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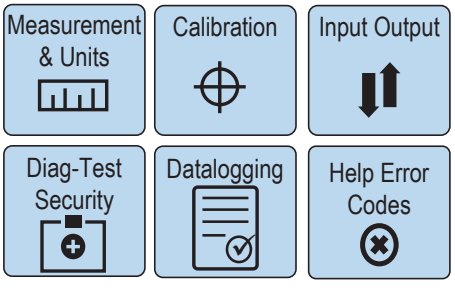


Installation Operation & Maintenance Manual

OXYvisor®

Optical Oxygen Analyzer
for use with BOSx Optical Sensors

Optical O_2 Products



ATEX / IEC / NEC / CEC



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Disclaimer

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Installation, Operation & Maintenance Manual
OXYvisor® Optical Oxygen Analyzer

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Section 1 - General Information & Safety

1.1 Introduction

Barben Analytical is a market leading analytical supplier that designs, manufactures and sells analytical measurement products for the process industries. Our core products consist of pH and ORP electrochemical sensors along with gas and liquid phase optical oxygen analyzers. These products help our customers achieve higher levels of productivity, efficiency, and quality and are designed to meet the most difficult and robust applications found in the industrial process markets such as; Chemical, Refining, Petrochemical, Oil & Gas, Pulp & Paper, Power and Semiconductor. Barben Analytical is an AMETEK company, within the Thermal Process Management business unit (TPM BU). AMETEK is a US company, operating globally in 30 countries throughout the world, with revenues exceeding $4.5 Billion.

For additional product and services related to the use and installation of this OXYvisor product, such as technical assistance, field start-up services, classroom product trainings, wet-gas sample probes, heated sample lines, pressure reduction stations or other needs please contact us at Barben Analytical or a qualified local representative (see back page for complete contact information).

- **Sample Probes**
- **Pressure Reduction Stations (PRS)**
- **Heated Sample Lines (HSL)**
- **Sample Conditioning Panels (SCP)**
- **Manual & Auto Calibration Panels**
- **Field Start-Up Services**
- **Product and Applications Training**

1.2 About the OXYvisor Product - (Overview)

The OXYvisor is Barben Analytical's second generation optical oxygen analyzer. The analyzer measures from trace level (ppmv (gas) / ppb (aqueous)) oxygen to percent level oxygen in both the gas and liquid phases, with the range and application being dependent on sensor selection, respectively. It's intended for indoor and outdoor use, as a continuous analytical measuring device, in manufacturing and industrial processes, along with laboratories. The device has been tested and approved for use in hazardous areas via a third party OSHA approved NRTL, Underwriters Laboratories Inc. (UL LLC), with North American, NEC and CEC, along with global, ATEX and IEC certifications.

The analyzer is either pipe or wall mounted in the proximity of the measuring point. The analyzer has a local display and can be operated (configuration, calibration, etc.) with the HMI via the "through-the-glass," keypad or via the OXYvisor software on a PC. The analyzer connects to a fiber optic cable, via a fiber optic SMA connection located in the easily accessible junction box. The fiber optic cable links the analyzer to the process sensor, which is mounted directly into the process or within an extractive sample system. The analyzer is fully compatible with all of the Barben Optical Sensors (BOSx) which are sold separately or included with integrated Sample Calibration Panels (SCP).

The analyzer uses a quench fluorescence technique with a sensor optically isolated from the process, using the absorbency as a diagnostic function and analyzing the phase angle in the time domain for measurement of the analyte, oxygen, in the modulated time domain. This gives the analyzer the ability to measure accurately and precisely under various and changing ambient and process conditions.

1.3 Definition of Symbols

Definition of the symbols for hazardous, cautionary, precautionary and general information are found and defined here below.



WARNING

Safety warning indicates a potentially or imminently hazardous situation which, if not avoided, may result in personal injury or environmental contamination.



AVERTISSEMENT

L'avertissement de sécurité indique une situation potentiellement dangereuse ou imminente qui, si elle n'est pas évitée, peut entraîner des blessures ou une contamination de l'environnement.



CAUTION

General warning, caution, that if an operating procedure which, if not strictly observed, may result in damage or malfunction of the analyzer.



ATTENTION

Avertissement général, mise en garde, si une procédure d'exploitation qui, si elle n'est pas strictement observée, peut entraîner des dommages ou un dysfonctionnement de l'analyseur.



CAUTION

Caution, possibility of electric shock may occur if an operating procedure which, if not strictly observed, may occur.



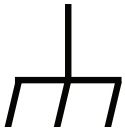
ATTENTION

Attention, un choc électrique peut se produire si une procédure qui, si elle n'est pas strictement observée, peut se produire.



IEC 60417-5019

Protective conductor terminal. (*Borne du conducteur de protection*.)



IEC 60417-5020

Frame or chassis terminal. (*Terminal cadre ou châssis*)



IEC 60417-5032

Alternating Current (AC) (*Courant alternatif*)



IEC 60417-5031

Direct Current (DC) (*Courant continu*)



Useful and/or important information that should not be overlooked (*Informations utiles et / ou importantes à ne pas négliger*)

1.4 Safety Summary

The OXYvisor is designed for use in manufacturing, industrial and laboratory analytical applications. Individual installations may vary in scope. The installer should consult national and local codes along with any site specific installation requirements to ensure that governing regulations are met.

The OXYvisor goes through functional, performance and quality testing prior to leaving the factory. For safe operation, prior to installation or operation, please read the entire manual and adhere strictly to all the **WARNINGS**, **CAUTIONS**, and **NOTES** contained within this manual. Failure to do so, could result in serious injury to the operator, the equipment, or property.



If the equipment is used in a manner not specified, the protection provided by the equipment may be impaired!

Si l'équipement est utilisé d'une manière non spécifiée, la protection fournie par l'équipement peut être altérée!

1.4.1 Electrical Safety



Up to 240* VAC may be present in the analyzer housings. Always shut down power source(s) before maintenance or troubleshooting. Only a qualified electrician should make electrical connections and ground checks.

Jusqu'à 240* VAC peuvent être présents dans les boîtiers de l'analyseur. Arrêtez toujours la ou les sources d'alimentation avant d'effectuer une maintenance ou un dépannage. Seul un électricien qualifié doit effectuer les raccordements électriques et les vérifications à la terre.

1.4.2 Grounding

Instrument grounding is mandatory. Performance specifications and safety protection are void if instrument is operated from an improperly grounded power source.



Verify ground connections and continuity of all equipment before applying power.

Vérifiez les connexions à la terre et la continuité de tous les équipements avant d'appliquer le courant.

1.4.3 General Installation Precautions

When installing optional electronic measurement or control equipment, general installation precautions should be observed:

- Select a site that is free from direct sunlight, extreme temperatures, or abrupt temperature variations.
- Select a site where the ambient air is free from corrosive gases or abrasive materials.

The equipment should not be connected to surfaces or enclosures subjected to severe vibration or conductive heat. Protective shock absorbent, non-thermally conductive mounts should be installed to isolate the equipment from excessive vibration and thermal conduction.

- Do not install analyzer near equipment emitting electromagnetic interference (e.g. AC pumps, motors, etc).
- Electrical wiring should be installed according to the National Electrical Code, local regulations and codes along with and in addition to any other applicable industry codes and regulations.
- The supply voltage should strictly adhere to the instrument specifications, be supplied from a stable reliable source, and be provided with proper ground connection(s).
- Signal connections should be made using shielded wiring.
- Signal , control, and interface wiring should be located separately from power supply lines.

