

OPERATING INSTRUCTIONS FOR

MODEL 3020M

ATEX/IECEX

Paramagnetic Oxygen Analyzer



P/N M94944
1/15/2019



DANGER



Toxic and or flammable gases may be present in this monitoring system.
Personal protective equipment may be required when servicing this instrument.
Hazardous voltages exist on certain components internally which may persist for a time even after the power is turned off and disconnected.
Only authorized personnel should conduct maintenance and/or servicing. Before conducting any maintenance or servicing, consult with authorized supervisor/manager.

EU DECLARATION OF CONFORMITY

This declaration of conformity is issued under the sole responsibility of the manufacturer

APPLICATION OF COUNCIL DIRECTIVE : 2014/34/EU

STANDARDS TO WHICH : EN 60079-0 : 2012+A11:2013
(IEC 60079-0 : 2011)

CONFORMITY IS DECLARED EN 60079-1 : 2014
(IEC 60079-1 : 2014-06)

MANUFACTURER'S NAME : TELEDYNE ANALYTICAL INSTRUMENTS

MANUFACTURER'S ADDRESS : 16830 Chestnut Street
City of Industry, CA 91748
U.S.A.

TYPE OF EQUIPMENT : * See page two

EQUIPMENT CLASS : Ex II 2 G Ex db IIB+H2 T6..T5 Gb
0°C≤Ta≤50°C

MODEL NUMBER : 2020, 3020M, 3020P, 3020T, 3020UV, 7320

I, THE UNDERSIGNED, HEREBY DECLARE THAT THE EQUIPMENT SPECIFIED ABOVE CONFORMS TO THE ABOVE STANDARD(S) PER 2014/34/EU and have been type-approved by Intertek Testing & Certification Limited, Intertek House, Cleeve Road, Leatherhead, Surrey, KT22 7SB. Intertek notified body identification number: 0359. Mark: Ex II 2 G. Code: Ex db IIB+H2 T6..T5 Gb.

EU Type Certificate Number: ITS19ATEX10485X

IECEX Certificate Number: IECEX ITS 19.0013X

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EU DECLARATION OF CONFORMITY

***Type of Equipment or Protective System**

Models covered by this Declaration of Conformity are:

<u>Model</u>	<u>Type of Equipment</u>
• 2020	Thermal Conductivity Analyzers
• 3020M	Oxygen Analyzers
• 3020P	Oxygen Analyzers
• 3020T	Oxygen Analyzers
• 3020UV	Oxygen Analyzers
• 7320	IR Absorption Analyzers

Note: When used with Killark Flame Arrestor (KB1FA25SS6) SIRA 10ATEX1351U, T-code rating will be T5. All other models are rated for T6.

Special Conditions for Safe Use

- All cable glands, blanking elements and thread adapters used with the equipment shall be certified Ex db parts. These parts shall have a suitable temperature range for the final installation and maintain a degree of protection of IP66 in accordance with IEC 60529.
- Equipment with windows and pilot light type EFL*PC* shall be installed in locations where the risk of impact is considered negligible.
- Flameproof joints are not intended to be repaired.

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Warranty

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

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

Important Notice

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

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

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

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

Paramagnetic Oxygen Analyzer

Specific Model Information

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

Instrument Serial Number: _____

Options Included in the Instrument with the Above Serial Number:

- 0-1% Special Sensor/Heater
- Auto Calibration
- Gas Panel with Flowmeter
- 1/4" Tube Connections

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Safety Messages

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

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

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



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



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



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



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

No
Symbol

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

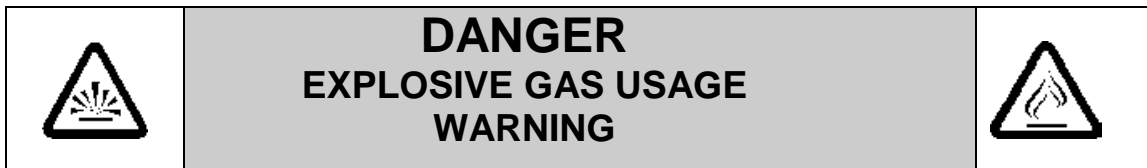


IF YOU USE THE ANALYZER IN A MANNER OTHER THAN THAT FOR WHICH IT WAS INTENDED, UNPREDICTABLE BEHAVIOR COULD RESULT POSSIBLY ACCOMPANIED WITH HAZARDOUS CONSEQUENCES.

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

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

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



The analyzer is housed in an explosion proof housing and is designed for use in a II 2G Ex db IIB+H2 T6 Gb environment. It is the customer's responsibility to ensure safety especially when flammable gases are being analyzed since the potential of leaks always exist.

THIS ANALYZER MUST NOT TO BE USED TO MEASURE ANY GAS MIXTURE THAT CONTAINS OXYGEN IN EXCESS OF 20.9%.

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

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

ATEX/IECEX Certified Product

This unit is ATEX and IECEX certified, no modifications are permitted without reference to Intertek.

ATEX: ITS17ATEX102893X

IECEX: IECEX ETL 17.0067X

Special Conditions for Safe Use

- Due to the window, the unit shall only be located in an area of low impact.

Note: The pilot light EFL PC and the covers with windows have only been tested with a shock corresponding to a low risk energy of 2 joules.

- Suitably certified Ex d IIC Gb cable glands, thread adapters and blanking elements must be used.
- This instrument must be externally and internally grounded as per the Wiring Diagram included in the Appendix.

WARNING: DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT.



WARNING: DO NOT OPEN WHEN POWER IS APPLIED AND AN EXPLOSIVE ATMOSPHERE IS PRESENT.



WARNING: ALL RETAINING BOLTS, BLANKING PLUGS, SEALING DEVICES AND GLANDS MUST BE FULLY SECURED PRIOR TO APPLING POWER.



SUITABLE FOR USE FOR IIB +H2 GASES AND UP TO 20.9% O2 (TEMPERATURE CLASS T6).

Paramagnetic Oxygen Analyzer

Additional ATEX/IECEX Information




This instrument uses flameproof joints that have different values from those specified in the tables of the IEC 60079-1 standard. If repairs are needed, please contact Teledyne Customer Service at the address below.

Teledyne Analytical Instruments
16830 Chestnut Street
City of Industry, CA 91748

Phone (626) 934-1500
Fax (626) 961-2538
Web: www.teledyne-ai.com

Labels

The following ATEX labels are affixed to this system and must remain attached and in readable condition.

 Teledyne Analytical Instruments CA 91748-1580 U.S.A.	
PROCESS ANALYZER SYSTEM MODEL 3020	
Serial No.:	_____
Year of construction:	___20___
Code:	_____  II 2 G Ex db IIB+H2 T6 Gb
Operating Temperature:	___ 0°C ≤ Tamb ≤ +50°C
WARNING DO NOT OPEN WHEN ENERGIZED!	
 1180	ITS17ATEX102893X IECEX ETL 17.0067X

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Introduction

1.1 Overview

The Teledyne Analytical Instruments Model 3020M Trace Oxygen Analyzer is a versatile microprocessor-based instrument for detecting oxygen in a variety of gases. This manual covers two versions of the ATEX/IECEX certified explosion-proof, bulkhead-mount Model 3020M Percent Oxygen Analyzer: the standard 0-5% version and 0-1% version.

1.2 Typical Applications

A few typical applications of the Model 3020M are:

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

1.3 Main Features of the Analyzer

The Model 3020M Trace Oxygen Analyzer is sophisticated yet simple to use. The main features of the analyzer include:

- A 2-line alphanumeric display screen, driven by microprocessor electronics that continuously prompts and informs the operator.
- High resolution, accurate readings of oxygen content from 0-5% (standard version) or 0-1% (optional version). Large, bright, meter readout.
- Stainless steel sample system.

- Versatile analysis over a wide range of applications.
- Microprocessor based electronics: 8-bit CMOS microprocessor with 32 kB RAM and 128 kB ROM.
- Three user definable output ranges:
 - Standard ranges: 0-5% through 0-100% (std. sensor).
 - Optional ranges: 0-1% though 0-100% (optional sensor).
- Auto Ranging allows analyzer to automatically select the proper preset range for a given measurement. Manual override allows the user to lock onto a specific range of interest.
- Two adjustable concentration alarms and a system failure alarm.
- Extensive self-diagnostic testing, at startup and on demand, with continuous power-supply monitoring.
- RS-232 serial digital port for use with a computer or other digital communication device.
- Four analog outputs: two for concentration (0-1 VDC and isolated 4-20 mA DC) and two for range identification.
- Explosion proof housing ATEX/IECEX certified for use in II 2G ExD IIB+H2 T6 Gb hazardous environments.
- 316SS tubing with 316SS and 303SS fittings.
- Internal gas filter.
- 316SS flame arrestors (ATEX, IECEX II2C).
- 6 mm user gas connections
- 1" and 3/4" feedthroughs for electrical cable entry into the enclosure.

1.4 Model Designations

3020M: Standard model.



3020M-C: In addition to all standard features, this model also has separate ports for zero and span gases, and built-in control valves. The internal valves are entirely under the control of the 3020M electronics, to automatically switch between gases in synchronization with the analyzer's operations

1.5 Operator Interface

All controls and displays on the standard 3020M are accessible from outside the housing. The instrument has two simple operator controls. The operator has constant feedback from the instrument through an alphanumeric display, a digital oxygen meter, and a sample flow meter. The displays and controls are described briefly here and in greater detail in chapter 4. Figure 1-1 shows the standard 3020M without the optional gas panel. Figure 1-2 is the same instrument with a gas panel.

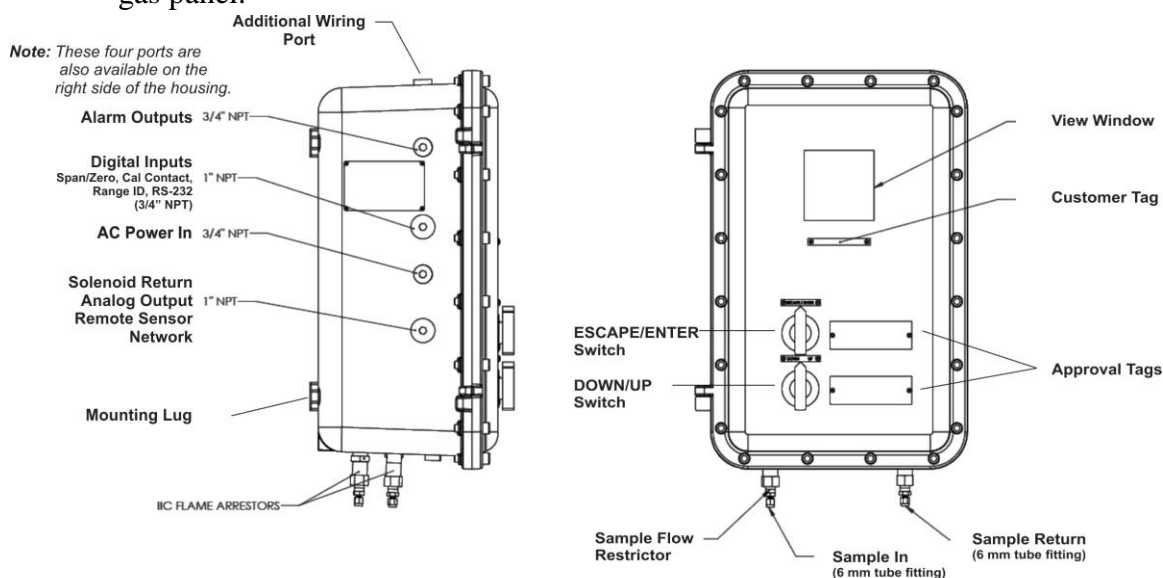


Figure 1-1: Model 3020M Standard Controls, Indicators, and Connectors Without Optional Gas Control Panel

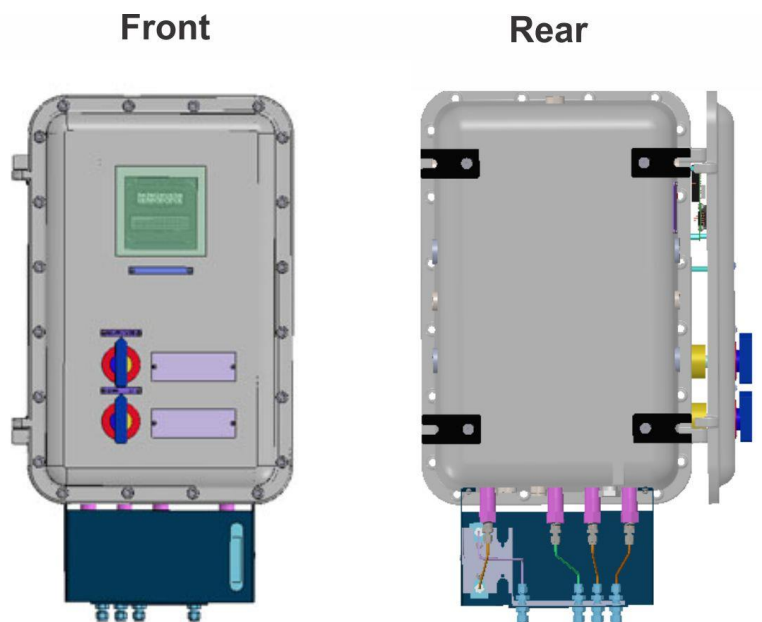


Figure 1-2: Standard Model 3020M-ATEX With Gas Control Panel

The standard tube connections are 6 mm but other sizes are available.

1.5.1 UP/DOWN Switch

Functions: The UP/DOWN switch is a 3-way switch used to select the function to be performed. Choose UP or DOWN to scroll through the following list of eleven functions:

- **Auto-Cal** Set up an automatic calibration sequence.
- **PWD** Install a password to protect your analyzer setup.
- **Logout** Locks Setup Mode.
- **Version** Displays model and version of analyzer.
- **Self-Test** Runs internal diagnostic program, displays results.
- **Span** Span calibrate the analyzer.
- **Zero** Zero calibrate the analyzer.
- **Alarms** Set the alarm setpoints and attributes.

- **Range** Set up the 3 user definable ranges for the instrument.
- **Contrast** Adjust LCD contrast.
- **Standby** Leave analyzer powered, but no outputs or displays.

Subfunctions: Once a Function is entered, the UP/DOWN switch is used to select between any subfunctions displayed on the VFD screen.

Parameter values: When modifiable values are displayed on the VFD, the UP/DOWN switch can be used to increment or decrement the values.

1.5.2 ESCAPE/ENTER Switch

Data Entry: The ESCAPE/ENTER switch is a 3-way switch used to input data, from the alphanumeric VFD screen into the instrument:

- **Escape** Moves VFD display back to the previous screen in a series. If none remains, returns to the *Analyze* screen.

With subfunction selected, moves VFD back through items on screen, to first item, then moves VFD to previous display.

- **Enter** With a Subfunction Selected: Moves VFD on to the next screen in a series. If none remains, returns to the *Analyze* screen.

With a Value Selected: Enters the value into the analyzer as data. Advances VFD to next operation.

(See Chapter 4 for details.)

1.5.3 Displays

Digital Meter Display: The meter display is a LED device that produces large, bright, 7-segment numbers that are legible in any lighting. It produces a continuous readout from 0-100%. It is accurate across all analysis ranges without the discontinuity inherent in analog range switching.

Alphanumeric Interface Screen: The backlit VFD screen is an easy-to-use interface from operator to analyzer. It displays values, options, and messages that give the operator immediate feedback.

Flowmeter: Monitors the flow of gas past the sensor. Readout is 100 to 1000 standard cubic centimeters per minute (SCCM).

1.6 Recognizing Difference Between LCD & VFD

LCD has *GREEN* background with *BLACK* characters. VFD has *DARK* background with *GREEN* characters. In the case of VFD - *NO CONTRAST ADJUSTMENT IS NEEDED*.

1.7 Equipment Interface

1.7.1 Electrical Connector Panel

The electrical connector panel, shown in Figure 1-3, contains the electrical connections for external inlets and outlets. The connectors are described briefly here and in detail in the *Installation* chapter of this manual.

CAUTION: *Power must be disconnected before opening the instrument door.*



WARNING: *DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT.*



- **Remote Valves** Used for controlling external solenoid valves, if desired.
- **Remote Span/Zero** Digital inputs allow external control of analyzer calibration.
- **Calibration Contact** To notify external equipment that instrument is being calibrated and readings are not monitoring sample.
- **Range ID Contacts** Four separate, dedicated, range relay contacts. Low, Medium, High, Cal.
- **Network I/O** Serial digital communications for local network access. For future expansion. Not implemented at this printing.

1.7.2 Gas Connector Panel (Option)

The optional gas connector panel is shown in Figure 1-4. It contains the 6 mm gas connections for external inlets and outlets (other size fittings are available on request). The connections are described briefly here and in detail in the *Installation* chapter of this manual.

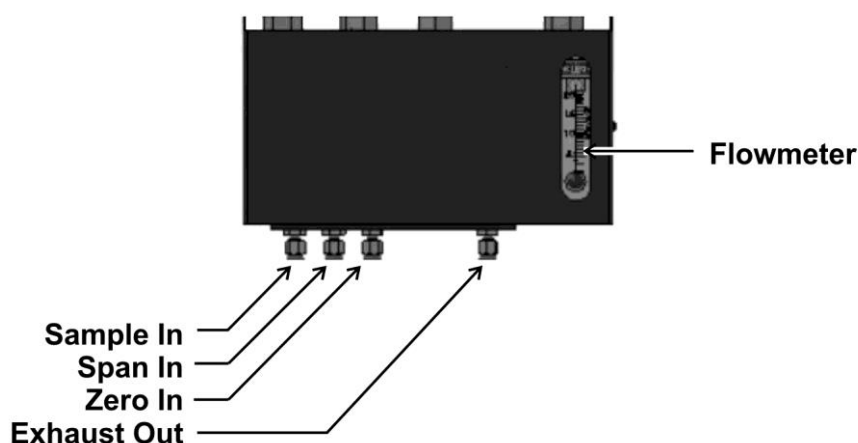


Figure 1-4: Model 3020M Optional Gas Connector Panel

- **Gas Sample Inlet and Outlet**
One inlet and one exhaust out.

Optional:

- **Calibration Gas Ports**
Separate fittings for zero, span and sample gas input, plus internal valves for automatically switching the gases in sync with the 3020M electronics.

Note: If you require highly accurate Auto-Cal timing, use external Auto-Cal control where possible. The internal clock in the Model 3020M is accurate to 2-3%. Accordingly, internally scheduled calibrations can vary 2-3% per day.

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Operational Theory

2.1 Introduction

The analyzer is composed of three subsystems:

1. Paramagnetic Sensor
2. Sample System
3. Electronic Signal Processing, Display and Control

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

2.2 Precise Paramagnetic Sensor

2.2.1 Principles of Operation

The heart of the 3020M is a paramagnetic type oxygen sensor that is maintenance free and has a long lifetime. Both the standard 3020M sensor (P/N S1731) and the 0-1% sensor (P/N S1638) are both paramagnetic sensors however the sensors are different and not interchangeable.

