following sample gases require conditioning prior to entering the sensors:

- Flammable gases such as methane, alcohol and carbon monoxide may cause a measurement error. They must be filtered from the sample gas before entering the cell.
- Gases containing halogen atoms (F, Cl, Br, etc.) such as Freon, must be filtered before entering the cell. The sensor will be damaged by the decomposition of Freon.
- Gases containing SOx, H_2S, silicone vapor and adhesives must not enter the sensor. These components adversely affect the performance of the sensor.
- Dust, particulates(>3 microns), and oil should be filtered from the sample gas.
- Water vapor in contact with the sensor will damage the sensor. Use a moisture trap or filter to remove any water vapor in the sample.

2.5 Electronics and Signal Processing

The Model 3000ZA2G Trace Oxygen Analyzer uses an 8031 microcontroller with 32 kB of RAM and 128 kB of ROM to control all signal processing, input/output, and display functions for the analyzer. System power (110/230 VAC) is user selectable from an internal switch. It is set at the factory for your specific requirement. Figure 2-4 shows the location of the power supply and the main electronic PC boards.

The signal processing electronics including the microprocessor, analog to digital (ADC), and digital to analog (DAC) converters are located on the motherboard at the bottom of the case. The preamplifier board is mounted on top of the motherboard as shown in the figure. These boards are accessible after removing the enclosure cover. Figure 2-5 is a block diagram of the analyzer electronics.

In the presence of oxygen the zirconia sensor generates a logarithmic response in the mV range and is passed to an amplifier. The output from the amplifier is sent to an 18 bit analog to digital converter controlled by the microprocessor.

The high operating temperature of the ZrO_2 sensor is required for proper operation of the sensor. The amplifier PCB contains a circuit that drives the heater embedded in the sensor. The voltage across the heater rises slowly to avoid damaging the heater/sensor assembly. After a few minutes, the sensor will be at the proper operating temperature.

The digital concentration signal along with input from the control panel is processed by the microprocessor, and appropriate control signals are directed to the display, alarms and communications port. The digital information representing the output from the sensor is linearized by the Model 3000ZA2G software and passed to a 12 bit digital to analog converter that produces the 4-20 mA DC and the 0-1 VDC analog concentration signal outputs, and the analog range ID outputs.

Signals from the power supply are also monitored, and through the microprocessor, the system failure alarm is activated if a malfunction is detected.

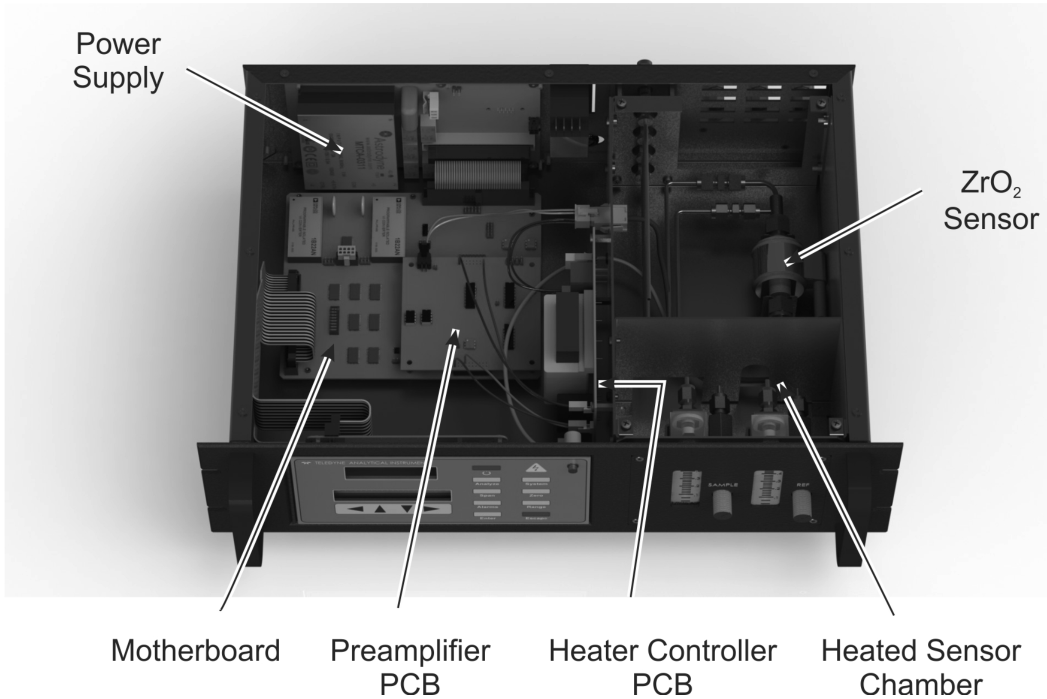


Figure 2-4: Component Locations

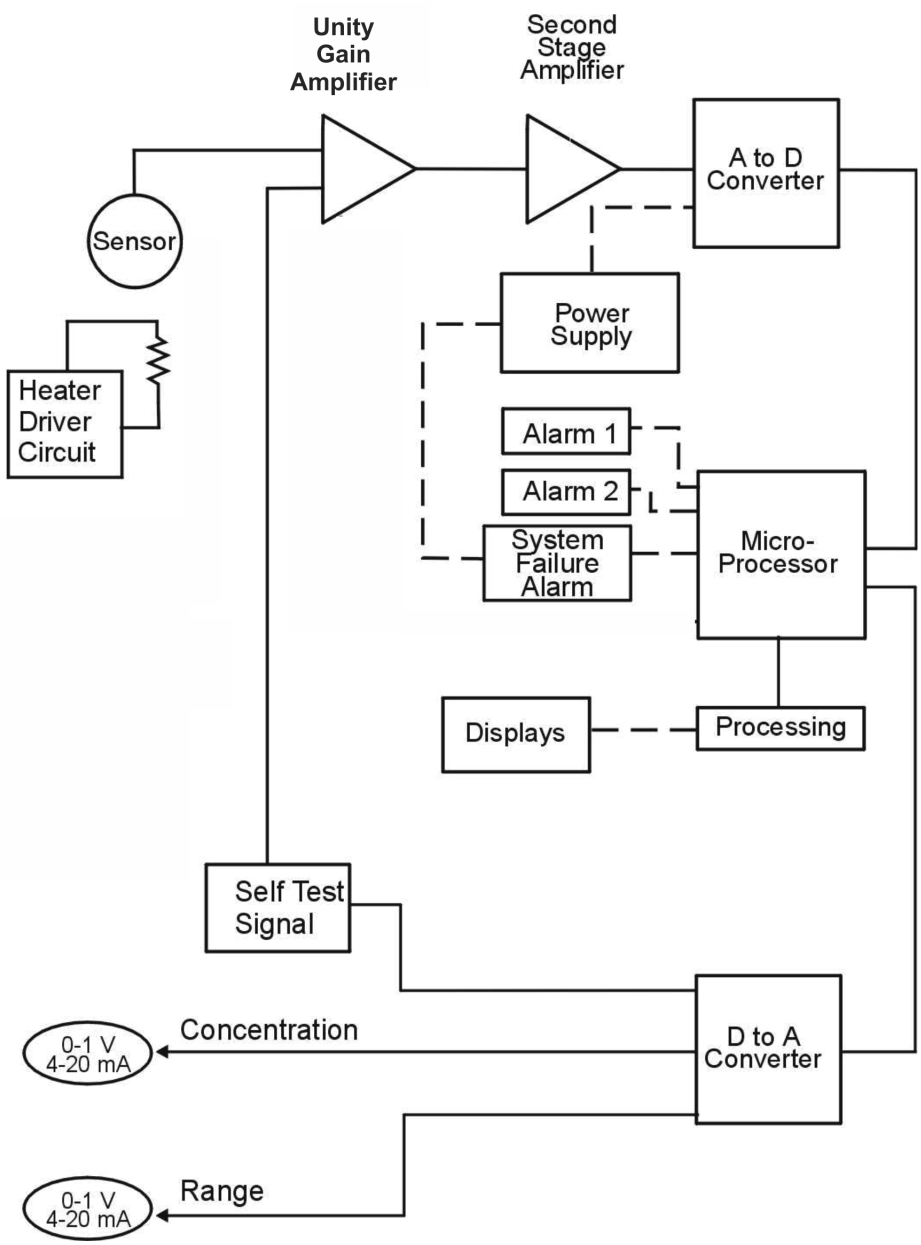


Figure 2-5: Electronic Block Diagram

Installation

Installation of the Model 3000ZA2G Analyzer includes:

1. Unpacking
2. Mounting
3. Gas connections
4. Electrical connections
5. Installing the sensor
6. Testing the system.

3.1 Unpacking the Analyzer

The analyzer is shipped with all the materials you need to install and prepare the system for operation. Carefully unpack the analyzer and inspect it for damage. Immediately report any damage to the shipping agent.

3.2 Mounting the Analyzer

The Model 3000ZA2G is for indoor use in a general purpose area. It is NOT for hazardous environments of any type.

The standard model is designed for 19" rack mounting. Figure 3-1 is an illustration of the 3000ZA2G.

Figure 3-1: Model 3000ZA2G

All operator controls, except the flow control needle valve, are mounted on the control panel, which is hinged on the left edge and doubles as the door that provides access to the sensor and connections inside the instrument. The door latch is spring loaded and will swing open when the button in the center of the latch (upper right corner) is pressed all the way in with a narrow gauge tool (less than 0.18 inch wide). Allow clearance for the door to open in a 90-degree arc of radius 7.125 inches. See Figure 3-2.

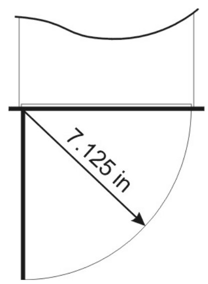


Figure 3-2: Required Front Door Clearance

3.3 Rear Panel Connections

Figure 3-3 shows the Model 3000ZA2G rear panel. There are ports for gas, power, and equipment interface. The Zero In and Span In ports are not included on the standard model but are available as options.

