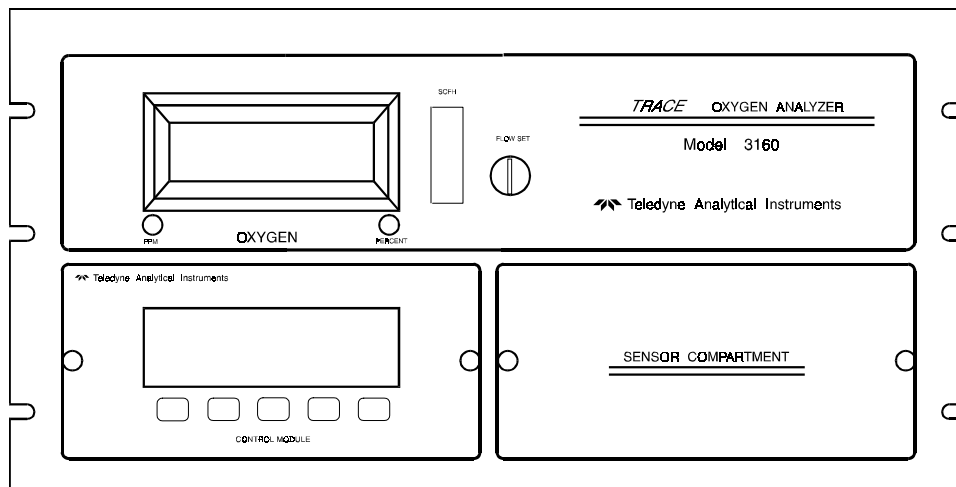

OPERATING INSTRUCTIONS FOR

Model 3160

Trace Oxygen Analyzer



DANGER



HIGHLY TOXIC AND/OR FLAMMABLE LIQUIDS OR GASES MAY BE PRESENT IN THIS MONITORING SYSTEM. PERSONAL PROTECTIVE EQUIPMENT MAY BE REQUIRED WHEN SERVICING THIS SYSTEM. HAZARDOUS VOLTAGES EXIST ON CERTAIN COMPONENTS INTERNALLY WHICH MAY PERSIST FOR A TIME EVEN AFTER THE POWER IS TURNED OFF AND DISCONNECTED. ONLY AUTHORIZED PERSONNEL SHOULD CONDUCT MAINTENANCE AND/OR SERVICING. BEFORE CONDUCTING ANY MAINTENANCE OR SERVICING CONSULT WITH AUTHORIZED SUPERVISOR/MANAGER.

P/N M52972
ECO# 99-0323
08/06/99

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Introduction

1.1 Features

1.1.1 Fixed Features

The Model 3160 is a microprocessor-based trace oxygen monitoring system that provides on-line monitoring of trace oxygen at parts-per-million (PPM) levels and can directly measure the level of purity in high-grade gases.

The 3160 computer uses an Intel® 80188 microprocessor combined with 32 kilobytes of random access memory (RAM) and 128 kilobytes of read-only memory (ROM). The total computer program resides in the ROM and is not affected by shut-down periods, loss of power, or battery failure. However, calibration parameters and stored measurement readings are retained in battery-backed-up RAM, which require continuous battery voltage in order to be retained. This information will be lost if battery power is interrupted, as in battery replacement.

Two displays help you monitor trace oxygen levels: a red 4-digit light emitting diode (LED) display with one-inch numerals is easily read at a distance or even in bright daylight, and a liquid crystal display (LCD) helps you keep track of alarm setpoints, ranges, mode and system statistics.

1.1.2 Variable Features

Various models are available. The following features describe the basic model, but the exact configuration depends on the standard options incorporated. Paragraph 1.3 contains a list of standard variations on the basic model.

The Class B-2 Micro-Fuel Cell measures trace O₂ in a mixture of gases. Because the Micro-Fuel Cell sensor is a sealed electrochemical device, it is replaced as a unit. There are no electrolytes to change or electrodes to clean, making the sensor maintenance free. The analyzer can be configured with one or two sensor blocks. Each block can be isolated by pneumatically switched valves. The software automatically adjusts when a second cell block is present.

1 Introduction

The 3160 features six full-scale linear ranges of analysis:

- 0–1 PPM
- 0–10 PPM
- 0–100 PPM
- 0–1000 PPM
- 0–1%
- 0–25%

An AutoRanging feature automatically selects the range that is appropriate for a given reading. For example, if the O₂ level exceeds 100% of the current range, the analyzer switches to the next higher range. When desired, a manual override feature allows a particular range of interest to be locked-in.

With the AutoSpan feature, the analyzer automatically calibrates at scheduled intervals, and automatically performs electronic zeroing and sensor settling detection during calibration.

Five user-programmable absolute-reading (PPM) alarm setpoints with assignable Form 1C (SPDT) relays are provided, along with a RS-232C bidirectional serial data port, and four signal outputs for chart recorders, etc. The RS-232 serial port can be used with or without a modem to connect with

- a personal computer loaded with the Teledyne Remote Analytical Control Software (TRACS)
- any terminal or terminal emulation software
- a custom computer program

Several analyzer functions, including troubleshooting, can be run from your PC through the phone line to the analyzer.

The analyzer has separate sample and span gas ports, which allow the installation of an external source of span gas for calibration without interfering with the sample gas line.

An optional scrubber installed into the sample system allows sample gas to be used as a zero gas after treatment with the scrubber. If the scrubber is installed, pneumatic valves on either side of the scrubber open automatically during zeroing.

Note: Units equipped with a scrubber should only be used with inert gases and saturated hydrocarbons.

The analyzer output is not affected by minor changes in the flow rate. Analyzer performance is stable under minor mechanical vibration.

1.2 Components

The analyzer is designed to mount in a standard 19-inch rack. All of the operational controls are easily accessed through the front panel. The analyzer contains each of the following:

- Analysis Section
 - Single or Dual Electrochemical Micro-Fuel Cell
 - Sample System
- Power Supply
- Microcontroller Module
- LED Display

The front panel consists of:

- LED Display
- LCD Display with Touch Panel
- Micro-Fuel Cell Access Panel
- Flowmeter and flow set knob

The back panel ports are:

- Gas Inlet/Outlet Ports
- Electrical Connections

1.3 Options and Model Numbers

The 3160 is available with the following standard options, which are designated by a descriptive suffix on the model number. Most of the options can be combined.

- **3160SA** Single fuel cell.
- **3160SB** Single fuel cell and oxygen scrubber
- **3160DA** Dual fuel cell
- **3160DB** Dual fuel cell and oxygen scrubber
- **3160SAS** Single cell and stainless steel cell block
- **3160SBS** Single cell, stainless steel cell block, and oxygen scrubber
- **3160DAS** Dual cell and stainless steel cell block
- **3160DBS** Dual cell, stainless steel cell block, and oxygen scrubber

1.4 Applications

The analyzer is an invaluable tool in the following applications and industries:

- Inert and gaseous hydrocarbon stream monitoring.
- Measuring the purity of various gases in air separation plants.
- Prevention of oxidation by measuring the purity of blanketing gases in fiber and glass industries.
- Monitoring and controlling gas atmospheres in the heat treatment of metals in steel and other metal industries.
- Gas analysis and research in laboratories and research and development areas.
- Semiconductor manufacturing.
- Process monitoring of gaseous monomers—vinyl chloride, propylene, butadiene, or ethylene.
- Gas purity certification.
- Glove box leak detection.
- Natural gas treatment and transmission.
- Inert gas welding of exotic metals.

Operational Theory

2.1 Principles of Operation

The sub-systems that make up the analyzer are:

1. Micro-Fuel Cell Sensor
2. Sample System
3. Electronic Signal Processing

The Micro-Fuel Cell sensor is an electrochemical galvanic device that translates the amount of oxygen present in the sample into an electrical current. The sample system delivers the sample gas in a form that is as unaltered as possible for testing, and for leak-free transport of gases through the analyzer.

The electronic signal processing unit (control module) is designed to simplify the operation of the analyzer and accurately process the signal from various components. The control module incorporates a microprocessor which allows the operation of the analyzer with a minimum of operator interaction. Figure 2-1 illustrates major components.

2 Operational Theory

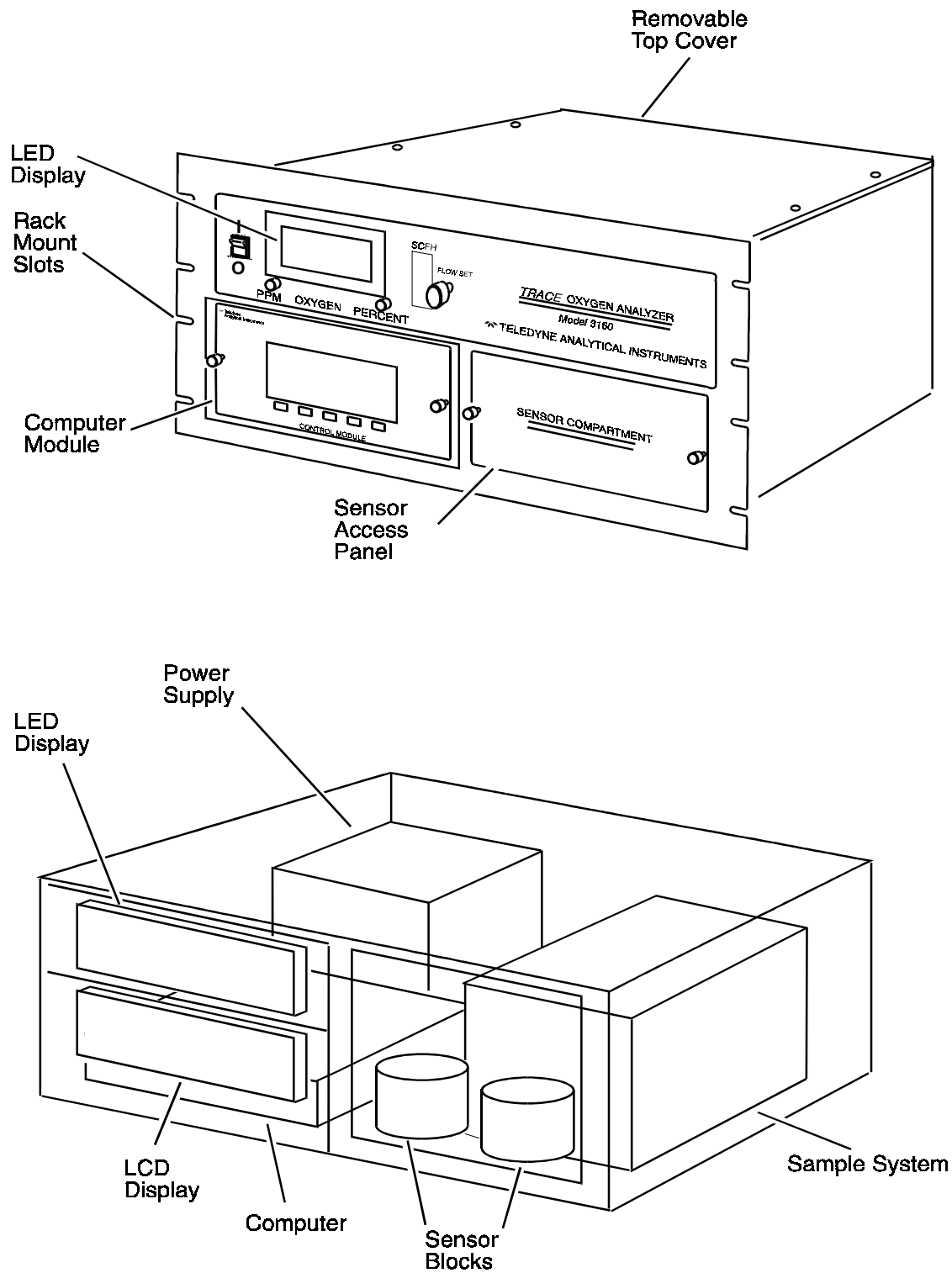


Figure 2-1. Major Components.

2.1.1 Micro-Fuel Cell Sensor

The Micro-Fuel Cell is a sealed plastic disposable oxygen transducer that measures 1¼ inches in diameter and is ¾ inch thick. Inside of the cell are a cathode and anode immersed in 15% aqueous KOH electrolyte. At one end of the sensor is a Teflon diffusion membrane; the other end is sealed with a polyethylene membrane. At the rear of the cell is a contact plate consisting of two concentric foils. The foils mate with spring-loaded contacts in the sensor block assembly and provide the electrical connection to the rest of the analyzer.

The sensing cathode, located beneath the diffusion membrane, has a surface area of 2.48 cm². The sample gas enters the sensor block through an inlet tube between the cathode and the sensor block cap, diffuses through the Teflon membrane, and any oxygen in the sample gas is reduced on the surface of the cathode by the following mechanism:

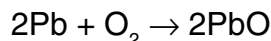


When the oxygen is reduced at the cathode, lead is simultaneously oxidized at the anode by the following mechanism.



The electrons released at the surface of the anode flow to the cathode surface via an external circuit. This current is proportional to the amount of oxygen. It is measured and used to determine the oxygen concentration in the gas mixture.

The overall reaction for the fuel cell is:



The output of the fuel cell is limited by the amount of oxygen in the cell at any one time, and the amount of stored anode material. In the absence of oxygen, there is no current generated.

2.1.2 Sample System

The sample system delivers gases to the Micro-Fuel Cell sensor from the analyzer rear panel inlet. Depending on the mode of operation either a sample or zero gas is delivered.

The Model 3160 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 following list of sample system and analyzer features are among those available, but the exact configuration depends on the standard options incorporated. Paragraph 1.3 contains a list of the standard variations on the basic model.

2 Operational Theory

- Electropolished 316L-type stainless steel components.

To eliminate oxygen absorption and desorption from the internal wetted surfaces of the sample system components, the sample system is fabricated from electropolished 316L-type stainless steel.
- Welding/Metal Gasket-Type Fittings.

All of the joints upstream of the Micro-Fuel Cell oxygen sensor are orbitally welded. Orbital welding is used in the sample system wherever feasible. Orbital welding fuses the electropolished 316L stainless steel components together, forming a smooth, clean internal (wetted) weld junction and eliminating small spaces around the weld junction where gases can get trapped or absorbed. All of the weld junctions in the entire assembly are purged using an inert gas during welding to ensure that there is no oxygen contamination.

Orbital welding is used where practical; otherwise, conventional precision welding is used. For example, conventional precision welding is used to fuse the tubes to the mounting blocks.
- Valves.

The analyzer sampling system utilizes three different types of valves. Each valve is selected to prevent oxygen contamination of the sample depending on its position and purpose in the circuit.