Oxygen has a very high magnetic susceptibility compared to other gases and thus displays a particularly pronounced paramagnetic behavior. The paramagnetic sensor employs a small glass dumbbell filled with nitrogen that can rotate on a taut platinum wire suspended in an inhomogeneous magnetic field. This glass dumbbell is diamagnetic and tends to rotate out of the magnetic field. The strength of the resulting torque is determined by the susceptibility of the sample gas. This torque is compensated for by a counter torque induced by an electrically charged platinum coil on the dumbbell. The zero position of the dumbbell is controlled by means of an optical system consisting of a

light source, a mirror at the dumbbell axis and a pair of detectors. The difference between the compensating currents required to bring the dumbbell to the zero position in the presence of zero gas (i.e. no O₂ present) or of sample gas is proportional to the partial pressure of oxygen in the sample gas.

The sensor enclosure is temperature controlled to 55°C to insure that the magnetic susceptibility of oxygen in the sample is not affected by the ambient temperature. The measuring cell has a measuring volume of approximately 3 cm³.

Figure 2-1A shows the standard version sensor (side view) and Figure 2-1B shows the optional 0-1% sensor version.



Figure 2-1: Sensor (side view shown)

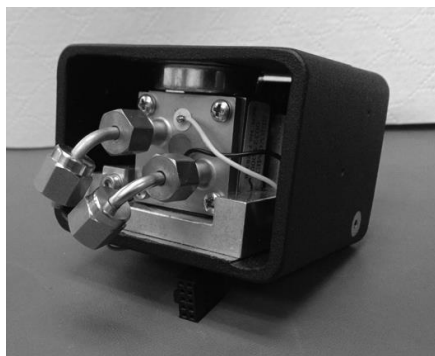


Figure 2-1B: Sensor 0-1% Version

The Paramagnetic sensor enclosure for the standard analyzer holds not only the sensing elements, but the temperature controller electronics, heating elements, sensor electronics, and preamplifier. The optional 0-1% analyzer uses a separate PID temperature controller and oven for controlling the thermal environment within the sensor housing.

The electronics and heating elements require a separate power source, from the rest of the 3020M capable of delivering 1.5 amps approximately at 24 volts DC. The output of the sensor is roughly calibrated to be 0 to 1 volt DC for the range of 0 to 100% O₂. The true calibration of the sensor is carried out by the microprocessor as described later in Chapter 4. The electrical interconnections to the sensor are done through a 15 pin D connector on the standard sensor or a 16 pin connector for the 0-1% sensor. Some signals from the sensor are not connected. They are only useful for troubleshooting, by trained personnel, as test points.

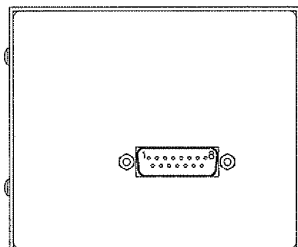


Figure 2-2: Sensor (rear view shown)

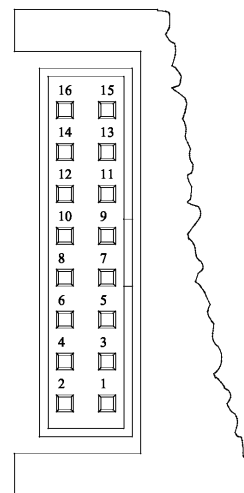
Pin out (Standard Version):

- 1 -15VDC test pin (not connected)
- 2 +15 VDC test pin (not connected)
- 3 Measuring ground
- 4 Not used
- 5 Preamplifier output —0- 1 VDC
- 6 Not used
- 7 24 VDC return, power ground
- 8 Collector of transistor switching heating element (not connected)
- 9 Fault signal: <0 VDC = OK, >4.6 VDC = Fault (not connected)

- 10 Not used
- 11 Negative reference voltage (not connected)
- 12 Positive reference voltage (not connected)
- 13 Nominal temperature voltage signal (not connected)
- 14 Actual temperature voltage signal (not connected)
- 15 +24 VDC power.

Pin out (0-1% Version):

P1 Pin No.	Description
1	Remote Zero pot (CCW) (Optional)
2	Remote Zero pot (CW) (Optional)
3	Remote Zero pot (WIPER) (Optional)
4	0V Internally connected
5	Supply 0V
6	Supply +5V
7	Remote Span pot (WIPER) (Optional)
8	Remote Span pot(CW) (Optional)
9	O ₂ output 0V
10	O ₂ output signal
11	Remote Span pot (CCW) (Optional)
12	Transducer temperature (1mV/Kelvin)
13	Do not connect (Test only)
14	Transducer temperature (10mV/°Celcius)
15	Do not connect (Test only)
16	Feed back loop failure indication



2.3 Cross interference

As mentioned previously, the selectivity of the measuring system is based on the extraordinarily high magnetic susceptibility of Oxygen compared to other gases. In most cases the presence of other gases can be ignored but significant errors can occur when the sensor is calibrated with a mixture of oxygen and nitrogen and the sample gas consists mainly of other gases with considerable magnetic susceptibility. In this case, the reading shows a measured value even if the sample gas contains no Oxygen. It is actually displaying the cross sensitivity to another gas.

The following table shows the cross sensitivity of some gases when changing from pure nitrogen to 100% of one of the gases listed.

Gas	Cross Sensitivity in vol. %	Gas	Cross Sensitivity in vol. %
Acetylene C ₂ H ₂	-0.24	Hydrogen chloride HCl	-0.30
Allene C ₃ H ₄	-0.44	Hydrogen fluoride HF	+0.10
Ammonia NH ₃	-0.26	Hydrogen iodide HI	-1.10
Argon Ar	-0.22	Hydrogen sulphide H ₂ S	-0.39
Bromine Br ₂	-1.30	Iodine I	-2.40
1.2 Butadiene C ₄ H ₆	-0.49	Isobutane C ₄ H ₁₀	-1.11
1.3 Butadiene C ₄ H ₆	-0.49	Isopentane C ₅ H ₁₂	-1.49
n-Butane C ₄ H ₁₀	-1.11	Krypton Kr	-0.51
I-Butane C ₄ H ₁₀	-0.85	Laughing gas N ₂ O	-0.20
cis 2-Butane C ₄ H ₈	-0.89	Methane CH ₄	-0.20
trans 2-Butane C ₄ H ₈	-0.92	Neon Ne	+0.13
Carbon dioxide CO ₂	-0.27	Neopentane C ₅ H ₁₂	-1.49
Carbon monoxide CO	+0.06	Nitric acid HNO ₃	+0.43
Chlorine Cl ₂	-0.77	Nitrogen dioxide NO ₂	+28.00
Cyclo hexane C ₆ H ₁₂	-1.56	Nitrous oxide NO	+40.00
Ethane C ₂ H ₆	-0.43	n-Octane C ₈ H ₁₈	-2.50
Ethylene C ₂ H ₄	-0.26	n-Pentane C ₅ H ₁₂	-1.45
Helium He	+0.30	Propane C ₃ H ₈	-0.86
n-Heptane C ₇ H ₁₆	-2.10	Propylene C ₃ H ₆	-0.55
n-Hexane C ₆ H ₁₄	-1.70	Vinyl chloride	-0.63
Hydrogen H ₂	+0.24	Water H ₂ O	-0.02
Hydrogen bromide HBr	-0.61	Xenon Xe	-0.95

With gas mixtures the components are weighted according to their proportional volumes.

The cross interference with a gas mixture can be determined in advance if the concentration of the individual background gases is known.

Example:

Cross sensitivity calculation for a gas mixture:

The gas to be measured consists of 10% CO₂, 40% N₂, and 50% Ar.

$$\text{CO}_2: -0.27 \times 10\% = -0.027$$

$$\text{Ar: } \underline{-0.22 \times 50\% = -0.11}$$

$$\text{TOTAL CROSS INTERFERENCE} = -0.137$$

Calculation of the zero value:

$$(0\% \text{ O}_2) - (\text{Cross Interference Value}) = \text{Zero Point Value}$$

$$0\% - (-0.137) = + 0.137\% \text{ O}_2$$

2.4 Sample System

The Model 3020M sample system is designed and fabricated to ensure that the oxygen concentration of the gas is not altered as it travels through the sample system. The sample encounters almost no dead space. This minimizes residual gas pockets that can interfere with trace analysis.

The sample system for the standard instrument incorporates 6 mm tube fittings for sample inlet and outlet connections at the bottom of the housing or on the optional gas panel. Other size tube fittings are available if needed.

Flame Arrestors and restrictors are placed on all gas inlets. The gas restrictors are external to the flame arrestors.



The sample or calibration gas flowing through the system is monitored by a flowmeter downstream from the sensor.

The gases delivered to the instrument should be at constant pressures and flow rates and must exit freely into the ambient atmosphere. The Span, Zero and Sample gases should be delivered at constant pressures of about 10 psig (Range 5-25 psig). The flow rate must be maintained at about 300 cc/minute (Range 50-600cc/m) and must exit freely into atmospheric pressure.

Figure 2-3 is the flow diagram for the sampling system. In the standard instrument (shown on the right), calibration gases (zero and span) can be connected directly to the Sample In port by teeing to the port with appropriate valves. The shaded portions of the diagram show the components added when the —C and/or —F options are ordered. The solenoid valves, when supplied, are installed inside the 3020M enclosure and are regulated by the instruments internal electronics. The flame arrestors, when supplied, are installed in the Gas Connector Panel..

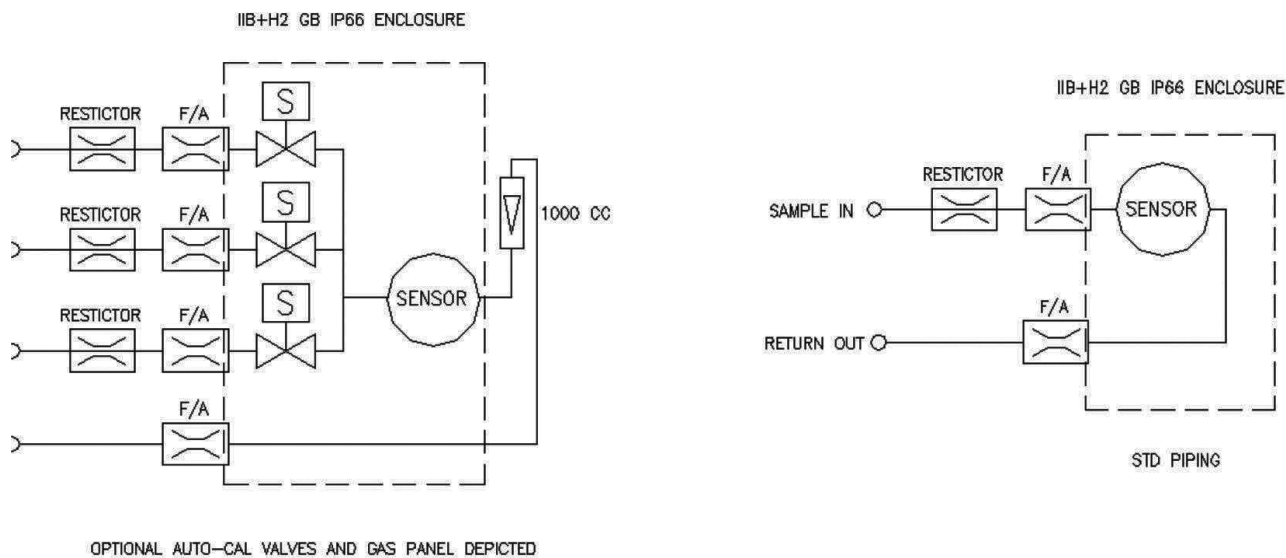


Figure 2-3: Flow Diagram

2.5 Electronics and Signal Processing

The Model 3020M Percent Oxygen Analyzer uses an 8031 microcontroller with 32 kB of RAM and 128 kB of ROM to control all signal processing, input/output, and display functions for the analyzer. System power is supplied from a universal power supply module designed to be compatible with most international power sources. See chapter 5 *Maintenance* for the location of the power supply and the main electronic PC boards. The Paramagnetic Sensor has its own dedicated universal 24V power supply that feeds the sensors internal heater and electronics.

The signal processing electronics including the microprocessor, analog to digital, and digital to analog converters are located on the main PCB, on the front door (see figure 5-1). The preamplifier board is mounted on top of the motherboard. These boards are accessible by opening the front door of the explosion proof enclosure. Figure 2-4 is a block diagram of the Analyzer electronics.

In the presence of oxygen the chamber is rotated in the magnetic field, but the cell generates a current to counter torque the oxygen action. This current is converted to a voltage, which is preamplified in the sensor internal electronics.

The preamplified signal (0-1 Volt) is fed to the 3020M amplifier for minor processing.

The digital concentration signal along with input from the control panel is processed by the microprocessor, and appropriate control signals are directed to the display, alarms and communications port. The same digital information is also sent to a 12 bit digital to analog converter that produces the 4-20 mA DC and the 0-1 V DC analog concentration signal outputs, and the analog range ID outputs.

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

2.6 Temperature Control

For accurate analysis the standard sensor temperature is controlled internally at 55°C. This is set at the factory. The 0-1% sensor is installed in an oven and uses a PID temperature controller to control the temperature of the sensor. It is also set at the factory prior to shipping but can be altered by the user.



CAUTION: CHANGING THE TEMPERATURE SETPOINT ON THE TEMPERATURE CONTROLLER WILL AFFECT OTHER PARAMETERS IN THE MEASURING PROCESS. ALWAYS CHECK WITH TELEDYNE CUSTOMER SERVICE BEFORE MAKING ANY TEMPERATURE CONTROLLER ADJUSTMENTS.



Refer to the included manual for the temperature controller for instructions on changing the temperature setpoint.

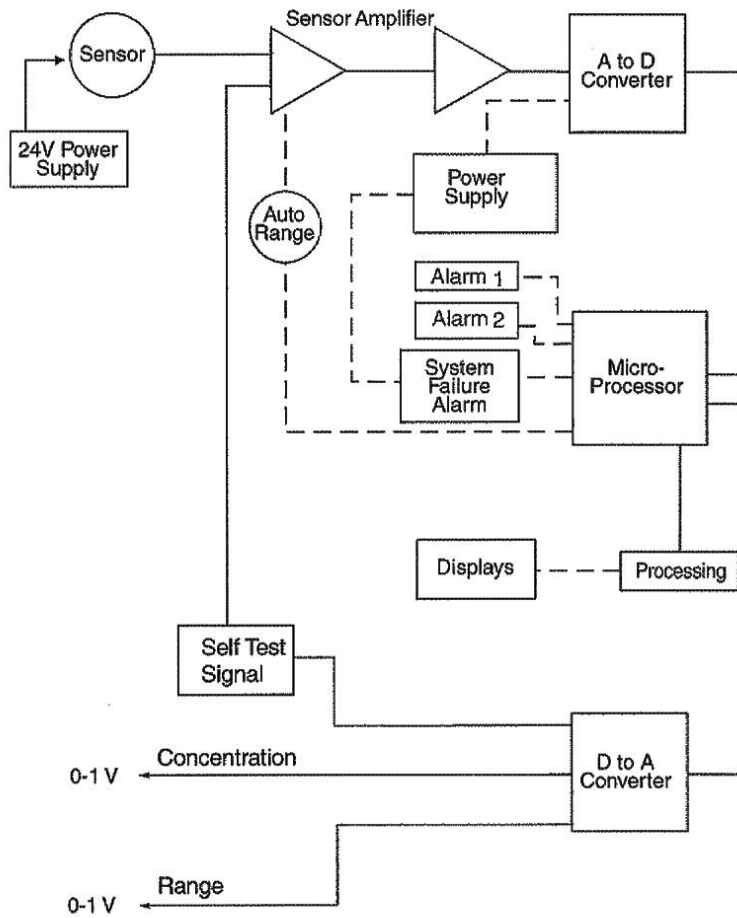


Figure 2-4: Block Diagram of the Model 3020M Electronics

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Installation

Installation of the Model 3020M Analyzer includes:

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

3.1 Unpacking the Analyzer

Carefully unpack the analyzer and inspect it for damage. Immediately report any damage to the shipping agent.

3.2 Mounting the Analyzer

The Model 3020M is designed for bulkhead mounting in hazardous environments. There are four mounting lugs—one in each corner of the enclosure, as shown in Figure 3-1. The outline drawing at the back of this manual gives the mounting hole size and spacing. The drawing also contains the overall dimensions. Do not forget to allow an extra 1 3/8" for the hinges.

The 3020M ***MUST be mounted in an upright position*** as shown in Figure 3-1. The paramagnetic sensor is orientation sensitive and will not work properly if operated horizontally (on its back or side).

Be sure to allow enough space in front of the enclosure to swing the door open—a 16 1/4" radius, as shown in Figure 3-3.

All electrical connections are made via cables which enter the explosion-proof housing through ports in its side. See Figure 3-4. No conduit fittings or sealing glands are supplied. All electrical ports are sealed with IIC rated blanking plugs as delivered. The installer must provide two 3/4" NPT and two 1" NPT adapters and the appropriate sealing conduit. All electrical connections, glands, conduit, or seals must provide a minimum of 5 full treads of engagement.

CAUTION: ALL ENTRIES MUST BE PROPERLY SEALED PRIOR TO PLACING THE ANALYZER INTO SERVICE.



ALL DOOR RETAINING HARDWARE MUST BE PROPERLY INSTALLED PRIOR TO PLACING THE ANALYZER IN SERVICE.

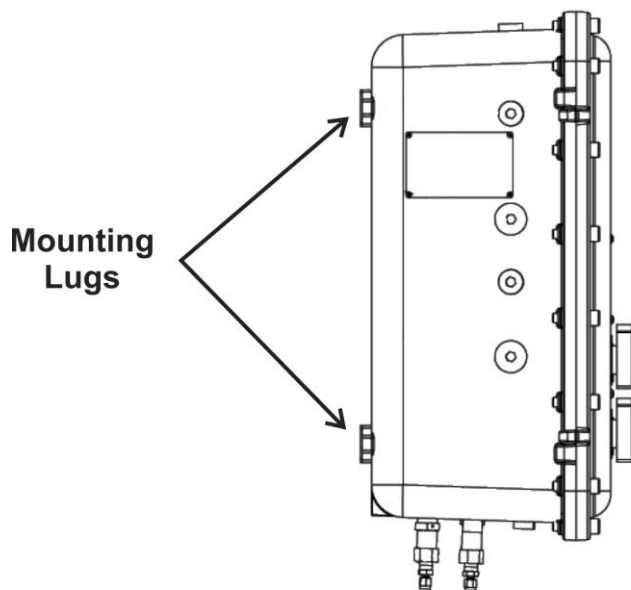
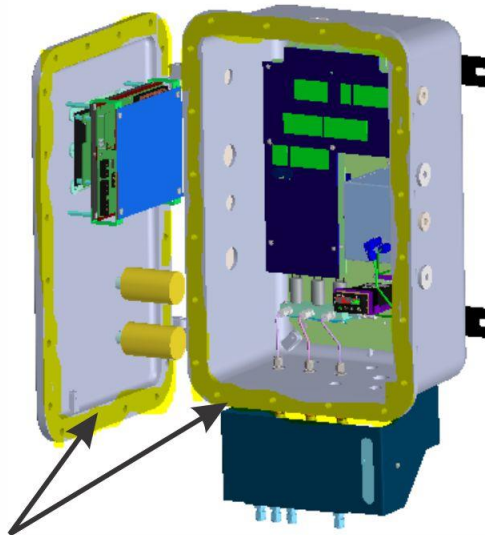


Figure 3-1: Mounting the Analyzer

The enclosure must be grounded. Refer to the Outline Diagram in the Appendix for the ground lug location. The ground wire must be the largest conductor in the installation. We recommended a wire size of 10-18 AWG for the power conductor wiring and so the ground wire size must be at least 10 AWG or heavier. A 6 mm external bolt is supplied with the instrument for the ground connection. The grounding (earthing) connection is located on the bottom of the enclosure near the gas connections.