Section 2 - Technical Product Specifications - RATINGS

2.1 OXYvisor - BOA Oxygen Analyzer Specifications

OXYvisor Oxygen Analyzer Specifications			
Power Supply - Selectable as AC or DC via Product Selection Nomenclature			
AC Power	~	85-240* VAC, 47-63 Hz, 6W	(AC, "4-wire," line powered analyzer), (*Zone 1 and CID2 can be up to 264V)
DC Power	⎓	24 V DC +/-10% 5W (Class 2 / LPS source)	(DC, "4-wire," line powered analyzer. Not a 2-wire loop powered transmitter)
Environmental			
Operating Temperature		-20 to +55ºC (-4 to 131ºF)	
Storage Temperature		-20 to +65ºC (-4 to 149ºF)	
Max. Operating Relative Humidity		95%, non-condensing	
Max Altitude		Maximum altitude up to 2,000 meters (6,561 ft)	
IEC		IEC Installation Category II and Pollution Degree 2	
Physical			
Main Enclosure and Junction Box	**Ratings**	IP66 and NEMA 4x, protected against dust and high pressure water ingress. Corrosion resistant.	
	Material Type	Copper Free Aluminum Alloy, EN 1706 (DIN 1725), pressure die-casting, yellow chromated, chemically resistant polyeurothane primer and coat.	
	Conduit Entries	Main enclosure = QTY 4, junction box = QTY 2, 3/4" FNPT or M25 x 1.5 6H conduit entries	
	O-Ring Seals	Silicone VMQ rubber	
Dimensions H x W x D (combined)		12.0 x 5.5 x 11.0 inches (30.5 x 14.0 x 28 cm)	
Weight (total/combined)		13.7 lb (6.2 kg)	
Liquid Crystal Display		Viewing = 79 (W) x 40 (H) mm, 240 x 128 dots, FSTN / Positive / Transflective	
HMI Touch-Keys (through-the-glass)		(4) proximity switches, infrared contacts for interactive user interface at HMI	
Input Information			
Sensor Inputs	**Optical O_2**	(1) O_2 optical input BOS1, BOS2 or BOS3 sensor (SMA connector)	
	RTD - Temp	(1) Pt100 or Pt1000 4-wire RTD Inputs (isolated)	
	Analog Input	(1) 4-20 mA input (24 Vdc active from OXYvisor) - For user configurable Temp or Pressure transmitter	
	Pressure Sensor	(1) On-board integrated pressure sensor measures and compensates for ambient pressure conditions	
Digital Inputs		(2) optically isolated inputs, 5 Vdc powered, remote initiation of automatic calibration and live validation gas	
Output Information			
Analog Outputs		(2) Programmable current outputs with galvanic isolation, 4 - 20 mA (Active), Linear or Bi-Linear, 24 Vdc, 12-Bit	
Digital Outputs (Alarm/Relays)		(4) Programmable relays, optically isolated, passive, 24Vdc, 0.05A pilot duty, 0.45 A general use / resistive load.	
Digital Communication		(1) Modbus RTU serial protocol RS485 - Two way Communication	
User Adjustable Options			
Oxygen Units		***Gas Phase:*** %O_2, ppm, hPa	***Liquid Phase:*** ppm, ppb, hPa
Temperature Units		Fahrenheit or Celsius	
Pressure Units		mbar, inches H_2O, Bar and PSI (absolute pressure)	
Advanced Features			
Automatic Calibration (AutoCal)		AutoCal logic controls 3 relays, user programmable with time based schedule or user initiated (requires AutoCal panel)	
Remote Validation (Test Gas Insert)		Test gas insert allows for remote or local validation with Test Gas (requires AutoCal panel)	
Auto-Sample Rate		Minimizes drift between calibrations, increases sensor lifetime without decreasing performance when needed	
Temperature Compensation		Automatic Temperature compensation to account for sensor output & used for DO calculation	
Pressure Compensation		Pressure compensates/corrects for concentration calculations due to ambient or process pressure changes	
Analog Input Calibration		Allows for correction/matching of Analog Input, either remote temperature or pressure transmitter	
Data & Error Logging Options		Last 10 error messages and calibrations time/date stamped (.pdf file), USB data trend storage (.csv file)	
OXYvisor PC Software		Configuration, programming, set-up, measurement, diagnostics, and trending (requires RS485 to USB cable)	

Table 1 - OXYvisor Technical Product Specification - Ratings

2.2 BOS Sensor Technical Performance Specifications (determines operating range for OXYvisor)

Barben Oxygen Sensors (BOS) can be purchased separately or as part of an integrated (SCP) package with the OXYvisor. The sensors feature a fiber optic cable with SMA termination for OXYvisor connection, and an oxygen-sensing luminophore at the other end for process or sample insertion. Three sensors—BOS1, BOS2, and BOS3—each have unique measurement ranges compatible with the OXYvisor, influencing its range, accuracy, and repeatability. For more details, consult the BOS sensor product data sheet.

BOS1 Sensor Specifications - Liquid Phase / Gas Phase		
	Dissolved Oxygen (DO)	**Gas Phase @ 1 atm, 20ºC**
Measurement Range	0-1.8 mg/L (ppm)	0-4.2 % O_2 (0 - 41.4 hPa)
Limit of Detection (LOD)	1.0 µg/L (ppb)	0.002 % O_2 (0.02 hPa)
Resolution @ 20ºC and 1013 hPa	±0.30 at 1 µg/L (ppb) ±0.63 at 200 µg/L (ppb)	±0.0007 % O_2 at 0.002 % O_2, ±0.0015 % O_2 at 0.02 % O_2, ±0.007 hPa at 0.023 hPa, ±0.015 hPa at 2.0 hPa
Response Time (T_{90})	< 30 sec.	< 6 sec.
Accuracy @ 20ºC	1 ppb (l), 0.002 % O_2 (g), or 3 % of the measured value whichever is greater	
Drift from Photo-decomposition	< 1.0 ppb within 30 days (1 min sample rate)	
Operating Temperature Range	0 to 50ºC (32 to 122ºF)	
Allowable Sensor Temperature	90ºC (194ºF) non-continuous	
BOS2 Sensor Specifications - Liquid Phase / Gas Phase		
	Dissolved Oxygen (DO)	**Gaseous & Dissolved Oxygen @ 1 atm, 20ºC**
Measurement Range	0-22 mg/L (ppm)	0-25 % O_2 (0 - 1013 hPa)
Limit of Detection (LOD)	15 ppb	0.03 % O_2
Resolution @ 20ºC and 1013 hPa	±4.5 at 90 µg/L (ppb) ±0.15 at 23 mg/L (ppm)	±0.01 % O_2 at 0.21 % O_2, ±0.1 hPa at 2 hPa ±0.1 % O_2 at 20.9 % O_2, ±1 hPa at 207 hPa
Response Time (T_{90})	< 30 sec.	< 6 sec.
Accuracy @ 20ºC	±0.4 % O_2 at 20.9 % O_2, ±0.05 % O_2 at 0.2 % O_2	
Drift from Photo-decomposition	< 0.03 % O_2 within 30 days (1 min sample rate)	
Operating Temperature Range	0 to 50ºC (32 to 122ºF)	
Allowable Sensor Temperature	90ºC (194ºF) non-continuous	
BOS3 Sensor Specifications - Liquid Phase / Gas Phase		
	Gas Phase Oxygen @ 1 atm, 20ºC	
Measurement Range	0-300 ppm with over-range of 1000 ppm	
Limit of Detection (LOD)	0.5 ppm O_2	
Resolution @ 20ºC and 1013 hPa	10 ±0.5 ppm; 100 ±0.8 ppm; 200 ±1.5 ppm	
Response Time (T_{90})	< 3 sec. based on 0-300 ppm measurement range	
Accuracy @ 20ºC	±2 ppm or ±5% of measured value whichever is greater (or as partial pressure, ±0.002 hPa)	
Drift from Photo-decomposition	< 1.5 ppm within 30 days (1 min sample rate)	
Operating Temperature Range	0 to 50ºC (32 to 122ºF)	
Allowable Sensor Temperature	90ºC (194ºF) non-continuous	
Cross Sensitivity for BOS1, BOS2, BOS3 Sensors Listed above		
No interference or degradation from carbon dioxide (CO_2), hydrogen sulfide (H_2S), ammonia (NH_3), gaseous sulfur dioxide (SO_2) or ionic species like sulfide, sulfate, or chloride. Compatible with many hydrocarbons, such as natural gas (with H_2S and CO_2) along with ethylene, propylene and polypropylene. Also compatible with methanol and ethanol mixtures.Incompatible with organic solvents, like benzene, chloroform, toluene, acetone, and methylene chloride along with any strong oxidizers such as gaseous chlorine (Cl_2).		
BOS SAFETAP Retractable Optical Oxygen Sensor Specifications		
Valve Options	316 stainless steel ball valve W.O.G., Optional 29" Hg full vacuum NACE MR0175 certified ball valve	
Operating Pressure Rating	750 psig (51.7 Bar)	
Insertion / Retraction Pressure Rating	450 psig (31.0 Bar)	
Temperature Rating	0 to 50ºC (32 to 122ºF) operating, 90ºC (194ºF) non-continuous	
Internal Seal Options	Viton, EPDM, FFKM (Kalrez)	