Air-Actuated Bellows Valves: These valves are normally closed in the sample system. They are used to control the delivery through the sample system of the sample or zero gas. The valve bodies are orbitally welded in the system and the valve bonnets make a metal-to-metal seal to the body. This valve system eliminates inboard and outboard gas leakage. The valves are activated (open/closed) by computer-controlled solenoid valves.

Metering Valve: The metering valve is used to manually control the gas flow rate to the sensor. The body of the metering valve is orbitally welded, and the bonnet is sealed to the body with metal O-rings. This type of valve eliminates inboard and outboard gas leakage.

Solenoid Valves: The solenoid valves control the air flow to the air-activated bellows valves. The solenoid valves are controlled by the microprocessor module. When de-energized, the valve outlet is open to ambient air, allowing the air-activated bellows valve to close.
- Scrubber (optional). See Appendix for details.

In systems with a scrubber, oxygen-trapping media is used to remove any trace oxygen from the sample gas. This occurs automatically in the zero menu, where the pneumatic valves leading to the scrubber are triggered by a certain menu sequence. This process enables sample gas

to be used to zero the analyzer, eliminating the need to switch external tanks.

- Overall Design.

The design of the sample system minimizes the volume of dead space, which can retain residual gas from another route or previous mode of analysis.

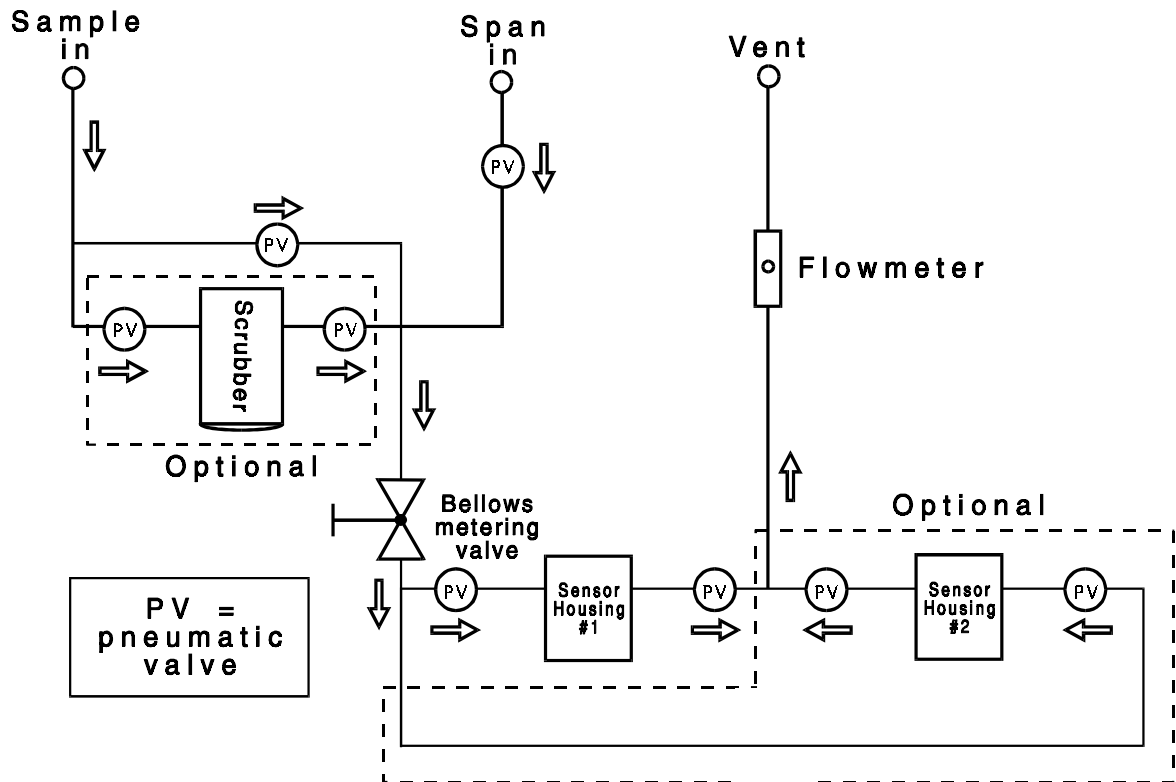


Figure 2-2: Model 3160 flow schematic.

2.1.3 Electronics and Signal Processing

The Model 3160 analyzer has an embedded microcomputer, which controls all signal processing, input/output, and display functions for the analyzer. System power is supplied from a power supply module designed to be compatible with any international power source.

The microcomputer, a liquid crystal display (LCD), and all analog signal processing electronics are located inside a replaceable control module. A light emitting diode (LED) display is located outside the control module.

2 Operational Theory

Electronics in the analyzer are grouped according to function:

1. Analog in
2. Analog out
3. Digital circuit
4. Power supply

Analog signal processing is accomplished in two plug-in circuit cards operating under control of the microcomputer. All analog signals are converted to digital early in the processing cycle to minimize analog processing and assure maximum system accuracy, since digital processing is much more accurate than analog and immune to many parameters such as drift and aging.

The initial processing and digitization of the signal from the Micro-Fuel Cell takes place on two circuit boards: the six-decade programmable printed circuit board (PCB), and the analog input board.

The first step in the chain takes place on the six-decade programmable PCB, which is mounted directly on top of the cell block. The output of the sensor is a current that is linearly proportional to the oxygen concentration. At low concentrations, the current from the sensor is low, which makes the close physical proximity of the pre-amp circuitry to the Micro-Fuel Cell necessary.

The sensor current is routed into a low-offset, low-bias current operational amplifier configured as a current-to-voltage converter. The signal is sent through two amplifiers to the analog input board. The pre-amp board provides sensor zeroing and a connection to the thermistor in the sensor cell block.

The analog input PCB, which plugs into a DIN connector on the digital PCB, performs three functions:

- Temperature compensation in the sensor signal
- Sensor offset correction
- Digitization

A thermistor inside the sensor block registers resistance and thus the temperature of the sensor. Accordingly, an analog-to-digital converter configured as a digitally-programmed attenuator (DPA) is used to reduce or increase the gain of the sensor signal, so that the signal coming out of the DPA is independent of temperature.

If the software determines that the sensor needs offsetting, the sensor current is back-calculated and an analog-to-digital converter on the analog board is driven by the software to produce a voltage that is used to force a current into the current-to-voltage converter located on the pre-amp board. The current injected is equal and opposite in polarity to the portion of the sensor current that needs offsetting.

Digitization is provided by a 12-bit analog-to-digital converter, which digitizes the oxygen and temperature signals.

The analog output printed circuit board (PCB) generates the two 0–1 volt and the two 4–20 mA analog signal outputs available on the rear panel of the analyzer. These signals, generated in digital format by the microcomputer, are converted into analog signals by the circuitry on this PCB. The output signals represent the following:

- **0–1V Signal (Oxygen Measurement):** This output goes from 0 to 1, representing 0 to 100% of the scale that has been set; i.e., 0.6 volt is equal to 60% of the full scale, or 6 PPM when on the 10 PPM scale. It is possible that the signal may go past zero into the negative range up to -0.25, especially if the analyzer has been zeroed with a gas that contains a significant concentration of oxygen. See Figure 2-3.
- **0-1V Range Identifier:** This 0 to 1 volt output represents each range with a particular voltage as shown in Table 2-1.
- **Isolated 4–20 mA Signal (Oxygen Measurement):** This is a 4 to 20 mA output representing 0 to 100% of the scale, with 4 mA equal to 0%, and 20 mA equal to 100% of that range. This output may also range lower than 4 mA, especially if the analyzer has been zeroed with a gas that contains a significant concentration of oxygen. See Figure 2-3.
- **Isolated 4–20 mA Range Identifier:** This 4 to 20 mA output represents individual ranges with discrete current output as shown in Table 2-1.

Table 2-1. Range Identifier

Range	Scale	Identifier Voltage (V)	Identifier Current(mA)
1	1 PPM	0.0	4.0
2	10 PPM	0.2	7.2
3	100 PPM	0.4	10.4
4	1000 PPM	0.6	13.6
5	1%	0.8	16.8
6	25%	1.0	20.0

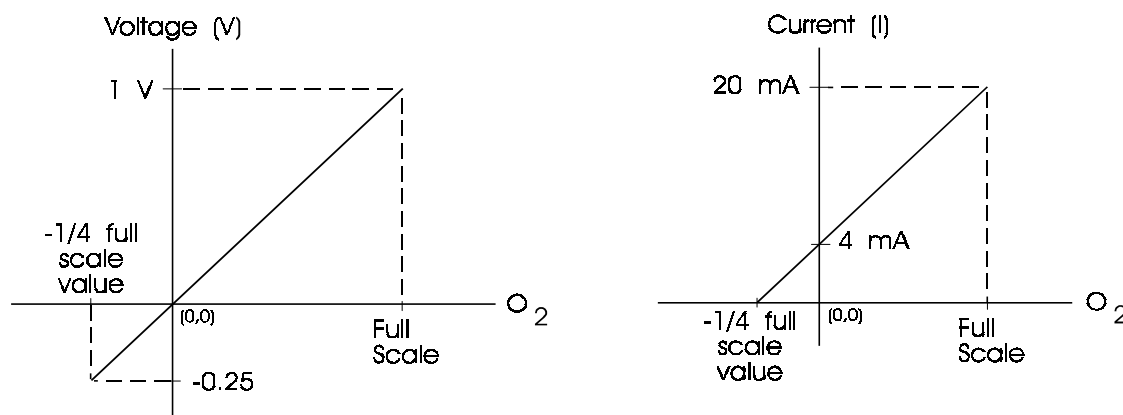


Figure 2-3: Analog signal output offset

2 Operational Theory

The digital printed circuit board (PCB) is a general purpose microcomputer used to control all functions of the analyzer. The analog input PCB and the analog output PCB plug directly into connectors located on the digital PCB. In addition to controlling these analog PCBs, the digital board performs the following functions:

1. Processes input from the control panel pushbuttons.
2. Provides signals for the selectable alarms.
3. Processes serial I/O functions (RS-232 data). The serial interface default and programmable parameters are listed in Table 2-2.

Table 2-2. Default and Programmable Parameters

Defaults	Programmable Options
1200 Baud	1200 Baud
8 Bits	5, 6, 7, or 8 Bits
No Parity	Even, Odd, or No Parity
1 Stop Bit	1 or 2 Stop Bits

4. Controls the LCD and the LED displays.

LCD: This screen is a dot-matrix display located on the control module of the analyzer. It is the user interface for system operations. It displays the menus and command options available for each function.

LED: This screen is a 7-segment display located on the front panel of the analyzer, above the control module. It displays only the oxygen concentration. It is large and bright to allow the operator to read it at a greater distance. A dimmer switch for this display is located on the display PCB behind the front panel.

The analyzer power supply module is a replaceable assembly containing four power supplies and five alarm relays. Electronic circuitry used to drive and interface the alarm relays to the output of the microcomputer is also located inside this module.

Note: This power supply contains an International Power Entry Module. This feature allows operation on any of four international voltage ranges: 100V, 120V, 220V or 240V (50Hz or 60Hz). It also facilitates both North American and European fusing arrangements. Programming this module is described in the installation section of this manual.

Installation

Installation of the analyzer includes:

1. Unpacking the system.
2. Recognizing the necessary precautions when installing the system.
3. Hooking up the sample/span gas and air supply to appropriate connections.
4. Installing the Micro-Fuel Cell sensor(s).
5. Hooking up electrical connections.
6. Testing the system.

3.1 Unpacking the Analyzer

The analyzer is shipped with all the materials and special items 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. Remove the packing slip and verify that you have received all the components listed in Table 3-1.

Table 3-1. Accessory Kit for Model 3160

Qty	Part No.	Description
3	G285	Weld glands, VCR-type
3	G284	Gaskets, VCR-type
3	N284	Nuts, female (Hoke 4NM316)
2	W64	Wrench, Open End, 3/4"–5/8"
1	M52973	Instruction Manual

3.2 Front Panel

The Model 3160 front and rear panels are illustrated in Figure 3–1 on the following page. The front panel contains the following displays and controls:

1. Main power switch.
2. Light Emitting Diode (LED) display: the O₂ concentration is displayed in bold lettering.

3 Installation

3. Parts Per Million (PPM) and Percent Oxygen indicators: the PPM light will light while the instrument is measuring O₂ in units of PPM. The percent light will light while the instrument is measuring O₂ concentration in percent.
4. Flow Indicator and Flow Set: a flowmeter and flow set knob are provided for adjusting gas flow in standard cubic feet per hour (SCFH).
5. Liquid Crystal Display (LCD) with keypad: the LCD shows system menus and data during instrument operation. The keypad is the primary user-input device used to enter information in the system.

3.3 Rear Panel

Figure 3-1 also shows the rear panel of the 3160. Located on the rear panel are the following electrical power and gas input ports, alarm relay outputs, and analog and digital outputs:

1. Gas Input/Vent: three input fittings are provided for span gas, sample gas, and compressed air for pneumatic valve operation. A single vent is used for the sample and span gas outlet. Consult the Appendix for scrubber selection.



2. AC Power Input: 110, 120, 220 or 240 V ~ at 50/60 Hz 1.5 A MAX.
Use 250 V 1.6 A T Fuse for 110, 120 V ~
Use 250 V 0.8 A T Fuse for 220, 240 V ~
3. Alarm Circuit Connections: there are five contact closures/openings provided for external alarms. The alarm functions are defined by the user via keypad input within the LCD menu system.
4. Analog Outputs: four analog output connectors are provided for use with a chart recorder. Two provide range and data in voltages; the other two provide range and data for current-driven recorders.
5. RS-232 Serial Port: a 9-pin digital input/output connector is provided for connecting either a serial printer or a serial link to an external computer. Optional serial link software (such as TRACS) can be used with the instrument for remote external computer monitoring and control of the instrument, via modem or hardware link.