CAUTION: CARE MUST BE TAKEN TO ENSURE THAT THE FLAME PATH ON THE OF THE DOOR AND SEALING FLANGE OF THE ENCLOSURE (SHOWN IN YELLOW IN FIGURE 3-2) ARE NOT DAMAGED. THE FLAME PATHS ARE NOT REPAIRABLE.





Flame Path
(non-repairable)

Figure 3-2: Flame Paths

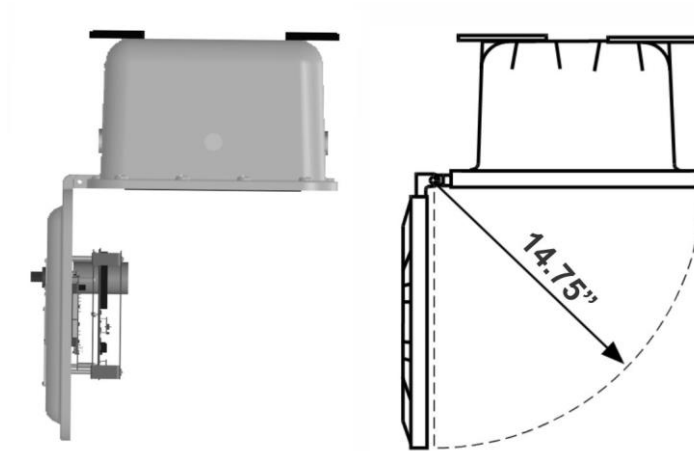


Figure 3-3: Required Front Door Clearance

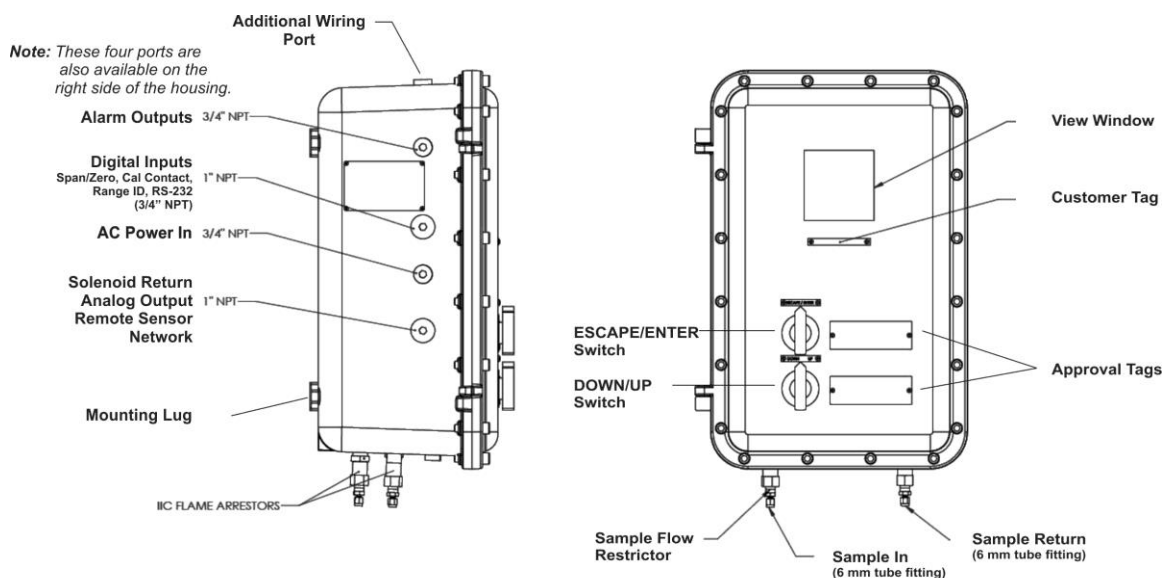


Figure 3-4: Front and Side View of the Model 3020M-ATEX (shown with optional Gas Panel)

CAUTION: ALL ENTRIES MUST BE PROPERLY SEALED PRIOR TO PLACING THE ANALYZER INTO SERVICE.



3.3 Electrical Connections

Figure 3-5 shows the Model 3020M Electrical Connector Panel. There are terminal blocks for connecting power, communications, and both digital and analog concentration outputs. The terminal blocks are rated for 32A, 630V, 0.55-6.0 mm conductors.

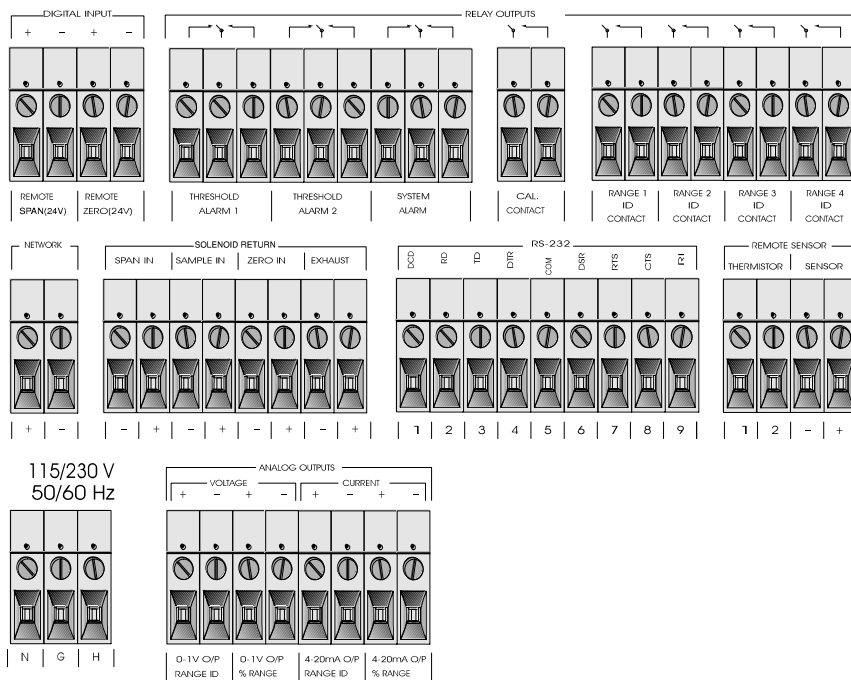


Figure 3-5: Electrical Connector Panel

For safe connections, ensure that no uninsulated wire extends outside of the connectors they are attached to. Stripped wire ends must insert completely into terminal blocks. No uninsulated wiring should be able to come in contact with fingers, tools or clothing during normal operation. The instrument must be grounded both internally and externally as per the Wiring Diagram in the Appendix.

3.3.1 Primary Input Power

The analyzer requires a 115 or 230 VAC, 50 or 60 Hz power source. The actual input voltage used must show in the window of the VOLTAGE SELECTOR switch **before** the power source is connected. See Figure 3-6 for detailed connections.

DANGER: Power is applied to the instrument's circuitry as long as the instrument is connected to the power



source. The Standby function switches power on or off to the displays and outputs only.

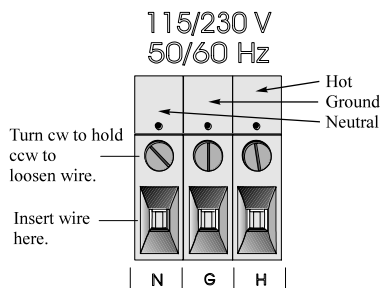


Figure 3-6: Primary Input Power Connections

3.3.2 Fuse Installation

The fuse holders accept 5 x 20 mm, 4 A, type 250VAC fuses. Fuses are not installed at the factory. Be sure to install the proper fuse as part of installation. (See *Fuse Replacement* in Chapter 5, *maintenance*.)

3.3.3 Analog Outputs

There are eight DC output signal connectors on the ANALOG OUTPUTS connector block. There are two connectors per output with the polarity noted. See Figure 3-7.

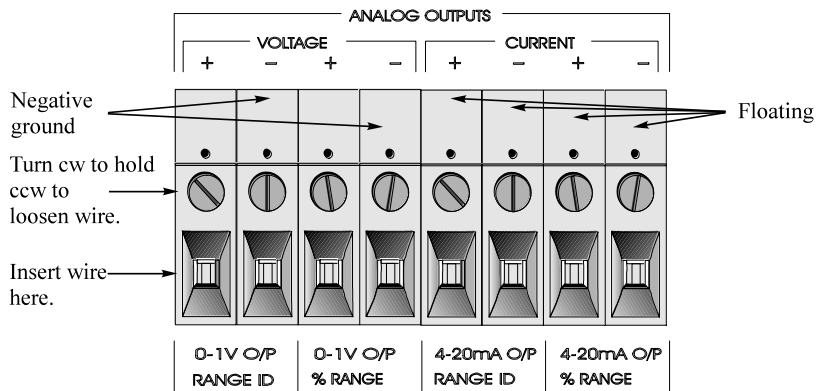


Figure 3-7: Analog Output Connections

The outputs are:

0–1 VDC % of Range: Voltage rises linearly with increasing oxygen, from 0 V at 0 % to 1 V at full scale. (Full scale = 100% of programmable range.)

0–1 VDC Range ID: 0.25 V = Low Range, 0.5 V = Medium Range, 0.75 V = High Range, 1 V = Air Cal Range.

4–20 mA DC % Range: (-M Option) Current increases linearly with increasing oxygen, from 4 mA at 0 % to 20 mA at full scale. (Full scale = 100% of programmable range.)

4–20 mA DC Range ID: (-M Option) 8 mA = Low Range, 12 mA = Medium Range, 16 mA = High Range, 20 mA = Air Cal Range.

Examples:

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

The signal output for concentration is linear over the currently selected analysis range. For example, if the analyzer is set on a range that was defined as 0–10 % O₂, then the output would be as shown in Table 3-1.

Table 3-1: Analog Concentration Output—Example

% O ₂	Voltage Signal Output (VDC)	Current Signal Output (mA DC)
0	0.0	4.0
1	0.1	5.6
2	0.2	7.2
3	0.3	8.8
4	0.4	10.4
5	0.5	12.0
6	0.6	13.6
7	0.7	15.2
8	0.8	16.8
9	0.9	18.4
10	1.0	20.0

To provide an indication of the range, a second pair of analog output terminals are used. They generate a steady preset voltage (or current when using the current outputs) to represent a particular range. Table 3-2 gives the range ID output for each analysis range.

Table 3-2: Analog Range ID Output—Example

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

3.3.4 Alarm Relays

There are three alarm-circuit connectors on the alarm relays block (under RELAY OUTPUTS) for making connections to internal alarm relay contacts. Each provides a set of Form C contacts for each type of alarm. Each has both normally open and normally closed contact connections. The contact connections are indicated by diagrams on the connector panel. They are capable of switching up to 3 amperes at 250 V ac into a resistive load. See Figure 3-8.

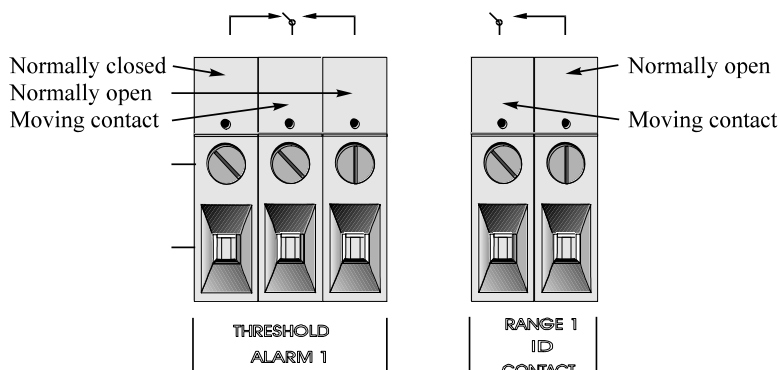


Figure 3-8: Types of Relay Contacts

The connectors are:

Threshold Alarm 1:

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

Threshold Alarm 2:

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

System Alarm:

- Actuates when DC power supplied to circuits is unacceptable in one or more parameters.
- Permanently configured as failsafe and latching. Cannot be defeated.
- Actuates if self test fails.

To reset a System Alarm during installation, disconnect power to the instrument and then reconnect it.

Further detail can be found in Chapter 4, Section 4-5.

3.3.5 Digital Remote Cal Inputs

Remote Zero and Span Inputs: The REMOTE SPAN and REMOTE ZERO inputs are on the DIGITAL INPUT terminal block. They accept 0 V (OFF) or 24 VDC (ON) for remote control of calibration. (See *Remote Calibration Protocol* below.)

- ZERO:** Floating input. 5 to 24 V input across the + and – terminals puts the analyzer into the *Zero* mode. Either side may be grounded at the source of the signal. 0 to 1 volt across the terminals allows *Zero* mode to terminate when done. A synchronous signal must open and close the external zero valve appropriately. See 3.3.9 *Remote Sensor and Solenoid Valves*. (With the –C option, the internal valves automatically operate synchronously.)
- SPAN:** Floating input. 5 to 24 V input across the + and – terminals puts the analyzer into the *Span* mode. Either side may be grounded at the source of the signal. 0 to 1 volt across the terminals allows *Span* mode to terminate when done. A synchronous signal must open and close the external span valve appropriately. See 3.3.9 *Remote Sensor and Solenoid Valves*. (With the –C option, the internal valves automatically operate synchronously.)

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

Remote Calibration Protocol: To properly time the Digital Remote Cal Inputs to the Model 3020M Analyzer, the customer's controller must monitor the CAL CONTACT relay.

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

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

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

For example:

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



4. When the CRC closes, remove the span command.

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

Note: The remote probe connections (paragraph 3.3.9) provides signals to ensure that the zero and span gas valves will be controlled synchronously. If you have the –C Internal valve option—which includes additional zero and span gas inputs—the 3020M automatically regulates the zero, span and sample gas flow.

3.3.6 Range ID Relays

There are four dedicated RANGE ID CONTACT relays. The first three ranges are assigned to relays in ascending order—Low range is assigned to RANGE 1 ID, Medium range is assigned to RANGE 2 ID, and High range is assigned to RANGE 3 ID. RANGE 4 ID is reserved for the Air Cal Range (25%).

3.3.7 Network I/O

A serial digital input/output for local network protocol. At this printing, this port is not yet functional. It is to be used in future versions of the instrument.

3.3.8 RS-232 Port

The digital signal output is a standard RS-232 serial communications port used to connect the analyzer to a computer, terminal, or other digital device. The pinouts are listed in Table 3-3.

Table 3-3: RS-232 Signals

RS-232 Sig	RS-232 Pin	Purpose
DCD	1	Data Carrier Detect
RD	2	Received Data
TD	3	Transmitted Data
DTR	4	Data Terminal Ready
COM	5	Common
DSR	6	Data Set Ready
RTS	7	Request to Send
CTS	8	Clear to Send
RI	9	Ring Indicator

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

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

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

Four input functions using RS-232 have been implemented to date. They are described in Table 3-4.

Table 3-4: Commands via RS-232 Input

Command	Description
as <enter>	Immediately starts an autospan.
az <enter>	Immediately starts an autozero.
co <enter>	Reports “Raw Cell Output” (current output of the sensor itself) in μA . For example— Raw Cell Output: 99 μA
st <enter>	Toggling input. Stops/Starts any status message output from the RS-232, until st <enter> is sent again.

The RS-232 protocol allows some flexibility in its implementation. Table 3-5 lists certain RS-232 values that are required by the 3020M implementation.

Table 3-5: Required RS-232 Options

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

3.3.9 Remote Sensor and Solenoid Valves

The 3020M is a single-chassis instrument, which has its own sensor and, in the -C option, its own gas-control solenoid valves. The REMOTE SENSOR connector is not used, and the SOLENOID RETURN connectors are used (without the -C option) to synchronize external gas control valves. See Figure 3-9.

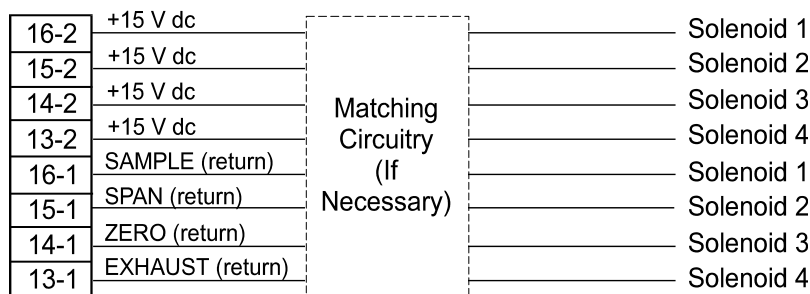


Figure 3-9: Remote Solenoid Return Connector Pinouts

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

In addition, each individual line has a series FET with a nominal ON resistance of 5 ohms (9 ohms worst case). This could limit the

obtainable voltage, depending on the load impedance applied. See Figure 3-10.

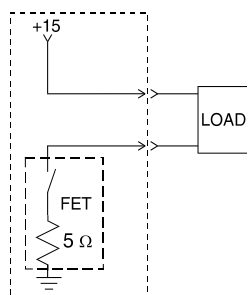


Figure 3-10: FET Series Resistance

3.4 Gas Connections

Restrictors are located in the flame arrestors on all input lines and in the auto-cal assembly if equipped.

The standard restrictor will limit the maximum sample flowrate to approximately 500 sccm at 20 psig. Other restrictors are available to meet customer requirements. Contact Teledyne Customer Service for additional information.

.WARNING: OPERATING THE UNIT WITHOUT RESTRICTORS WOULD CREATE AN UNSAFE OPERATING CONDITION AND IS PROHIBITED.



The unit is manufactured with 6mm tube fittings, and 1/4" fittings are available as an option. For a safe connection:

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

The gas pressure in should be reasonably regulated and stable as indicated by a stable flowmeter reading. The maximum pressure should not exceed 25 psig.

SAMPLE IN:

In the standard model, gas connections are made at the SAMPLE IN and EXHAUST OUT connections. Calibration gases must be tee'd into the Sample inlet with appropriate valves.

The gas pressure in should be reasonably regulated. Pressures between 3 and 25 psig are acceptable as long as the pressure, once established, will keep the front panel flowmeter reading in an acceptable range (50 to 250 sccm). For non-pressurized sample or very low pressure, (1 psig or less) vacuum service plumbing is recommended. Exact figures will depend on your process.

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

Note: If the unit is for vacuum service, the above numbers apply instead to the vacuum at the EXHAUST OUT connector, described below, with minus signs before the pressure readings.

EXHAUST OUT:

Exhaust connections must be consistent with the hazard level of the constituent gases. Check Local, State, and Federal laws, and ensure that the exhaust stream vents to an appropriately controlled area if required.

ZERO IN and SPAN IN (Optional):

These are additional ports for inputting span gas and zero gas. There are electrically operated valves inside for automatic switching between sample and calibration gases. These valves are completely under control of the 3020M Electronics. They can be externally controlled only indirectly through the Remote Cal Inputs, described below.

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

3.5 Temperature Controller Settings (0-1% Analyzer only)

The 0-1% Sensor uses a PID Temperature Controller to control an oven that surrounds the sensor. It has been set up at the factory for your application. Nevertheless, it is possible to make changes to the thermal environment if required however this should never be done without contacting Teledyne Customer Service first. Other parameters will be affected if the temperature setpoint or other feature is changed.