Table 2 - BOSx Sensor Technical Performance Specifications

2.3 OXYvisor Configuration - Product Model Selection

Analyzer	Power	Agency Approval	Sensor Style	Mounting Orientation	Conduit Entries	
OXYvisor Base Model Number						
BOA	OXYvisor - Barben Oxygen Analyzer					
	Input Power					
	DC	22 to 26.5 VDC, 5W (4-wire, line powered analyzer, this is NOT a loop powered analyzer. Requires two wires for DC power and two separate wires for 4-20 mA output)				
	AC	85 to 240* VAC, 47-63 Hz, 6W (4-wire, line powered analyzer), (*Zone 1 and CID2 can be up to 264 V)				
		Agency Approval				
		1	CE Ex II 2 G	Ex db op is IIC	T4 Gb ||	ATEX
			IECEx	Ex db op is IIC	T4 Gb ||	IEC / EU
			Class I Zone 1	AEx db op is IIC	T4 Gb ||	US (NEC 505)
				Ex db op is IIC	T4 Gb ||	CA (CEC Section 18)
		2	Class I Division 2	Group A, B, C, D	T4a ||	US (NEC 500) & CA (CEC Annex J18)
		3	CE Ex II 3 G	Ex ec [ic] op is IIC	T4 Gc ||	ATEX
			IECEx	Ex ec [ic] op is IIC	T4 Gc ||	IEC / EU
			Sensor Style			
			SFP	Standard Fiber Patch		
			-	Saved for future use - Integral Wands with lengths (2.5, 5.0 and 10 M)		
				Mounting Orientation		
				B	Junction Box placed below main enclosure, fiber optic exits bottom (as shown)	
				-	Saved for future use - other orientations w/ display and JB	
					Conduit Entries	
					SI	25 mm Conduit Entries
					AM	3/4" FNPT Conduit Entries
Analyzer	**Power**	**Agency Approval**	**Sensor Style**	**Mount Orientation**	**Conduit Entries**	
BOA	***DC***	***2***	***SFP***	***B***	***AM***	***Typical Analyzer Model Number (Example)***

Table 3 - OXYvisor Configuration - Product Model Selection

2.4 OXYvisor Accessories

Part Number	Description
B5008-1125	Pipe Mount Kit - 316 SS (1 to 1.5" pipe) - Included with OXYvisor (standard)
B5008-1225	Wall Mount Kit - Indoor wall-mount with Swivel, 304 SS
B5600-1185	Compact Flash Drive, USB, short profile, Sandisk for data logging download, 8 GB
B5008-1140	Compact sunshade, highly recommended for outdoor installations
B8010-1019	Zero Gas, 99.999% O_2 (<1ppm O_2), CGA 580, 550L Steel Disposable
B8010-1020	Span Gas, 100 ppm O2, remainder N2, CGA 580, 550L Steel Disposable (other span ranges available)
B8200-1008	Regulator, CGA 580, Dual Stage, 3000 psig inlet, 0 - 50 psig outlet, brass (composite finish)
B3905-1100	RS485 Modbus cable USB (PC) to 2 wire OXYvisor connection cable, 2.5 m
B4951-1140	Plug 3/4" MNPT Aluminum Zone 1&2
B4951-1141	Plug M25 Aluminum Zone 1&2
B4951-1142	Plug 3/4" MNPT CI D1&2

Table 4 - OXYvisor Accessories Parts

2.5 General principle of operation

The OXYvisor analyzer uses a quench fluorescence technique, with a sensor optically isolated from the process, using the absorbency as a diagnostic function, and analyzing the phase angle for measurement of the analyte, oxygen, in the modulated time domain. This technique, gives the analyzer the ability to measure accurately, and precisely, under dynamic ambient and process conditions.

The analyzer uses an LED to emit blue light, through the fiber optic cable, down to the luminophore which resides at the sensor tip [Fig 1]. The luminophore absorbs the light energy and rises to an excited molecular state. It then, naturally, falls back to it's ground-state while emitting the excitation energy, in the form of a red-shifted light, indicated by the red arrow [Fig 1], returning back-through the fiber optic cable to the analyzer. The properties of the emitted light, are measured through a photomultiplier tube, back at the electro-optical bench within the analyzer.

In the absence of oxygen, the excited luminophore will fall back to its ground state at a specific intensity and decay time. However, when oxygen is present, via molecular collision, it will very specifically quench the luminescence of the excited sensing material on a molecular basis, resulting in a lower intensity emission, proportional to the oxygen concentration [Fig 2.], along with a phase angle shift, observed in the time domain due to the faster decay rate. The phase shift and intensity differences between the excitation source and the luminescent signal is measured and the oxygen concentration is calculated [Fig 3].

The resulting measurement is specific to oxygen concentration. The luminophore is unaffected by other constituent gases and flow rate. The measurement is applicable in both gas and liquid phase. Temperature compensation is required to account for quenching efficiency at different temperatures and pressure compensation is required to measure at process pressured different than the pressure at time of calibration.