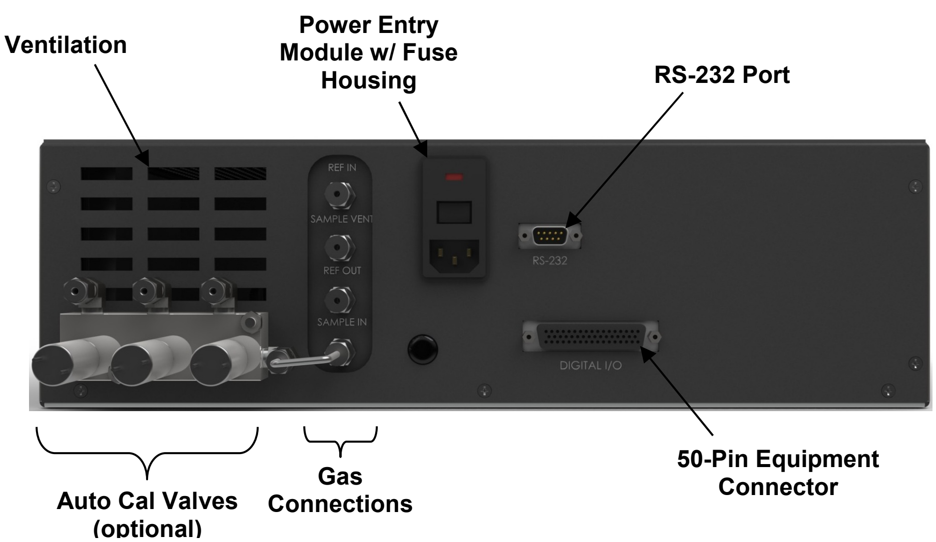


Figure 3-3: Model 3000ZA2G Rear Panel

3.3.1 Gas Connections

All gas and exhaust connections are made to the labeled 1/4" tube fittings (6 mm adapters for metric system installations are available) on the rear panel. The rear panel connections are different between the standard unit and one which includes the auto calibration option. For safe connections:

1. Insert the tube into the fitting and finger-tighten the nut until the tubing cannot be rotated freely by hand in the fitting. This may require an additional 1/8 turn beyond finger tight.
2. Hold the fitting body steady with a backup wrench. Using another wrench, rotate the nut another 1-1/4 turns.

SAMPLE IN:
In the standard model, gas connections are made at the SAMPLE IN and EXHAUST OUT connections. Calibration gases must tee into the sample inlet with appropriate valves (not supplied).

The inlet gas pressure should be reasonably regulated. Pressures between 2 and 50 psig are acceptable as long as the pressure, once established, will keep the front panel flowmeter reading in the acceptable range.

Use the sample flow control valve on the front panel to adjust the flow rate to within the acceptable range of 0.1-0.3 SLPM. See the recommended flow rates for sample flows given on page 10.

If greater sample flow is required for improved response time, install a bypass in the sampling system upstream of the analyzer input.

SAMPLE VENT:
Exhaust connections must be consistent with the hazard level of the constituent gases. Check local, state, and federal laws, and ensure that the exhaust stream vents to an appropriately controlled area, if required.

REF IN/OUT:
Flowing air reference. Air must be clean, dry, and free of hydrocarbons. Use the reference flow control valve on the front panel to adjust the flow rate to within the acceptable range of 0.1-0.2 SLPM. See the recommended flow rates for reference flow given on page 10.

Note: It is possible to use the instrument without a flowing reference, however doing so will result in a marginal reduction in performance and is not recommended for best performance. When operating without a flowing reference, *place screen caps on the REF IN and REF OUT ports (do* ***not*** *use solid caps).*

ZERO IN and SPAN IN (Auto Calibration Option):
With the auto calibration option there are additional ports for span and zero gas connections. The auto calibration module uses electrically operated valves for automatic switching between calibration and sample gases. These valves are completely under control of the 3000ZA2G electronics. They can also be externally controlled indirectly through the remote cal inputs as described below.

Pressure, flow, and safety considerations are the same as prescribed for the SAMPLE IN inlet above.

3.3.2 Calibration Gas

The Model 3000ZA2G will require periodic calibration on known gases for maintaining the specified accuracy. Both zero and span calibrations are required. Air (20.9% O_2) must be used for the zero gas. For span gas requirements, see Section 4.4. These gases must be supplied to the instrument at the same pressure and flow as the sample gas.

3.3.3 Electrical Connections

For safe connections, no uninsulated wiring should be able to come in contact with fingers, tools or clothing during normal operation.

CAUTION: USE SHIELDED CABLES. ALSO, USE PLUGS THAT PROVIDE EXCELLENT EMI/RFI PROTECTION. THE PLUG CASE MUST BE CONNECTED TO THE CABLE SHIELD, AND IT MUST BE TIGHTLY FASTENED TO THE ANALYZER WITH ITS FASTENING SCREWS. ULTIMATELY, IT IS THE INSTALLER WHO ENSURES THAT THE CONNECTIONS PROVIDE ADEQUATE EMI/RFI SIELDING.

3.3.3.1 PRIMARY INPUT POWER

The power cord receptacle and fuse block are located in the same assembly. Insert the power cord into the power cord receptacle.

CAUTION: POWER IS APPLIED TO THE INSTRUMENT'S CIRCUITRY AS LONG AS THE SWITCH ON THE REAR PANEL IS IN THE ON POSITION. THE RED

SWITCH ON THE FRONT PANEL IS FOR SWITCHING POWER ON OR OFF TO THE DISPLAYS AND OUTPUTS ONLY.

Fuse Installation: The fuse block, at the right of the power cord receptacle, accepts US or European size fuses. A jumper replaces the fuse in whichever fuse receptacle is not used. Fuses are not installed at the factory. Be sure to install the proper fuse as part of installation. (See *Fuse Replacement* in Chapter 5, *Maintenance*.)

3.3.3.2 50-Pin Equipment Interface Connector

Figure 3-4 shows the pin layout of the Equipment Interface Connector. The arrangement is shown as seen when the viewer faces the rear panel of the analyzer. The pin numbers for each input/output function are given where each function is described in the paragraphs below.

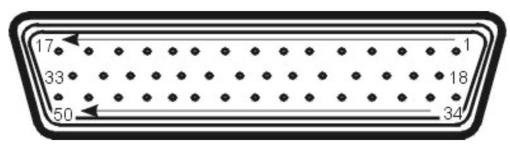


Figure 3-4: Equipment Interface Connector Pin Arrangement

Analog Outputs: There are four DC output signal pins—two pins per output. For polarity, see Table 3-1. The outputs are:

- 0–1 VDC % of Range: Voltage rises linearly with increasing oxygen, from 0 V at 0 ppm to 1 V at full scale ppm. (Full scale = 100% of programmable range.)
- 0–1 VDC Range ID: 0.20 V = Low Range, 0.5 V = Medium Range, 0.80 V = High Range.
- 4–20 mA DC % Range: Current increases linearly with increasing oxygen, from 4 mA at 0 ppm to 20 mA at full scale ppm. (Full scale = 100% of programmable range)

- 4–20 mA DC Range ID: 7.2 mA = Low Range
  12 mA = Medium Range
  16.8 mA = High Range

Table 3-1: Analog Output Connections

Pin	Function
3	+ Range ID, 4-20 mA, floating
4	– Range ID, 4-20 mA, floating
5	+ ppm Range, 4-20 mA, floating
6	– ppm Range, 4-20 mA, floating
8	+ Range ID, 0-1 VDC
23	– Range ID, 0-1 V dc, negative ground
24	+ ppm Range, 0-1 VDC
7	– ppm Range, 0-1 VDC, negative ground

Alarm Relays: The nine alarm-circuit connector pins connect to the internal alarm relay contacts. Each set of three pins provides one set of Form C relay contacts. Each relay has both normally open and normally closed contact connections. The contact connections are shown in Table 3-2. They are capable of switching up to 3 amperes at 250 VAC into a resistive load. The possible alarm configurations are as follows:

Threshold Alarm 1:

- Can be configured as high (actuates when concentration is above threshold), or low (actuates when concentration is below threshold).
- Can be configured as failsafe or non-failsafe.
- Can be configured as latching or non-latching.
- Can be configured out (defeated).

Threshold Alarm 2:

- Can be configured as high (actuates when concentration is above threshold), or low (actuates when concentration is below threshold).

- Can be configured as failsafe or non-failsafe.
- Can be configured as latching or non-latching.
- Can be configured out (defeated).

System Alarm:

- Actuates when DC power supplied to circuits is unacceptable in one or more parameters. Permanently configured as failsafe and latching. Cannot be defeated. Actuates if self test fails.
- (Reset by pressing button to remove power to relay. Then press again and any other button Up and Down simultaneously to resume.
- Further detail can be found in Chapter 4, Section 4.6.

Table 3-2: Alarm Relay Contact Pins

Pin	Contact
45	Threshold Alarm 1, normally closed contact
28	Threshold Alarm 1, moving contact
46	Threshold Alarm 1, normally open contact
42	Threshold Alarm 2, normally closed contact
44	Threshold Alarm 2, moving contact
43	Threshold Alarm 2, normally open contact
36	System Alarm, normally closed contact
20	System Alarm, moving contact
37	System Alarm, normally open contact

Digital Remote Cal Inputs: Accept 0 V (off) or 24 VDC (on) inputs for remote control of calibration. (See *Remote Calibration Protocol* below). See Table 3-3 for pin connections.

Zero: Floating input. 5 to 24 V input across the + and – pins puts the analyzer into the *Zero* mode. Either side may be grounded at the source of the signal. 0 to 1 volt across the terminals allows *Zero* mode to terminate when done. A synchronous signal must open and close the external zero valve appropriately. See

Remote Probe Connector. (The –C option internal valves operate automatically.)