The following settings for the temperature controller have been set at the factory:

Function	Value	Description
hPb	3.1	Heater proportional band setting
ti	455	Setting for time integral for the output
td	114	Setting for time derivative for the output
o.tb 1	1	Time base output. Sets the time base for fixed time base control.
SEn	R0.1H	Sensor type used in the instrument. RTD 100Ω
C_F	C	
dEC	0.00	Sets the display precision. (hundreths)
Fn1	heat	Sets which function drives Output 1
h.Ag	Pid	Heat control method.

3.6 Testing the System

Before plugging the instrument into the power source:

- Check the integrity and accuracy of the gas connections. Make sure there are no leaks.
- Check the integrity and accuracy of the electrical connections. Make sure there are no exposed conductors
- Check that sample pressure is between 3 and 25 psig, according to the requirements of your process.



- Check that the voltage selector switch on the Electrical Connector Panel is in the appropriate position for your power source.

Power up the system, and test it by performing the following operations:

1. Repeat the Self-Diagnostic Test as described in Chapter 4, Section 4.3.5.

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Operation

4.1 Introduction

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

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

Before you configure your 3020M these default values are in effect:

Ranges: LO = 0-5%, MED = 0-25%, HI = 0-100%.
Auto Ranging: ON
Alarm Relays: Defeated, 10%, HI, Not failsafe, Not latching.
Zero: Auto, every 0 days at 0 hours.
Span: Auto, at 20.9%, every 0 days at 0 hours.
Password: T E T A I

4.2 Using the Controls

To get the proper response from these controls, turn the control toward the desired action (ESCAPE or ENTER—DOWN or UP), and then release it. Turn-and-release once for each action. For example, turn-and-release twice toward UP to move the VFD screen two selections upwards on the list of options (menu).

The item that is between arrows on the screen is the item that is currently selectable by choosing ENTER (turn-and-release toward ENTER with the ESCAPE/ENTER control).

In these instructions, to ENTER means to turn-and-release toward ENTER, and To ESCAPE means to turn-and-release towards ESCAPE. To scroll UP (or scroll DOWN) means to turn-and-release toward UP (or DOWN) as many times as necessary to reach the required menu item.

4.2.1 Mode/Function Selection

When the analyzer is first powered up, and has completed its initialization and self diagnostics, ESCAPE toggles the instrument between the ANALYZE screen (*Analysis Mode*) and the MAIN MENU screen (*Setup Mode*). The ANALYZE screen is the only screen of the *Analysis Mode*.

The MAIN MENU screen is the top level in a series of screens used in the *Setup Mode* to configure the analyzer for the specific application. The DOWN/UP commands scroll through the options displayed on the VFD screen. The selectable option appears between arrows. When you reach the desired option by scrolling, ENTER the selection as described below.

ESCAPE takes you back up the hierarchy of screens until you reach the MAIN MENU again. ESCAPING any further just toggles between the MAIN MENU and the ANALYZE screen.

4.2.1.1 ANALYSIS MODE

This is the normal operating mode. The analyzer monitors the oxygen content of the sample, displays the percent of oxygen, and warns of any alarm conditions. Either control switches you to *Setup Mode*. *Setup Mode* switches back to *Analyze Mode* if no controls are used for more than five seconds.

4.2.1.2 SETUP MODE

The MAIN MENU consists of 12 functions you can use to customize and check the operation of the analyzer. Figure 4-1 shows the functions available with the 3020M. They are listed here with brief descriptions:



1. **AUTO-CAL**: Used to define and/or start an automatic calibration sequence.
2. **PWD**: Used to establish password protection or change the existing password.
3. **LOGOUT**: Logging out prevents unauthorized tampering with the analyzer settings.
4. **VERSION**: Displays Manufacturer, Model, and Software version of the instrument.
5. **SELF-TEST**: The instrument performs a self-diagnostic routine to check the integrity of the power supply, output boards and amplifiers.
6. **SPAN**: Set up and/or start a span calibration.
7. **ZERO**: start a zero calibration.
8. **ALARMS**: Used to set the alarm setpoints and determine whether each alarm will be active or defeated, HI or LO acting, latching or not, and failsafe or not.
9. **RANGE**: Used to set up three analysis ranges that can be switched automatically with auto-ranging or used as individual fixed ranges.
10. **CONTRAST**: The contrast function is disabled in this version.
11. **STANDBY**: Remove power to outputs and displays, but maintain power to internal circuitry.

Any function can be selected at any time. Just scroll through the **MAIN MENU** with the **DOWN/UP** control to the appropriate function, and **ENTER** it. The analyzer will immediately start that function, unless password restrictions have been assigned. (Password assignment is explained further on.)

All of these functions are described in greater detail in the procedures starting in section 4.3. The VFD screen texts used to illustrate the procedures are reproduced in the **Arial Narrow Bold** type style.

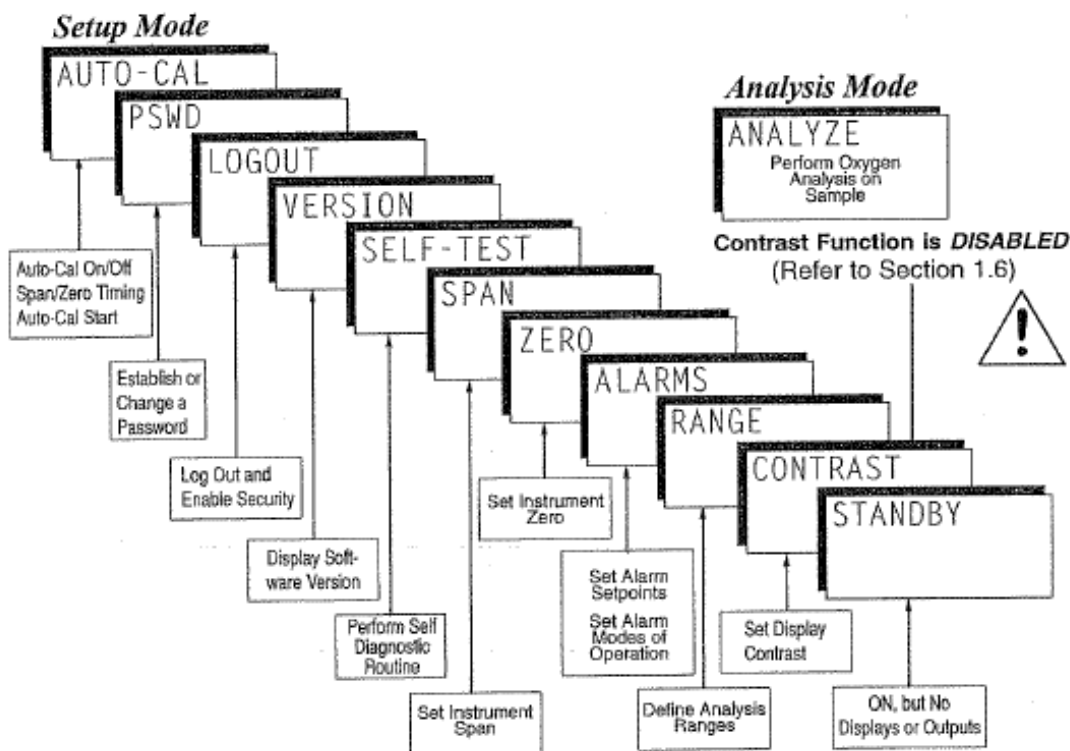


Figure 4-1: Modes and Functions

4.2.2 Data Entry

4.2.2.1 ENTER

When the selected option is a function on the Main Menu screen, the function name appears between the arrows on the screen. You activate the function by turning the ESCAPE/ENTER control to ENTER.

When the selected option is a **function or subfunction**, ENTER moves the display to the VFD screen for that function or subfunction.

When the selected option is a **modifiable item**, the DOWN/UP control can be used to increment or decrement that modifiable item to the value or action you want. Then you ENTER the item, which also puts you into the next field to continue programming.

When the last field is entered, ENTER takes you to the next screen in the process, or if the process is completed, ENTER takes you back to the ANALYZE screen.

4.2.2.2 ESCAPE

A turn-and-release toward ESCAPE moves the blinking to the next field on the left. When you are on the leftmost field, another ESCAPE takes you back to the previous screen.

If you do not wish to continue a function, you can abort the session by escaping to the leftmost field, and then issuing another ESCAPE. Escaping a function takes the analyzer back to the previous screen, or to the ANALYZE Function, depending on the function escaped.

4.3 The AUTO-CAL Function

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

*Note: If you require highly accurate timing of your **AUTO-CAL**, use external **AUTO-CAL** control where possible. The internal clock in the Model 3020M is accurate to 2-3 %. Accordingly, internally scheduled calibrations can vary 2-3 % per day.*

To setup an AUTO-CAL cycle:

Scroll to AUTO-CAL, and ENTER. A new screen for Span/Zero set appears.

Span OFF Nxt: 0d 0h
Zero OFF Nxt: 0d 0h

If SPAN (or ZERO) is not flashing, scroll with DOWN/UP control to SPAN (or ZERO), then ENTER. (*You won't be able to set OFF to ON if a zero interval is entered.*) A Span Every ... (or Zero Every ...) screen appears.

Span Every 0 d
Start 0 h from now

Use DOWN/UP control to set an interval value, and ENTER. Then use DOWN/UP to set a start-time value, and ENTER.

Span OFF Nxt: 0d 0h
Zero OFF Nxt: 0d 0h

When the Span/Zero values screen appears, use the scroll DOWN to blink the OFF/ON field of the SPAN (or ZERO) function. Use

DOWN/UP to set the OFF/ON field to ON. *You can now turn these fields ON because there is a nonzero span interval defined.*

4.4 The PWD (Password) Function

Security can be established by choosing a 5 digit password from the standard ASCII character set. If you decide NOT to employ password security, use the default password TETAI. This password will be displayed automatically by the microprocessor. The operator just ENTERs it to be allowed total access to the instrument's features.

Once a unique password is assigned and activated, the operator MUST enter the UNIQUE password to gain access to any of the set-up functions (except to enter the **password**). However, the instrument will continue to analyze sample gas and report on alarm conditions without entering the password.

- Only one password can be defined.
- After a password is assigned, the operator must log out to activate it. Until then, anyone can continue to operate the instrument without entering the new password.
- To defeat the security after a unique password is activated, the password must be changed back to **TETAI**.

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

4.4.1 Entering the Password

To install a new password or change a previously installed password, you must key in and enter the old password first. If the default password is in effect, issuing the ENTER command will enter the default **TETAI** password for you.

Scroll to **PWD**, and ENTER to select the password function. Either the **TETAI** default password or **AAAAA** place-holder password for an existing password will appear on screen depending on whether or not a password has been previously installed.

T E T A I
Enter PWD

or



A A A A A
Enter PWD

The screen prompts you to enter the current password. If you are not using password protection, ENTER to accept **TETAI** as the default password. If a password has been previously installed, enter the password using ENTER to scroll through the letters, and the DOWN/UP switch to change the letters to the proper password. The last ENTER enters the password.

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

PWD Restrictions
Removed

In a few seconds, if you do not ESCAPE, you will be given the opportunity to change this password or keep it and go on.

Change Password?
<ENT>=Yes <ESC>=No

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

4.4.2 Installing or Changing the Password

If you want to change the existing password: Proceed as above in *Entering the Password*, until you are given the opportunity to change the password:

Change Password?
<ENT>=Yes <ESC>=No

ENTER to change the password (to change either the default TETAI or the previously assigned password), or ESCAPE to keep the existing password and move on.

If you choose ENTER to change the password, the password assignment screen appears.

T E T A I
<ENT> To Proceed

or

A A A A A
 <ENT> To Proceed

Enter the password using ENTER to scroll through the existing password letters, and DOWN/UP to change the letters to the new password. The full set of 94 characters available for password use are shown in the table below.

Characters Available for Password Definition:

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

When you have finished typing the new password, the last ENTER enters it. A verification screen appears. The screen will prompt you to retype your password for verification.

A A A A A
 Retype PWD To Verify

Wait a moment for the entry (<ENT>) screen. You will be given clearance to proceed.

A A A A A
 <ENT> TO Proceed

ENTER the letters of your new password. Your password will be stored in the microprocessor and the system will immediately switch to the ANALYZE screen, and you now have access to all instrument functions.

If all alarms are defeated, the ANALYZE screen appears as:

0.0 % Anlz
 Range: 0 — 100

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

0.0 % Anlz
 AL—1

*Note: If you log off the system using the **LOGOUT** function in the **MAIN MENU**, you will now be required to re-enter the password to gain access to any of the functions except password (PWD).*

4.5 The LOGOUT Function

By entering LOGOUT, you effectively log off the instrument, leaving the system protected against tampering until the password is reentered. To log out, scroll to place the LOGOUT function between the arrows, and ENTER to log out. The screen will display the message:

**Protected Until
Password Reentered**

4.6 The VERSION Screen

Scroll through the MAIN MENU to **VERSION**, and ENTER. The screen displays the manufacturer, model, and software version information.

4.7 The SELF-TEST Function

The Model 3020M has a built-in self-testing diagnostic routine. Preprogrammed signals are sent through the power supply, output board and sensor circuit. The return signal is analyzed, and at the end of the test the status of each function is displayed on the screen, either as **OK** or as a number between 1 and 3. (See *System Self Diagnostic Test* in chapter 5 for number code.)

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

Use the DOWN/UP control to scroll through the MAIN MENU to **SELF-TEST**. The screen will follow the running of the diagnostic.

**RUNNING DIAGNOSTIC
Testing Preamp — 83**

During preamp testing there is a countdown in the lower right corner of the screen. When the testing is complete, the results are displayed.

Power: OK Analog: OK
Preamp: 3

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

Press Any Key
To Continue...

Then the analyzer returns to the ANALYZE screen.

4.8 The Zero and Span Functions

Note: Zeroing is not required in order to achieve the published accuracy specification of this unit.

Zeroing will eliminate offset error contributed by sensor, electronics, and internal and external sampling system and improve performance beyond published specification limits.

The analyzer is calibrated using zero and span gases.

Any suitable oxygen-free gas can be used for zero gas as long as it is known to be oxygen free and does not react adversely with the sample system.

Although the instrument can be spanned using air, 20.9% (209,000 ppm), a span gas with a known oxygen concentration in the range of 70–90% of full scale of the range of interest is recommended

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

Shut off the gas pressure before connecting it to the analyzer, and be sure to limit the pressure to 25 psig or less when turning it back on.

Readjust the gas pressure into the analyzer until the flowrate (as read on the analyzer's SLPM flowmeter) settles between 50 and 250 sccm (approximately).



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

4.8.1 Zero Cal

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

4.8.1.1 AUTO MODE ZEROING

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

Zero: Settling: AUTO

<ENT> To Begin

Select *Enter* to begin zeroing.

PPM Zero

Slope=#### ppm/s

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

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


```

##### PPM      Zero
1 Left=###     ppm/s

```

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

4.8.1.2 MANUAL MODE ZEROING

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

```

Zero:   Settling: Man
<ENT>  To Begin

```

Select *Enter* to begin the zero calibration. After a few seconds the first of five zeroing screens appears. The number in the upper left hand corner is the first-stage zero offset. The microprocessor samples the output at a predetermined rate. It calculates the differences between successive samplings and displays the rate of change as **Slope=** a value in parts per million per second (ppm/s).

```

##### ppm      Zero
Slope=#####  ppm/s

```

Note: It takes several seconds for the true Slope value to display. Wait about 10 seconds. Then, wait until Slope is sufficiently close to zero before pressing Enter to finish zeroing.

Generally, you have a good zero when Slope is less than 0.05 ppm/s for about 30 seconds. When Slope is close enough to zero, select *Enter*. In a few seconds, the screen will update.



Once span settling completes, the information is stored in the microprocessor, and the instrument automatically returns to the *Analyze* mode.

Connect the calibration gases to the analyzer according to the instructions given in section 3.5, *Gas Connections*, observing all the prescribed precautions.

Shut off the gas pressure before connecting it to the analyzer, and be sure to limit the pressure to 25 psig or less when turning it back on.

Readjust the gas pressure into the analyzer until the flowrate (as read on the analyzer's SCCM flowmeter) settles between 50 and 250 sccm.

If you are using password protection, you will need to enter your password to gain access to either of these functions. Follow the instructions in section 4.4 to enter your password. Once you have gained clearance to proceed, you can ENTER the ZERO or SPAN function.

4.8.2 Span Cal

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

4.8.2.1 AUTO MODE SPANNING

Scroll to **SPAN**, and ENTER the SPAN function. The screen that appears allows you to select whether the span calibration is to be performed automatically or manually. Use the DOWN/UP switch to toggle between **AUTO** and **MAN** span settling. Stop when **AUTO** appears on the display.

Span: Settling: AUTO
<ENT> For Next

Use ENTER to move to the next screen.

Span Val: 20.90
<ENT>Span <UP>Mod #

Use DOWN/UP to start changing the oxygen-concentration. Use ESCAPE/ENTER to blink the digit you are going to modify. Use DOWN/UP again to change the value of the selected digit. When you have finished typing in the concentration of the span gas you are using, repeatedly select ENTER until the rightmost digit is reached, then, the next ENTER will exit the Span Val screen. One more ENTER will enter the new span value, bring up the next screen, and start the span calibration.

```
#### % Span
Slope=#### ppm/s
```

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

4.8.2.2 MANUAL MODE SPANNING

ENTER SPAN from the MAIN MENU to start the SPAN function. The screen that appears allows you to select whether the span calibration is to be performed automatically or manually.

```
Span: Settling:MAN
<ENT> For Next
```

Use DOWN/UP to toggle between **AUTO** and **MAN** span settling. Stop when MAN appears on the display. Use ENTER to move to the next screen.

```
Span Val: 20.90
<ENT>Span <UP>Mod #
```

Use UP to permit modification (**Mod #**) of span value.

Use ESCAPE/ENTER to choose the digit, and use DOWN/UP to choose the value of the digit.

When you have finished typing in the concentration of the span gas you are using, repeatedly select ENTER until the rightmost digit is reached, then, the next ENTER will exit the Span Val field. One more ENTER will enter the new span value, bring up the next screen, and start the span calibration.

Once the span has begun, the microprocessor samples the output at a predetermined rate. It calculates the difference between successive



samplings and displays this difference as Slope on the screen. It takes several seconds for the first Slope value to display. Slope indicates rate of change of the Span reading. It is a sensitive indicator of stability.

```
#### % Span  
Slope=#### ppm/s
```

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

4.9 The ALARMS Function

The Model 3020M is equipped with 2 fully adjustable concentration alarms and a system failure alarm. Each alarm has a relay with a set of form "C" contacts rated for 3 amperes resistive load at 250 V ac. See Figure in Chapter 3, *Installation* and/or the Interconnection Diagram included at the back of this manual for relay terminal connections.

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

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

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

1. Which if any of the alarms are to be high alarms, and which if any are to be low alarms?

Setting an alarm as HIGH triggers the alarm when the oxygen concentration rises above the setpoint. Setting an alarm as LOW triggers the alarm when the oxygen concentration falls below the setpoint.

Decide whether you want the alarms to be set as:

- Both high (high and high-high) alarms, or

- One high and one low alarm, or
 - Both low (low and low-low) alarms.
2. Are either or both of the alarms to be configured as failsafe?

In failsafe mode, the alarm relay de-energizes in an alarm condition. For non-failsafe operation, the relay is energized in an alarm condition. You can set either or both of the concentration alarms to operate in failsafe or non-failsafe mode.