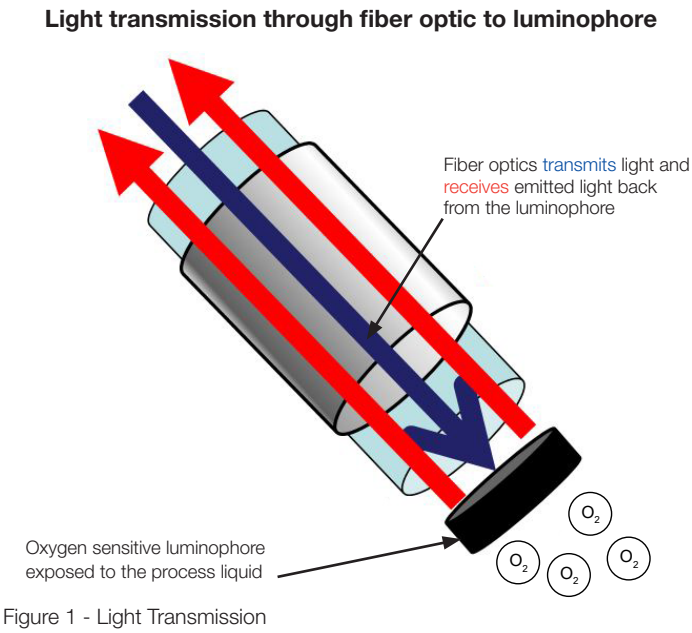


Figure 1 - Light Transmission

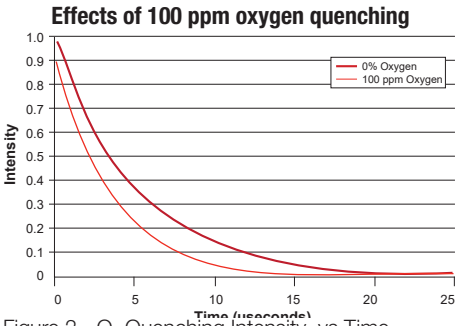


Figure 2 - O_2 Quenching Intensity vs Time

The effect of O2 quenching on light intensity from the luminophore sensor is shown above. Light emitted from the excited luminophore has higher intensity over a longer period than when oxygen is present. The intensity and time are measured by the spectrometer withing the OXYvisor to provide an oxygen measurement.

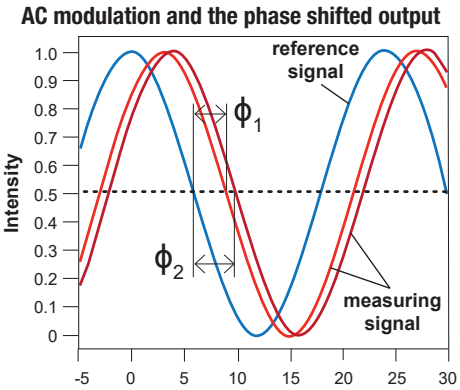


Figure 3 - O_2 Quenching AC Modulation

AC modulation of the blue light results in a similar waveform of the emitted red light from the luminophore sensor. The presence of oxygen causes a phase shift between Φ1 and Φ2 of the red light waveform. Measurement of this phase shift proportionally matches the loss of intensity shown in Fig 2 above. The combination of both measurement techniques provides a stable, accurate method to measure oxygen in liquid and gas phase applications.

2.6 OXYvisor Analyzer Features (Hardware/Firmware/Software)

HMI Touch Keys (through-the-glass): Easy to use configuration and calibration menus can be accessed via the infrared keypad, through-the-glass, yet protected behind the analyzer window.

HMI Lockout Screen: HMI lockout screen prevents any unwanted HMI interaction with critters, debris, or working technicians.

Sensor Connection Junction Box: Connection of the BOS Optical Sensor is easily and quickly made through the junction box. In the rare case it is ever needed, this design allows for easy fiber optic sensor replacement, in the field, without exposing the electronics to dust, humidity or human error. Normally, the fiber optic is installed once and the sensor cap is the standard consumable replacement.

On-board Data-logging: Historical time based oxygen, phase angle, intensity, temperature and pressure measurement, along with error logs and calibration history can be logged via the on-board memory. The time based logs can be downloaded in .csv format, via USB port located within the rear compartment or the OXYvisor software over the RS 485 Modbus.

Programmable I / O: The OXYvisor comes standard with two analog outputs, four isolated digital relay outputs, one analog input. All I / O's are fully user configurable (variable and range) through the keypad, software or RS485 Modbus. Additionally, two digital inputs (active), can be used to connect a customer supplied toggle switch or other external contact, to initiate **AutoCal** or test gas insert **(REMOTE VALIDATION)**.

Calibration Options: Several calibration options are available to best suit the customers installation and application requirements.

- **Factory Cal** provides quick startup without test gas. The calibration values found on the sensor certification sheet can be uploaded and good results can be expected. (We recommend to validate with test gas.)
- **Manual One-point** calibration with either zero or span gas, depending on the customer requirements.
- **Manual Two-point** calibration using zero and span gas (standard factory recommendation).
- **Auto-calibration** (**AutoCal**) logic in the OXYvisor firmware along with three on-board digital relays (passive) allows for complete AutoCal and validation with know test gases. The AutoCal logic allows user programming of timed based calibration, gas selection and the hysteresis criteria for pass / fail evaluation.

Requires: AutoCal SCP Panel (SCP Data Sheet) or three user provided, powered, solenoids & test gases

Data Logging Built In: The last ten calibrations as well as the last ten error messages are stored within the analyzer at all times and can be viewed through the firmware at the HMI or software via PC. User selected PV's can also be logged over time and can be downloaded via USB stick or software.

Security: If operator access control is required, then all, or individual menus, can be chosen to be locked out, using a four digit security pass-code. These codes can be entered through the keypad or via the OXYvisor software.

MODBUS RS 485 RTU (Serial):

The OXYvisor is equipped with digital communication via MODBUS RS485 serial. This two-wire two-way communication signal can be used to poll measurement values, reconfigure firmware, perform **Test Gas Insert** for remote validation or to initiate an **AutoCal** of the analyzer.