Span: Floating input. 5 to 24 V input across the + and – pins puts the analyzer into the *Span* mode. Either side may be grounded at the source of the signal. 0 to 1 volt across the terminals allows *Span* mode to terminate when done. A synchronous signal must open and close external span valve appropriately. See Figure 3-5 Remote Probe Connector. (The –C option internal valves operate automatically.)

Cal Contact: This relay contact is closed while analyzer is spanning and/or zeroing. (See *Remote Calibration Protocol* below).

Table 3-3: Remote Calibration Connections

Pin	Function
9	+ Remote Zero
11	– Remote Zero
10	+ Remote Span
12	– Remote Span
40	Cal Contact
41	Cal Contact

Remote Calibration Protocol: To properly time the Digital Remote Cal Inputs to the Model 3000ZA2G Analyzer, the customer's controller must monitor the Cal Relay Contact.

When the contact is OPEN, the analyzer is analyzing, the Remote Cal Inputs are being polled, and a zero or span command can be sent.

When the contact is CLOSED, the analyzer is already calibrating. It will ignore your request to calibrate, and it will not remember that request.

Once a zero or span command is sent, and acknowledged (contact closes), release it. If the command is continued until after the zero or span is complete, the calibration will repeat and the Cal Relay Contact (CRC) will close again.

For example:

1. Test the CRC. When the CRC is open, send a zero command until the CRC closes (The CRC will quickly close.)
2. When the CRC closes, remove the zero command.
3. When CRC opens again, send a span command until the CRC closes. (The CRC will quickly close.)
4. When the CRC closes, remove the span command.

When CRC opens again, zero and span are done, and the sample is being analyzed.

Note: The Remote Valve connections (described below) provides signals to ensure that the zero and span gas valves will be controlled synchronously. If you have the –C Internal valve option—which includes additional zero and span gas inputs—the 3000ZA2G automatically regulates the zero, span and sample gas flow.

Range ID Relays: There are four dedicated Range ID relay contacts. The first three ranges are assigned to relays in ascending order—Low range is assigned to Range 1 ID, Medium range is assigned to Range 2 ID, and High range is assigned to Range 3 ID. Table 3-4 lists the pin connections.

Table 3-4: Range ID Relay Connections

Pin	Function
21	Range 1 ID Contact
38	Range 1 ID Contact
22	Range 2 ID Contact
39	Range 2 ID Contact
19	Range 3 ID Contact
18	Range 3 ID Contact
34	Spare Contact
35	Spare Contact

Network I/O: Pins 13 (+) and 29 (–) are for serial digital input/output for local network protocol. At this printing, this port is not yet functional. It is to be used for future options to the instrument.

Remote Valve Connections: The 3000ZA2G is a single-chassis instrument, which has no Remote Valve Unit. Instead, the Remote Valve connections are used as a method for directly controlling external sample/zero/span gas valves. See Figure 3-5.

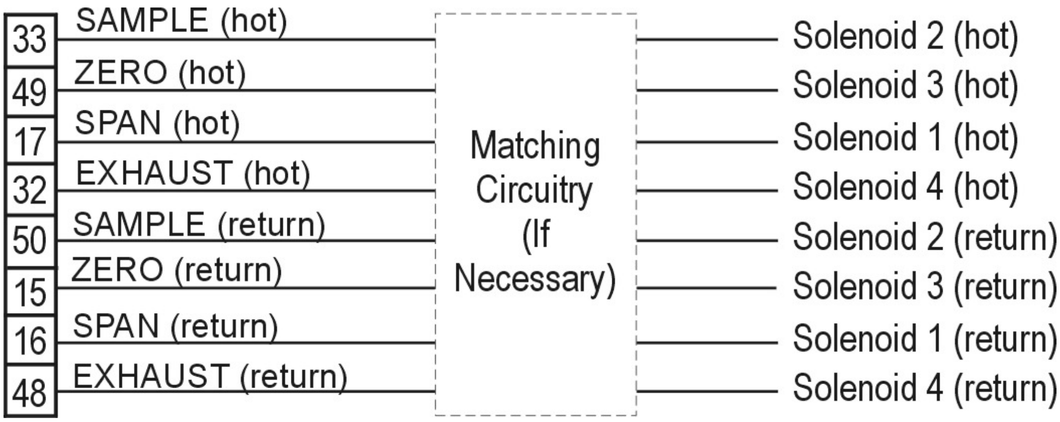


Figure 3-5: Remote Probe Connections

The voltage from these outputs is nominally 0 V for the OFF and 15 VDC for the ON conditions. The maximum combined current that can be pulled from these output lines is 100 mA. (If two lines are ON at the same time, each must be limited to 50 mA, etc.) If more current and/or a different voltage is required, use a relay, power amplifier, or other matching circuitry to provide the actual driving current.

In addition, each individual line has a series FET with a nominal ON resistance of 5 ohms (9 ohms worst case). This can limit the obtainable voltage, depending on the load impedance applied. See Figure 3-6.

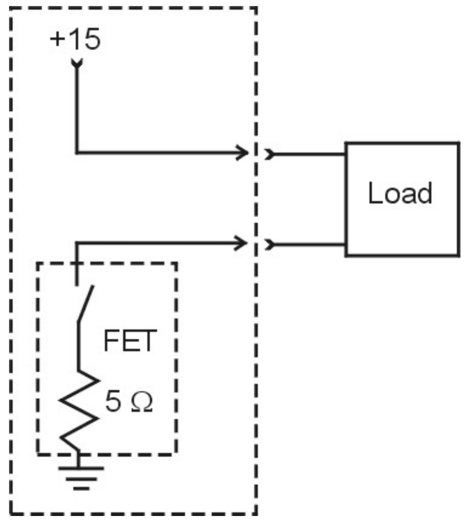


Figure 3-6: FET Series Resistance

3.3.3.3 RS-232 PORT

The digital signal output is a standard, full duplex RS-232 serial communications port used to connect the analyzer to a computer, terminal, or other digital device. It requires a standard 9-pin D connector.

The output data is status information, in digital form, updated every two seconds. Status is reported in the following order:

- The concentration in ppm or percent
- The range in use (HI, MED, LO)
- The span of the range (0-100 ppm, etc)
- Which alarms—if any—are disabled (AL–x DISABLED)
- Which alarms—if any—are tripped (AL–x ON).

Each status output is followed by a carriage return and line feed.

Three input functions using RS-232 have been implemented to date. They are described in Table 3-5.

Table 3-5: Commands via RS-232 Input

Command	Description
as<enter>	Immediately starts an auto span.
az<enter>	Immediately starts an auto zero.
st<enter>	Toggling input. Stops/Starts any status message output from the RS-232, until **st**<enter> is sent again.

The RS-232 protocol allows some flexibility in its implementation. Table 3-6 lists certain RS-232 values that are required by the 3000ZA2G implementation.

Table 3-6: Required RS-232 Options

Parameter	Setting
Baud	2400
Byte	8 bits
Parity	none
Stop Bits	1
Message Interval	2 seconds.

3.4 Testing the System

Before applying power to the instrument:

- Check the integrity and accuracy of the gas connections. Make sure there are no leaks.
- Check the integrity and accuracy of the electrical connections. Make sure there are no exposed conductors.
- Check that inlet sample pressure is within the accepted range (see Section 3.3.1).
- Power up the system, and test it by repeating the Self-Diagnostic Test as described in Chapter 4, Section 4.3.5.

Operation

4.1 Introduction

Once the analyzer has been installed, it can be configured for your application. To do this you will:

- Set system parameters.
- Establish a security password, if desired, requiring the operator to log in.
- Establish and start an automatic calibration cycle, if desired.
- Calibrate the instrument.
- Define the three user selectable analysis ranges, then choose auto ranging or select a fixed range of analysis, as required.
- Set alarm setpoints, and modes of alarm operation (latching, failsafe, etc).

Before you configure your 3000ZA2G, these default values are in effect:

Ranges:	LO = 10 ppm, MED = 100 ppm, HI = 1000 ppm. Auto Ranging: ON
Alarm Relays:	Defeated, 1000 ppm, HI, Not failsafe, Not latching.
Zero:	Auto, every 0 days at 0 hours.
Span:	Auto, at 000008.00 ppm, every 0 days at 0 hours.
Password:	TAI

If you choose not to use password protection, the default password is automatically displayed on the password screen when you start up and you have access to all functions of the analyzer.

4.2 Using the Data Entry and Function Buttons

Data Entry Buttons: The ◄►arrow buttons select options from the menu currently being displayed on the VFD screen. The selected option blinks.

When the selected option includes a modifiable item, the ▲/▼ arrow buttons can be used to increment or decrement that modifiable item.

The *Enter* button is used to accept any new entries on the VFD screen. The *Escape* button is used to abort any new entries on the VFD screen that are not yet accepted by use of the *Enter* button.

Figure 4-1 shows the hierarchy of functions available to the operator via the function buttons. The six function buttons on the analyzer are:

Analyze. This is the normal operating mode. The analyzer monitors the oxygen content of the sample, displays the percent of oxygen, and warns of any alarm conditions.

System. The system function consists of six sub functions that regulate the internal operations of the analyzer:

- Auto-Cal setup
- Password assignment
- Self-Test initiation
- Checking software version
- Logging out
- Display negative oxygen readings

Zero. Used to set up a zero calibration. Zero calibration must use air as the zero gas.

Span. Used to set up a span calibration.

Alarms. Used to set the alarm setpoints and determine whether each alarm will be active or defeated, HI or LO acting, latching, and/or failsafe.

Range. Used to set up three analysis ranges that can be switched automatically with auto-ranging or used as individual fixed ranges.

Any function can be selected at any time by pressing the appropriate button (unless password restrictions apply). The order as presented in this manual is appropriate for an initial setup.