DIMENSIONS: $\frac{\text{In}}{\text{mm}}$

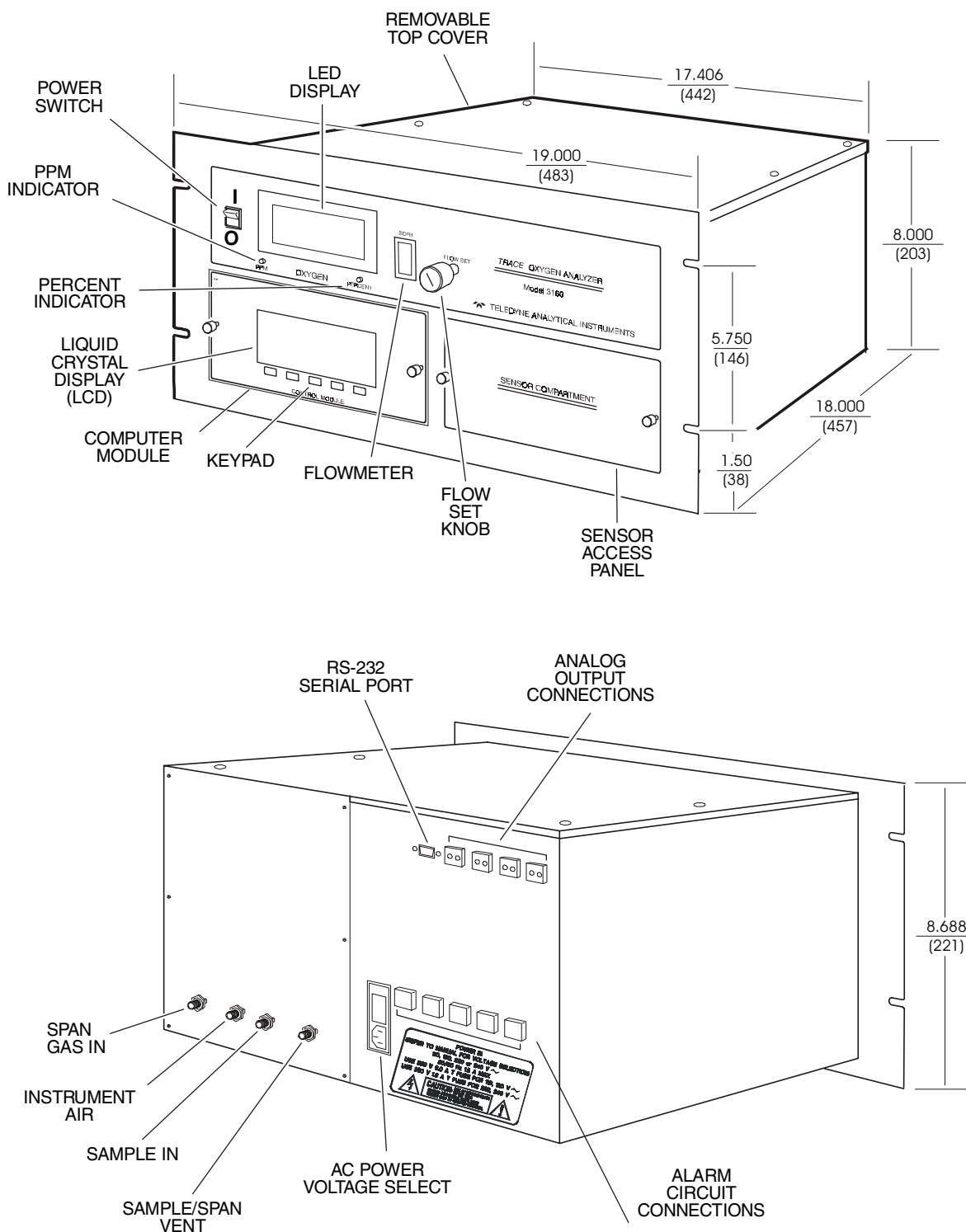


Figure 3-1: Analyzer front and rear panels.

3 Installation

3.4 Gas Line Connections

All of the gas lines to the system hook up at the back of the unit (see Figure 3–1). All of the fittings on the removable back panel are ¼ " male VCR type fittings, with the exception of the compressed air inlet fitting. Use the wrenches provided to connect the gas lines. Insert the gasket between the fitting and tighten the female and male nuts until finger-tight; then, by holding the male nut with the wrench, tighten the female nut with the second wrench by ¼ turn.

CAUTION: Do not put any torque on the tubes welded on the sampling system.

Check that each of the lines is hooked up to the correct connection. The lines should be connected in the following order (from left to right):

3.4.1. Span Gas In

Provide at least one sample gas of a known oxygen concentration. Using 70-99 % of the range just one range above the range of interest is recommended. Any range EXCEPT 0-1 ppm may be used to calibrate.

3.4.2. Instrument Air (Compressed Air Fitting)

The gas pressure (70–80 psi) needed to operate the pneumatic valves in the analyzer can be supplied through this fitting.

CAUTION: Pressure higher than 80 psig can damage the solenoid valves.

3.4.3. Sample Gas In

Hook up the sample gas to the sample gas inlet. When the sample gas flows through the optional oxygen scrubber, the sample gas becomes the zero gas and can be used for calibration.

Note: Sample and span gas pressure should be between 5 and 10 psig and within ±2 psi of each other. A substantial difference in the span and sample gas pressures will cause a sudden change in gas flow rate.

3.4.4. Vent

The vent transports the sample or span gas out of the system after exposure to the Micro-Fuel Cell sensor.

3.5 Micro-Fuel Cell Sensor Installation or Replacement

The 3160 comes with the Micro-Fuel Cell(s) already installed. When installing or replacing the cells, remember to inspect the replacement sensor for leaks or damage. See Figure 3-2.

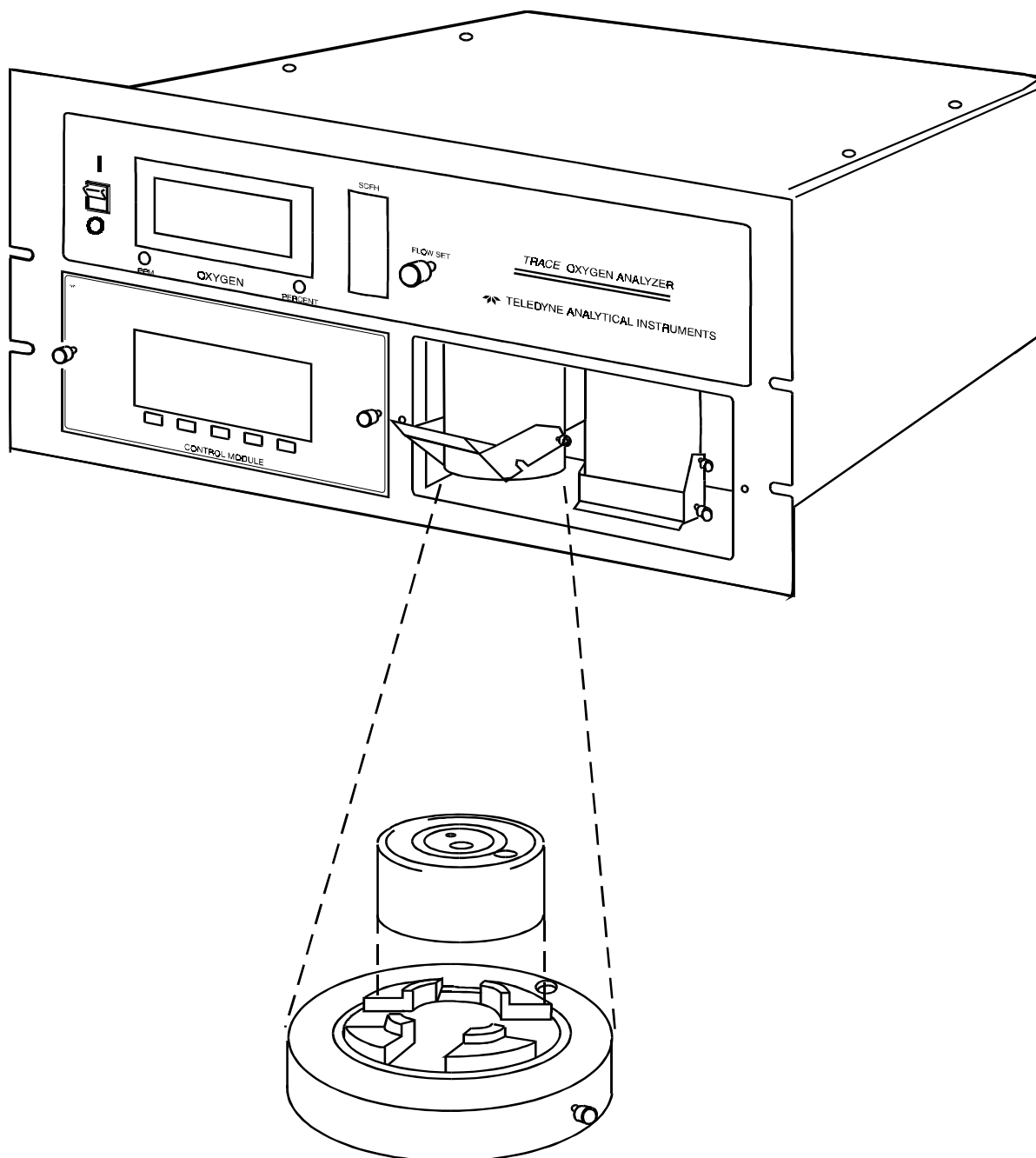


Figure 3-2: Sensor Installation.

3 Installation

1. The sensor compartment is located in the lower right-hand corner of the analyzer front panel. To remove the sensor compartment panel, loosen the thumbscrews located left and right center of the panel.
2. Make sure that sample gas is flowing through the analyzer, then shut off the flow completely. This insures that air does not diffuse into the analyzer.
3. Inside the compartment should be two (one) stainless steel cylindrical sensor block(s), each with a clamp lever across the front. The bottom half of the clamp face is bent outward. To release the clamp, pull the clamp lever up and toward you slowly.
4. Releasing the clamp releases the stainless steel block cap on the bottom of the sensor block. Pull the cap downward to remove it. There is a guide pin to the rear of the sensor block that aligns the cap to the block.

Note: It is important to minimize the amount of time that the new cell is exposed to air in order to reduce the time required for the reading to drop to zero.

5. Remove the Micro-Fuel Cell from the plastic bag. The cell has a mesh screen with a raised plastic dress ring on one side and flat gold contact rings on the other. Place the screen side of the cell face down on the block cap so that the dress ring locks onto the cap ridges and will not move side to side. The gold contact rings will be facing up.
6. Carefully guide the sensor and cap into the block, putting the guide pin through the hole in the back edge of the cap.
7. While holding the cap in place, squeeze the clamp down **firmly** until the notches on the clamp lock onto the block side pins.
8. Immediately start the sample flow, and set to about **2 SCFH**. The analyzer now needs to be zeroed and calibrated.

3.6 Electrical Connections

All of the electrical connections are located on the analyzer back panel. The analyzer is shipped with all of the electrical connections intact, with no assembly or installation required. The power cord receptacle is located in the lower center of the panel. The voltage selection terminal and the fuse block are in the same fitting directly above the power cord receptacle. There are four output signal connectors with screw terminals in the upper right-hand panel. There are two wires per output with the polarity noted below each. The five alarm circuit connectors, located in the lower center right-hand panel, are screw terminals for alarm relay contacts. These five provide a set of Form C contacts for the user. The contacts are capable of switching up to 3 amperes at 115 V ac into a resistive load.

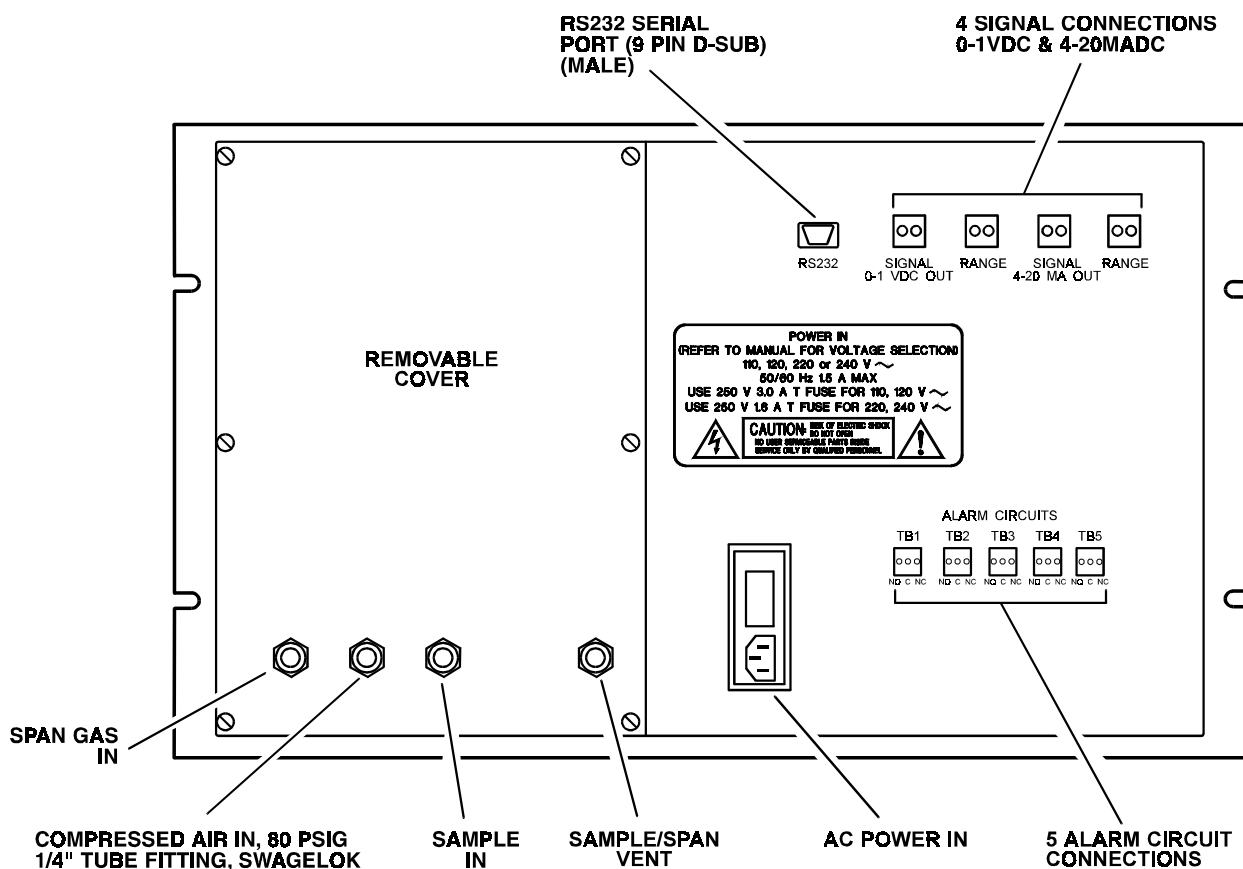
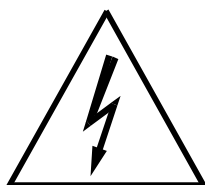


Figure 3-3: 3160 Rear Panel.



3.6.1 Voltage Selection

WARNING: Power cord must be disconnected before performing any voltage selection!