3. Are either of the alarms to be latching?

In latching mode, once the alarm or alarms trigger, they will remain in the alarm mode even if process conditions revert back to non-alarm conditions. This mode requires an alarm to be recognized before it can be reset. In the non-latching mode, the alarm status will terminate when process conditions revert to non-alarm conditions.

4. Are either of the alarms to be defeated?

The defeat alarm mode is incorporated into the alarm circuit so that maintenance can be performed under conditions which would normally activate the alarms.

The defeat function can also be used to reset a latched alarm.
(See procedures, below.)

If you are using password protection, you will need to enter your password to access the alarm functions. Follow the instructions in Section 4.4 to enter your password. Once you have clearance to proceed, ENTER the ALARM function.

```
AL-1  AL-2
Choose Alarm
```

Use the DOWN/UP control to blink your choice of alarm, **AL-1** or **AL-2**. Then ENTER to move to the next screen.

```
AL-1  1.00%  HI
Dft-N  Fs-N  Ltch-N
```

Five parameters can be changed on this screen.

1. Value of the alarm setpoint: **AL-1 #####** % (oxygen)
2. Out-of-range direction: **HI** or **LO**



3. Defeated? (Yes/No): **Dft–Y/N**
 4. Failsafe? (Yes/No): **Fs–Y/N**
 5. Latching? (Yes/No): **Ltch–Y/N**.
- To define the setpoint, use ENTER to blink **AL-1 #####**, if not already blinking. Then use the DOWN/UP control to change the number. Holding the control on the DOWN or UP position, while the number changes, speeds up the incrementing or decrementing. (Remember, the setpoint units are always ppm O₂.)
 - To set the other parameters use ENTER to blink the desired parameter. Then use DOWN/UP to change the parameter.
 - Once the parameters for the alarm have been set, ENTER the ALARM function again, and repeat this procedure for next alarm.
 - To reset a latched alarm:
 - Go to **Dft–** and then assert either DOWN two times or UP two times. (Toggle it to **Y** and then back to **N**.)
- OR –
- Go to **Ltch–** and then assert either DOWN two times or UP two times. (Toggle it to **N** and back to **Y**.)

Note: In this screen, ENTER moves you through the fields and ESCAPE takes you back to the previous screen.

4.10 The RANGE Function

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

Low = 0–5% (std.) or 0–1% 0–1% version)
Med = 0–25%
High = 0–100%

The Model 3020M is set at the factory to default to auto-ranging. In this mode, the microprocessor automatically responds to concentration changes by switching ranges for optimum readout sensitivity. If the current range limits are exceeded, the instrument will automatically shift to the next higher range. If the sample concentration falls below the full scale of the next lower range, the instrument will switch to that range. A

corresponding shift in the DC percent-of-range output, and in the range ID outputs, will be noticed.

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

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

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

4.10.1 Setting the Analog Output Ranges

To set the ranges, ENTER the RANGE function mode by selecting **RANGE** from the MAIN MENU. The RANGE screen appears.

L—5.00 M—25.0
H—100.00 Mode—AUTO

Use the DOWN/UP control to the range to be set: low (L), medium (M), or high (H).

Use the DOWN/UP switch to enter the upper value of the range (all ranges begin at 0 ppm). Repeat for each range you want to set. ENTER to accept the values and return to the *Analysis Mode*. (See note below.)

Note: The ranges must be increasing from low to high, for example, if range 1 is set as 0–5% and range 2 is set as 0–90 %, range 3 cannot be set as 0–50% since it is lower than range 2.

4.10.2 Automatic Ranging

After defining your analysis ranges, set Mode– to AUTO, if not already there. ESCAPE to re-enter the ANALYZE screen using the fixed range.

4.10.3 Fixed Range Analysis

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



To switch from auto-ranging to fixed range analysis, ENTER the RANGE function by selecting RANGE from the MAIN MENU.

Use the DOWN/UP switch to move AUTO between the arrows.

Use the DOWN/UP switch to switch from AUTO to FX/LO, FX/MED, or FX/HI to set the instrument on the desired fixed range (low, medium, or high).

L—5.00 M—25.00
H—100.00 Mode—FX/LO

OR

L—5.00 M—25.00
H—100.00 Mode—FX/MED

OR

L—5.00 M—25.00
H—100.00 Mode —FX/HI

ESCAPE to re-enter the ANALYZE screen using the fixed range.

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

4.11 The CONTRAST Function

The contrast function is not available in this model.

4.12 The STANDBY Function

In STANDBY, the analyzer's internal circuits are powered, but there are no displays or outputs from the analyzer.

WARNING: **THE POWER CABLE MUST BE UNPLUGGED TO FULLY DISCONNECT POWER FROM THE INSTRUMENT. WHEN THE ACCESS DOOR IS OPEN AND THE POWER CABLE IS CONNECTED, EXTRA CARE IS REQUIRED TO AVOID CONTACT WITH LIVE ELECTRICAL CIRCUITS.**



CAUTION: *If you disconnect the primary power source from the analyzer, then on re-energizing, you will be required to choose to keep the configuration you previously programmed into your instrument in the Setup Mode by pressing the “Enter” key, or by pressing the “Escape” key to reset to factory defaults. Of you press neither key, the instrument will time out and take your previous configuration.*



4.13 The Analysis Mode

This is the normal operating mode of the analyzer. In this mode the analyzer is monitoring the sample, measuring and displaying the amount of oxygen, and reporting alarm conditions.

Normally, the Version, Self-Test, Sensor, Main Menu, and the Span and Zero (in auto-settling mode) functions automatically switch back to the *Analysis Mode* ANALYZE screen when they have completed their assigned operations. After four or five seconds in the MAIN MENU without any action by the operator, the analyzer automatically switches itself back to the ANALYZE screen. ESCAPE, asserted one or more times, depending on the starting point, also switches the analyzer back to the ANALYZE screen.



Maintenance

5.1 Routine Maintenance

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

SEE WARNINGS ON TITLE PAGE OF THIS MANUAL.

5.2 Major Internal Components

WARNING: DO NOT OPEN THE COVER WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT.

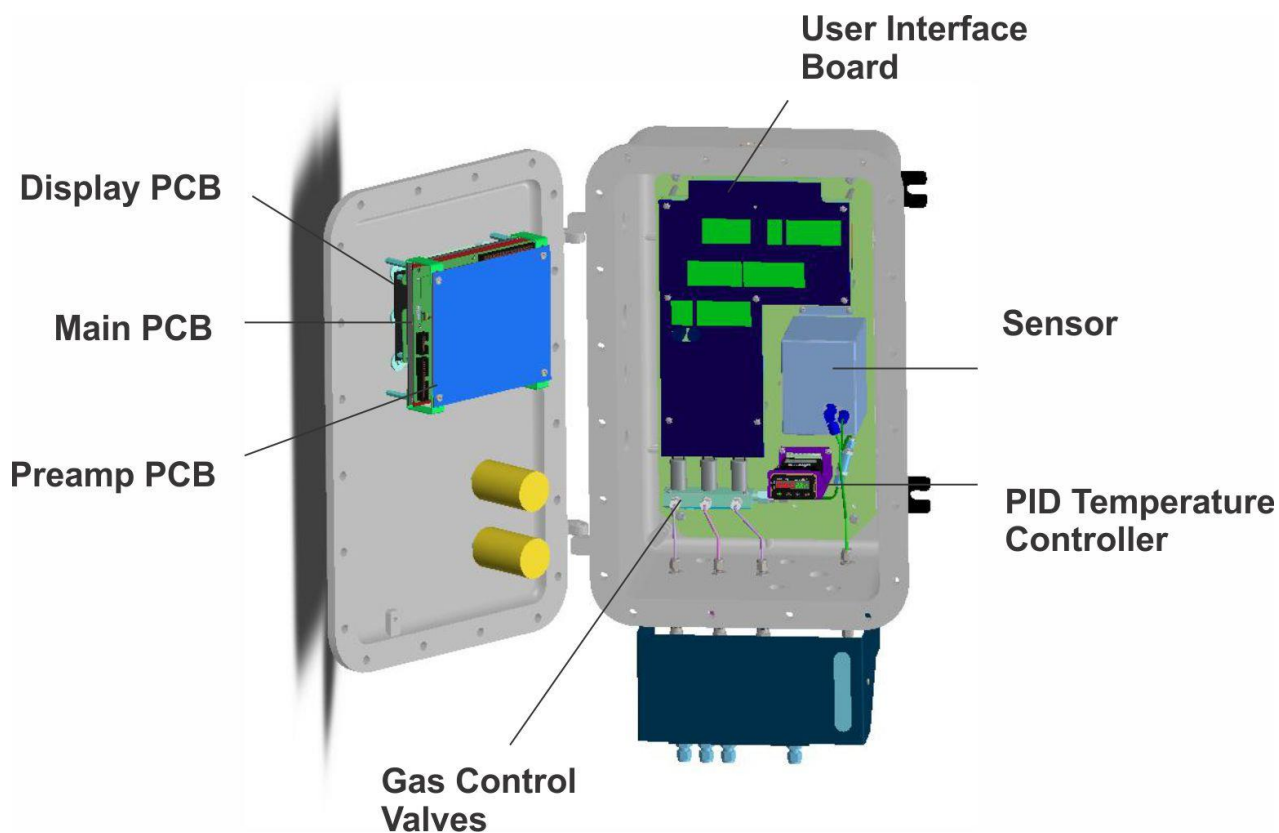


All internal components are accessed by unbolting and swinging open the front cover, as described earlier. The major internal component locations are shown in Figure 5-1 which shows the 0-1% version with the Auto Cal option and gas control panel. The fuse receptacle is shown in Figure 5-2.

The 3020M contains the following major internal components:

- Paramagnetic Sensor
- Paramagnetic Sensor 24VDC Power Supply
- Customer Interface PCB (Power Supply on bottom surface)
- Preamp PCB (Contains Microprocessor)
- Front Panel PCB (Contains Displays)
 - 5 digit LED meter
 - 2 line, 20 character, alphanumeric, VFD display
- Solenoid Operated Gas Control Valves (—C option only).

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



*Figure 5-1: Major Internal Components
(0-1% Version with Auto-Cal and optional Gas Panel and Flowmeter
shown)*

To swing open the cover panel, remove all screws.

5.3 Cell Replacement

The paramagnetic sensor is maintenance free and has a long life. Should the sensor fail, contact Teledyne for service and replacement.

5.4 Fuse Replacement

WARNING: Risk of electric shock high voltage exposed at the end of enclosure!



The 3020M requires two 5 x 20 mm, 4 A, T type (Slow Blow) fuses. The fuses are located inside the explosion proof housing on the Electrical Connector Panel, as shown in Figure 5-2. To replace a fuse:

1. Disconnect the Unit from its power source.
2. Place a small screwdriver in the notch in the fuse holder cap, push in, and rotate 1/4 turn. The cap will pop out a few millimeters. Pull out the fuse holder cap and fuse, as shown in Figure 5-3.
3. Replace fuse by reversing process in step 1.

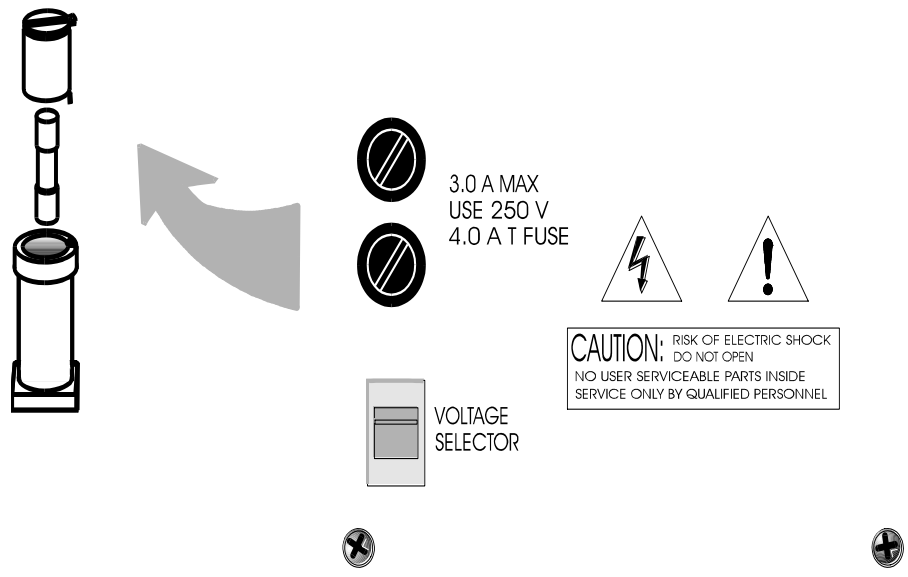


Figure 5-2: Removing Fuse Cap and Fuse from Holder

5.5 System Self Diagnostic Test

Use the DOWN/UP switch to scroll through the MAIN MENU to SELF-TEST. The screen will follow the running of the diagnostic.

RUNNING DIAGNOSTIC
Testing Preamp — 83

During preamp testing there is a countdown in the lower right corner of the screen. When the testing is complete, the results are displayed.

Power: OK Analog: OK
Preamp: 3

The module is functioning properly if it is followed by OK. A number indicates a problem in a specific area of the instrument. Refer to Table 5-1 for number-code information. The results screen alternates for a time with:

Press Any Key
To Continue...

The following failure codes apply:

Table 5-1: Self Test Failure Codes

Power

0	OK
1	5 V Failure
2	15 V Failure
3	Both Failed

Analog

0	OK
1	DAC A (0–1 V Concentration)
2	DAC B (0–1 V Range ID)
3	Both Failed

Preamp

0	OK
1	Zero too high
2	Amplifier output doesn't match test input
3	Both Failed



Appendix

A-1 Specifications

Packaging: Explosion-proof. Bulkhead mount.

Sensor: Paramagnetic Sensor.

Cell Block: Application dependent.

Ranges: Three user definable ranges:
0-5% to 0-100% (std. sensor)
0-1% to 0-100% (optional sensor)
Autoranging with range ID output.

Sample System: Flow indicator visible from front of unit.

Maximum flowrate: 1.1 SLPM

Positive pressure service.

Maximum inlet pressure: 25 psig

Auto Cal / Auto Zero. (Available with optional, electrically operated valves.)

Alarms: One system-failure alarm contact to detect power failure.

Two adjustable concentration threshold alarms with fully programmable setpoints.

Diagnostics: Start-up or on-demand self-testing function.

Response Time: 90% in 10 seconds or less.

Displays: 2 line by 20 alphanumeric, VFD screen, and one 5 digit LED display.

Digital Interface: Full duplex RS-232 communications port.

Power: User selectable power supply 115 or 230 VAC, at 50 or 60 Hz.

Operating Temperature: 0-45°C

Accuracy: ±1% of full scale at constant temperature.
±5% of full scale over operating temperature range, on factory default analysis ranges, once thermal equilibrium has been achieved.

Analog outputs: 0-1 VDC percent-of-range
0-1 VDC range ID.
4-20 mA DC percent-of-range
4-20 mA DC range ID.

Password Access: Can be user-configured for password protection.

A-2 Recommended 2-Year Spare Parts List

QTY.	PART NUMBER	DESCRIPTION
1	C62371B	Display PCB
1	D70046	Customer Interface PCB
1	C70043	Percent Preamplifier Board
1	D95295A	Main PCB STD
1	D70046A	Main PCB (0-1%)
4	F1295	Fuse, 4A, 250V, 5x20 mm, T (Slow Blow)

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

Orders should be sent to:

Teledyne Analytical Instruments
16830 Chestnut Street
City of Industry, CA 91748

Phone (626) 934-1500
Fax (626) 961-2538
Web: www.teledyne-ai.com

or your local representative.

A-3 Drawing List

C94974	Outline Drawing
D94906, D94907	Wiring Diagrams
B95024	Piping Diagram
D94409, C94905	Interconnection Diagrams

4

NOTES: UNLESS OTHERWISE SPECIFIED.

1. 1" NPT, AND 3/4" NPT REMOVEABLE BLANKING PLUGS THESE LOCATIONS CAN BE USED FOR USER WIRING

2. 6MM TUBE CONNECTIONS ARE STD. OTHER SIZES ARE AVAILABLE

3. APPROXIMATE WEIGHT 100LBS [43.5KG]

4. ALL DIM ARE IN INCHES [MM]

3

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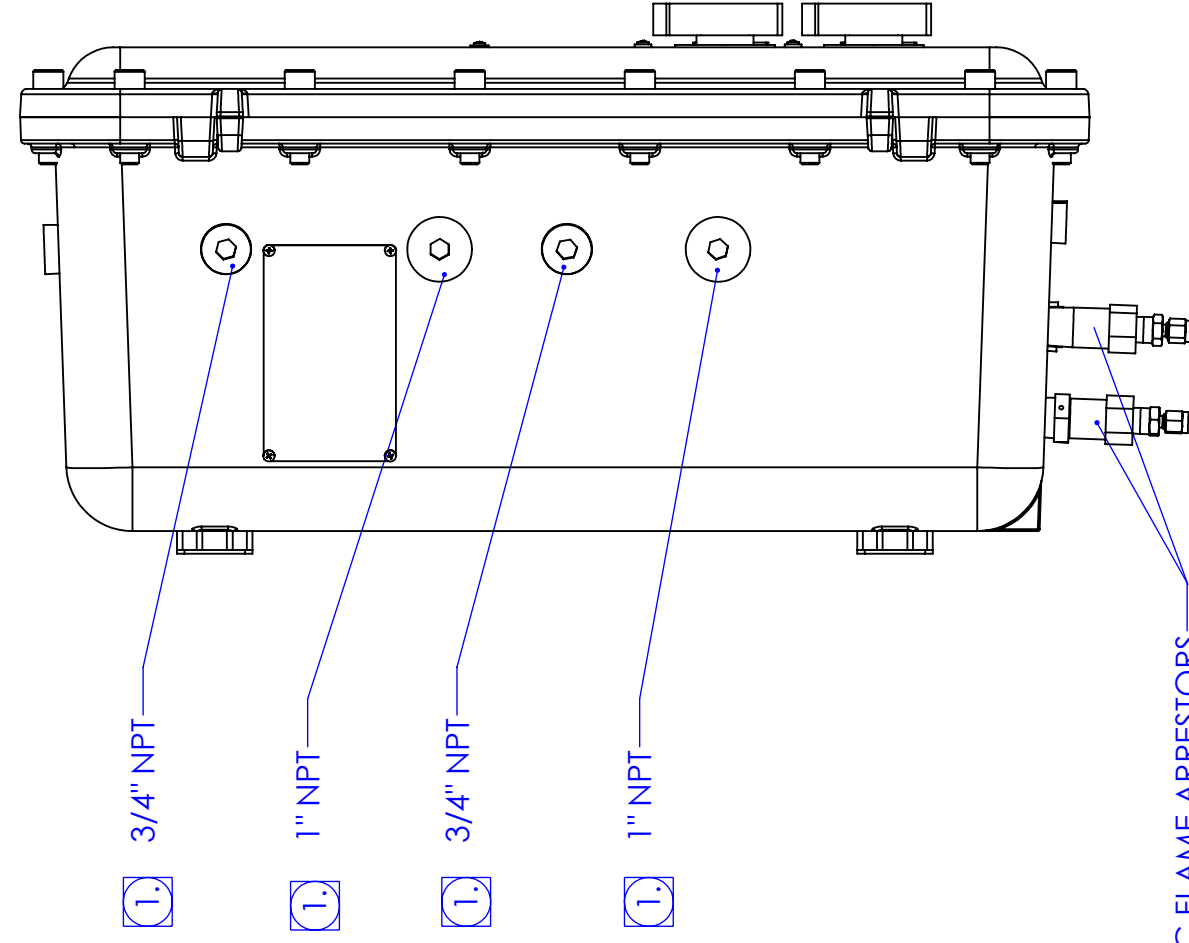
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REVISION