Each of these functions is described in greater detail in the following procedures. The VFD screen text that accompanies each operation is reproduced, at the appropriate point in the procedure, in a Monospaced type style. Pushbutton names are printed in *Italic* type.

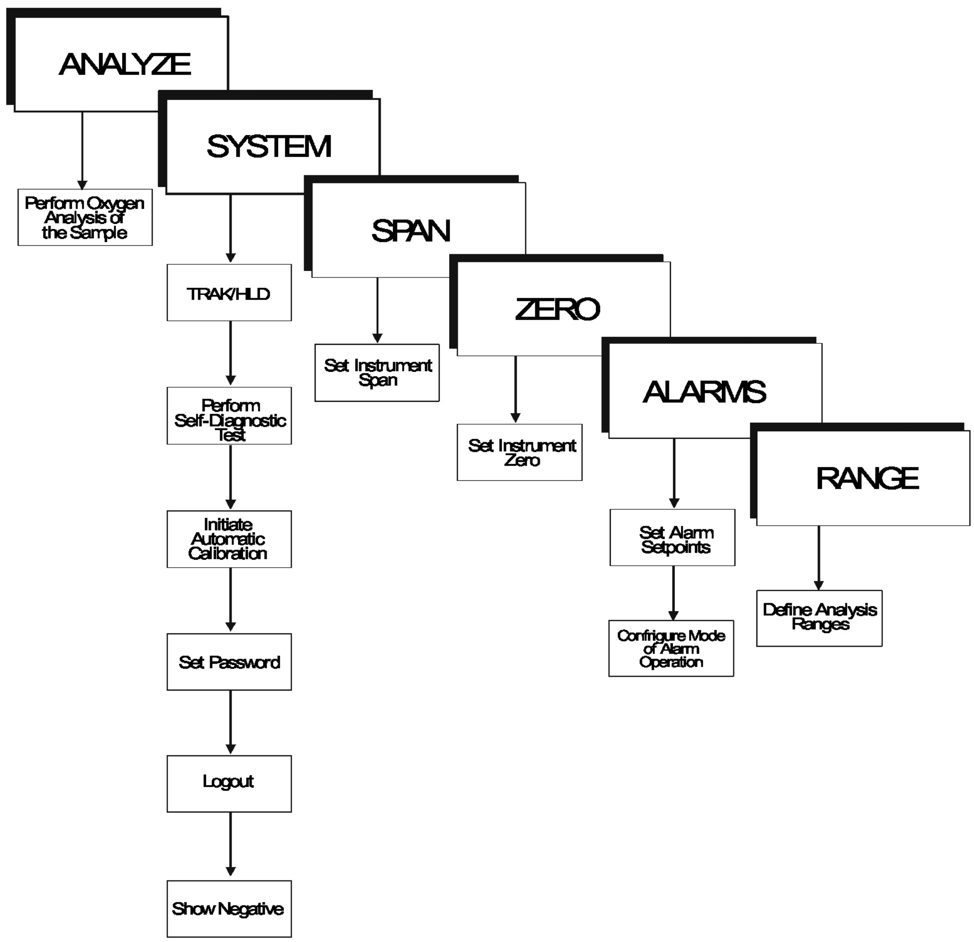


Figure 4-1: Hierarchy of Functions and Sub functions

4.3 The System Function

The sub functions of the *System* function are described below. Specific procedures for their use follow the descriptions:

- **Auto-Cal:** Used to define an automatic calibration sequence and/or start an Auto-Cal.

Note: This function will have no effect if the auto calibration option is not present.

- **PSWD:** Security can be established by choosing a 5 digit password (PSWD) from the standard ASCII character set. (See Installing or Changing a Password, below, for a table of ASCII characters available.) Once a unique password is assigned and activated, the operator MUST enter the UNIQUE password to gain access to set-up functions which alter the instrument's operation, such as setting the instrument span or zero setting, adjusting the alarm setpoints, or defining analysis ranges.

  After a password is assigned, the operator must log out to activate it. Until then, anyone can continue to operate the instrument without entering the new password.

  Only one password can be defined. Before a unique password is assigned, the system assigns TAI by default. This allows access to anyone. After a unique password is assigned, to defeat the security, the password must be changed back to TAI.

- **Logout:** Logging out prevents an unauthorized tampering with analyzer settings.
- **More:** Select and enter More to get a new screen with additional sub functions listed.
- **Self–Test:** The instrument performs a self-diagnostic test to check the integrity of the power supply, output boards and amplifiers.
- **Version:** Displays Manufacturer, Model, and Software Version of the instrument.

- **Show Negative:** The operator selects whether display can show negative oxygen readings or not.
- **TRAK/HLD:** The operator sets whether the instrument analog outputs track the concentration change during calibration and sets a time delay for the concentration alarms after calibration

4.3.1 Tracking Oxygen Readings During Calibration and Alarm Delay

The user has the option of setting the preference as to whether the analog outputs track the display readings during calibration or not. To set the preference, press the *System* key once and the first System menu will appear in the VFD display:

TRAK/HLD Auto-Cal

PSWD Logout More

TRAK/HLD should be blinking. To enter this system menu press the *Enter* key once:

Output Sttng: TRACK

Alarm Dly: 10 min

or

Output Sttng: HOLD

Alarm Dly: 10 min

In the first line, TRACK or HOLD should be blinking. The operator can toggle between TRACK and HOLD with the ▲/▼ keys. When TRACK is selected, the analog outputs (0-1 VDC and 4-20 mA) and the range ID contacts will track the instrument readings during calibration (either zero or span). TRACK is the factory default.

When HOLD is selected, the analog outputs (0-1 VDC and 4-20 mA) and the range ID contacts will freeze on their last state before entering one of the calibration modes. When the instrument returns to the Analyze mode, either by a successful or an aborted calibration, there will be a three-minute delay before the analog outputs and the range ID contacts start tracking again.

The concentration alarms freeze on their last state before entering calibration regardless of selecting HOLD or TRACK. But, when HOLD is selected the concentration alarms will remain frozen for the time displayed in the second line of the TRAK/HLD menu after the analyzer returns to the Analyze mode.

The factory default is three minutes, but the delay time is programmable. To adjust to delay time use the ◄► arrow keys. When the time displayed on the second line blinks, it can be adjusted by pressing the ▲/▼ keys to increase or decrease its value. The minimum delay is 1 minute, the maximum is 30.

This preference is stored in non-volatile memory so that it is recovered if power is removed from the instrument.

4.3.2 Setting up an Auto-Cal

When proper automatic valving is connected (see Chapter 3, *Installation*), the analyzer can cycle itself through a sequence of steps that automatically zero and span the instrument.

Note: *If you require highly accurate Auto-Cal timing, use external Auto-Cal control where possible. The internal clock in the Model 3000ZA2G is accurate to 2-3 %. Accordingly, internally scheduled calibrations can vary 2-3 % per day.*

To setup an Auto–Cal cycle:

Choose *System* from the Function buttons. The LCD will display five sub functions.

TRAK/HLD Auto—Cal

PSWD Logout More

Use ◄►arrows to blink Auto—Cal, and press *Enter*. A new screen for Span/Zero set appears.

Span OFF Nxt: 0d 0h

Zero OFF Nxt: 0d 0h

Press ◄►arrows to blink Span (or Zero), then press *Enter* again. *(You won't be able to set OFF to ON if a zero interval is entered.)* A Span Every ... (or Zero Every ...) screen appears.

Span Every 0 d

Start 0 h from now

Use ▲/▼ arrows to set an interval value, and then use ◄► arrows to move to the start-time value. Use ▲/▼ arrows to set a start-time value.

To turn ON the Span and/or Zero cycles (to activate Auto-Cal): Press *System* again, choose Auto—Cal, and press *Enter* again. When the Span/ Zero values screen appears, use the ◄► arrows to blink the Span (or Zero) OFF/ON field. Use▲/▼ arrows to set the OFF/ON field to ON. You can now turn these fields ON because there is a nonzero span interval defined.

4.3.3 Password Protection

If a password is assigned, then setting the following system parameters can be done only after the password is entered:

- Span and zero settings
- Alarm setpoints
- Analysis range definitions
- Switching between auto ranging and manual override
- Setting up an auto-cal
- Assigning a new password

However, the instrument can still be used for analysis or for initiating a self- test without entering the password.

If you have decided not to employ password security, use the default password TAI. This password will be displayed automatically by the microprocessor. The operator just presses the Enter key to be allowed total access to the instrument's features.

Note: If you use password security, it is advisable to keep a copy of the password in a separate, safe location.

4.3.3.1 ENTERING THE PASSWORD

To install a new password or change a previously installed password, you must key in and *Enter* the old password first. If the default password is in effect, pressing the *Enter* button will enter the default TAI password for you.

Press *System* to enter the *System* mode.

TRAK/HLD Auto—Cal

PSWD Logout More

Use the ◄►arrow keys to scroll the blinking over to PSWD, and press *Enter* to select the password function. Either the default TAI password or AAAAA place holders for an existing password will appear on screen depending on whether or not a password has been previously installed.

T A I

Enter PWD

or

A A A A A

Enter PWD

The screen prompts you to enter the current password. If you are not using password protection, press *Enter* to accept TAI as the default password. If a password has been previously installed, enter the password using the ◄►arrow keys to scroll back and forth between letters, and the ▲/▼ arrow keys to change the letters to the proper password. Press *Enter* to enter the password.

If the password is accepted, the screen will indicate that the password restrictions have been removed and you have clearance to proceed.

PSWD Restrictions

Removed

In a few seconds, you will be given the opportunity to change this password or keep it and go on.

Change Password?

<ENT>=Yes <ESC>=No

Press *Escape* to move on, or proceed as in *Changing the Password*, below.

4.3.3.2 Installing or Changing the Password

If you want to install a password, or change an existing password, proceed as above in *Entering the Password*. When you are given the opportunity to change the password:

Change Password?