The voltage setting and fuses of the analyzer can be changed to international standards. To change the voltage setting or fuses:

1. Open the cover using a small blade screwdriver.
2. Remove the cover and the fuse block assembly.
3. Pull the voltage selector card straight out of the housing by pulling on the indicator pin (see Figure 3-4).

3 Installation

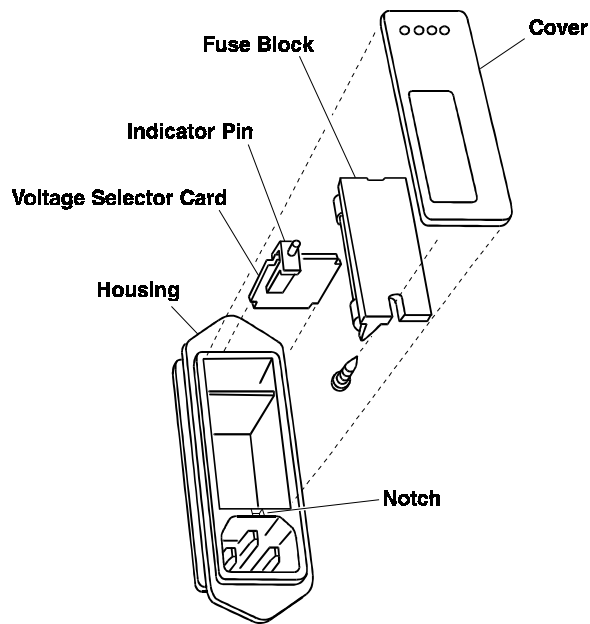


Figure 3-4: Removing the Voltage Card

4. Turn the card so that the desired voltage can be read at the bottom.
5. Slide the indicator pin around the card so that it is pointing up when the voltage is read at the bottom (see Figure 3-5).

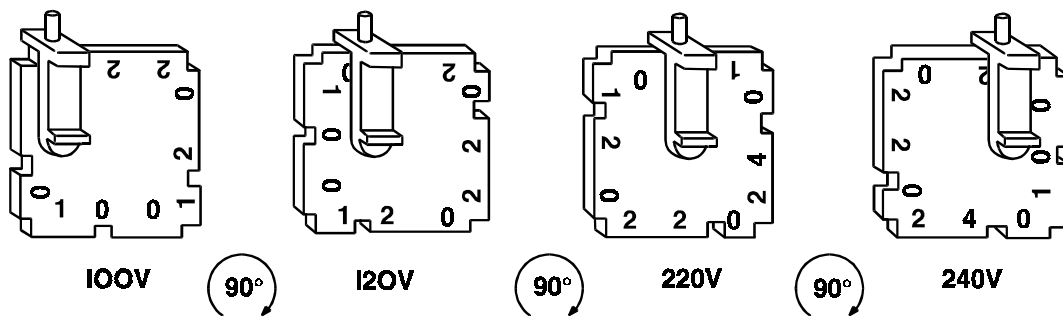
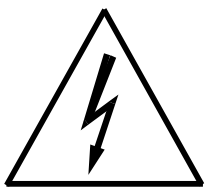


Figure 3-5: Voltage Selection

6. Place the voltage selector card back into the housing. The edge where the desired voltage is printed should go in first and the printed side of the card should be facing the IEC connector.
7. Replace the fuse block and the cover. Verify that the indicator pin is pointing to the correct voltage.

3.6.2 Fuse Changing

NOTE: Spare fuses are located in a clip attached to the power supply enclosure inside of the analyzer.



WARNING: Power cord must be disconnected before performing any voltage selection!

To change from North American to European fuses, perform the following:

1. Use a small blade screwdriver to open the cover.
2. Loosen the Phillips screw two turns and remove the fuse block by sliding it away from the screw and up from the pedestal.
3. Remove the North American fuse and turn the fuse block over.
4. Replace the fuse with European fuses. Two European fuses are required, but the lower one may be replaced with a dummy fuse, or jumper bar (see Figure 3-6).

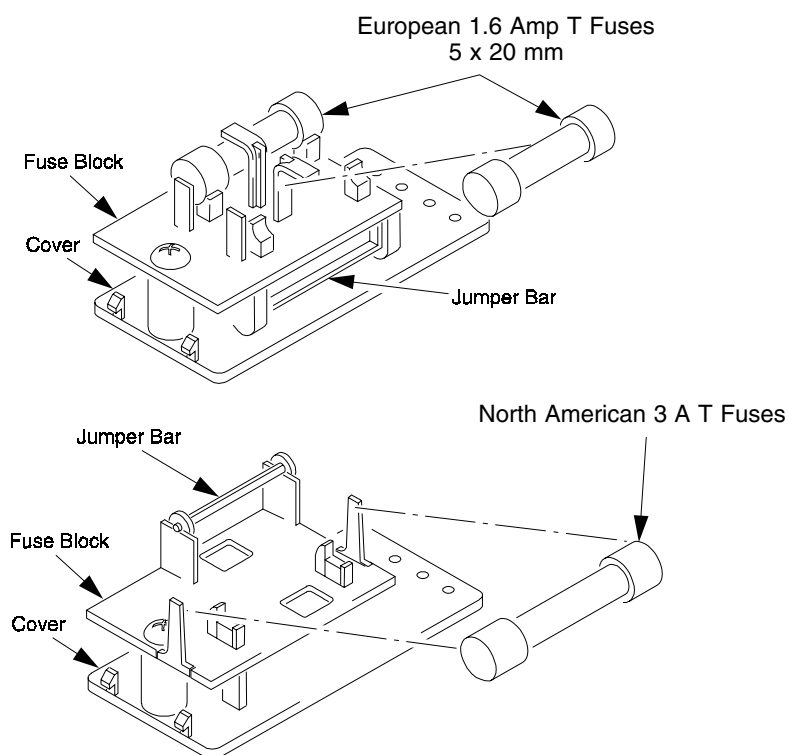


Figure 3-6: Fuse Replacement

5. Slide the fuse block back on the Phillips screw and pedestal.
6. Tighten the Phillips screw and replace the cover.

NOTE: The fuses that go into the housing first are the active set.

3 Installation

3.6.3 RS-232 Serial Digital Port

The RS-232 port is configured as data terminal equipment (DTE) and uses a 9-pin D connector wired as follows:

1. No connection
2. Transmit Data
3. Receive Data
4. N/C
5. Ground
6. N/C
7. RTC
8. CTS
9. N/C

Connecting the analyzer to a modem requires a PC to modem cable. When connecting the analyzer directly to a PC, terminal or other data terminal equipment, a “null-modem” cable is required.

The following serial interface default parameters are used:

Defaults	Programmable Options
1200 Baud	1200 Baud
8 Bits	5, 6, 7, or 8 Bits
No Parity	Even, Odd, or None
1 Stop Bit	1 or 2 Stop Bits

3.7 Installation Checklist

Have you:

- Checked for leaks from any of the rear panel connections?
- Checked the sample and span gas pressures (5–10 psi)?
- Checked the instrument air pressure (70–80 psi)?

Operations

4.1 Front Panel Controls

The front panel of the analyzer, shown in Figure 4-1, contains indicators and displays through which the computer module can be accessed. The upper left-hand side of the panel has an LED screen that displays the oxygen content of the sample in one-inch high numerals. This display can be brightened or dimmed by a potentiometer located directly behind the panel inside of the analyzer case. To access it, remove the top cover of the analyzer.

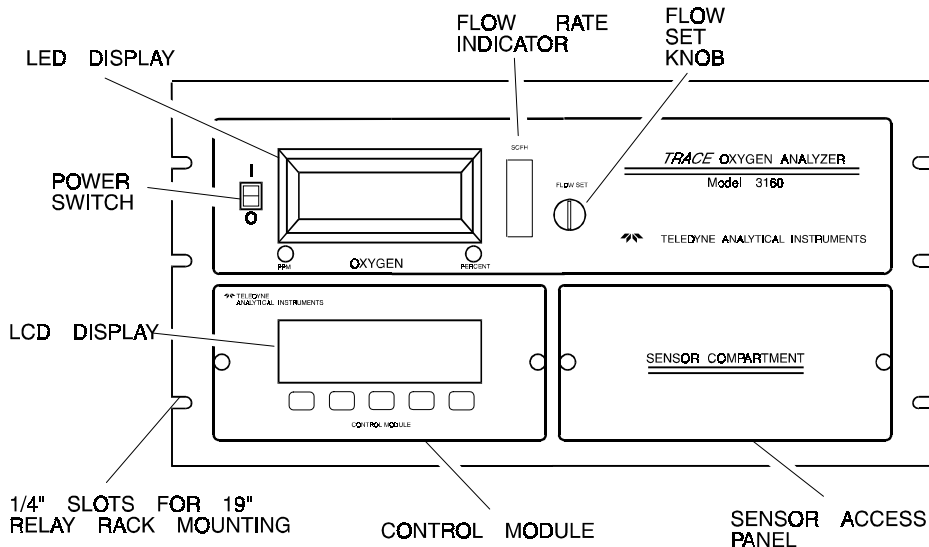


Figure 4.1: Analyzer front panel.

Below the LED screen are two red LED lights. Each will light to indicate whether the oxygen is being displayed in parts per million (PPM) or percent (%).

To the right of the LED screen is a flowmeter in standard cubic feet per hour (SCFH). The flow set knob adjusts the flow rate of the gas during calibration and zeroing.

In the panel below the LED screen is the LCD display. The five colored buttons below it are used to interface with the computer module in selecting modes, with the LCD

4 Operations

displaying the function of each button directly above it. The LCD screen displays the current mode and any warning messages, instructions and button functions.

4.1.1 Spinning Wheel

A “spinning wheel” appears in the upper left-hand corner of the LCD display to indicate that the alarms are enabled (any that are not defeated), or that scheduled zeroing (AutoZeroing) or scheduled spanning (AutoSpanning) may take place. If the spinning wheel does not appear, the alarms are disabled, and a scheduled zero or span is defeated. Note that there is a delay of several minutes before the spinning wheel appears whenever the Analyze mode is re-entered.

4.1.2 Cell Output Factor (Span Factor)

The expected life of the Micro-Fuel Cell sensor is about eight months. A guide to the relative life left in the cell can be found on status page 2 (see System Statistics near the end of this chapter) or retrieved from the serial port through the serial command SF. The span factor ranges from 0.00 to 1.00, with 1.00 representing full life expectancy. A span factor below 0.1 indicates that the Micro-Fuel Cell needs replacing.

4.2 Modes of Operation

To use the system and select displayed options, press the button directly underneath the option you wish to select. There are eleven different menus:

Cold Start-Up: During the first startup, and when subsequent cold start-ups are chosen by the user, initial values set at the factory for alarms, I/O, calibration, zeroing and other data are used.

Upon cold start, zeroing and calibration should be performed before accurate oxygen measurements are obtained. A system warm start is automatically performed on each subsequent power-up. For a warm start, previous user-input configuration data is preserved in RAM by battery-preserved memory in the system control module.

Calibration Zeroing: For the highest possible accuracy, the analyzer must be zeroed using an oxygen-free gas. By eliminating normal background “noise” from the sensor reading, zeroing resets the level referred to as the “zero” oxygen concentration.

If the analyzer is equipped with a scrubber, it is important to zero the analyzer with a near-zero gas connected to the sample port. The zeroing process automatically opens pneumatic valves on either side of the scrubber, and a gas with a high concentration of oxygen will react with the scrubber and necessitate replacement sooner.

When waiting for manual sensor settling during calibration zeroing, wait until the oxygen concentration has reached its lowest value and has remained so for 10–15 minutes. It is important to make sure that the sensor is reading the lowest possible value, since zeroing will reset the point at which the sensor reads zero. Do not zero prior to reaching the lowest possible oxygen concentration. When initially installing the sensor(s), do a zero calibration, then a span calibration. If desired, the instrument may be programmed for automatic periodic zeroing (AutoZeroing) if the optional scrubber is installed. AutoZeroing uses the scrubber to generate a zero gas from a low O₂ sample gas.

NOTE: 1. Zeroing in the 0-1 PPM range preserves the life of the scrubber.

In scheduled zeroing and spanning (AutoZeroing and AutoSpanning), a time interval must be chosen. This interval determines how often the instrument zeros or spans itself. To change the scheduled time, edit it after setting the interval in the Set Up Clock Functions mode.

NOTE: 2. AutoZeroing and AutoSpanning may be delayed until the alarms have been enabled.

Calibration Using Span Gas: After zeroing, the instrument can now be calibrated using a span gas with a known oxygen concentration. The analyzer may be calibrated on any range other than 0–1 PPM, but it is best to calibrate one range up from the range where the sample is expected to be. The span gas concentration should be within 70% to 99% of full scale of the range selected.

NOTE: 3. Prior to calibration, allow the analyzer reading to come to a stable value with zero or sample gas flowing through the analyzer.

Select Active Sensor (Two cell blocks only): One or two O₂ sensor blocks can be installed in the system. In dual sensor systems, either sensor can be isolated with pneumatic valves, and the other sensor chosen as the active sensor for O₂ measurements. The system software is aware of how many sensor blocks are present, but will not automatically switch sensors should one fail.

This menu will not appear if only one cell block is installed.

Install Sensor and Test Alternate Sensor (Two cell blocks only): Procedures are provided for installing a new sensor and for testing the alternate O₂ sensor.

This menu will not appear if only one cell block is installed.

O₂ Range Set-Up: The measurement range may be manually chosen, or the system may be set to automatically choose the range (AutoRanging). In the AutoRanging mode, the range will step up at greater than 100% and step down at 80% of full scale of the current range. The analyzer is programmed to prevent oscillation between ranges during rapidly changing oxygen levels.

4 Operations

Set-Up Alarms: Each of five alarms provided may be programmed to actuate at any O₂ trace level above or below a threshold. The fifth alarm may also be programmed as a system alarm to monitor several system-level conditions. The system alarm can be triggered by the following system operations:

- Scheduled zero (AutoZero) failure
- Scheduled span (AutoSpan) failure
- Battery failure
- Internal errors

Any condition triggering the system alarm can be determined from status page 4 (see this chapter: System Statistics).

When the alarms are disabled, scheduled zeroing or spanning will not take place.

Logger Set-Up: A system data logger keeps a record of past oxygen measurements. The logger is presented in the form of a graphed chart on the system LCD; gaps in time will not display, and all points shown on a single chart have the same range and sensor number.

The logger will not record in the Test Alternate Sensor mode.

Set Up Clock Functions: An internal clock provides the time and date for events scheduled by the user. The internal clock is also used by the logger to record events scheduled at timed intervals.