OXYvisor Analyzer Overview

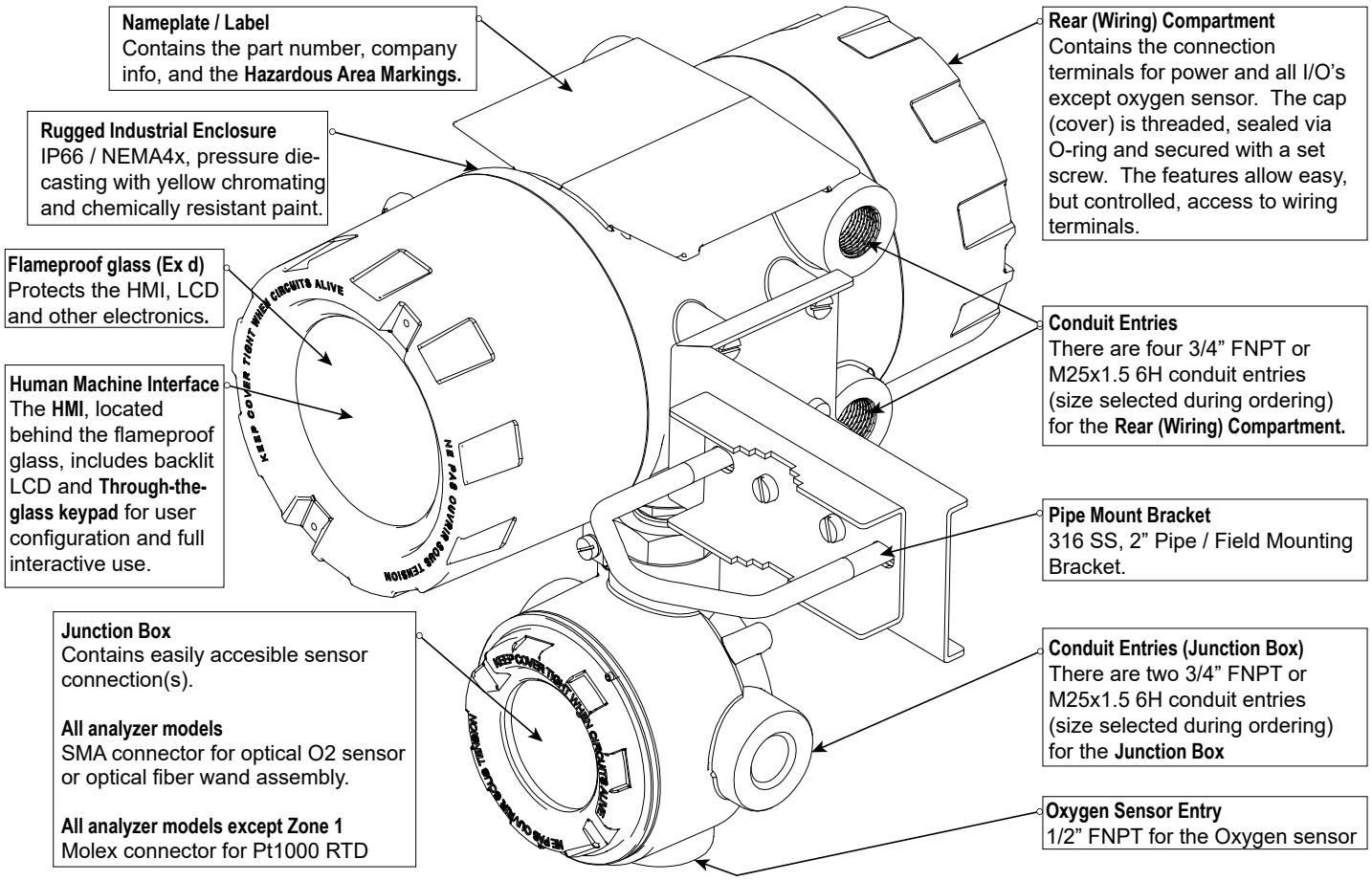


Figure 4 - OXYvisor overview of hardware features

OXYvisor Analyzer Dimensions

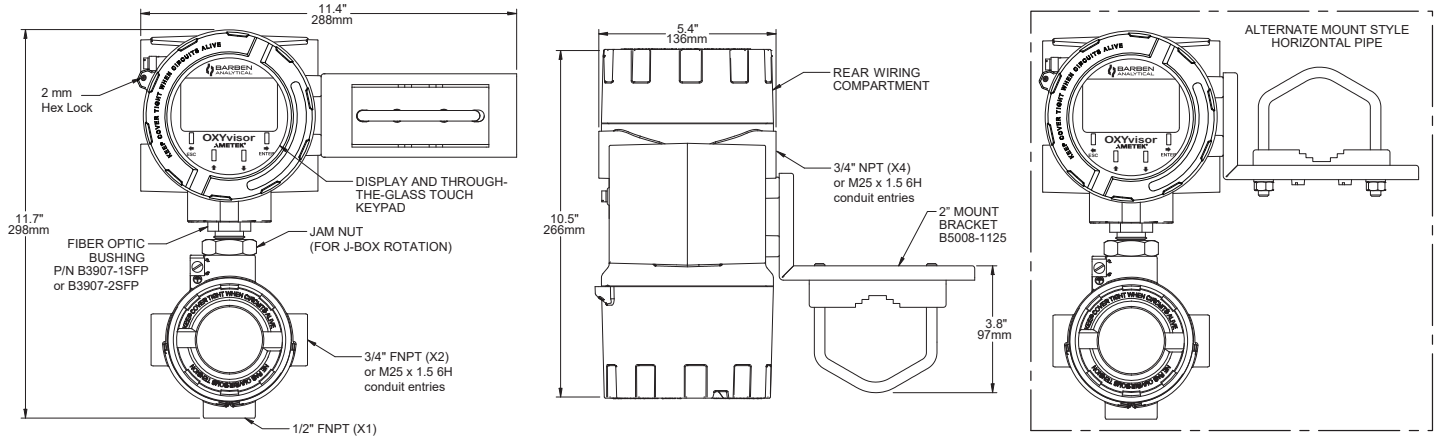


Figure 5 - OXYvisor Overall Dimensions

2.7 Hazardous Area Agency Certification & Markings

2.7.1 Zone 1 Group IIC -

OXYvisor is certified as **Process Control Equipment** for use in **Zone Classified Hazardous Locations** (**QVAJ** and **QVAJ7**) - Zone 1, Group IIC

ATEX Zone 1, Group IIC Markings:

CE 0539 Ex II 2 G Ex db op is IIC T4 Gb Ta = -20 C to +55 C

Certificate Number:	DEMKO 19 ATEX 2031,	issued by UL DEMKO International A/S
Standards:	EN 60079-0:2018 EN 60079-1:2014 EN 60079-28:2015	

IECEx Zone 1, Group IIC Markings:

IEC IECEx Ex db op is IIC T4 Gb Ta = -20 C to +55 C

Certificate Number:	IECEx UL 19.0040 issued by UL LLC		
Standards:	IEC 60079-0,	7th Edition,	Issued 2017-12
	IEC 60079-1,	7th Edition,	Issued 2014-06
	IEC 60079-28,	2nd Edition,	Issued 2015-05

North American Zone 1, Group IIC Markings:

c UL us LISTED Class 1 Zone 1 AEx db op is IIC T4 Gb Ta = -20 C to +55 C
Ex db op is IIC T4 Gb Ta = -20 C to +55 C

US NEC Standards:	UL 60079-0,	7th Edition,	Dated 2020-04-15
	UL 60079-1,	7th Edition,	Dated 2020-01-23
	UL 60079-28,	2nd Edition,	Dated 2021-12-07
CAN CEC Standards:	CSA C22.2 No. 60079-0,	4th Edition,	Dated 2019-02
	CSA C22.2 No. 60079-1,	3rd Edition,	Dated 2016-05
	CSA C22.2 No. 60079-28,	1st Edition,	Dated 2016-12

WARNING

Specific Conditions of Use - Consult Drawing No. 2P0345 for complete installation details.

- **Unused entries shall be closed with suitable certified Ex db blanking elements with a minimum IP66 rating**
- **Flameproof joints are not intended to be repaired. For repair or replacement of any part, contact Barben Analytical.**

2.7.2 Zone 2 Group IIC

The OXYvisor is certified as **Process Control Equipment** for use in **Zone Classified Hazardous Locations** - Zone 2, Group IIC

ATEX Zone 2 Markings:

CE Ex II 3 G Ex ec [ic] op is IIC T4 Gc Ta = -20 C to +55 C

Certificate Number:	DEMKO 19 ATEX 2036		
Standards:	CENELEC	EN 60079-0	2018
	CENELEC	EN 60079-7 +A1	2015, 2018
	CENELEC	EN 60079-11	2012
	CENELEC	EN 60079-28	2015

IECEx Zone 2, Group IIC Markings:

IECEx Zone 2, Group IIC Markings:

Ex ec [ic] op is IIC T4 Gc

Certificate Number:	IECEx UL 19.0072	
Standards:	IEC 60079-0,	Edition 7, Issued 2017-12
	IEC 60079-7,	Edition 5.1, Issued 2017-08
	IEC 60079-11,	Edition 6, Issued 2019-12
	IEC 60079-28,	Edition 2, Issued 2019-10

North American Zone 2, Group IIC Markings:

Class 1 Zone 2 AEx ec [ic] op is IIC T4 Gc
Class 1 Zone 2 Ex ec [ic] op is IIC T4 Gc

US NEC Standards:	UL 60079-0,	Edition 6, Dated 2017/10/20
	UL 60079-7,	Edition 5.1, Dated 2017/04/21
	UL 60079-11,	Edition 6, Dated 2018/09/14
	UL 60079-28,	Edition 2, Dated 2017/12/08
CAN CEC Standards:	CSA C22.2 No. 60079-0,	Edition 3, Issue Date 2015/10/01
	CSA C22.2 No. 60079-7,	Edition 2, Issue Date 2016
	CSA C22.2 No. 60079-11,	Edition 2, Issue Date 2014/02/01
	CSA C22.2 No. 60079-28,	Edition 1, Issue Date 2016

WARNING

Specific Conditions of Use **- Consult Drawing No. 2P0346 for complete installation details.**

- Transient protection shall be provided that is set at a level not exceeding 140% of the peak rated voltage value at the supply terminals to the equipment.
- The equipment shall only be used in an area of not more than Pollution Degree 2, as defined in IEC/EN 60664-1.