<ENT>=Yes <ESC>=No

Press *Enter* to change the password (either the default TAI or the previously assigned password), or press *Escape* to keep the existing password and move on.

If you chose *Enter* to change the password, the password assignment screen appears.

T A I

<ENT> To Proceed

or

A A A A A

<ENT> To Proceed

Enter the password using the ◄►arrow keys to move back and forth between the existing password letters, and the ▲/▼ arrow keys to change the letters to the new password. The full set of 94 characters available for password use is shown in the table below.

Characters Available for Password Definition:

A	B	C	D	E	F	G	H	I	J
K	L	M	N	O	P	Q	R	S	T
U	V	W	X	Y	Z	[	¥	]	^
	`	a	b	c	d	e	f	g	h
i	j	k	l	m	n	o	p	q	r
s	t	u	v	w	x	y	z	{	|
}	_	!	"	#	$	%	&	'	(
)	*	+	'	-	.	/	0	1	2
3	4	5	6	7	8	9	:	;	<
=	>	?	@						

When you have finished typing the new password, press *Enter*. A verification screen appears. The screen will prompt you to retype your password for verification.

A A A A A

Retype PWD To Verify

Wait a moment for the entry screen. You will be given clearance to proceed.

A A A A A

<ENT> TO Proceed

Use the arrow keys to retype your password and press *Enter* when finished. Your password will be stored in the microprocessor and the system will immediately switch to the *Analyze* screen, and you now have access to all instrument functions.

If all alarms are defeated, the *Analyze* screen appears as:

0.0 ppm Anlz

Range: 0 — 100

If an alarm is tripped, the second line will change to show which alarm it is:

0.0 ppm Anlz

AL—1

Note: If you log off the system using the logout function in the system menu, you will now be required to re-enter the password to gain access to Span, Zero, Alarm, and Range functions.

4.3.4 Logout

The Logout function provides a convenient means of leaving the analyzer in a password protected mode without having to shut the instrument off. By entering Logout, you effectively log off the instrument leaving the system protected against use until the password is reentered. To log out, press the *System* button to enter the *System* function.

TRAK/HLD Auto—Cal

PSWD Logout More

Use the ◄►arrow keys to position the blinking over the Logout function, and press *Enter* to Log out. The screen will display the message:

Protected Until

Password Reentered

4.3.5 System Self-Diagnostic Test

The Model 3000ZA2G has a built-in self-diagnostic testing routine. Pre-programmed signals are sent through the power supply, output board and sensor circuit. The return signal is analyzed, and at the end of the test the status of each function is displayed on the screen, either as OK or as a number between 1 and 3. (See *System Self Diagnostic Test* in Chapter 5 for number code).

The self diagnostics are run automatically by the analyzer whenever the instrument is turned on, but the test can also be run by the operator at will. To initiate a self diagnostic test during operation:

Press the *System* button to start the *System* function.

TRAK/HLD Auto—Cal

PSWD Logout More

Use the ◄►arrow keys to blink More, and then press *Enter*.

Version Self—Test

Use the ◄►arrow keys again to move the blinking to the Self–Test function. The screen will follow the running of the diagnostic. When the testing is complete, the results are displayed.

Power: OK   Analog: OK

The module is functioning properly if it is followed by OK. A number indicates a problem in a specific area of the instrument. Refer to Chapter *5 Maintenance and Troubleshooting* for number-code information. The results screen alternates for a time with:

Press Any Key

To Continue...

Then the analyzer returns to the initial System screen.

4.3.6 Version Screen

Move the ◄►arrow key to More and press *Enter*. With Version blinking, press *Enter*. The screen displays the manufacturer, model, and software version information.

4.3.7 Showing Negative Oxygen Readings

For software version 1.4.4 or later, the instrument only displays oxygen readings that are positive or zero. The instrument can be reconfigured to show negative readings if sensor output drifts below zero. This situation may arise after the instrument has been zeroed, as time progresses the sensor may drift below the zero calibration setpoint.

To show negative oxygen readings on the display:

Press the *System* key.

TRAK/HLD Auto-Cal

PSWD Logout More

Use the Right or Left arrow keys and select More. Press *Enter*.

Version Self-Test

Show_Negative=NO

Use the ◄► arrow keys and select "Show_Negative=NO".

Use the ▲/▼ keys to toggle from NO to YES.

Press the *Escape* key twice to return to the analyze mode.

This preference is stored in non-volatile memory, so this configuration is remembered after a power shutdown. If the instrument is cold started, it will go back to default (not showing negative oxygen readings).

4.4 The Zero and Span Functions

Note: A zero calibration is required for the zirconia sensor installed in this instrument. Air must be used for the zero gas. The Zero calibration will eliminate offset error contributed by sensor, electronics, and internal and external sampling system and maintain performance at the published specification for this instrument.

The analyzer is calibrated using air for zero calibration and a known concentration of oxygen in a suitable background gas for span calibration.

The software in the Model 3000ZA2G assumes that air is used as the zero gas and automatically sets the zero point of the instrument based on the 20.9% oxygen concentration in air. Do not substitute another gas for zero gas.

A known oxygen concentration in the range of 70–90% of full scale of the range of interest is recommended for use as a span gas. The span gas used must have a concentration greater than 7.0 ppm oxygen. When 70-90% of full scale is close to air concentration (e.g. 0-25% range), 0.1-1.0% O_2 span gas is recommended.

Connect the calibration gases according to the instructions given in Section 3.4.1, *Gas Connections*, observing all the prescribed precautions.

Shut off the gas pressure before connecting it to the analyzer, and be sure to limit the pressure to 40 psig or less when turning it back on.

Adjust the needle valve on the front panel of the analyzer until the flow rate (as read on the analyzer's flowmeter) is 0.1-0.3 SLPM.

If you are using password protection, you will need to enter your password to gain access to either of these functions. Follow the instructions in Sections 4.3.3 to enter your password. Once you have gained clearance to proceed, you can enter the *Zero* or *Span* function.

4.4.1 Zero Cal

The *Zero* button on the front panel is used to enter the zero calibration function. Zero calibration can be performed in either the automatic or manual mode. In the **automatic** mode, an internal algorithm compares consecutive readings from the sensor to determine when the output is within the acceptable range for zero. In the **manual** mode, the operator determines when the reading is within the acceptable range for zero. Make sure air is connected to the instrument. If you get a CELL FAILURE message skip to Section 4.4.1.3.

4.4.1.1 AUTO MODE ZEROING

Press *Zero* to enter the zero function mode. The screen allows you to select whether the zero calibration is to be performed automatically or manually. Use the ▲/▼ arrow keys to toggle between AUTO and MAN zero settling. Stop when AUTO appears, blinking, on the display.

Zero: Settling: AUTO

<ENT> To Begin

Press *Enter* to begin zeroing.

PPM Zero

Slope=#### ppm/s

The beginning zero level is shown in the upper left corner of the display. As the zero reading settles, the screen displays and updates information on Slope (unless the Slope starts within the acceptable zero range and does not need to settle further).

Then, and whenever Slope is less than 0.08 for at least 3 minutes, instead of Slope you will see a countdown: 5 Left, 4 Left, and so forth. These are five steps in the zeroing process that the system must complete, AFTER settling, before it can go back to *Analyze*.

PPM Zero

4 Left=### ppm/s

The zeroing process will automatically conclude when the output is within the acceptable range for a good zero. Then the analyzer automatically returns to the *Analyze* mode.

4.4.1.2 MANUAL MODE ZEROING

Press *Zero* to enter the *Zero* function. The screen that appears allows you to select between automatic and manual zero calibration. Use the ▲/▼ keys to toggle between AUTO and MAN zero settling. Stop when MAN appears, blinking, on the display.

Zero: Settling: Man

<ENT> To Begin

Press *Enter* to begin the zero calibration.

After the zero calibration completes its cycle, the information is stored in the microprocessor, and the instrument automatically returns to the *Analyze* mode.

4.4.2 Span Cal

The *Span* button on the front panel is used to span calibrate the analyzer. Span calibration can be performed using the **automatic** mode, where an internal algorithm compares consecutive readings from the sensor to determine when the output matches the span gas concentration. Span calibration can also be performed in **manual** mode, where the operator determines when the span concentration reading is acceptable and manually exits the function.

4.4.2.1 AUTO MODE SPANNING

Press *Span* to enter the span function. The screen that appears allows you to select whether the span calibration is to be performed automatically or manually. Use the ▲/▼ arrow keys to toggle between AUTO and MAN span settling. Stop when AUTO appears, blinking, on the display.

Span: Settling: AUTO

<ENT> For Next

Press *Enter* to move to the next screen.

Calib. Holding time

Cal hold: 5 min

This menu allows the operator to set the time the analyzer should be held in the span mode, after the readings of the analyzer settle. Five minutes is the default, but it could be adjusted anywhere from 1 to 60 minutes by using the UP or DOWN keys.

Press *Enter* to move to the next screen.

Span Val: 000008.00

<ENT>Span <UP>Mod #

Use the ▲/▼ arrow keys to enter the oxygen-concentration mode. Use the ◄►arrow keys to blink the digit you are going to modify. Use the ▲/▼ arrow keys again to change the value of the selected digit. When you have finished typing in the concentration of the span gas you are using, press *Enter* to begin the Span calibration.

ppm   Span

Slope=####   ppm/s

The beginning span value is shown in the upper left corner of the display. As the span reading settles, the screen displays and updates information on Slope. Spanning automatically ends when the span output corresponds, within tolerance, to the value of the span gas concentration. Then the instrument automatically returns to the analyze mode.

4.4.2.2 Manual Mode Spanning

Press *Span* to start the *Span* function. The screen that appears allows you to select whether the span calibration is to be performed automatically or manually.

Span: Settling:MAN

<ENT> For Next

Use the ▲/▼ keys to toggle between AUTO and MAN span settling. Stop when MAN appears, blinking, on the display. Press *Enter* to move to the next screen.