Scheduled zeroing and spanning (AutoZeroing and AutoSpanning) are set in this mode. The mode uses an electronic timer to set off the zeroing or spanning sequence at pre-selected intervals. During an AutoZero or AutoSpan, the alarms are defeated and the screen displays “PLEASE WAIT. SCHEDULED SPAN IN PROGRESS.”

Since AutoZeroing and AutoSpanning uses automatic settling detection of the sensor, which can take up to fifteen minutes, oxygen monitoring will be interrupted for the length of time it takes to zero or span, after which monitoring will resume. The LCD will display the current background level during zeroing or spanning.

Changing Passwords For Remote Monitoring and Control:

Programmable security passwords are provided to prevent unauthorized access to remote monitoring and control. “Monitor” is the lowest authorization level and only permits monitoring of analyzer functions, while “Control” allows remote control of any function.

System Statistics: Menu screens are available to view various system parameters, and for setting serial link operation parameters, including modem operation.

Cold Start-Up

Model 3160 OXYGEN ANALYZER
 COPYRIGHT 1990, 1 VER: 1.0
 TELEDYNE ANALYTICAL
 INSTRUMENTS
 COLD START
 PLEASE WAIT ...

1 2 3 4 5

VALVE MODE = OFF
 TIME = 6:00:00 PM 12:01:90
 NEW TIME = 6:00:00 PM 12:01:90
 SET NEW TIME AND DATE

SELEC UP DOWN ACCPT ESC

1 2 3 4 5

VALVE MODE = OFF
 SENSOR A ON LINE
 SELECT SENSOR OR ESC

A B ESC

1 2 3 4 5

VALVE MODE = OFF
 CONNECT A SAMPLE GAS
 TO THE SAMPLE PORT
 --- PRESS ACK WHEN READY ---

ACK ESC

1 2 3 4 5

VALVE MODE = OFF
 SENSOR A ON LINE
 SET FLOW RATE TO 2 SCFH
 --- PRESS ACK WHEN READY ---

ACK ESC

1 2 3 4 5

VALVE MODE = ANALYZE
 SENSOR A ON LINE
 5.00 PPM O₂
 AUTORANGE: 10 PPM

ZERO SPAN SETUP RANGE ALMR

1 2 3 4 5

1. A cold start will automatically occur the first time you start the analyzer. In any other situation, you can cold start by turning the analyzer off and holding down the red key below the LCD screen while you turn the power back on. Continue to hold the red key until the screen comes on. There will be a two minute wait for system initialization before the second screen.

A warm start will take you directly to step 5.

2. Set the time using the SELEC, UP and DOWN keys, and press ACCPT.

3. Select sensor A or B as the active sensor. (This menu is omitted if only one cell block is installed.)

4. If you have not done so, connect the sample gas to the sample port and press ACK.

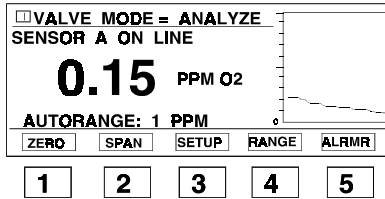
5. Using the valve and meter on the sample gas supply, set the flow rate to 2 SCFH and press ACK.

If you have warm-started, this is the second screen you will see.

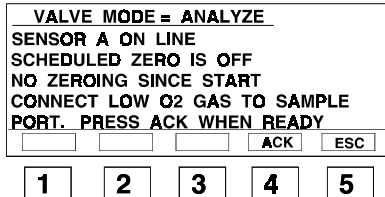
6. The main Analyze mode menu will appear, and the measured O₂ level of the sample gas will display. The system should first be zeroed, then spanned, to obtain the most accurate O₂ measurements.

4 Operations

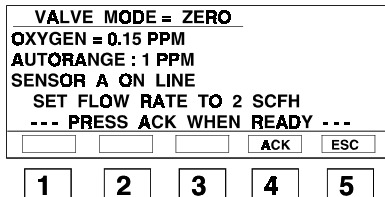
Calibration Zeroing



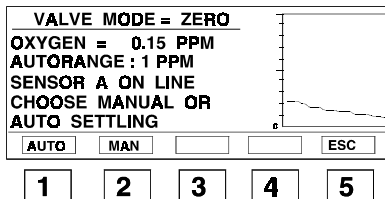
1. At the main Analyze mode screen press ZERO.



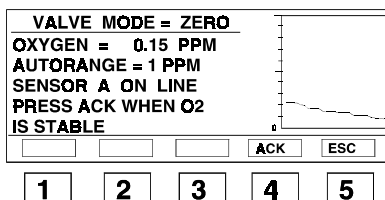
2. Press ACK to acknowledge that a low O₂ gas has already been connected to the sample port. The sample gas O₂ level should be close to zero to preserve the life of the scrubber (if one is installed).



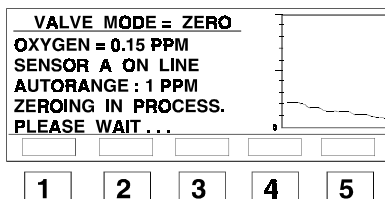
3. Set the flow rate to 2 SCFH using the knob on the system front panel and press ACK.



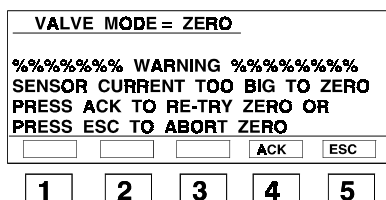
4. Press AUTO to let the system determine the settling time before spanning or press MAN for manual.



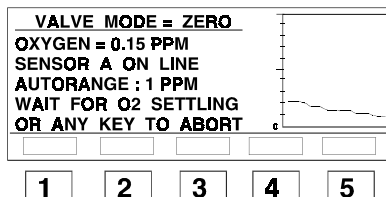
5. If MAN was chosen in step 4, watch the logger or the O₂ value on the screen to assess when the output is constant, and then press ACK.



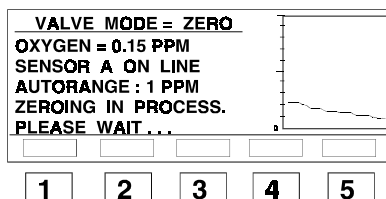
6. After step 5, the system will automatically span to the user-entered span value. If the zeroing is successful, the main Analyze mode menu will appear as in step 10.



7. If the O₂ cell current is too large to be zeroed, an error message will appear. Press ACK to retry or ESC to abort the zeroing process.

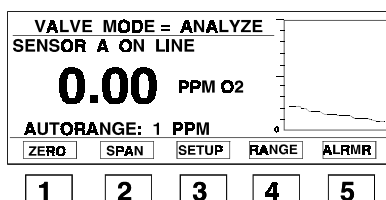


8. If AUTO was chosen in step 4, wait for the O₂ level to settle before the system zeros. This may take from thirty (30) seconds to fifteen (15) minutes, depending on the sample gas oxygen level.



9. After a stable low oxygen level is detected by the system, the system will automatically zero.

If the O₂ cell current is too large to be zeroed, an error message will appear (see step 7). You will then have to press ESC to abort, or ACK to retry.



10. If the zero is successful, the system will return to the main Analyzer mode menu.

4 Operations

Calibration Using Span Gas

VALVE MODE = ANALYZE
SENSOR A ON LINE
5.00 PPM O₂
AUTORANGE: 10 PPM

ZERO SPAN SETUP RANGE ALRM R

1 2 3 4 5

1. Enter the Calibration mode from the Analyze mode by pressing SPAN.

VALVE MODE = ANALYZE
SPANNING BEFORE ZEROING WILL
CAUSE INCORRECT O₂ READINGS
SCHEDULED SPAN IS OFF
NO SPAN SINCE START
--- PRESS ACK WHEN READY ---

ACK ESC

1 2 3 4 5

2. Press ACK if zeroing has already been done. Make sure to zero before calibrating to ensure correct O₂ readings.

VALVE MODE = ANALYZE
SENSOR A ON LINE
CONNECT THE SPAN GAS TANK
TO THE SPAN PORT
--- PRESS ACK WHEN READY ---

ACK ESC

1 2 3 4 5

3. If the span gas tank is not connected to the span port, connect it now and press ACK.

VALVE MODE = ANALYZE
OXYGEN = 5.0 PPM
AUTORANGE : 10 PPM
SENSOR A ON LINE
ENTER SPAN GAS CONCENTRATION
5.1 PPM

UP DOWN ACCPT ESC

1 2 3 4 5

4. Enter the span gas concentration using the UP and DOWN keys, and press ACCPT.

VALVE MODE = SPAN
OXYGEN = 5.00 PPM
AUTORANGE : 10 PPM
SENSOR A ON LINE
SET FLOW RATE TO 2 SCFH
--- PRESS ACK WHEN READY ---

ACK ESC

1 2 3 4 5

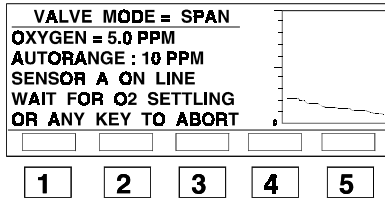
5. Set the flow rate to 2 SCFH and press ACK.

VALVE MODE = SPAN
OXYGEN = 5.0 PPM
AUTORANGE : 10 PPM
SENSOR A ON LINE
CHOOSE MANUAL OR
AUTO SETTling

AUTO MAN ESC

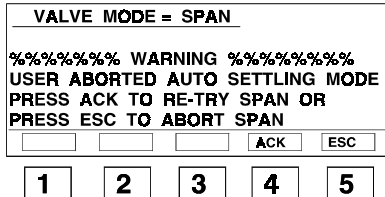
1 2 3 4 5

6. Select manual or automatic sensor settling detection by pressing MAN or AUTO. Automatic sensor settling detection lets the system determine when the sensor has stabilized.

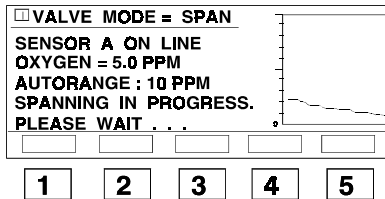


7. If AUTO was chosen in step 6, wait for the O₂ level to settle before the system spans. This may take from fifteen (15) to thirty (30) minutes or longer, depending on the sample gas oxygen level.

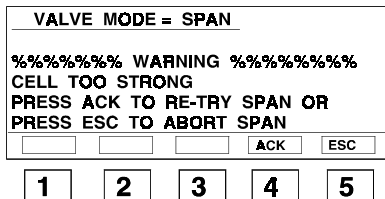
Go to step 11 if MAN was chosen in step 6.



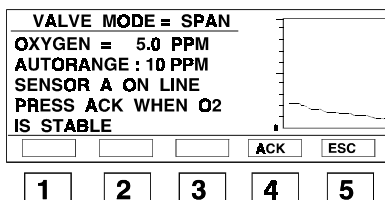
8. If any key was pressed in step 7, the screen indicates that the span has been aborted. Press ACK to retry spanning, or ESC to abort the span.



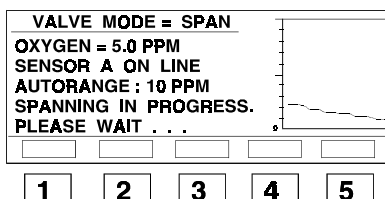
9. After the system has automatically detected sensor stability, the system will automatically span. If the system spans correctly, the next screen will be the Analyze mode main menu (see step 14).



10. If the O₂ cell current is too strong or too weak to be spanned, an error message will appear. Insure that the span gas concentration has been entered correctly. Press ACK to retry, or ESC to abort the span.

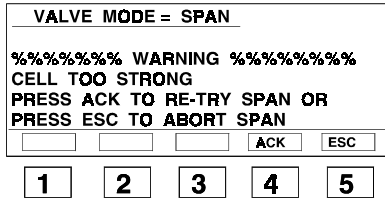


11. If MAN was pressed in step 6, watch the logger or the O₂ value on the screen to determine when the output is constant, and then press ACK.

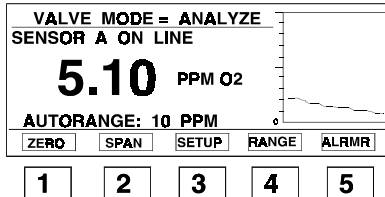


12. After step 11, the system will automatically span to the user-entered span value.

4 Operations

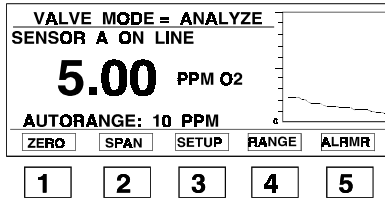


13. If the O₂ cell current is too strong or too weak to span, an error message will appear. This will not occur if the user-entered span gas concentration is correct. Press ACK to retry, or ESC to abort the span.

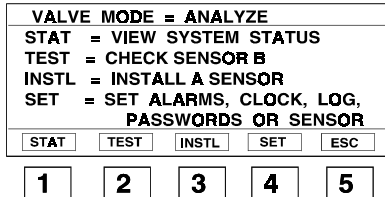


14. If the span is successful, the system will return the main Analyze mode menu. Check to see that the span value is correct.

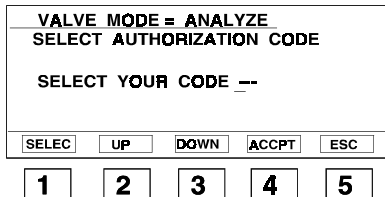
Select Active Sensor (Two Cells Only)



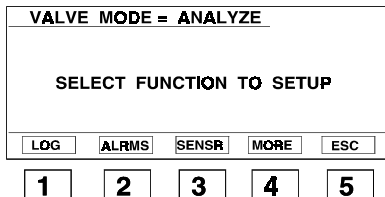
1. Enter set-up from the Analyze mode main menu by pressing SETUP.
If only one cell block is installed, the TEST and INSTL options on the next screen are omitted.



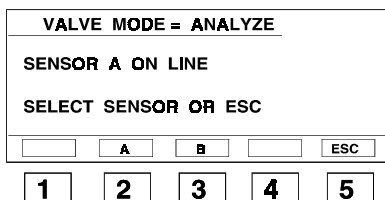
2. Press SET to change the active sensor.



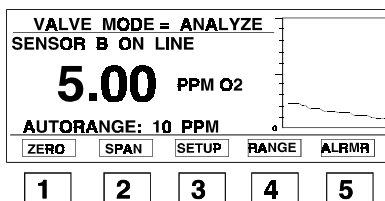
3. Enter your authorization code by using the SELEC, UP and DOWN keys, and press ACCPT.