2.7.3 Class I, Division 2 Groups A,B,C, & D

The OXYvisor is certified as **Process Control Equipment** for use in hazardous locations (**QUZW**, **QUZW7**) **Class I, Division 2 Groups A, B, C, & D**

Class I, Division 2, Groups A, B, C, & D T4A

US NEC Standards:	UL 12.12.01 - Edition 9 Issued 2017/09/15
CAN CEC Standards:	CSA C22.2 No. 213-17 - Edition 3 Issued 2017/09/15

2.8 Product Label / Name Plate -

2.8.1 - Product Label / Name Plate Overview

The Product Label (Name Plate), Fig 6, is found at the top of the analyzer, Fig 4. The product label identifies important information and attributes of the specific model and should be reviewed in detail prior to installation.

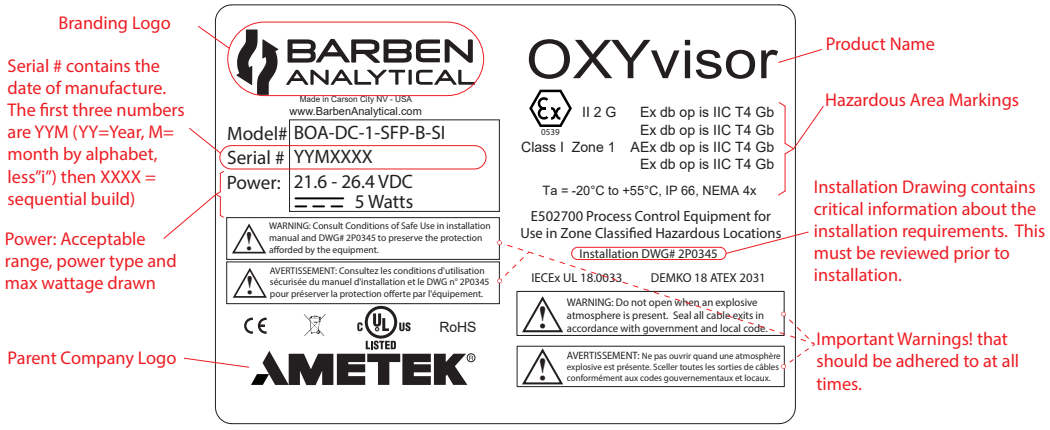


Figure 6 - OXYvisor Product Label / Name Plate

2.8.2 - Product Labels / Name Plate - Zone 1 Groups IIC

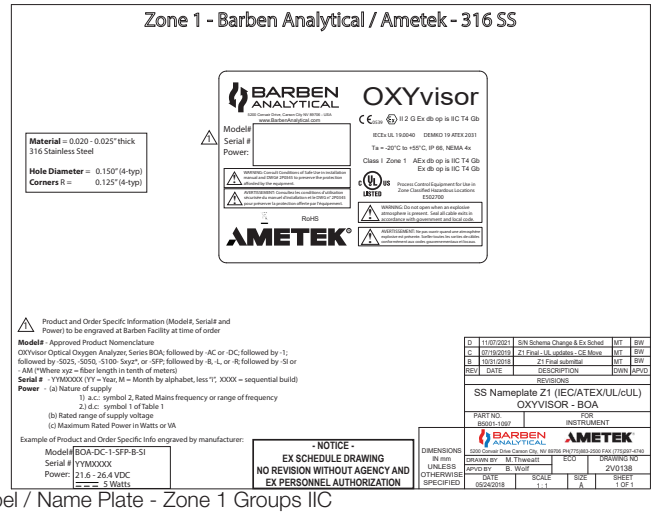


Figure 7 - **OXYvisor** Product Label / Name Plate - Zone 1 Groups IIC

2.8.3 - Product Labels / Name Plate - Zone 2 Groups IIC

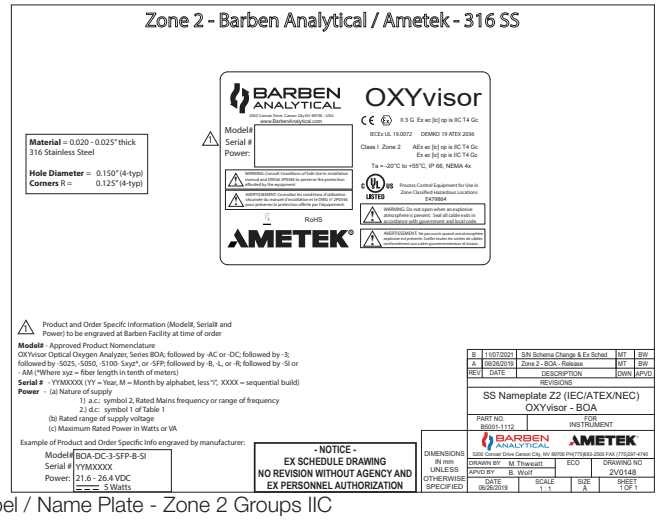


Figure 8 - **OXYvisor** Product Label / Name Plate - Zone 2 Groups IIC

2.8.3 - Product Labels / Name Plate - CID2 ABCD

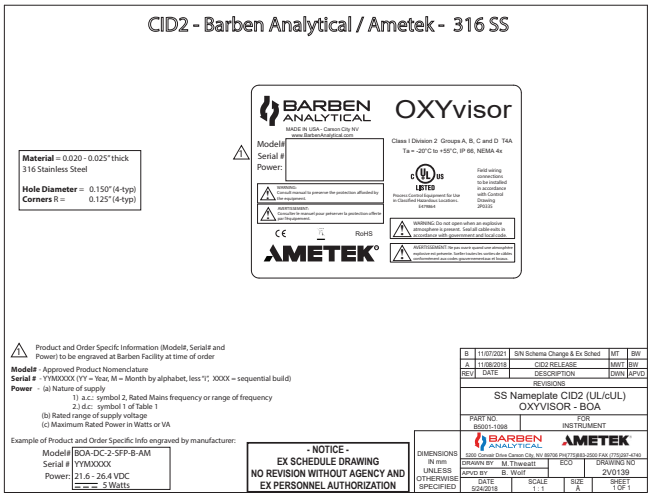


Figure 9 - **OXYvisor** Product Label / Name Plate - CID2 ABCD

2.9 Declaration of Conformity - Certificate

BARBEN ANALYTICAL
AMETEK

CE

Declaration of Conformity

According to EN ISO/IEC 17050-1:2010

Manufacturer Name (Nom du Fabricant): Barben Analytical | AMETEK
Address (Adresse): 5200 Convair Drive
Carson City NV, 89706 USA
Web: https://www.barbenanalytical.com

We hereby declare under our sole responsibility that the following apparatus:
(Nous déclarons par la présente sous notre seule responsabilité que les appareils suivants:)

Product Name (Nom du produit): OXYvisor
Product Description (Description du produit): Process Oxygen Analyzer
Model Number(s) (Numéros de modèle): Series BOA; followed by -AC or -DC; followed by -1, -2 & -3; followed by -S025, -S050, -S100, -Sxyz, or-SFP; followed by -B, -L or -R; followed by -SI or -AM
Product Category (Catégorie de produit): Electrical equipment for meaurement , control and laboratory use.