Press *Enter* to move to the next screen.

Calib. Holding time

Cal hold: 5 min

This menu allows the operator to set the time the analyzer should be held in the auto span mode. It does not affect anything in Manual Mode. Just press *Enter* to continue.

Span Val: 000008.00

<ENT>Span <UP>Mod #

Press ▲ (<UP>) to permit modification (Mod #) of span value.

Use the arrow keys to enter the oxygen concentration of the span gas you are using (209000.00 if you are using air). The ◄►arrows choose the digit, and the ▲/▼ arrows choose the value of the digit.

Press *Enter* to enter the span value into the system and begin the span calibration.

Once the span has begun, the microprocessor samples the output at a predetermined rate. It calculates the difference between successive samplings and displays this difference as Slope on the screen. It takes several seconds for the first Slope value to display. Slope indicates rate of change of the Span reading. It is a sensitive indicator of stability.

% Span

Slope=####   ppm/s

When the Span value displayed on the screen is sufficiently stable, press *Enter*. (Generally, when the Span reading changes by 1% or less of the full scale of the range being calibrated for a period of ten minutes it is sufficiently stable.) Once *Enter* is pressed, the Span reading changes to the correct value. The instrument then automatically enters the Analyze function.

4.4.3 Span Failure

The analyzer checks the output of the sensor at the end of the span. The output signal decreases approximately 50 mV per decade increase in the oxygen concentration. The software analyzes the change in output and will trigger a span failure message if it is found differ significantly from the 50 mV/decade value. When this occurs, the span will not be accepted. The analyzer will return to the previous calibration values and trigger the System Alarm, and display in the VFD:

Span Failed!!

This message will be shown for five seconds and the instrument will return to the *Analyze* mode. In the upper right hand corner of the VFD display “FCAL” will be shown. This message flag will help the operator troubleshoot in case calibration was initiated remotely. To reset the alarm and the flag message, the unit must be turned off by cycling the standby key ⏻. It will reset if the next span cycle is correct.

A typical cause for span failure is by feeding the wrong span gas during calibration or entering the wrong value. It can also be triggered by an electronics failure.

4.5 The Alarms Function

The Model 3000ZA2G is equipped with 2 fully adjustable concentration alarms and a system failure alarm. Each alarm has a relay with a set of form “C" contacts rated for 3 amperes resistive load at 250

VAC. See Figure in Chapter 3, Installation and/or the Interconnection Diagram included at the back of this manual for relay connections.

The system failure alarm has a fixed configuration described in Chapter 3 Installation.

The concentration alarms can be configured from the front panel as either high or low alarms by the operator. The alarm modes can be set as latching or non-latching, and either failsafe or non-failsafe, or, they can be defeated altogether. The setpoints for the alarms are also established using this function.

Decide how your alarms should be configured. The choice will depend upon your process. Consider the following four points:

1. Which if any of the alarms are to be high alarms and which if any are to be low alarms?
   Setting an alarm as HIGH triggers the alarm when the oxygen concentration rises above the setpoint. Setting an alarm as LOW triggers the alarm when the oxygen concentration falls below the setpoint.

   Decide whether you want the alarms to be set as:
   - Both high (high and high-high) alarms, or
   - One high and one low alarm, or
   - Both low (low and low-low) alarms.

2. Are either or both of the alarms to be configured as failsafe?
   In failsafe mode, the alarm relay de-energizes in an alarm condition. For non-failsafe operation, the relay is energized in an alarm condition. You can set either or both of the concentration alarms to operate in failsafe or non-failsafe mode.
3. Are either of the alarms to be latching?
   In latching mode, once the alarm or alarms trigger, they will remain in the alarm mode even if process conditions revert back to non-alarm conditions. This mode requires an alarm to be recognized before it can be reset. In the non-latching mode, the alarm status will terminate when process conditions revert to non- alarm conditions.
4. Are either of the alarms to be defeated?
   The defeat alarm mode is incorporated into the alarm circuit

so that maintenance can be performed under conditions which would normally activate the alarms.
The defeat function can also be used to reset a latched alarm. (See procedures, below.)

If you are using password protection, you will need to enter your password to access the alarm functions. Follow the instructions in section 4.3.3 to enter your password. Once you have clearance to proceed, enter the Alarm function.

Press the Alarm button on the front panel to enter the Alarm function. Make sure that AL–1 is blinking.

AL—1 AL—2

Choose Alarm

Set up alarm 1 by moving the blinking over to AL–1 using the ◄►arrow keys. Then press Enter to move to the next screen.

AL—1 1000 ppm HI

Dft—N Fs—N Ltch—N

Five parameters can be changed on this screen:

Value of the alarm setpoint, AL–1 #### ppm (oxygen)

Out-of-range direction, HI or LO

Defeated? Dft–**Y/N** (Yes/No)

Failsafe? Fs–**Y/N** (Yes/No)

Latching? Ltch–**Y/N** (Yes/No).

To define the setpoint, use the ◄►arrow keys to move the blinking over to AL–1 ####. Then use the ▲/▼ arrow keys to change the number. Holding down the key speeds up the incrementing or decrementing. (Remember, the setpoint units are ppm O_2.)

To set the other parameters use the ◄►arrow keys to move the blinking over to the desired parameter. Then use the ▲/▼ arrow keys to change the parameter.

Once the parameters for alarm 1 have been set, press *Alarms* again, and repeat this procedure for alarm 2 (AL–2).

To reset a latched alarm, go to Dft– and then press either ^ two times or v two times. (Toggle it to Y and then back to N.)

–OR –

Go to Ltch– and then press either ▲ two times or ▼ two times. (Toggle it to N and back to Y.)

4.6 The Range Function

The Range function allows the operator to program up to three concentration ranges to correlate with the DC analog outputs. If no ranges are defined by the user, the instrument defaults to:

Low = 0–10 ppm

Med = 0–100 ppm

High = 0–1000 ppm

The Model 3000ZA2G is set at the factory to default to auto ranging. In this mode, the microprocessor automatically responds to concentration changes by switching ranges for optimum readout sensitivity. If the current range limits are exceeded, the instrument will automatically shift to the next higher range. If the concentration falls to below 85% of full scale of the next lower range, the instrument will switch to that range. A corresponding shift in the DC percent-of-range output, and in the range ID outputs, will be noticed.

The auto ranging feature can be overridden so that analog output stays on a fixed range regardless of the oxygen concentration detected. If the concentration exceeds the upper limit of the range, the DC output will saturate at 1 VDC (20 mA for the current output).

However, the digital readout and the RS-232 output of the concentration are unaffected by the fixed range. They continue to read accurately with full precision. See *Front Panel* description in Chapter 1.

The automatic air calibration range is always 0-25 % and is not programmable.

4.6.1 Setting the Analog Output Ranges

To set the ranges, enter the range function mode by pressing the *Range* button on the front panel.

L—10 M—100

H—1000 Mode—AUTO

Use the ◄►arrow keys to blink the range to be set: low (L), medium (M), or high (H).

Use the ▲/▼ arrow keys to enter the upper value of the range (all ranges begin at 0 ppm). Repeat for each range you want to set. Press *Enter* to accept the values and return to *Analyze* mode. (See note below.)

Note: The ranges must be increasing from low to high, for example, if range 1 is set as 0–100 ppm and range 2 is set as 0–1,000 ppm, range 3 cannot be set as 0– 500 ppm since it is lower than range 2.

Ranges, alarms, and spans are always set in ppm units (over the entire 0-250,000 ppm range), even though all concentration-data outputs change from ppm units to percent when the concentration is above 10,000 ppm.

4.6.2 Fixed Range Analysis

The auto ranging mode of the instrument can be overridden, forcing the analyzer DC outputs to stay in a single predetermined range.

To switch from auto ranging to fixed range analysis, enter the range function by pressing the *Range* button on the front panel.

Use the ◄►arrow keys to move the blinking over AUTO.

Use the ▲/▼ arrow keys to switch from AUTO to FX/LO, FX/MED, or FX/H I to set the instrument on the desired fixed range (low, medium, or high).

L—10 M—1000

H—1000 Mode—FX/ LO

or

L—10	**M—1000**
H—1000	**Mode—FX/MED**

or

L—10	**M—1000**
H—1000	**Mode—FX/ HI**

Press *Escape* to re-enter the *Analyze* mode using the fixed range.

Note: When performing analysis on a fixed range, if the oxygen concentration rises above the upper limit (or default value) as established by the operator for that particular range, the output saturates at 1 VDC (or 20 mA). However, the digital readout and the RS-232 output continue to read the true value of the oxygen concentration regardless of the analog output range.

4.7 The Analyze Function

Normally, all of the functions automatically switch back to the *Analyze* function when they have completed their assigned operations. Pressing the *Escape* button in many cases also switches the analyzer back to the *Analyze* function. Alternatively, you can press the *Analyze* button at any time to return to analyzing your sample.

4.8 Signal Output

The standard Model 3000ZA2G Trace Oxygen Analyzer is equipped with two 0–1 VDC analog output terminals accessible on the back panel (one concentration and one range ID), and two isolated 4–20 mA DC current outputs (one concentration and one optional range ID).

See *Rear Panel* in Chapter 3, *Installation*, for illustration.

The signal output for concentration is linear over the currently selected analysis range. For example, if the analyzer is set on range that was defined as 0–100 ppm O_2, then the output would be:

ppm O_2	Voltage Signal Output (VDC)	Current Signal Output (mA dc)
0	0.0	4.0
10	0.1	5.6
20	0.2	7.2
30	0.3	8.8
40	0.4	10.4
50	0.5	12.0
60	0.6	13.6
70	0.7	15.2
80	0.8	16.8
90	0.9	18.4
100	1.0	20.0

The analog output signal has a voltage which depends on the oxygen concentration AND the currently activated analysis range. To relate the signal output to the actual concentration, it is necessary to know what range the instrument is currently on, especially when the analyzer is in the auto ranging mode.