4. Press SENSR. (This option will not appear if only one sensor block is installed.)



5. Select sensor A or B.



6. The main Analyze mode menu will appear, and will indicate the chosen sensor.

4 Operations

Install Sensor and Test Alternate Sensor (Two Cells Only)

VALVE MODE = ANALYZE				
SENSOR = A				
5.00	PPM O ₂			
AUTORANGE: 10 PPM				
ZERO	SPAN	SETUP	RANGE	ALRMR
1	2	3	4	5

1. Enter set-up from the Analyze mode by pressing SETUP.
If only one cell is installed, the TEST and INSTL options on the next screen are omitted.

VALVE MODE = ANALYZE				
STAT = VIEW SYSTEM STATUS				
TEST = CHECK ALTERNATE SENSOR				
INSTL = INSTALL A SENSOR				
SET = SET ALARMS, CLOCK, LOG, PASSWORDS OR SENSOR				
STAT	TEST	INSTL	SET	ESC
1	2	3	4	5

2. Press TEST to test the alternate sensor or INSTL to install a new sensor.

VALVE MODE = ANALYZE				
SENSOR A ON LINE				
PRESS ACK TO TEST SPARE SENSOR				
			ACK	ESC
1	2	3	4	5

3. If TEST was chosen in step 2, the active sensor is displayed and you are directed to press ACK to test the alternate sensor.

If INSTL was chosen in step 2, go to step 5.

VALVE MODE = ANALYZE				
OXYGEN = 5.00 PPM O ₂				
AUTORANGE: 1 PPM				
SENSOR B ON LINE				
FLUSHING, ALARMS DISABLED				
TIME REMAINING: 00:10:00				
SKIP	RESET			ESC
1	2	3	4	5

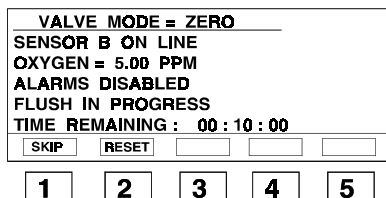
4. After pressing ACK in step 3, the alternate sensor is flushed for 10 minutes while the measured O₂ level is displayed. The 10 minute flush may be restarted by pressing RESET, or aborted by pressing SKIP. Go to step 8.

VALVE MODE = ANALYZE				
SENSOR A ON LINE				
PRESS A OR B FOR THE SENSOR TO BE INSTALLED.				
	A	B		ESC
1	2	3	4	5

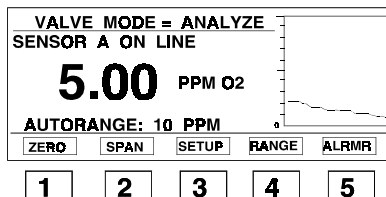
5. If INSTL was chosen in step 3, the screen will display the active sensor. Press A or B for the sensor you are installing.

VALVE MODE = ZERO				
SENSOR B ON LINE				
INSTALL THE NEW SENSOR QUICKLY.				
DO NOT LEAVE OPEN FOR MORE THAN 2 MINUTES				
PRESS ACK WHEN READY...				
			ACK	ESC
1	2	3	4	5

6. Install the sensor (either A or B from step 5) into the sensor block within two minutes, and press ACK.



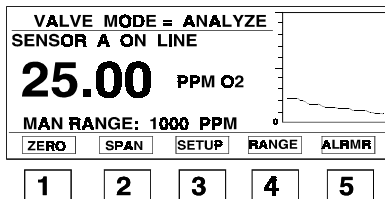
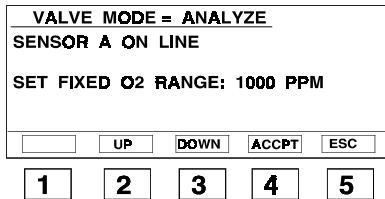
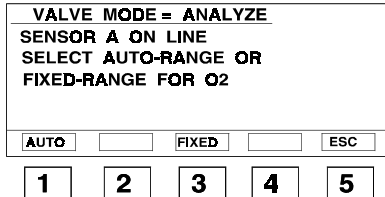
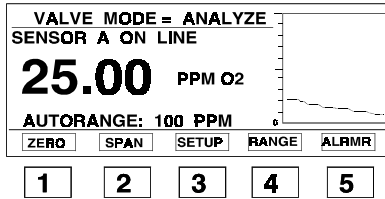
- After pressing ACK in step 6, the new sensor is flushed for 10 minutes while the measured O₂ level is displayed. The 10-minute flush may be restarted by pressing RE-SET, or aborted by pressing SKIP.



- When sensor installation or alternate sensor test are complete, the system will return to the main Analyze mode menu.

4 Operations

O₂ Range Set-Up



1. Enter Range Set-Up mode from the Analyze mode by pressing RANGE.
2. Press AUTO for AutoRanging, or FIXED to manually fix the O₂ measurement range. In AutoRange mode, the range will be automatically determined so that the O₂ measurements are within a range which maximizes the accuracy of the reading.
3. If AUTO is chosen in step 2, the main Analyze mode menu will appear, and will indicate the automatically determined range (see screen for step 1). If FIXED is chosen in step 2, use the UP and DOWN keys to choose the desired manual range, and press ACCPT.
4. If FIXED was chosen in step 2 and the range was specified in step 3, the main Analyze mode screen will appear, and will indicate the new manually set range.

Set-Up Alarms

VALVE MODE = ANALYZE		SENSOR A ON LINE	
5.00		PPM O ₂	
AUTORANGE: 10 PPM			
ZERO	SPAN	SETUP	ALRMR
1	2	3	4 5

1. Enter set-up from the Analyze mode by pressing SETUP.

VALVE MODE = ANALYZE				
STAT = VIEW SYSTEM STATUS				
TEST = CHECK ALTERNATE SENSOR				
INSTL = INSTALL A SENSOR				
SET = SET ALARMS, CLOCK, LOG, PASSWORDS OR SENSOR				
STAT	TEST	INSTL	SET	ESC
1	2	3	4	5

2. Press SET to set the alarms.

VALVE MODE = ANALYZE				
SELECT AUTHORIZATION CODE				
SELECT YOUR CODE --				
SELEC	UP	DOWN	ACCPT	ESC
1	2	3	4	5

3. Enter the authorization code by using the SELEC, UP and DOWN keys, and press ACCPT.
If this is a COLD START, the code you enter will be the code set for every subsequent start-up until the next COLD START.

If this is a WARM START, enter the code used during the last COLD START.

VALVE MODE = ANALYZE				
SELECT FUNCTION TO SETUP				
LOG	ALRMS	SENSR	MORE	ESC
1	2	3	4	5

4. Press ALRMS.

VALVE MODE = ANALYZE				
ALARMS SETUP				
SELECT ALARM TO SETUP				
AL 1	AL 2	MORE		ESC
1	2	3	4	5

5. Press
 - AL1 for alarm 1
 - AL2 for alarm 2
 - MORE for alarms 3–5
 - ESC twice to return to the main menu

Note that alarm 5 may be programmed as a system alarm.

VALVE MODE = ANALYZE				
ALARM1 SETUP				
LEVEL= 1.00 PPM RELAY TB1				
HIGH/LOW . . HI FAILSAFE . . YES				
LATCHING . . NO DEFEAT . . NO				
SELEC	UP	DOWN	ACCPT	ESC
1	2	3	4	5

6. If AL1 or AL2 was chosen in step 5, use the SELEC, UP and DOWN keys to configure alarm 1 or 2, and press ACCPT, which will take you back to step 5.

- LEVEL is the O₂ concentration for the alarm threshold.
- HIGH/LOW determines whether the alarm condition is above or below the alarm threshold.

4 Operations

VALVE MODE = ANALYZE				
MORE ALARMS TO SETUP				
SELECT ALARM TO SETUP				
AL3	AL4	AL5		ESC
1	2	3	4	5

VALVE MODE = ANALYZE				
ALARM 5 MAY BE SET TO MONITOR				
O ₂ LEVELS OR SYSTEM ERRORS.				
CURRENTLY MONITORING O ₂				
SELECT TYPE OF ALARM ...				
O ₂	SYSTEM			ESC
1	2	3	4	5

VALVE MODE = ANALYZE				
ALARM 5 SETUP				
SYSTEM MODE	RELAY TB5			
LATCHING. YES	FAILSAFE YES			
	DEFEAT YES			
SELEC	UP	DOWN	ACCPT	ESC
1	2	3	4	5

VALVE MODE = ANALYZE				ALARM 1
SENSOR A ON LINE				
5.00		PPM O ₂		
AUTORANGE: 10 PPM				
ZERO	SPAN	SETUP	RANGE	ALRM
1	2	3	4	5

- LATCHING actuates the alarm above a certain setpoint even if the level falls back below the setpoint.
- RELAY indicates the relay (on the rear panel) actuated by the alarm, which is changeable.
- FAILSAFE=YES enables the relay which actuates the alarm during system failure.
- DEFEAT=NO actuates the alarms for normal use.

7. If MORE was pressed in step 5, choose alarms 3, 4, or 5 by pressing AL3, AL4, or AL5. Choose AL5 to set-up a system alarm.

8. If AL5 was pressed in step 7, choose alarm 5 to be an O₂ or system alarm by pressing O₂ or SYSTEM. Configured as a system alarm, alarm 5 will ring when a scheduled calibrator zeroing or a scheduled span calibration fails, when there is an internal system failure, or when the RAM back-up battery fails.

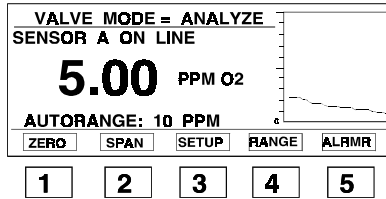
9. If SYSTM was pressed in step 8, configure the system alarm using the SELEC, UP and DOWN keys.

- LATCHING=YES actuates alarm 5 above a certain setpoint even if the level falls back below the setpoint.
- FAILSAFE=YES enables the relay which actuates the alarm during system failure.
- DEFEAT=YES actuates the alarm for normal use.

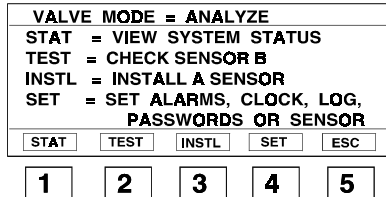
Press ACCPT to accept the new system alarm configuration. The next screen will ask you if there are more alarms to set. If not, pressing ESC three times will take you back to the Analyze mode main menu.

10. If O₂ was pressed in step 8, the screen will resemble the one in step 6. Use the SELEC, UP and DOWN keys to configure alarm 5. When finished, press ACCPT. The next screen will ask you if there are more alarms to set. If not, pressing ESC three times will take you back to the Analyze mode main menu.

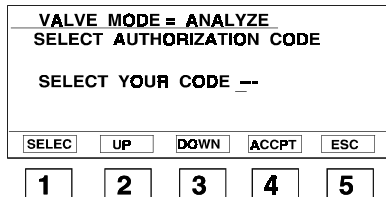
Logger Set-Up



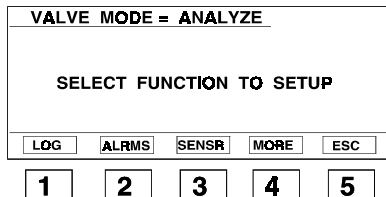
1. Enter set-up from the Analyze mode by pressing SETUP.



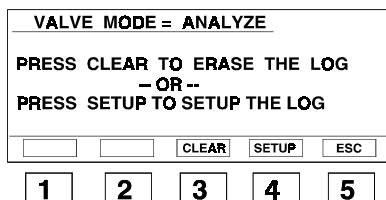
2. Press SET to set up the logger.



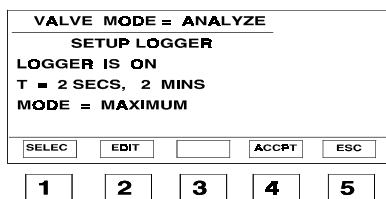
3. Enter the authorization code by using the SELEC, UP and DOWN keys. Then press ACCPT.



4. Press LOG for the logger functions. Press ESC to return to the Analyze mode main menu.



5. Press CLEAR if you want to clear the current logger data. Press SETUP to continue setting up the logger.



6. If you chose SETUP in step 5, use SELEC to choose logger ON/OFF, the time period between samples, or the mode of measurement. Then choose EDIT to change the values. After you are finished, press ACCPT, which will take you to step 4.

The choices for the logger chart sampling mode (MODE =) are on the next page.

4 Operations

Note: The above screens use T to indicate two values: seconds and minutes. The first value is the time period between samples on the logger, and is programmable. The second time value is the width of the logger chart page, and is not programmable. There are 64 samples per logger chart page, and over 20 pages of past data which may be viewed.

Mode determines how to calculate the sample values shown on the logger chart:

Average: The average of all measurements in the time period between samples.

Median: The average of the minimum and the maximum values measured in the time period between samples.

Maximum: The maximum of all values measured in the time period between samples.

Minimum: The minimum of all values measured in the time period between samples.

Sample: The last sample measured in the time period between samples.

Press EDIT in step 6 and then use the UP and DOWN keys to select the above choices for the logger chart mode.

Set-Up Clock Functions

VALVE MODE = ANALYZE		SENSOR A ON LINE	
5.00		PPM O2	
AUTORANGE: 10 PPM			
ZERO	SPAN	SETUP	ALRMR
1	2	3	4

1. Enter set-up from the Analyze mode by pressing SETUP.

VALVE MODE = ANALYZE				
STAT = VIEW SYSTEM STATUS				
TEST = CHECK ALTERNATE SENSOR				
INSTL = INSTALL A SENSOR				
SET = SET ALARMS, CLOCK, LOG, PASSWORDS OR SENSOR				
STAT	TEST	INSTL	SET	ESC
1	2	3	4	5

2. Press SET to set the clock functions.
(If only one cell block is installed, TEST and INSTL will be omitted.)

VALVE MODE = ANALYZE				
SELECT AUTHORIZATION CODE				
SELECT YOUR CODE --				
SELEC	UP	DOWN	ACCP	ESC
1	2	3	4	5

3. Enter the authorization code by using the SELEC, UP and DOWN keys, and press ACCPT.

VALVE MODE = ANALYZE				
SELECT FUNCTION TO SETUP				
LOG	ALRMS	SENSR	MORE	ESC
1	2	3	4	5

4. Press MORE.

VALVE MODE = ANALYZE				
SELECT FUNCTION TO SETUP				
CLOCK	PASS1	PASS2		ESC
1	2	3	4	5

5. Press CLOCK to select clock functions.

VALVE MODE = ANALYZE				
TIME = 6:00:00 PM 01/01/91				
SELECT CLOCK FUNCTION				
SET	SKED	SKED	VIEW	
TIME	ZERO	SPAN	TIME	
SET	ZERO	SPAN	ALRMS	ESC
1	2	3	4	5

6. Enter the function that you would like to change.
 SET: Sets the time.
 ZERO: Sets the time for the next zero and the interval times for automatic zeroing.
 SPAN: Sets the time for the next span and interval times for automatic spanning.
 ALRMS: Displays alarm times and dates.