REV	DESCRIPTION	DATE	APP	REV BY
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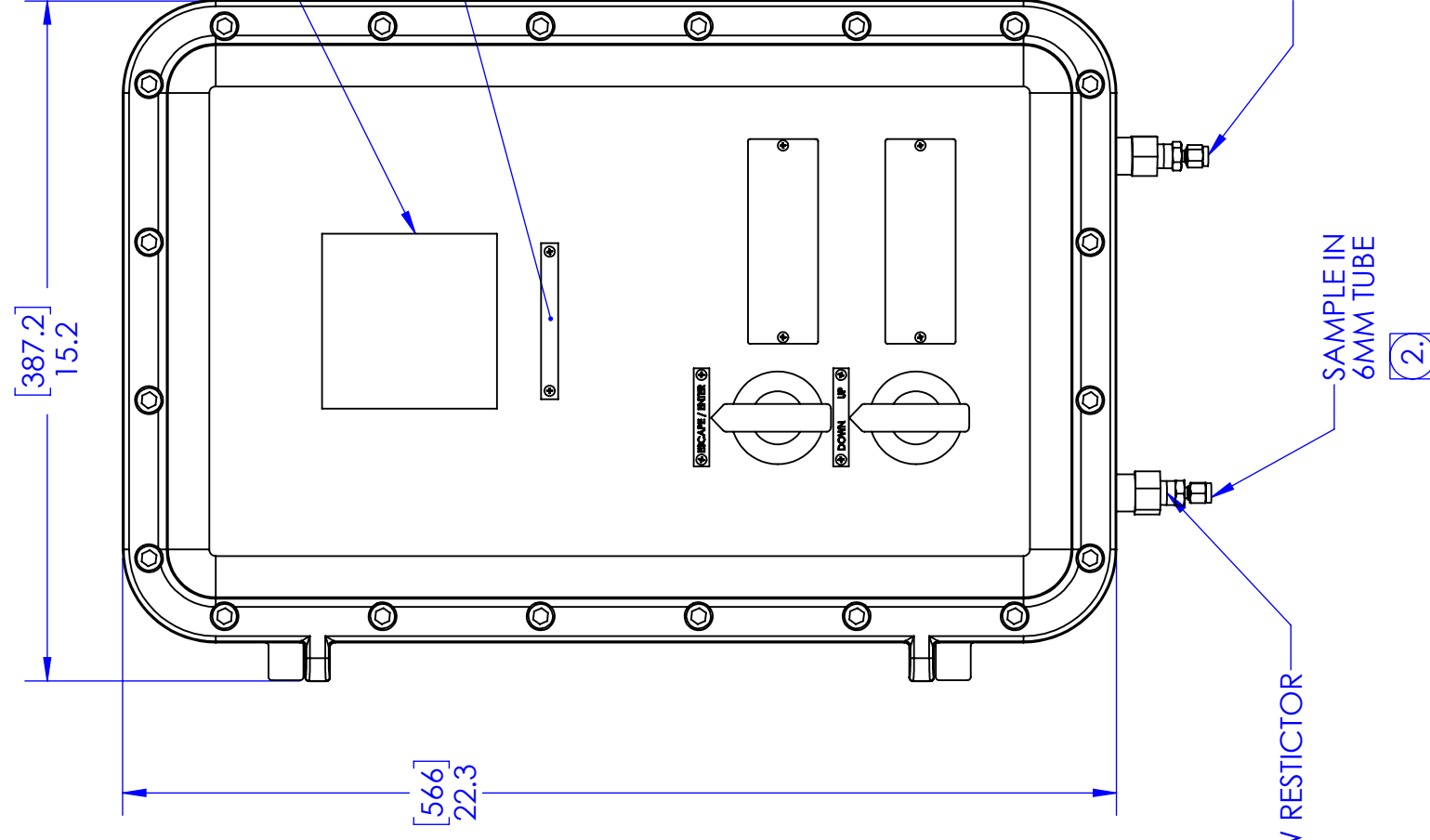
1. 3/4" NPT

1. 1" NPT

1. 3/4" NPT

1. 1" NPT

IIC FLAME ARRESTORS



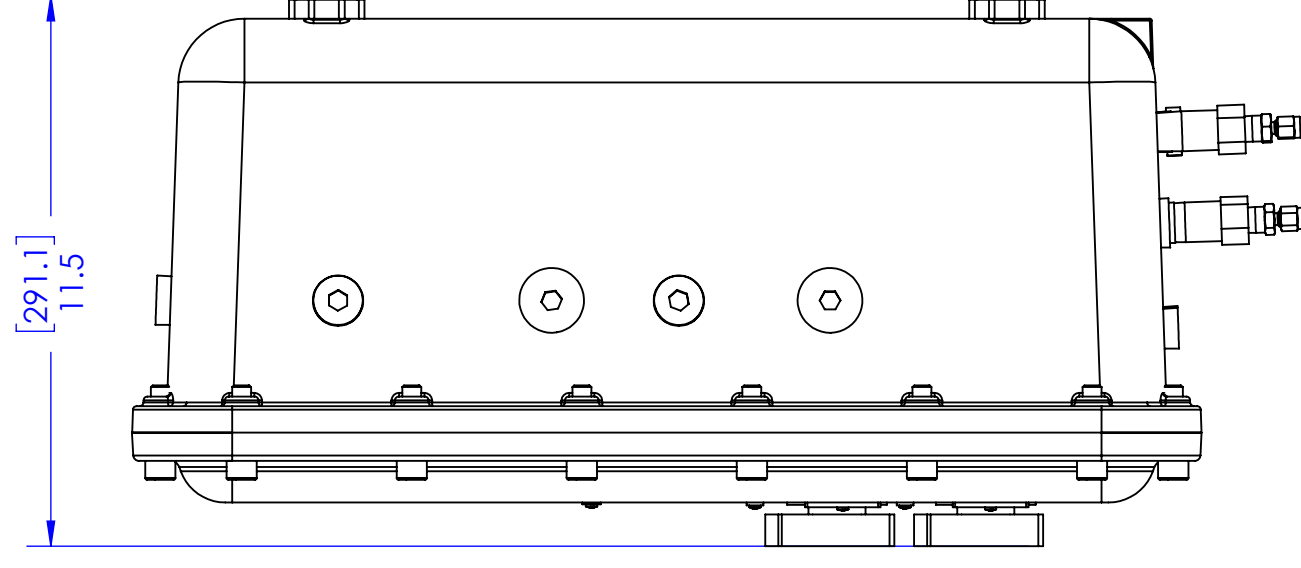
VIEWING WINDOW

CUSTOMER TAG

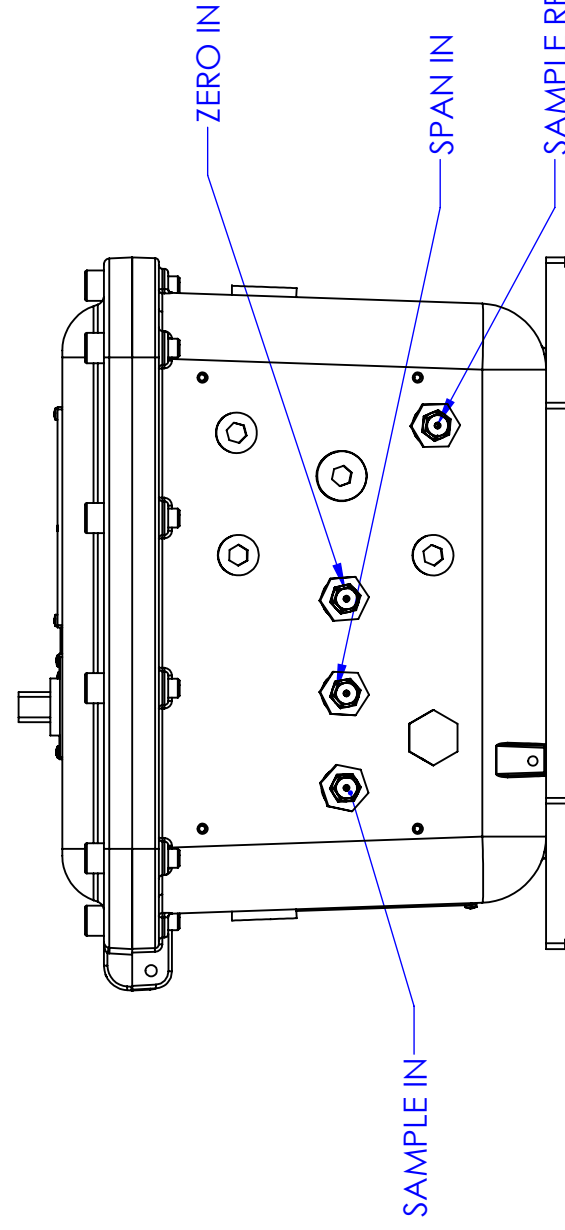
SAMPLE FLOW RESTRICTOR

SAMPLE RETURN 6MM TUBE 2

SAMPLE IN 6MM TUBE 2



[291.1] 11.5



SAMPLE IN

ZERO IN

SPAN IN

SAMPLE RETURN IN

BOTTOM VIEW WITH OPTIONAL AUTO-CAL VALVES

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SIGNATURES	DATE	LINEAR { X = ±0.1 XX = ±0.02 .XXX = ±0.010	
DRAFT: KFP	11/2/18		
CHK:			
APPR:			
ENGR: KFP			
S.O.			
REFERENCE	CAD ID	C94974-0	
BILL OF MATERIALS			
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TITLE		SCALE	1:4
OUTLINE 3020 (ATEX)		SIM	
MATERIAL		SHEET	1 OF 2
NONE		DWG NO.	C94974
		REV	0

4

3

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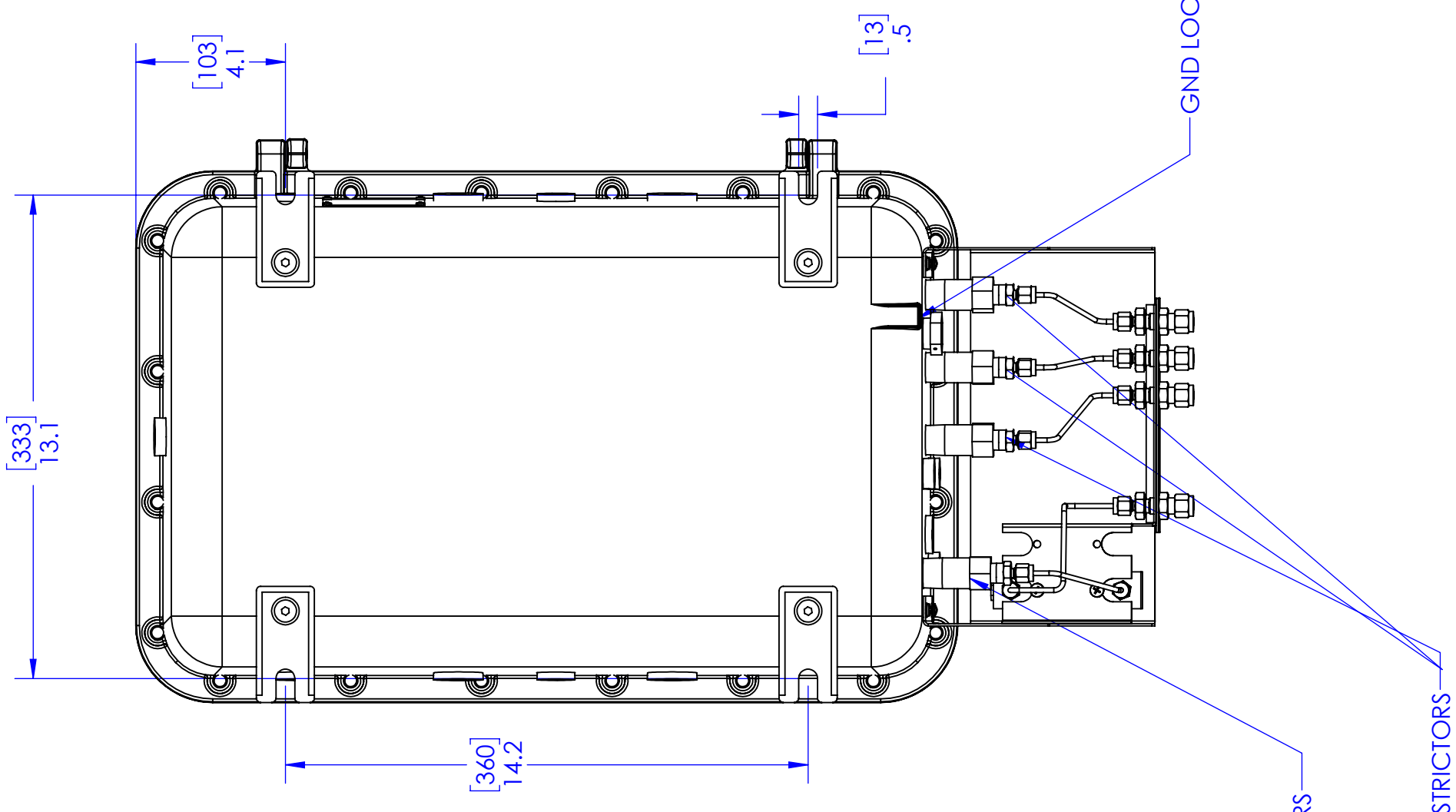
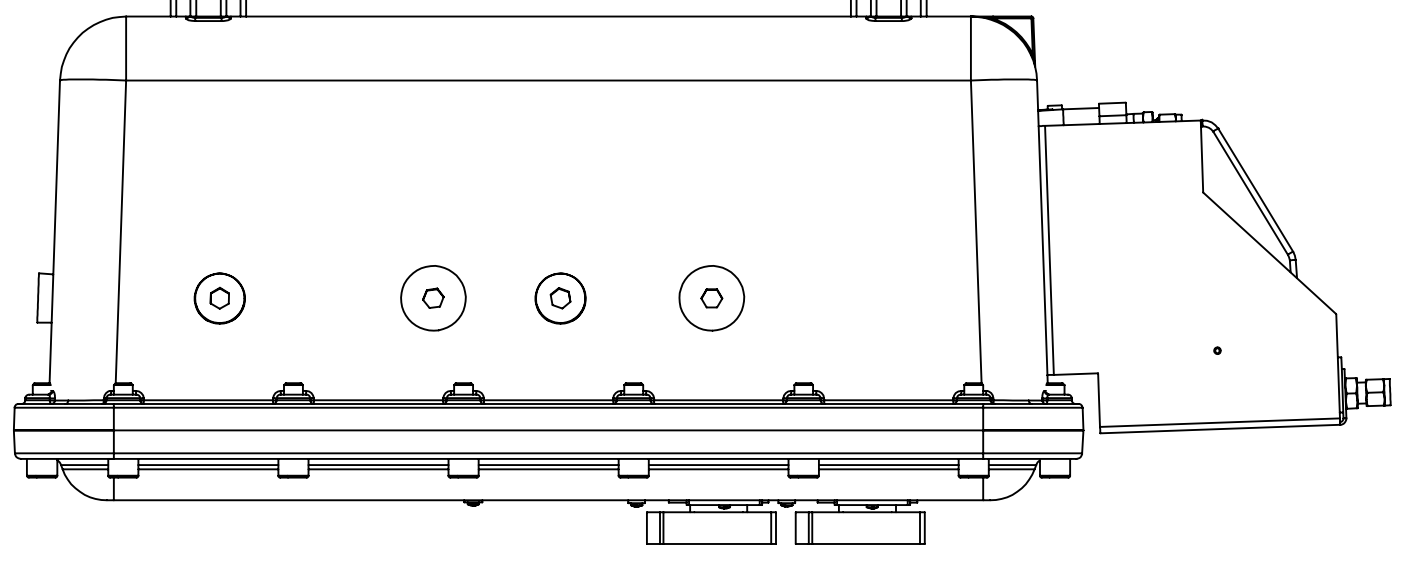
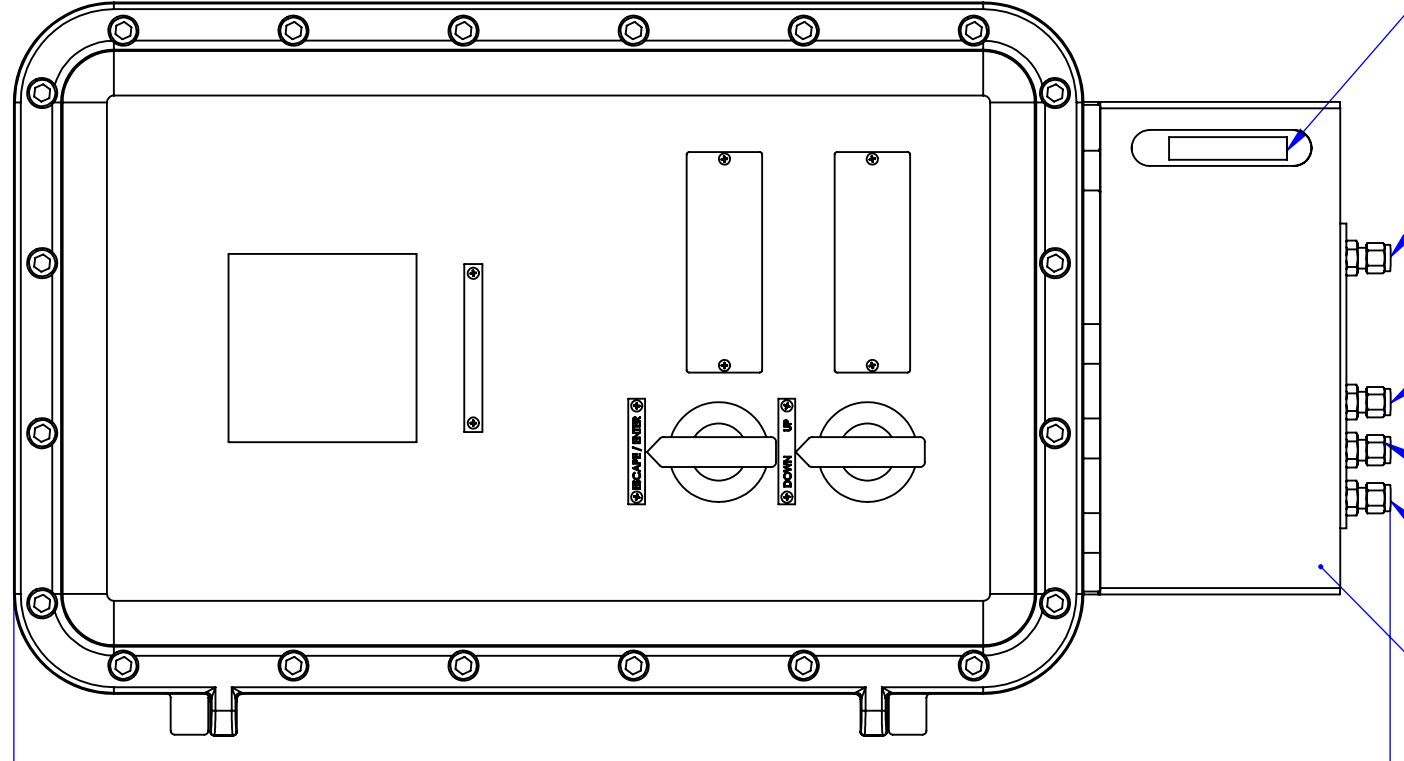
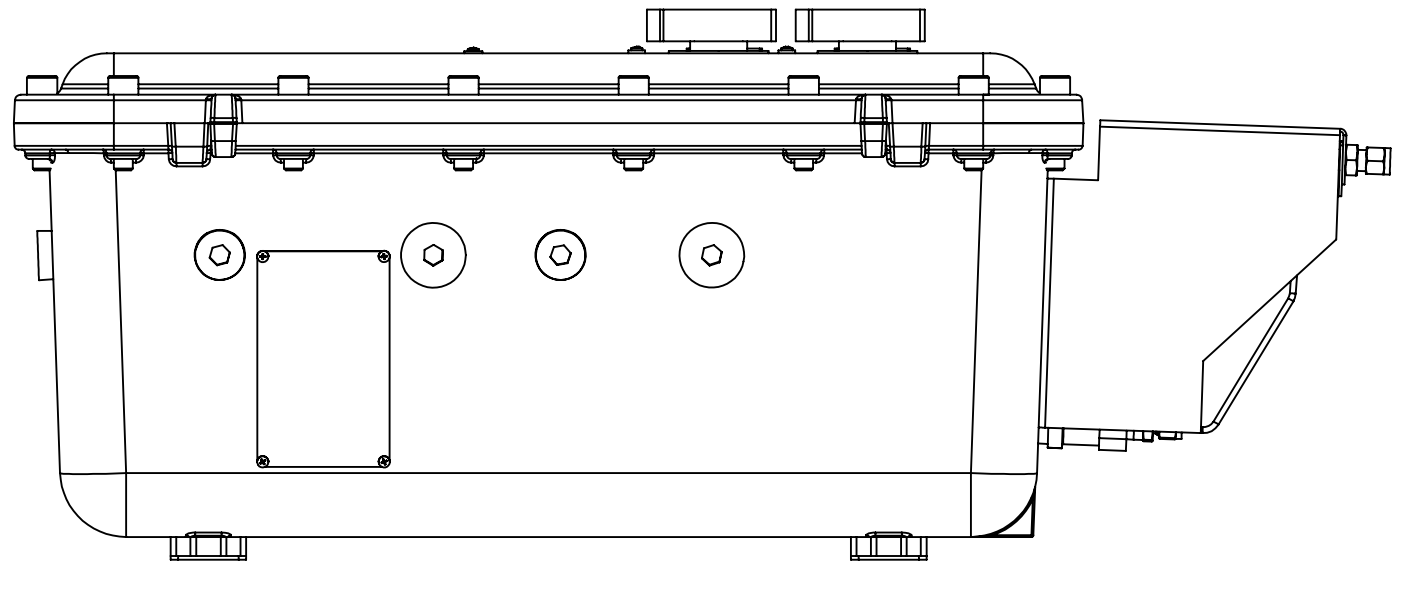
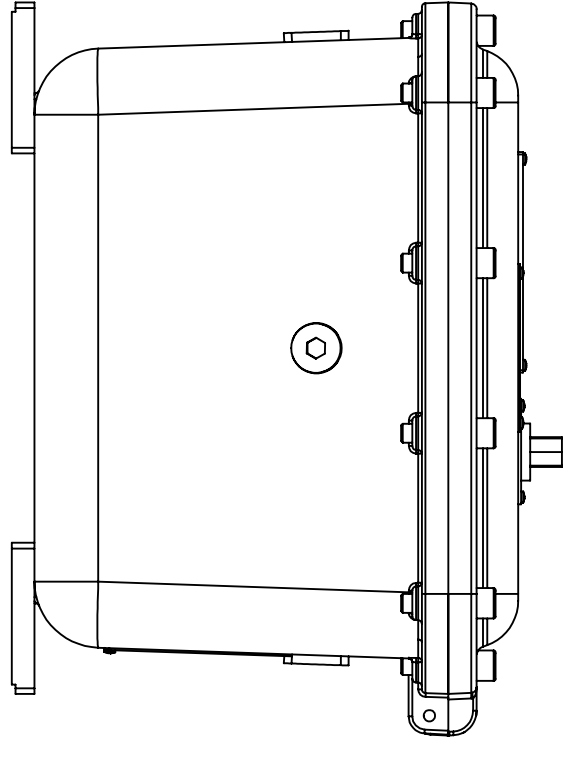
3