Complies with the essential requirements of the following applicable European Directives:
(Conforme aux exigences essentielles des directives européennes applicables suivantes):

Electromagnetic Compatibility (EMC) Directive 2014/30/EU
Low-voltage (Safety) Directive 2014/35/EU
Potentially Explosive Atmospheres (ATEX) Directive 2014/34/EU
RoHS Directive 2011/65/EU

EMC:

Emissions (Les émissions)
- EN 61326-1:2013 (IEC 61326-1:2012) Group 1 Class A
- EN 61000-3-2:2014 (IEC 61000-3-2:2014)
- EN 61000-3-3:2013 (IEC 61000-3-3:2013)

Immunity (Immunité)
- EN 61326-1:2013 (IEC 61326-1:2012) Group 1, Class A
- EN 61000-4-2:2009 (IEC 61000-4-2:2009)
- EN 61000-4-3:2006/A1:2008/A2:2010 (IEC 61000-4-3:2006+A1+A2)
- EN 61000-4-4:2004/A1:2010 (IEC 61000-4-4:2004+A1)
- EN 61000-4-5:2006 (IEC 61000-4-5:2006)
- EN 61000-4-6:2009 (IEC 61000-4-6:2009)
- EN 61000-4-8:2010 (IEC 61000-4-8:2010)
- EN 61000-4-11:2004 (IEC 61000-4-11:2004)

Safety (Sécurité): EN 61010-1 (IEC 61010-1)

Potentially Explosive Atmospheres:
(Atmosphères Potentiellement Explosif):

Zone 1 (Model Selection):
EN 60079-0:2012/A11:2013 (IEC 60079-0 6th Ed)
EN 60079-1:2014 (IEC 60079-1 7th Ed)
EN 60079-28:2015 (IEC 60079-28 2nd Ed)

Zone 2 (Model Selection):
EN 60079-0:2018 (IEC 60079-0 7th Ed)
EN 60079-7:2015/A1:2018 (IEC 60079-7 Ed 5.1)
EN 60079-11:2012 (IEC 60079-11 6th Ed)
EN 60079-28:2015 (IEC 60079-28 2nd Ed)

Meets the applicable HazLoc requirements as described in Certificates:

Zone 1 (Model Selection):
Demko 19 ATEX 2031 Rev. 1,
CE 0539 Ex II 2 G Ex db op is IIC T4 Gb
issued by UL DEMKO International A/S
IECEx UL 19.0040, Ex db op is IIC T4 Gb
issued by UL LLC

Zone 2 (Model Selection):
Demko 19 ATEX 2036 Rev. 1,
CE Ex II 3 G Ex ec [ic] op is IIC T4 Gc
issued by UL DEMKO International A/S
IECEx UL 19.0072, Ex ec [ic] op is IIC T4 Gc
issued by UL LLC

Environmental Affairs (Affaires environnementales): EN IEC 63000:2018
Articles manufactured on or after the Date of Issue of this Declaration of Conformity do not contain any of the restricted substances in concentrations/applications not permitted by the RoHS Directive.

Supplementary Information (Information supplémentaire):

1. This product meets the Safety requirements of the United States (UL 61010-1) and Canada (CAN/CSA-C22.2 No. 61010-1)
2. This product meets the HazLoc Zone 1 requirements in the United States (UL 60079-0 7th Ed, UL 60079-1 7th Ed and 60079-28 2nd Ed) and Canada (CAN/CSA C22.2 No. 60079-0 4th Ed, CSA C22.2 No. 60079-1 3rd Ed, CSA C22.2 No. 60079-28 1st Ed)
3. This product meets the HazLoc Zone 2 requirements in the United States (UL 60079-0 7th Ed, UL 60079-7 Ed 5.1, UL 60079-11 6th Ed and UL 60079-28 2nd Ed) and Canada (CAN/CSA C22.2 No. 60079-0 4th Ed, CSA C22.2 No. 60079-7 2nd Ed, CSA C22.2 No. 60079-11 2nd Ed and CSA C22.2 No. 60079-28 1st Ed)

September 6th, 2023 || Carson City NV USA
Date and Place of Issue

Gary Evans || Director of Engineering

OV BA DoC EU R2

Section 3 - Quick Start Guide -

3.1 Quick Start Guide

Installation - *See Section 4 for installation details: mounting, wiring and important safety information. Sensors should be connected.*

1. **Power on the OXYvisor**. The main display will show O_2, pressure, temperature, any existing errors, time & date.
2. **Confirm the proper sensor type of BOS1, BOS2 or BOS3** (The sensor's black fiber optic cable has a white tag with part number.)

   Press the Escape key → Measurement and Units → Basic Setup → Oxygen Sensor Type → BOS1, BOS2 or BOS3

   Press the Escape key until you reach Main Menu ("Escape Out")
3. **Select the proper process Media** (will the sensor be measuring in gas or liquid?).

   Press the Escape key → Measurement and Units → Basic Setup → Media → Gas Phase or Aqueous Liquids
4. **Set the Oxygen units** [Gas Phase: %, ppm or hPa] or [Liquid: ppb or ppm]

   Press the Escape key → Measurement and Units → Oxygen Units → select preferred unit (availability depends on media selection)
5. **Set the Temperature and Pressure Compensation units to user preferred settings**

   Press the Escape key → Measurement and Units → Compensation Units → Temperature Units (°C or °F)

   Press the Escape key → Measurement and Units → Compensation Units → Pressure Units (mbar, inches H_2O, Bar, Torr or psi)

   **Note: If you have an external pressure transmitter, select the same pressure units as it has, so matching the 4-20 mA in step 8 will be easy.*
6. **Set the Sample Rate.** The faster the sensor rate, the faster the drift of the sensor. It is recommended to set sample rate as slow as possible for your process. Typically, 30 to 60 seconds sample rates are used.

   Press the Escape key → Measurement and Units → Basic Setup → Oxygen Sample Rate → Manual Adjust (set the update rate to your process.)
7. **Set up Temperature sensor.** Default is Pt1000 RTD and if the analyzer is reading temp properly without error, skip this step.

   Press the Escape key → Input Output → Temperature Input (select the appropriate temp sensor input, usually Pt1000)
8. **Set up Pressure transmitter.** Default is the on-board ambient pressure sensor. If the installation has an external pressure transmitter (common for in-situ or if sample stream is at other than ambient pressure) then perform as follows:

   Press the Escape key → Input Output → Pressure Sensor Input (Ambient, External Analog or manual)

   **Note: When selecting External Analog, you will need to input (match) the 4-20 mA range of the attached pressure transmitter.*
9. **Set up 4-20 mA outputs.** Enable and assign the 4-20 mA outputs. (Alarm relays and RS485 Modbus RTU are also available)

   Press the Escape key → Input Output → Analog Output → Enable Analog Output → Select Oxygen → Linear → Enter 20 mA O_2 value.
10. **Set the Signal Intensity (AMP).** This value is set at the factory per Sensor Type, so adjustment is not required unless Sensor Type has been changed or if X21 error is observed during calibration.