To provide an indication of the range, a second pair of analog output terminals is used. They generate a steady preset voltage (or current when using the current outputs) to represent a particular range. The following table gives the range ID output for each analysis range:

Range	Voltage (V)	Current (mA)
LO	0.25	8
MED	0.50	12
HI	0.75	16
CAL (0-25%)	1.00	20

Maintenance

5.1 Routine Maintenance

Aside from normal cleaning and checking for leaks at the gas connections, routine maintenance is limited to replacing fuses, and recalibration. For recalibration, see Section 4.4 *Calibration*.

WARNING: SEE WARNINGS ON THE TITLE PAGE OF THIS MANUAL.

5.2 Sensor Replacement

There are no user-serviceable parts in the sensor assembly. If the sensor has failed, contact TAI for replacement.

CAUTION: POWER IS APPLIED TO THE INSTRUMENT CIRCUITRY WHENEVER THE POWER ENTRY SWITCH ON THE REAR PANEL IS IN THE ON POSITION. THE RED SWITCH ON THE FRONT PANEL IS FOR SWITCHING POWER ON OR OFF TO THE DISPLAYS AND OUTPUTS ONLY.

CAUTION: THE SENSOR IS MAINTIANED AT A HIGH TEMPERATURE. THE HOUSING AND INTERNAL COMPONENTS WILL BE HOT! AFTER REMOVING POWER. LET THE SENSOR AND HOUSING COOL FOR TWO HOURS BEFORE DISASSEMBLING.

5.3 Fuse Replacement

1. Place small screwdriver in notch, and pry cover off, as shown in Figure 5-1.

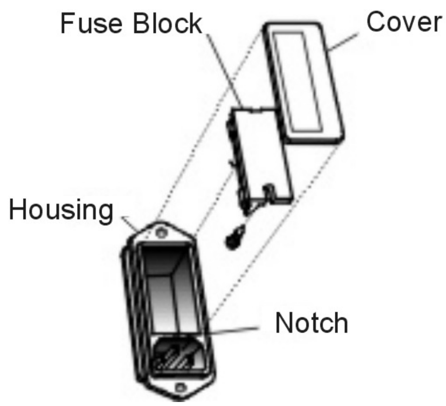
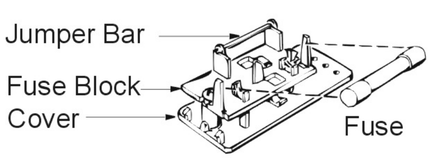
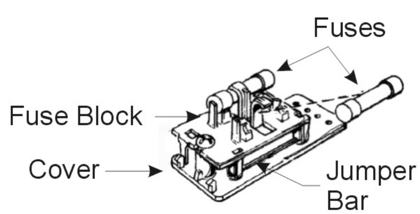


Figure 5-1: Removing Fuse Block from Housing

2. To change between American and European fuses, remove the single retaining screw then flip the Fuse Block over 180 degrees. Replace the screw.
3. Replace fuse as shown in Figure 5-2.
4. Reassemble housing as shown in Figure 5-1.





American Fuses European Fuses

Figure 5-2: Installing Fuses

5.4 System Self Diagnostic Test

1. Press the SYSTEM button to enter the system mode.
2. Use the ◄► arrow keys to move to **More**, and press ENTER.
3. Use the ◄► arrow keys to move to Self-Test, and press ENTER.

The following Items are tested:

Table 5-1: Self-Test Result Display

Power: OK	5V and +/-15V power supplies
Analog: OK	Measurement and range ID DACs

If any item above fails this test, it will be listed on the VFD display followed by a code number instead of "**OK**"

5.5 Major Internal Components

The zirconium sensor assembly is accessed by removing the top cover of the analyzer. The electronic PC boards are accessed by opening the door on the front panel. The gas piping is illustrated in Figure 2-3 and the major electronic components locations are shown in Figure 2-4, in Chapter 2.

CAUTION: SEE WARNINGS ON THE TITLE PAGE OF THIS MANUAL.

The 3000ZA2G contains the following major components:

- Analysis Section
- Zirconium oxide sensor assembly
- Sample system
- Power Supply
- Microprocessor
- Displays
- 5 digit LED meter

- 2 line, 20 character, alphanumeric, VFD display
- RS-232 Communications Port

See the drawings in the Drawings section in back of this manual for details.

5.6 Cleaning

If instrument is unmounted at time of cleaning, disconnect the instrument from the power source. Close and latch the front-panel access door. Clean outside surfaces with a soft cloth dampened slightly with plain clean water. Do not use any harsh solvents such as paint thinner or benzene.

For panel-mounted instruments, clean the front panel as prescribed in the above paragraph. DO NOT wipe front panel while the instrument is controlling your process.

5.7 Troubleshooting

Table 5-2: Troubleshooting

Problem	Possible Cause	Solution
Erratic readings of the oxygen concentration as reported by the analyzer	Analyzer may have been calibrated in an inaccurate fashion.	Recalibrate analyzer, making sure the proper gas is fed, and the proper value of span gas is input.
	Atmospheric oxygen diffusing through vent and altering the oxygen level the sensor sees	Increase flow rate and/or length of vent tubing to dilute or minimize oxygen diffusion from vent to sensor.
Inaccurate zero operation	Zero calibration using a gas with a concentration different from air.	Rezero the instrument using air.

Appendix

A-1 Specifications

Packaging:	General Purpose 19” standard instrument rack mount.
Sensor:	Zirconium oxide sensor.
Output Signal:	0-1 VDC % of range 0-1 VDC Range ID 4-20 mA DC % of range 4-20 mA DC Range ID (optional)
Sample System:	All wetted parts of 316 stainless steel.
90 % Response Time:	15 seconds at 25 °C (77 °F) on 0-100 ppm to 0-25% ranges, 30 seconds on 0-10 ppm range.
Ranges:	Three programmable ranges from 0-10 ppm to 0-25 % oxygen. Auto ranging with range ID output.
Alarms:	One system-failure alarm contact to detect power failure. Two adjustable concentration threshold alarm contacts with fully programmable setpoints.
Displays:	2-line by 20-character, VFD screen, and one 5 digit LED display.
Digital Interface:	Full duplex RS-232 communications port.
Power Requirement:	Factory configured for either 115 VAC or 230 VAC operation, 50/60 Hz.
Power Consumption:	30 VA maximum

Operating Temperature: 5-35 °C

Accuracy: ±2% of full scale at constant temperature (at calibrated range).

±5% of full scale over operating temperature range once thermal equilibrium is reached.

Repeatability: 1% of full scale

A-2 Recommended 2-Year Spare Parts List

Qty.	Part Number	Description
1	C84132-A	Back Panel Board
1	C84129-A	Front Panel Board
1	B86654	ZrO_2 Amplifier Board
1	C86655	Main Computer Board
2	F1296	Fuse, 2A, 250V 5x20mm Slow Blow
1	A68314	Back Panel Connector Kit
1	B89410B	Heater Controller Board
1	S1816	Zirconium oxide sensor

Note: Orders for replacement parts should include the part number (if available) and the model and serial number of the instrument for which the parts are intended.

Orders should be sent to:

TELEDYNE Analytical Instruments

16830 Chestnut Street
City of Industry, CA 91748

Phone (626) 934-1500, Fax (626) 961-2538

Web: www.teledyne-ai.com
or your local representative.

A-3 Drawing List

D-89402 Outline Diagram

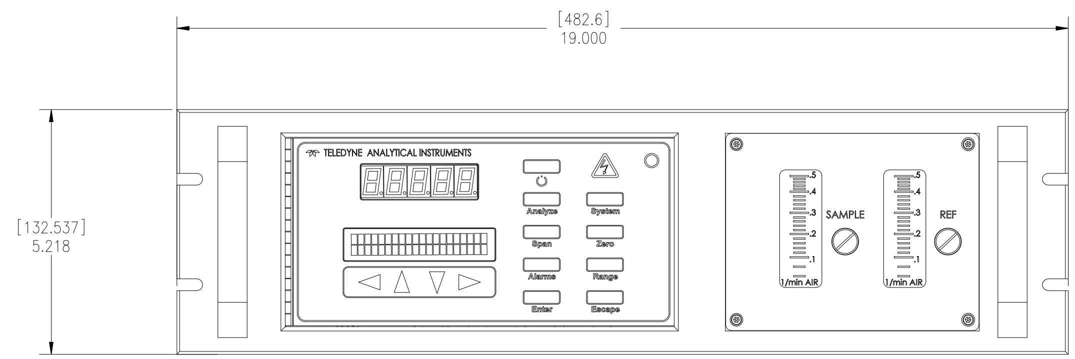
B-86694 Piping Diagram

NOTES: UNLESS OTHERWISE SPECIFIED.
1. INPUT/OUTPUT DATA CONNECTIONS:
RS232: 9 PIN DSUB CONNECTOR
CONTROL DATA: 50 PIN DSUB CONNECTOR.
2. ALL DIMENSIONS ARE IN INCHES [MILLIMETERS]

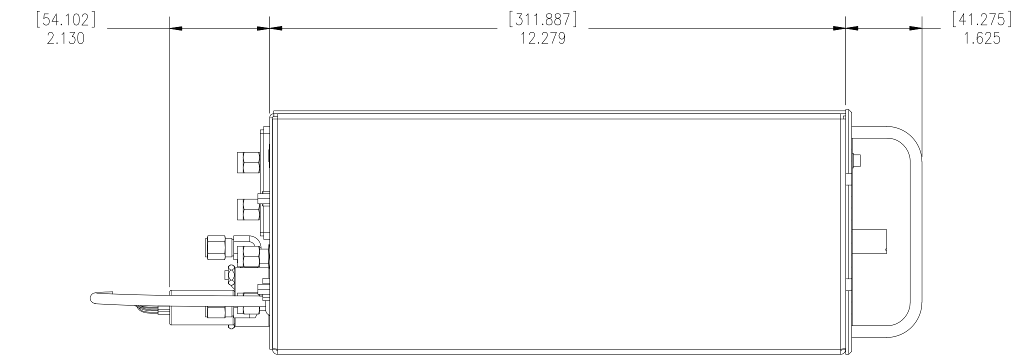
3 AUTOCAL VALVE MANIFOLD: 1/8 TUBE FITTINGS, OPTIONAL FEATURE.