4

REVISIONS
SEE SHEET 1

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3020 WITH OPTIONAL AUTO-CAL VALVES AND GAS PANEL



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SAMPLE GAS PANEL

SAMPLE GAS IN

SPAN GAS IN

SAMPLE FLOW METER

SAMPLE RETURN

IIC FLAME ARRESTORS

SAMPLE FLOW RESTRICTORS

GND LOC.

[333]
13.1

[103]
4.1

[13]
.5

[360]
14.2

[728.3]
28.7

SHEET
2 OF 2

DWG NO.
C-94974

REV
0

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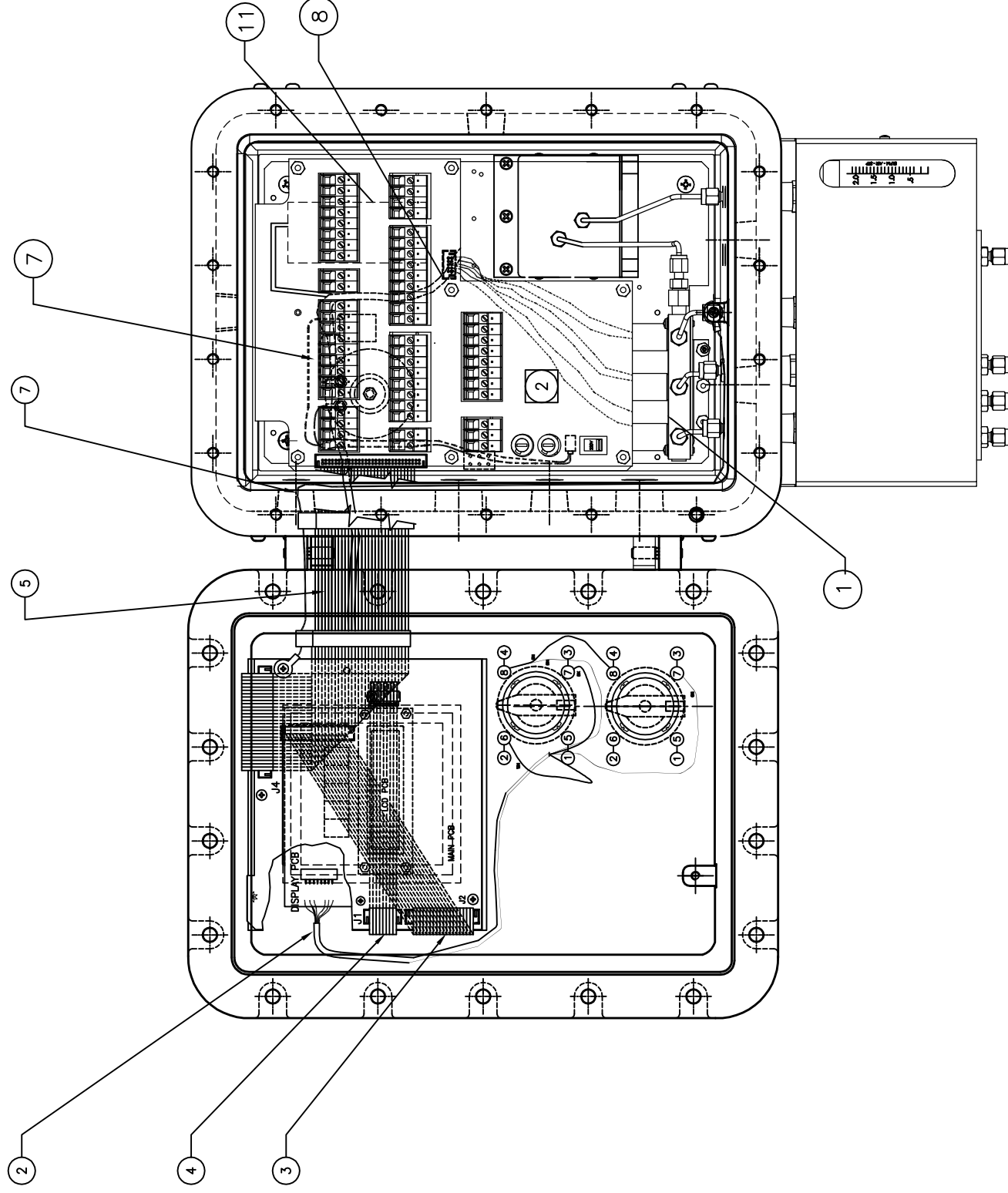
2

1

NOTES: UNLESS OTHERWISE SPECIFIED.
 1 REFER INTERCONNECTION DIAGRAM D94409
 2 AUTO CAL IS OPTIONAL

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REV	DESCRIPTION	DATE	APP.	REV.
0	INITIAL RELEASE	09/26/18	KFP	--



ITEM	QTY	PART NO.	DESCRIPTION
11			
10	REF	B94882B	EMI FILTER AND GROUNDING WIRE ASSEMBLY
9	3	CP1787	CABLE CLIPS
8	1	B94903	SENSOR / POWER SUPPLY CABLE
7	1	B-65918	WIRING ASSY (HEATER TO INTERFACE PCB)
6	--	--	--
5	1	B65913	RIBBON CABLE ASSY
4	1	B65912	RIBBON CABLE ASSY (MAIN PCB - DISPLAY PCB)
3	1	B65914	WIRING ASSY (MAIN PCB- DISPLAY PCB)
2	1	B93562	WIRING ASSY (CONTROL SWITCHES - DISPLAY PCB)
1	REF	B94389C	AUTO-CAL ASSY

SIGNATURES		DATE	TITLE	SCALE
N/	DRFT: KFP	09/26/18	WIRING ASSEMBLY	1:2
V/	CHK:		3020M (ATEX)	SIM D69991
G/	APPR:			SHEET 1 OF 1
P/	ENGR: KFP			REV
F/	C.O. STANDARD			0
REFERENCE	CAD ID D94406-0		AS LISTED	DWG NO. D-94906

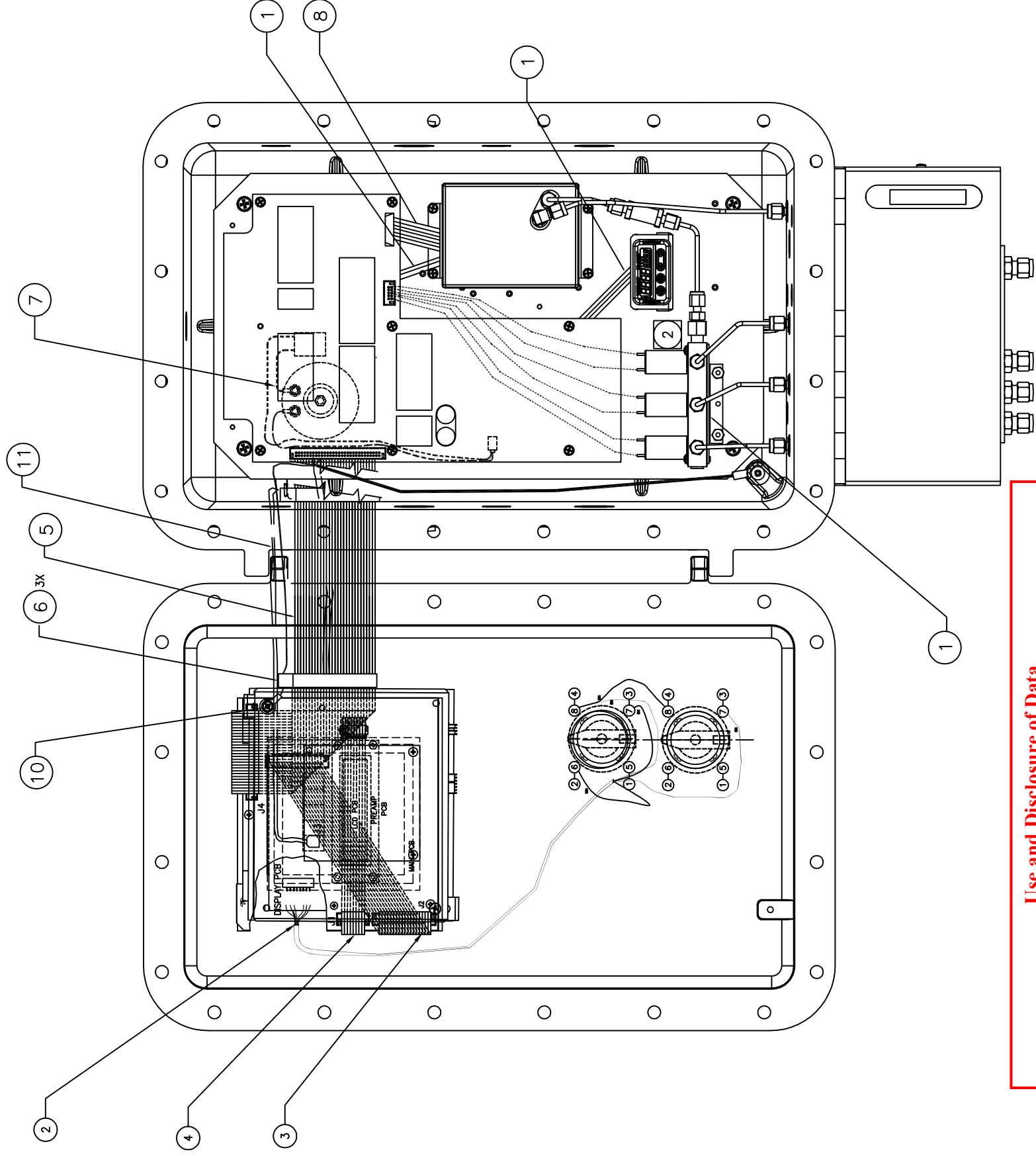
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 2 AUTO CAL IS OPTIONAL



REV.	DESCRIPTION	DATE	APP.	REV.
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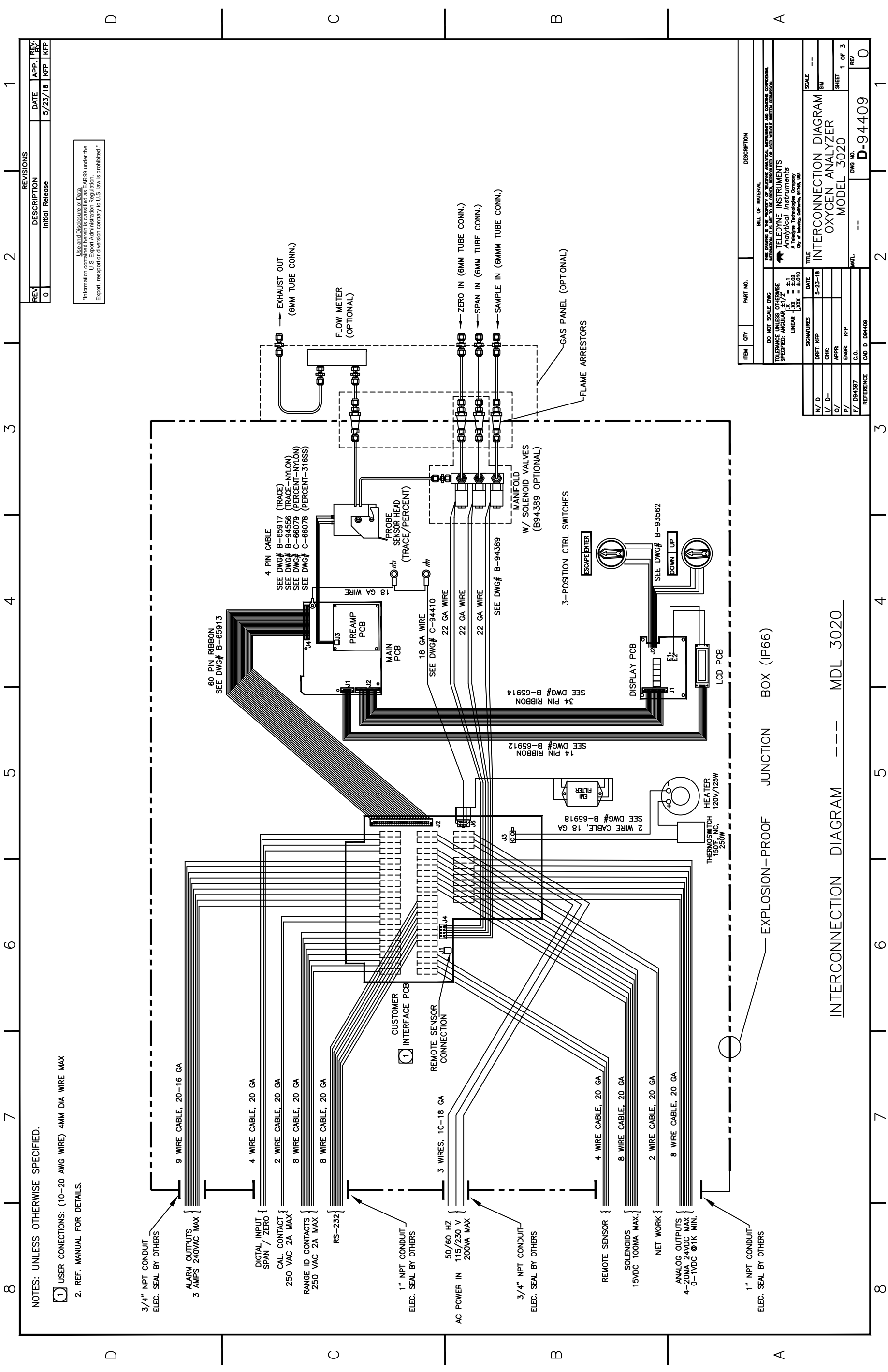
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11	1	B70289	PRE-AMP CABLE
10	REF.	C94410	EMI FILTER AND GROUNDING WIRE ASSEMBLY
9	3	CP1787	CABLE CLIPS
8	1	B92212	SENSOR CABLE TYPE S
7	1	B-65918	WIRING ASSY (HEATER TO INTERFACE PCB)
6	REF.	B94389C	AUTO-CAL ASSY
5	1	B65913	RIBBON CABLE ASSY
4	1	B65912	RIBBON CABLE ASSY (MAIN PCB - DISPLAY PCB)
3	1	B65914	WIRING ASSY (MAIN PCB - DISPLAY PCB)
2	1	B93562	WIRING ASSY (CONTROL SWITCHES - DISPLAY PCB)
1	1	C92262	3020M HEATER CABLE ASSY

SIGNATURES		DATE	TITLE	SCALE
N/	DRFT: KFP	09/26/18	WIRING ASSEMBLY	1:2
V/	CHK:		3020M (0-1%) (ATEX)	SIM D69991
G/	APPR:			SHEET 1 OF 1
P/	ENGR: KFP			REV
F/	C.O. STANDARD			0
REFERENCE	CAD ID D94407-0			

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- 1 USER CONNECTIONS: (10-20 AWG WIRE) 4MM DIA WIRE MAX
- 2. REF. MANUAL FOR DETAILS.