4 Operations

VALVE MODE = ANALYZE				
TIME = 6:00:00 PM 12:01:00				
NEW TIME = 6:00:00 PM 12:01:00				
SET NEW TIME AND DATE				
SELEC	UP	DOWN	ACCPT	ESC

1 2 3 4 5

7. If SET was pressed in step 1, the menu for setting the time and date will appear. Use the SELEC, UP and DOWN keys to set the time and date, and then press ACCPT.

VALVE MODE = ANALYZE				
TIME = 6:00:00 PM 12:01:00				
-SCHEDULED ZERO = OFF				
INTRVAL - DAY : HR : MIN = 007:00:00				
NEXT ZERO = 01:00 AM 01:01:01				
SELEC	EDIT		ACCPT	ESC

1 2 3 4 5

8. If ZERO was pressed in step 1, the menu for setting AutoZeroing ON/OFF, time/date of the next zeroing, and time interval for automatic zeroing will appear.

VALVE MODE = ANALYZE				
TIME = 6:00:00 PM 12:01:00				
SCHEDULED ZERO = ON				
-INTRVAL - DAY : HR : MIN = 007:00:00				
NEXT ZERO = 01:00 AM 01:01:01				
SELEC	UP	DOWN	ACCPT	ESC

1 2 3 4 5

9. Use the SELEC, UP and DOWN keys to make selections, and press ACCPT.

VALVE MODE = ANALYZE				
TIME = 6:00:00 PM 12:01:00				
-SCHEDULED SPAN = OFF				
SKED SPAN Q2 = 5.0 PPM				
INTRVAL - DAY : HR : MIN = 007:00:00				
NEXT SPAN = 01:00 AM 01:01:01				
SELEC	EDIT		ACCPT	ESC

1 2 3 4 5

10. If SPAN was pressed in step 1, the menu for setting AutoSpanning ON/OFF, time/date for the next calibration, and interval for automatic calibration will appear.

VALVE MODE = ANALYZE				
TIME = 6:00:00 PM 12:01:00				
SCHEDULED SPAN = ON				
-SKED SPAN Q2 = 5.0 PPM				
INTRVAL - DAY : HR : MIN = 007:00:00				
NEXT SPAN = 01:00 AM 01:01:01				
SELEC	UP	DOWN	ACCPT	ESC

1 2 3 4 5

11. Use the SELEC, UP and DOWN keys to make selections, and press ACCPT.

VALVE MODE = ANALYZE				
ALARM 1 = 00:00 PM 00/00/00				
ALARM 2 = 00:00 PM 00/00/00				
ALARM 3 = 00:00 PM 00/00/00				
ALARM 4 = 00:00 PM 00/00/00				
ALARM 5 = 00:00 PM 00/00/00				
				ESC

1 2 3 4 5

12. If ALRMS was pressed in step 1, a menu displaying the most recent triggering time and date of each of the alarms will appear. From here, press ESC three times to return to the main menu screen.

Changing Passwords for Remote Monitoring and Control

VALVE MODE = ANALYZE				
SENSOR A ON LINE				
5.00	PPM O2			
AUTORANGE: 10 PPM				
ZERO	SPAN	SETUP	RANGE	ALRM
1	2	3	4	5

1. Enter set-up from the Analyze mode by pressing SETUP.

VALVE MODE = ANALYZE				
STAT = VIEW SYSTEM STATUS				
TEST = CHECK ALTERNATE SENSOR				
INSTR = INSTALL A SENSOR				
SET = SET ALARMS, CLOCK, LOG, PASSWORDS OR SENSOR				
STAT	TEST	INSTR	SET	ESC
1	2	3	4	5

2. Press SET to set the password(s).

VALVE MODE = ANALYZE				
SELECT AUTHORIZATION CODE				
SELECT YOUR CODE --				
SELEC	UP	DOWN	ACCPT	ESC
1	2	3	4	5

3. Enter your authorization code by using the SELEC, UP and DOWN keys, and press ACCPT. You must enter the same authorization code set during the last COLD START.

VALVE MODE = ANALYZE				
SELECT FUNCTION TO SETUP				
LOG	ALRMS	SENSR	MORE	ESC
1	2	3	4	5

4. Press MORE. Press ESC to return to the Analyze mode main menu.

VALVE MODE = ANALYZE				
SELECT FUNCTION TO SETUP				
CLOCK	PASS1	PASS2		ESC
1	2	3	4	5

5. Press PASS1 to change the remote monitoring password, or PASS2 to change the remote control password.

VALVE MODE = ANALYZE				
CHANGE PASSWORD FOR REMOTE MONITORING, READ-ONLY ACCESS				
CURRENT PASSWORD: MONITR				
SELEC	UP	DOWN	ACCPT	ESC
1	2	3	4	5

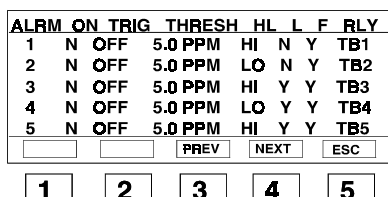
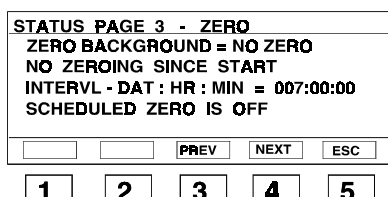
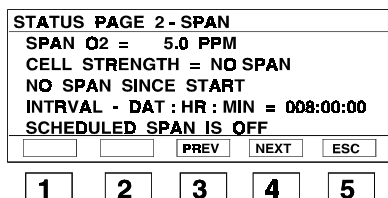
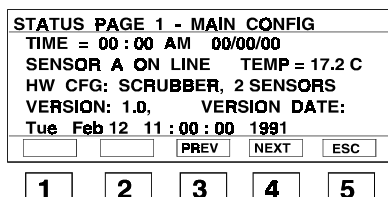
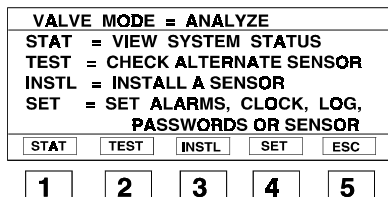
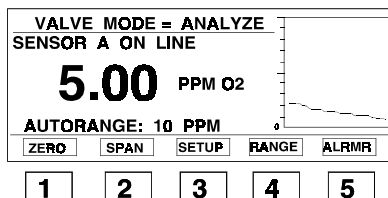
6. If you pressed PASS1 in step 5, the next screen will allow you to change the remote monitoring password. Use SELEC, UP and DOWN to choose the new password, and then press ACCPT, which will take you to step 4.

4 Operations

VALVE MODE = ANALYZE				
CHANGE PASSWORD FOR REMOTE CONTROL, READ-ONLY ACCESS				
CURRENT PASSWORD: <u>C</u> ONTRL				
SELEC	UP	DOWN	ACCPT	ESC
1	2	3	4	5

7. If you pressed PASS2 in step 5, the next screen will allow you to change the remote control password. Use SELEC, UP and DOWN to choose the new password, and press ACCPT, which will take you to step 4.

System Statistics



1. Enter set-up from the Analyze mode by pressing SETUP.
 ESC in any status page will take you to the last set-up screen and eventually the main analyze mode.
 PREV steps you back one status page.
 NEXT moves forward one status page.
2. Press STAT for system status.
 (If only one cell block is installed, TEST and INSTL will be omitted.)
3. Status page one displays the active sensor (A or B), the system time/date, and the system hardware configuration. The number and date of the installed software version are also shown.
 Press PREV for the previous screen, or NEXT for the next screen.
4. Status page two shows the O₂ level set for spanning, the cell strength factor, the type and time of the last span, the time interval for scheduled spanning (AutoSpan), and whether or not scheduled spanning is active. [The cell strength factor is an indication of the amount of cell life left in the cell, with 1.00 being the most and 0.00 being the least.]
5. Status page three shows the time of the last zero, the time interval for scheduled zeroing (AutoZero), and whether or not scheduled zeroing is active.
6. Status page four shows the settings for the five programmable alarms.

4 Operations

ALARM NUM	HR : MIN	MON/DAY/YR
ALARM1 =	00 : 00 AM	00/00/00
ALARM2 =	00 : 00 AM	00/00/00
ALARM3 =	00 : 00 AM	00/00/00
ALARM4 =	00 : 00 AM	00/00/00
ALARM5 =	00 : 00 AM	00/00/00

7. Status page five shows the time and date of the last time the alarm was triggered for each of the five programmable alarms.

STATUS PAGE 6 - SERIAL PORT	
BAUD = 2400	DATA BITS = 8
PARITY = NONE	STOP BITS = 1
MODE= MONITOR	
INTERVAL = 3 SECS	
TERMINATORS: TX = CR,LF	

8. Status page six shows the set-up for the serial port, and allows you to reconfigure the serial port. Press EDIT to bring up the following screen. Press NEXT to go to status page 7.

EDIT SERIAL SETUP	
BAUD = 2400	DATA BITS = 8
PARITY = NONE	STOP BITS = 1
MODE= MONITOR	
INTERVAL = 3 SECS	
TERMINATORS: TX = CR,LF	

9. Use the SELEC, UP and DOWN keys to select the desired serial port configuration, and press ACCPT.

Baud rate: 300–2400

Parity: Odd, Even, or None

Mode: Monitor, Remote, or Off

ASCII Data Bits: 7 or 8

Stop Bits: 1 or 2

Modem: On, Off or Auto

Output Interval for Monitoring: 1–32000 sec.

Transmit/Receive Line Terminators: CR or CRLF

STATUS PAGE 7 - MODEM / REMOTE	
MODEM MODE = AUTO	
MODEM STATUS = NO MODEM, CTS = 0	
LOGIN ACCESS = NONE	
PHONE JACK = SINGLE - LINE RJ11	
COMM STD FOR 1200B = BELL - USA	

10. Status page seven allows for configuration of the modem/remote. Press EDIT to change the configuration.

- **Modem Mode:** AUTO/OFF/ON
- **Modem Status:** NO (set by system)
- **Login Access:** LOCAL (set by system)
- **Phone Jack:** SINGLE/MULTI, RJ12
- **Comm. Std. for 1200B:** BELL USA/CCITT

EDIT MODEM SETUP	
MODEM MODE = AUTO	
MODEM STATUS = NO MODEM, CTS = 0	
LOGIN ACCESS = NONE	
PHONE JACK = SINGLE - LINE RJ11	
COMM STD FOR 1200B = BELL - USA	

11. After pressing EDIT, a cursor will appear and you will be able to edit the settings. Press ACCPT when done. Pressing INIT in status page seven (step 10) takes you to the screen at the top of the next page and gives you the option of either checking for a modem, or setting up the modem. Set-up sets up the modem for auto answer and other communication protocols.

```

STATUS PAGE 7 - MODEM / REMOTE
PRESS CHECK TO TEST MODEM OR
SETUP TO START AUTO ANSWER

[ ] [ ] [SETUP] [CHECK] [ESC]

1 2 3 4 5
    
```

12. After checking for the modem, pressing ESC returns you to status page seven in step 10. If INIT was pressed in status page 7 and then SETUP pressed in step 11, pressing ACK will return you to this screen. Press ESC to return to status page seven in step 10.

```

STATUS PAGE 8 - PRINTER PORT
MODE = ON
INTERVAL = 3 SECS

PRESS EDIT TO CHANGE SETUP

[EDIT] [ ] [PREV] [NEXT] [ESC]

1 2 3 4 5
    
```

13. If you have purchased the parallel printer option, status page eight allows for configuration of the port. Press EDIT to change the configuration.

- **Mode:** ON/OFF
- **Interval:** 3–32000 seconds

NOTE: The printer report will always be in the same format—O₂ Level, Range, Active Sensor, Time & Date.

```

STATUS PAGE 8 - PRINTER PORT
MODE = ON
INTERVAL = 3 SECS

EDIT PRINTER SETUP

[SELEC] [UP] [DOWN] [ACCP] [ESC]

1 2 3 4 5
    
```

14. After pressing EDIT, a cursor will appear and you will be able to edit the settings.

```

STATUS PAGE 9 - STARTUP STATUS
STARTUP WAS: COLD START
NEXT STARTUP: WARM START
PRESS COLD OR WARM TO CHANGE
NEXT SETUP

[COLD] [WARM] [PREV] [NEXT] [ESC]

1 2 3 4 5
    
```

15. Status page nine shows whether or not the last and next start-ups were WARM or COLD. The next start-up may be changed by pressing the COLD or WARM keys.

```

STATUS PAGE 10 - LOGGER DATA

LOGGER IS ON
T = 2 SEC, 2 MINS
MODE = MAXIMUM

[VIEW] [ ] [PREV] [NEXT] [ESC]

1 2 3 4 5
    
```

16. Status page ten displays logger data. Press VIEW to see the logger data history. Press NEXT to return to status page one. Press ESC twice to return to the Analyze mode main menu.

```

LOG POS = 11, PAGE = 0
O2 = 0.00 PPM, SENSOR = A
RANGE 1 PPM
T = 2 SECS, 2 MINS
MODE = MAXIMUM
TD = 00 : 01 : 06 00/00/00

[ ] [ ] [REV] [FWD] [ESC]

1 2 3 4 5
    
```

17. If VIEW was pressed in step 13, logger data may be viewed by using the +, -, REV and FWD keys. The O₂ level, range, and time are shown for each data point. NEXT takes you to status page two. REV and FWD change the date by one page (or 64 points), while - and + go through the data one point at a time within a single page. Press ESC to return to status page ten.

4 Operations

Maintenance & Troubleshooting

5.1 Routine Maintenance

1. Calibrate the analyzer at least once each week during the first four weeks and then once every two weeks during the next eight weeks. Afterwards, the analyzer should be calibrated once a month.
2. Check the pressure of the air supply to the analyzer. Air pressure should be maintained between 70 and 80 psig.

Note: The instrument air pressure must be greater than 70 psig in order to open and close the pneumatic solenoid valves.

3. Check the sample pressure. Pressure should be maintained between 5 and 10 psig. Sample and span gas pressures should be within ± 2 psig of each other.

5.1.1 Sensor Maintenance

Sensor maintenance in the 3160 is limited to replacing the sensor(s) when replacement is indicated. Consult the troubleshooting section for symptoms that indicate that the sensor needs replacing.