REVISIONS

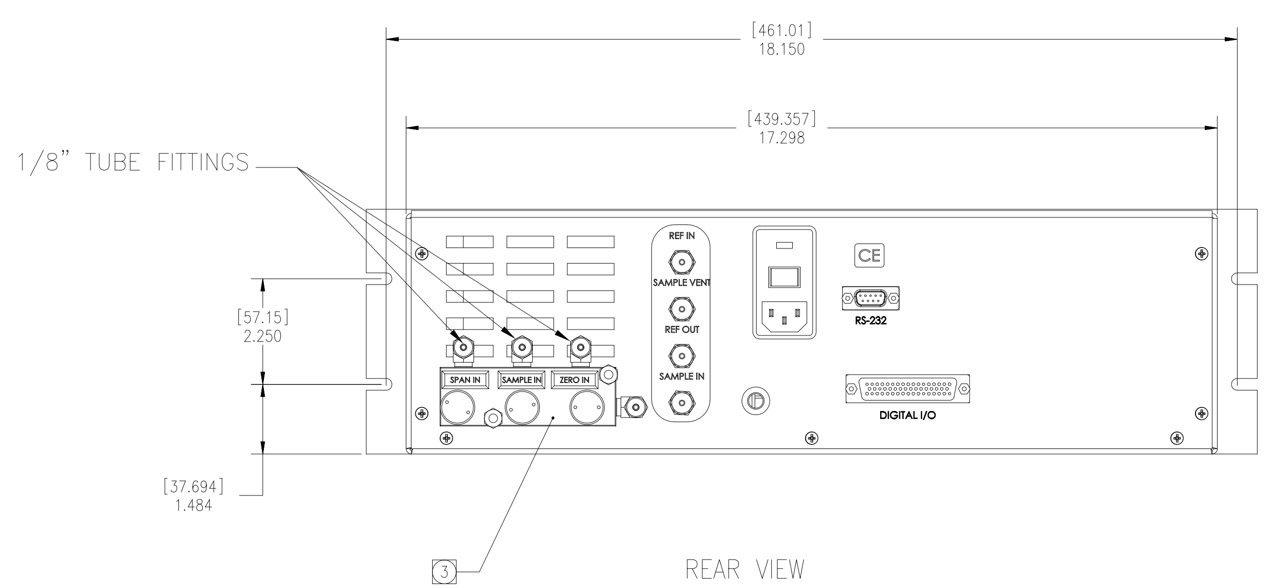
REV.	DESCRIPTION	DATE	APP.	REV. BY
0	INITIAL RELEASE	05/22/12	JG	--
1	ECO 13-0016	2/8/2013	JG	JA
2	INC ECO 15-0093	10/1/15	JG	VF



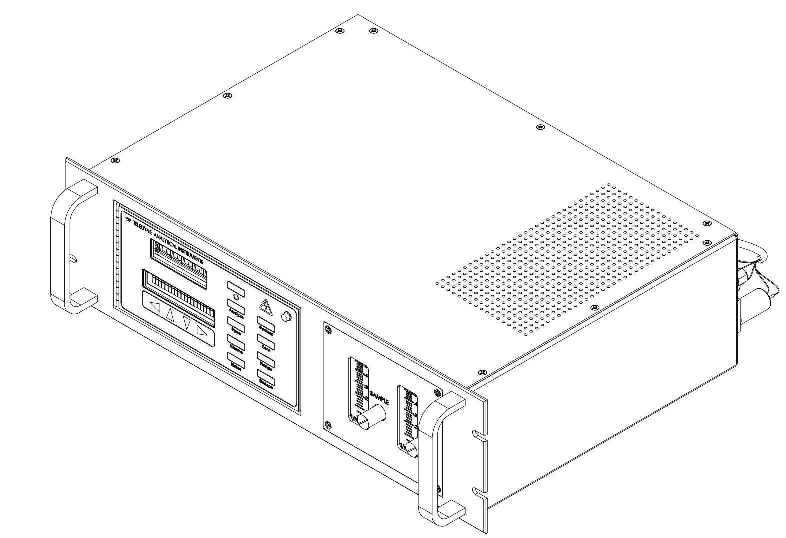
FRONT VIEW



SIDE VIEW



REAR VIEW



BILL OF MATERIALS

DO NOT SCALE DWG

TOLERANCE UNLESS OTHERWISE SPECIFIED: ANGULAR ±1/2°
LINEAR .X = ± 0.1, .XX = ± 0.02, .XXX = ± 0.010

Teledyne Analytical Instruments
A Business Unit of Teledyne Instruments, Inc.
City of Industry, California, 91748, USA

REFERENCE	SIGNATURES	DATE
S/	DRFT: JORGE ASEVEDO	5/22/2012
I/	CHK:	
O/	APPR:	
P/ B86694	ENGR: JOHN GIORS	
F/ D89401	S.O. STANDARD	
	CAD ID D89402-2	

TITLE: OUTLINE DIAGRAM
ZRO2 ANALYZER
MODEL 3000ZA2G

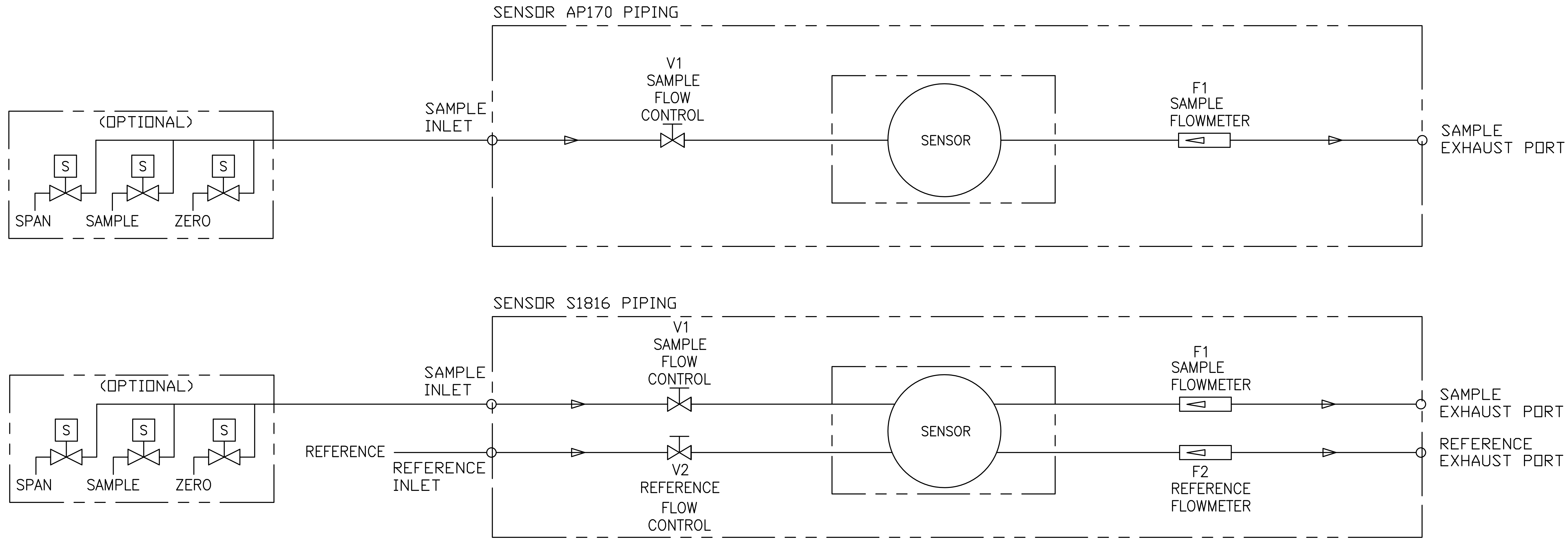
SCALE 1:2
SIM NONE
SHEET 1 OF 1
MATL. AS NOTED
DWG NO. D-89402
REV 2

NOTES: UNLESS OTHERWISE SPECIFIED.

Use and Disclosure of Data
Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

REVISIONS

REV	DESCRIPTION	DATE	APP.	REV. BY
0	INITIAL RELEASE	01/12/12	J.G.	--
1	ADDED REF DESIGNATORS	01/19/12	JG	JG
2	ADDED REF FLOW OPTION	05/14/12	JG	JG



ITEM	QTY	PART No.	DESCRIPTION
			BILL OF MATERIAL

DO NOT SCALE DWG

TOLERANCE UNLESS OTHERWISE SPECIFIED: ANGULAR ±1/2°
LINEAR .X = ±.1, .XX = ±.02, .XXX = ±.010

Teledyne Analytical Instruments
A business unit Teledyne Electronic Technologies
CITY OF INDUSTRY, CALIFORNIA 91748

REFERENCE	SIGNATURES	DATE
S/		
N/	DRFT: JORGE ASEVEDO	01/12/12
I/	CHK:	
P/ B86161	APPR:	
O/ D86304	ENGR: JOHN GOIRS	
F/ D86303	C.O.: STANDARD	
	CAD I.D. B86694-2	

TITLE
PIPING DIAGRAM
ZIRCONIUM O2 ANALYZER
MODEL 3000Z2G

SCALE NONE
SIM NONE
SHEET 1 OF 1

MATL. AS NOTED

DWG NO. **B-** 86694

REV 2