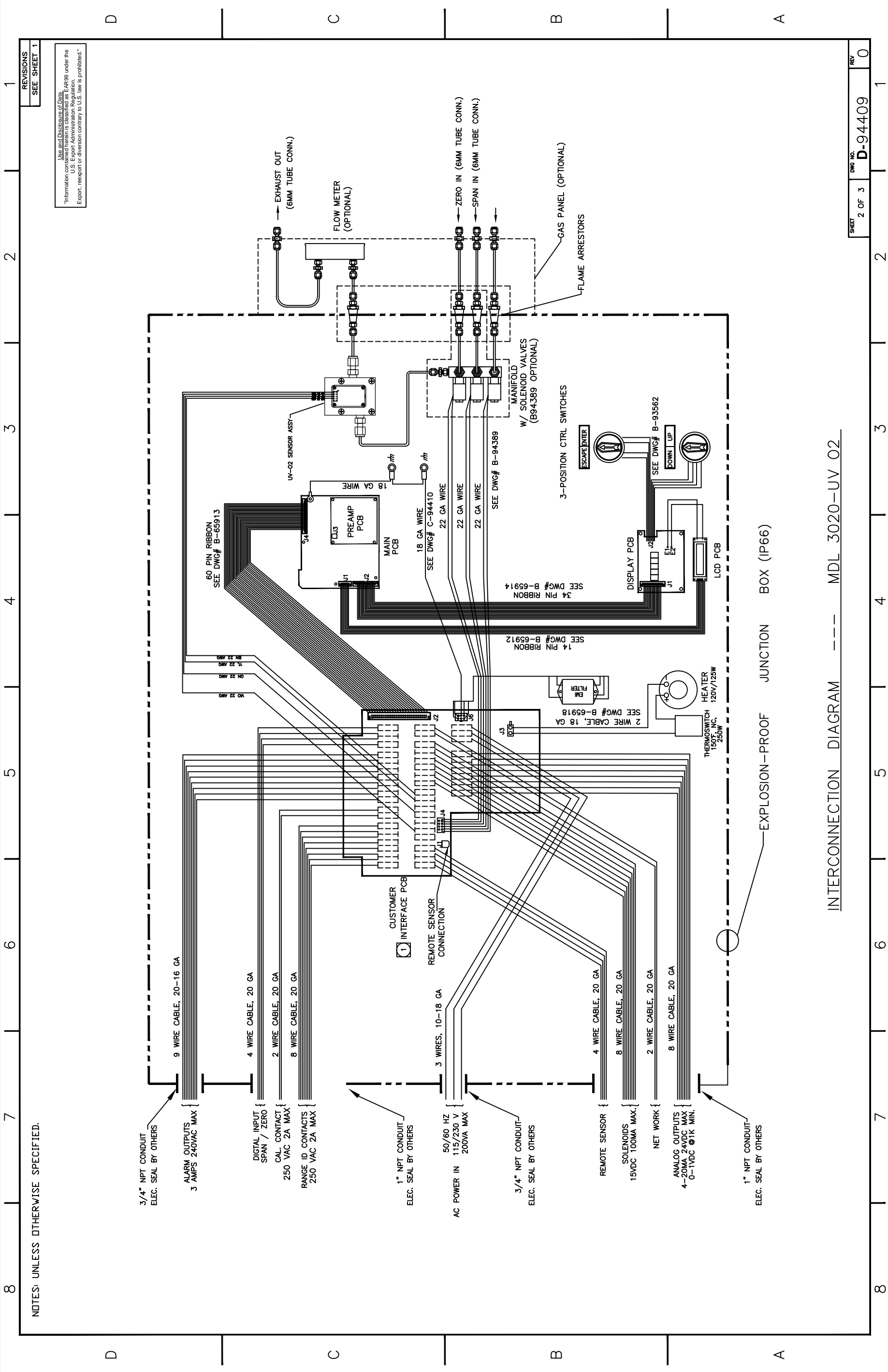
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REV	DESCRIPTION	DATE	APP.	REV.
0	Initial Release	5/23/18	KFP	KFP

ITEM	QTY	PART NO.	DESCRIPTION
BILL OF MATERIAL			
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TELEDYNE INSTRUMENTS Analytical Instruments A High Purity Instrument Company City of Industry, California 91714, USA			
N/D		DRAFT: KFP	DATE: 5-23-18
V/D		CHK:	
O/		APPR:	
P/		ENGR: KFP	
F/		C.O.:	
REFERENCE		CAD ID: B94409	
TITLE: INTERCONNECTION DIAGRAM OXYGEN ANALYZER MODEL 3020			SCALE: ---
DWG NO.: D-94409			SHEET: 1 OF 3
REV: 0			REV: 0

EXPLOSION-PROOF JUNCTION BOX (IP66)

INTERCONNECTION DIAGRAM --- MDL 3020



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REVISIONS
 SEE SHEET 1

INTERCONNECTION DIAGRAM --- MDL 3020-UV 02

SHEET 2 OF 3
 DWG NO. D-94409
 REV 0

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

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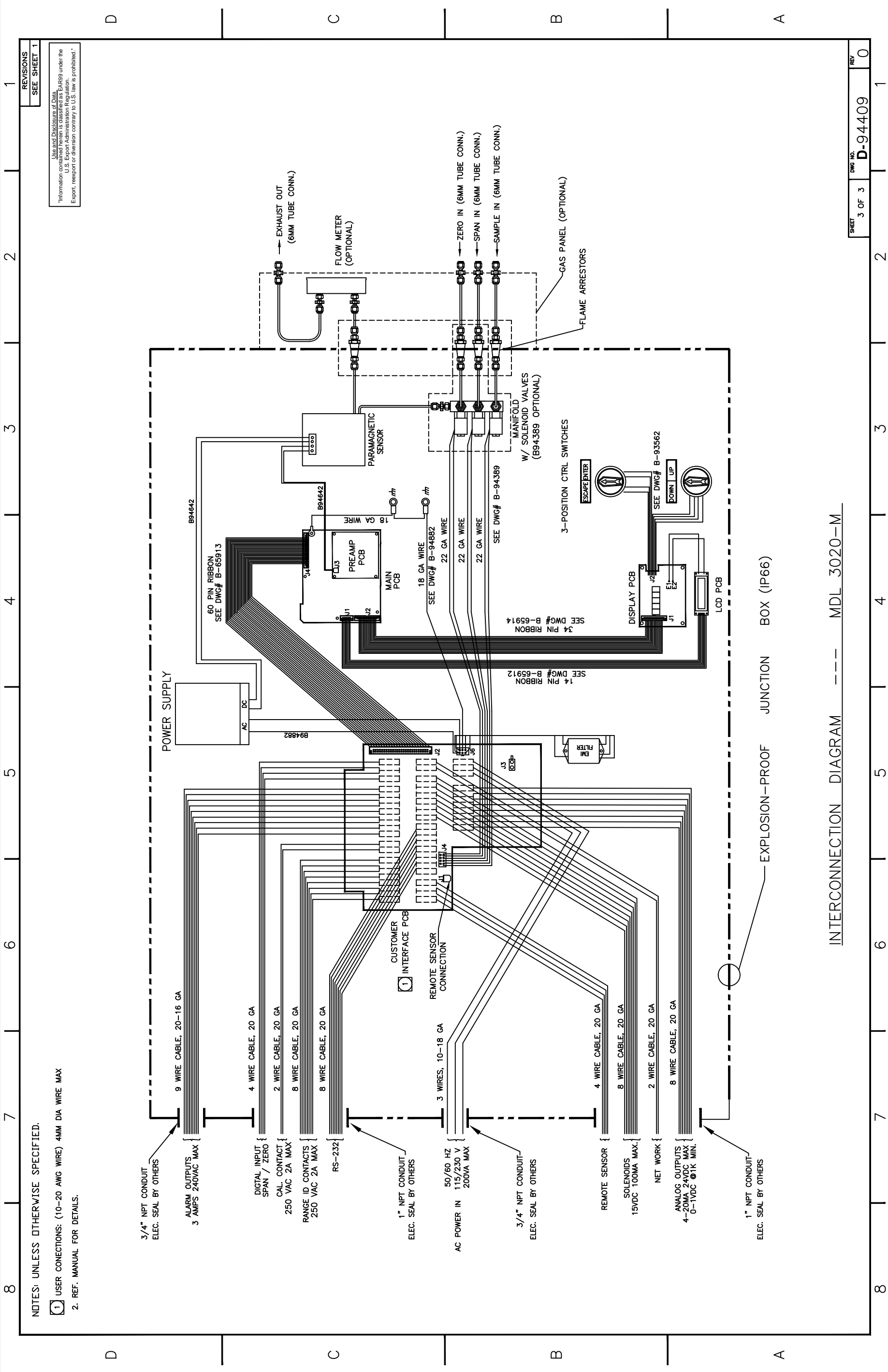
1 2 3 4 5 6 7 8

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- NOTES: UNLESS OTHERWISE SPECIFIED.
- 1 USER CONNECTIONS: (10-20 AWG WIRE) 4MM DIA WIRE MAX
 2. REF. MANUAL FOR DETAILS.

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REVISIONS
 SEE SHEET 1

INTERCONNECTION DIAGRAM --- MDL 3020-M

EXPLOSION-PROOF JUNCTION BOX (IP66)

NOTES: UNLESS OTHERWISE SPECIFIED.

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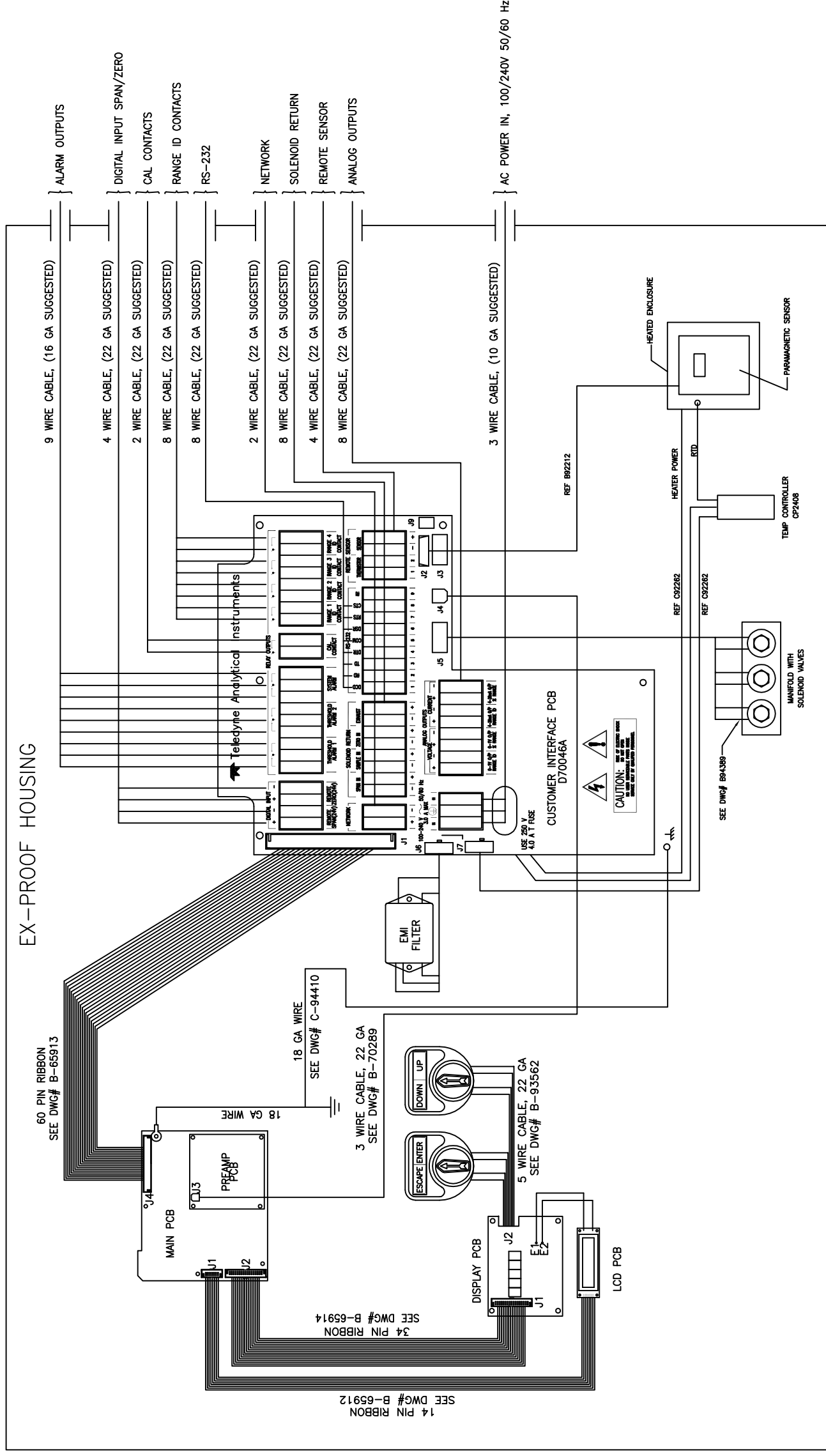
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S/	SIGNATURES	DATE	TITLE	SCALE
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N/	CHK:		PARAMAGNETIC UNIT	SIM C-69989
P/	APPR:		MODEL 3020M (0-1%)	SHEET 1 OF 1
O/	ENGR: KFP			REV
F/	C.O.: STANDARD			0
REFERENCE	CAD ID C94905-0		MATL. NOTED	DWG NO. C-94905

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 UNLESS OTHERWISE SPECIFIED
 DIMENSIONS ARE IN INCHES
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 ANGULAR ±1/2° LINEAR .XX ±.02
 .XXX ±.010

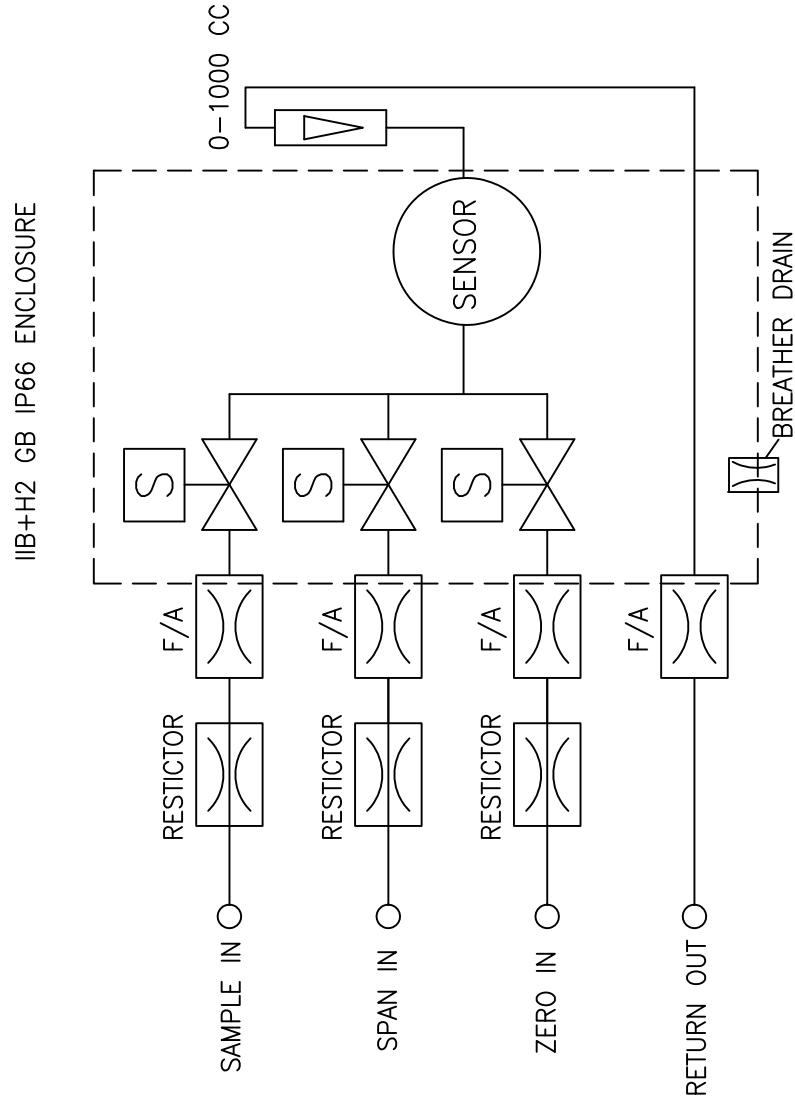
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 City of Industry, California 91746, USA

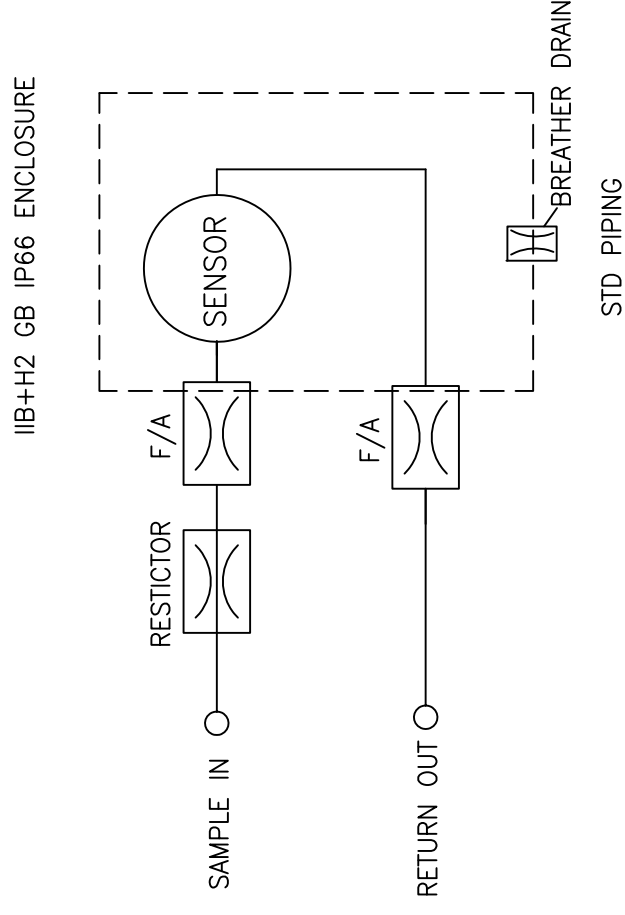
NOTES: UNLESS OTHERWISE SPECIFIED.

REVISIONS

REV	DESCRIPTION	DATE	APP.	REV. BY
0	Initial Release	1-2-19	KFP	--



OPTIONAL AUTO-CAL VALVES AND GAS PANEL DEPICTED



ITEM	QTY	PART No.	DESCRIPTION
BILL OF MATERIAL			
DO NOT SCALE DWG			
TOLERANCE UNLESS OTHERWISE SPECIFIED: ANGULAR ±1/2°			
LINEAR { .X = ±.1 .XX = ±.02 .XXX = ±.010			
SIGNATURES		DATE	TITLE
DRFT: K P		1/2/19	PIPING DIAGRAM
CHK:			3020M SYSTEM
APPR:			SCALE NONE
ENGR: Karl Penson			SIM
C.O.:			SHEET 1 OF 1
REFERENCE	CAD I.D. B95024-0	MATL. NONE	DWG NO. B-95024
			REV 0

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