A guide to the relative life left in the cell can be found on status page 2. See “Cell Strength Factor” at the beginning of Chapter 3.0.

In units with 2 cell blocks, if sensor A fails, sensor B will not automatically switch online. This must be done manually through the Install Sensor and Test Alternate Sensor menu.

5.1.2 Scrubber Maintenance

The oxygen scrubber is a replaceable component. With normal use, the scrubber usually lasts for several years.

NOTE: Do not zero in ranges other than 0-1 ppm, as zeroing in higher ranges will exhaust the scrubber.

5 Maintenance & Troubleshooting

Analyzers equipped with a scrubber should only be used with inert gases and saturated hydrocarbons.

5.2 Troubleshooting

To troubleshoot the analyzer, identify the problem in the following list and then follow the procedures to correct the problem. If you cannot identify the problem, or if you cannot resolve the problem after following the corrective procedure, call a service representative.

Symptom	Cause	Correction
LCD or LED display will not light.	Faulty LCD or LED.	Return the unit to factory.
Display too bright.		Remove analyzer cover. Adjust potentiometer located behind LCD display.
No analog output.	Faulty electrical connection.	Remove analyzer cover. Check PC board connections and make sure that they are firmly seated.
Zero gas signal >2 PPM.	Bad sensor. High O ₂ level.	Replace sensor. Check zero gas inlet connection.
Slow response/recovery time.	Bad sensor.	Replace sensor.
Displays "--" value.		Re-zero sensor.
Can't calibrate (with sensor installed). Display reads "cell too strong" or "cell too weak."	a) The wrong span gas concentration has been entered.	a) Re-enter span gas concentration. b) Replace or reinstall sensor.
No sample gas flow.	a) The pneumatic air supply pressure is too low, making the valves stick. b) The sample supply pressure is too low.	a) Raise air supply pressure to at least 70 psig. b) Check back panel connections. Raise sample supply to at least 5 psig but within ±2 psig of the span gas pressure.

Symptom	Cause	Correction
		c) Make sure metering valve (flow set knob on front panel) is sufficiently open.
	Back panel vent is blocked.	Clear and check connection to back panel vent.
Will not switch modes.	See a) above.	See a) above.
Sensor output does not drop to a stable, low value during zeroing or spanning.	a) Sensor has been exposed to high concentrations of O ₂ for an extended time period. b) Bad sensor. c) Leak in system.	a) Replace sensor and/or wait for stable reading. b) Replace sensor. c) Check sensor block clamp. Make sure the sensor block is tightly closed. Check the gas supply tank, line and connections for leaks.
Unit will not turn on although it is plugged in and the Power Switch is ON (at "I" position).	Fuse is blown.	Check fuse(s) in back panel fuse block assembly located above the power cord receptacle.

5 Maintenance & Troubleshooting

Appendix

A.1 Specifications

(Subject to change without notice.)

- Ranges:** (Six ranges with AutoRanging on all ranges)
- 1: 0–1 part per million (ppm) O₂
 - 2: 0–10 ppm O₂
 - 3: 0–100 ppm O₂
 - 4: 0–1000 ppm O₂
 - 5: 0–1 % O₂
 - 6: 0–25 % O₂

Accuracy: ±2% of full scale when calibrated and operated at the same constant temperature and pressure.*
±5% of full scale over the operating temperature range once temperature equilibrium is reached.*

* Additional 0.04 ppm on 0-1 ppm range, generated by internal scrubber (which is necessary to maintain these specifications).

Response Time: 90 % of final reading in less than 61 seconds at 25 °C

Operating Temperature: 0-50°C (32-122 °F)

Analog Signal Outputs: For percent of full scale indication:
one 0–1 V dc non-isolated signal
one 4–20 mA dc isolated signal
For range identification:
one 0–1 V dc non-isolated signal
one 4–20 mA dc isolated signal

Digital Data Lines: One RS-232C serial interface for 2-way communications with separate host computer—for remote monitoring and control of all functions.

Alarms: Five user-programmable absolute-reading alarm setpoints, with Form C, SPDT relays (3A resistive).

Appendix

Mounting and Enclosure:	19" relay rack, 20.3 cm (12.25 inches) high, for general purpose (nonhazardous) areas. (Class I, Division II, hazardous area models available on special order.)
Sensor:	Class B-2, B2C, A2, or A2C, Micro-Fuel Cells.
Altitude:	1,609 m
Relative Humidity:	Up to 99%
Power Requirements:	100, 120, 220, or 240~ 50-60 Hz 1.5 A MAX Use 250 V 3.0 A T Fuse for 110, 120 V~ Use 250 V 1.6 A T Fuse for 220, 240 V~

TELEDYNE Analytical Instruments

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Web: www.teledyne-ai.com

A.2 Recommended Spare Parts List

Description	P/N
Micro-Fuel Cell sensor	C6689B2 C6689B2C C6689A2 C6689A2C
O-ring	O165
Suction purifier	P670
Solenoid valve	V462
Pneumatic valve upper body	B435
Hose fitting tee	T978
Fuse, 3A T Type	F68
Fuse, 1.6A T Type (European)	F768
Scrubber	C58750

A.3 Drawing List

D-56534	OutlineDrawing
C-64819	InterconnectionDrawing

NOTE: The MSDS on this material is available upon request through the Teledyne Environmental, Health and Safety Coordinator. Contact at (626) 934-1592

Appendix

A.4 Material Safety Data Sheet I

Section I – Product Identification

Product Name: Micro-Fuel Cells and Super Cells, all classes except A-2C, A-3, and A-5.

Electrochemical Oxygen Sensors, all classes except R-19.

Mini-Micro-Fuel Cells, all classes.

Manufacturer: Teledyne Analytical Instruments

Address: 16830 Chestnut Street, City of Industry, CA 91749

Phone: (818) 961-9221

Customer Service: Extension 222

Environmental Health

and Safety: Extension 230

Date Prepared : 2/12/96

Section II – Hazardous Ingredients/Composition

Material or Component TLV	C.A.S. #	Quantity	OSHA PEL	ACGIH
Lead (Pb)	7439-92-1	3–20 gms	0.05 mg/m ³	0.15 mg/m ³
Potassium Hydroxide Solution 15% (KOH)	1310-58-3	1–5 ml	None	2 mg/m ³

Section III – Physical/Chemical Characteristics

Material Appearance or Component	Boiling Point (°C)	Specific Gravity	Vapor Pressure	Melting Point (°C)	Density	Evap. Rate	Solubility in Water	Odor
Lead	1744	11.34	na	328	na	na	Insoluble	Solid, silver gray, odorless
Potassium Hydroxide	1320	2.04	na	360	na	na	Complete	White or slightly yellow, no odor

Section IV – Fire and Explosion Hazard Data

Flash Point:	na	Flammable Limits:	na	LEL:	na	UEL:	na
Extinguishing Media:	Use extinguishing media appropriate to surrounding fire conditions. No specific agents recommended.						
Special Fire Fighting Equipment:	Wear NIOSH/OSHA approved self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.						
Unusual Fire and Explosion Hazards:	Emits toxic fumes under fire conditions.						

Section V – Reactivity Data

Stability:	Stable
Incompatibilities:	Aluminum, organic materials, acid chlorides, acid anhydrides, magnesium, copper. Avoid contact with acids and hydrogen peroxide > 52%.
Hazardous Decomposition of Byproducts:	Toxic fumes
Hazardous Polymerization:	Will not occur.

Section VI – Health Hazard Data

Routes of Entry:	Inhalation: Highly unlikely
	Ingestion: May be fatal if swallowed.
Skin:	The electrolyte (potassium hydroxide) is corrosive; skin contact may cause irritation or chemical burns.
Eyes:	The electrolyte (potassium hydroxide) is corrosive; eye contact may cause irritation or severe chemical burns.
Acute Effects:	The electrolyte is harmful if swallowed, inhaled or adsorbed through the skin. It is extremely destructive to tissue of the mucous membranes, stomach, mouth, upper respiratory tract, eyes and skin.
Chronic Effects:	Prolonged exposure with the electrolyte has a destructive effect on tissue. Chronic exposure to lead may cause disease of the blood and blood forming organs, kidneys and liver, damage to the reproductive systems and decrease in fertility in men and women, and damage to the fetus of a pregnant woman. Chronic exposure from the lead contained in this product is extremely unlikely.

Appendix

Signs and Symptoms of Exposure:	Contact of electrolyte with skin or eyes will cause a burning sensation and/or feel soapy or slippery to touch. Other symptoms of exposure to lead include loss of sleep, loss of appetite, metallic taste and fatigue.
Carcinogenicity:	Lead is classified by the IARC as a class 2B carcinogen (possibly carcinogenic to humans).
OSHA:	Where airborne lead exposures exceed the OSHA action level, refer to <i>OSHA Lead Standard 1910.1025</i> .
NTP:	na
Medical Conditions Generally Aggravated by Exposure:	Lead exposure may aggravate disease of the blood and blood forming organs, hypertension, kidneys, nervous and possibly reproductive systems. Those with preexisting skin disorders or eye problems may be more susceptible to the effects of the electrolyte.
Emergency First Aid Procedures:	In case of contact with the skin or eyes, immediately flush with plenty of water for at least 15 minutes and remove all contaminated clothing. Get medical attention immediately. If ingested, give large amounts of water and DO NOT INDUCE VOMITING. Obtain medical attention immediately. If inhaled, remove to fresh air and obtain medical attention immediately.

Section VII – Precautions for Safe Handling and Use

NOTE: The oxygen sensors are sealed, and under normal circumstances, the contents of the sensors do not present a health hazard. The following information is given as a guide in the event that a cell leaks.

Protective measures during cell replacement:	Before opening the bag containing the sensor cell, check the sensor cell for leakage. If the sensor cell leaks, do not open the bag. If there is liquid around the cell while in the instrument, wear eye and hand protection.
Cleanup Procedures:	Wipe down the area several times with a wet paper towel. Use a fresh towel each time. Contaminated paper towels are considered hazardous waste.

Section VIII – Control Measures

Eye Protection:	Chemical splash goggles
Hand Protection:	Rubber gloves
Other Protective Clothing:	Apron, face shield
Ventilation:	na

Section IX – Disposal

Both lead and potassium hydroxide are considered poisonous substances and are regulated under TSCA and SARA Title III.

EPA Waste Number:	D008
California Waste Number:	181
DOT Information:	RQ Hazardous Waste Solid N.O.S. (Lead), 9, UN3077, PG III

Follow all Federal, State and Local regulations.

Section X – References

Material Safety Data Sheets from J.T. Baker Chemical, Aldrich, Mallinckrodt, ASARCO
U.S. Department of Labor form OMB No. 1218-0072
Title 8 California Code of Regulations
TSCA
SARA Title III
CFR 49
CFR 29
CFR 40

NOTE: The above information is believed to be correct and is offered for your information, consideration, and investigation. It should be used as a guide. Teledyne Analytical Instruments shall not be held liable for any damage resulting from handling or from contact with the above product.

A.5 Material Safety Data Sheet II

Section I – Product Identification

Product Name: Micro-Fuel Cells
Mini-Micro-Fuel Cells, all classes
Super Cells, all classes except T-5F
Oxygen Sensors, all classes.

Manufacturer: Teledyne Analytical Instruments

Address: 16830 Chestnut Street, City of Industry, CA 91749

Phone: (818) 961-9221

Date Prepared or Last Revised: 08/08/91

Emergency Phone Number: (818) 961-9221

Section II – Physical and Chemical Data

Chemical and Common Names: Potassium Hydroxide (KOH), 15% (w/v)

Lead (Pb), pure

CAS Number: KOH 1310-58-3

Pb 7439-92-1

	KOH (15% w/v)	Pb (pure)
Melting Point/Range:	-10 to 0 °C	328 °C
Boiling Point/Range:	100 to 115 °C	1744 °C
Specific Gravity:	1.09 @ 20 °C	11.34
pH:	>14	N/A
Solubility in Water:	Completely soluble	Insoluble
Percent Volatiles by Volume:	None	N/A
Appearance and Odor:	Colorless, odorless solution	Grey metal, odorless

Section III – Physical Hazards

Potential for fire and explosion: The electrolyte in the Micro–Fuel Cells is not flammable. There are no fire or explosion hazards associated with Micro–Fuel Cells.

Potential for reactivity: The sensors are stable under normal conditions of use. Avoid contact between the sensor electrolyte and strong acids.

Section IV – Health Hazard Data

Primary route of entry:	Ingestion, eye/skin contact
Exposure limits: OSHA PEL:	.05 mg/cu.m. (Pb)
ACGIH TLV:	2 mg/cu.m. (KOH)
Effects of overexposure	
Ingestion:	The electrolyte could be harmful or fatal if swallowed. Oral LD50 (RAT) = 3650 mg/kg
Eye:	The electrolyte is corrosive; eye contact could result in permanent loss of vision.
Dermal:	The electrolyte is corrosive; skin contact could result in a chemical burn.
Inhalation:	Liquid inhalation is unlikely.
Signs/symptoms of exposure:	Contact with skin or eyes will cause a burning sensation and/or feel soapy or slippery to touch.
Medical conditions	
aggravated by exposure:	None
Carcinogenicity:	NTP Annual Report on Carcinogens: Not listed LARC Monographs: Not listed OSHA: Not listed
Other health hazards:	Lead is listed as a chemical known to the State of California to cause birth defects or other reproductive harm.

Section V – Emergency and First Aid Procedures

- Eye Contact:** Flush eyes with water for at least 15 minutes and get immediate medical attention.
- Skin Contact:** Wash affected area with plenty of water and remove contaminated clothing. If burning persists, seek medical attention.
- Ingestion:** Give plenty of cold water. Do not induce vomiting. Seek medical attention. Do not administer liquids to an unconscious person.
- Inhalation:** Liquid inhalation is unlikely.

Section VI – Handling Information

NOTE: The oxygen sensors are sealed, and under normal circumstances, the contents of the sensors do not present a health hazard. The following information is given as a guide in the event that a cell leaks.

Protective clothing: Rubber gloves, chemical splash goggles.

Clean-up procedures: Wipe down the area several times with a wet paper towel. Use a fresh towel each time.

Protective measures

during cell replacement: Before opening the bag containing the sensor cell, check the sensor cell for leakage. If the sensor cell leaks, do not open the bag. If there is liquid around the cell while in the instrument, put on gloves and eye protection before removing the cell.

Disposal: Should be in accordance with all applicable state, local and federal regulations.

NOTE: The above information is derived from the MSDS provided by the manufacturer. The information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. Teledyne Analytical Instruments shall not be held liable for any damage resulting from handling or from contact with the above product.