    While flowing Nitrogen past the sensor tip, observe the signal intensity (AMP) in the Alternate Main Display (from the Main Display press Enter once). If the signal intensity (AMP) is near the Ideal Intensity shown for the Sensor Type in Table 5, then proceed to Calibration without changes.

    Press the Escape key → Measurement and Units → Signal Intensity (1 to 100%) [see table 5, Signal Intensity]

    Go back to the Alternate Main Display and check the AMP. Re-adjust if necessary. Once inside or near the range, proceed to calibration.

Dynamic Sensor Ranges				Calibration Gases - Recommendations		Signal Intensity (AMP)	
Sensor Type	Full Range (per accuracy spec)	Low Limit of Detection @ 1atm	Max Over-Range Limit (small non-linearity)	Zero Gas Purity	Span Gas	Signal Intensity (new sensor cap)	Ideal Intensity in N_2 (zero oxygen)
BOS2	0 to 25% O_2	300 ppm	100% O_2	99.99% Nitrogen	10 to 20.95% O_2	5%	35,000 +/- 1,500
BOS1	0 to 4.2% O_2	20 ppm	5.0% O_2	99.999% Nitrogen	1 to 2% O_2 or 80 - 100% Critical Value	10%	24,000 +/- 1,500
BOS3	0 to 300 ppm O_2	0.5 ppm	1000 PPM	99.999+% Nitrogen	80 - 100% of Critical Value	25%	28,000 +/- 1,500

Table 5 - BOSx sensor Ranges, Calibration and Signal Intensity settings

Calibration

1. **The O_2 and temperature sensors should be placed within a flow-cell, so the zero (N_2) and Span Gas (2'nd cal point) can flow past the sensor tips.**
2. **If an external pressure sensor is used, place it directly after the oxygen sensor, to measure the correct pressure of the system during calibration.**
3. **If the ambient (on-board) pressure sensor is used, ensure there is no pressure build-up during calibration. If a rotameter is available, adjust the calibration gas flow to approximately 0.5 - 2 L/min, and outlet/vent to ambient.**
4. **Input and Calibrate with Zero Gas.** Under the OXYvisor menu, go to;

   Calibration → Basic Setup → Manual O2 Calibrating → Calibration Temp On → Two Point Calibration → Input Zero Gas (nitrogen).

   With Zero Gas flowing, monitor sensor measurement values on the screen. Once the Phase Angle stabilizes, press Enter to store value.

   **Note the stability of the phase angle should be +/- 0.07 and Temperature should be +/-0.2C*
5. **Input and Calibrate with Span Gas.** (con't)

   → Enter Span Gas O_2 concentration. With Span Gas flowing, monitor the live values. Once the Phase Angle stabilizes, press Enter to store value.

   *Stop the flow of Span Gas and return sensors back to process gas flow. *Note, the outputs will be live once you return to Main Menu(s).*

   Press the Escape key until you reach Main Menu ("Escape Out").

Maintenance

1. Do NOT attempt to clean the sensing tip with any hard or abrasive object that may damage the sensor.
2. If coated with oil or particulates, rinse carefully and gently daub with clean, wetted towel (water or isopropyl alcohol).
3. If the OXYvisor HMI glass needs cleaning, use a black towel to avoid triggering infrared buttons.

Section 4 - Installation

4.1 Installation Overview

The OXYvisor Optical Oxygen Analyzer includes a 316 SS pipe-mount bracket for field mounting. An optional wall mount kit is available. Additional components needed to produce a functional oxygen measurement include a Barben Oxygen Sensor (BOS) and Pt1000 RTD (Resistance Temperature Sensor). Other components are commonly required to make a reliable measurement; such as a pressure transmitter, "wet-gas" sample probe, heated pressure reduction stations (HPRS), heated sample lines (HSL's) and a manual or automatic sample calibration panel (SCP). If any of these items are required, please consult a Barben Analytical representative regarding your application.

It is important that the product **Name Plate** (Figure 6) is reviewed to properly identify the product, it's power input, and the specific hazardous area markings for the actual unit. It is equally important that the installation control drawing referenced in Table 6, is fully understood and followed along with the inclusion of any applicable federal, state and local codes.

OXYvisor Model Number	Type of Protection	Installation - Control Drawing
BOA-DC-1-SFP-B-x	Zone 1 IIC	2P0345 (Zone 1)
BOA-AC-1-SFP-B-x		
BOA-DC-2-SFP-B-x	Class I, Division 2 Groups A,B,C,D	2P0335 (Class I Div2)
BOA-AC-2-SFP-B-x		
BOA-DC-3-SFP-B-x	Zone 2 IIC	2P0346 (Zone 2)
BOA-AC-3-SFP-B-x		
Where "x" at the end of the model number can be either SI (25 mm) or AM (3/4") conduit entries		

Table 6 - OXYvisor HazLoc Summary by Product Model Number Selection

The OXYvisor is used to quantitatively measure the amount of oxygen in a gaseous or liquid sample. The analyzer may only be installed as specified in these instructions per its intended use. Modifications to the analyzer which are not expressly referred to within these instructions, will result in an application which is not in accordance with the intended use. Such modifications are then the exclusive responsibility of the user.

4.2 Inspection of the Analyzer Shipment (consignment)

Check the packaging and the device for visible damage caused by inappropriate handling during shipping. Close attention should be paid to the powder coated analyzer enclosure for signs of impact or abrasion during shipping. All threads should be inspected for burrs and any residual packing material should be removed.

Report any claims for damages immediately to the shipping company. Take pictures and retain damaged parts for clarification. Check the scope of delivery by comparing the shipping documents with your order for correctness and completeness.



Do not use any damaged or incomplete devices. Danger of explosion in hazardous areas.

4.3 Weight

The approximate weight of the analyzer is 13.7 lb (6.2 kg).

4.4 Tools

Suggested tools to complete the installation are listed below:

- M8 or Small crescent Wrench (Used for 2” pipe mount bracket installation)
- Large flathead Screwdriver (Used to mount analyzer to mounting bracket)
- Small flathead Screwdriver (used for wiring)
- 36mm Open End or large adjustable wrench (Used to adjust jam nut between analyzer and junction box)
- 2 mm Hex Key or driver to lock the rear compartment
- Loctite 577, P/N: B8008-1014 (Only if J-Box needs re-orientation, see Section 6.4.2)

4.5 Mounting the Analyzer

Factors to consider when mounting the analyzer:

- **Analyzer/Pipe Mount Orientation:** The analyzer and pipe mount kit can be mated/arranged to mount to either a vertical (Fig 10) or horizontal pipe (Fig 11), shown on page 26.
- **Outside Mounting:** Avoid direct sunlight. Use a sunshade.
- **Sensor Fiber Optic Length:** Consider the distance from the analyzer to the sensor installation into the process. This may be quite short if a sample panel is used. If the sensor is mounted directly into the process then consider a mounting point that is close to the sensor, but avoids excess heat or cold from the process.
- **Sample Conditioning Panel (SCP):** An accurate temperature measurement is required for an accurate oxygen measurement. The SCP temperature sensor has been specially selected and thermally isolated from the sample tubing, in order to accurately measure the sample gas temperature and not the sample tube temperature. Avoid situations where the sample gas temperature may be considerably different than the sample tubing near the temperature and oxygen sensors.
- **Conduit / Cable Routing:** Consider possible interference with the conduit / cable routing and the mounting bracket before installation is finalized.

CAUTION

When appropriate, use sunshade and/or enclosures, heated sample lines or other means necessary to avoid extreme temperature differences between the sample tubing and gas sample.

CAUTION

The front compartment contains the display and electronics boards. It is secured via the 2 mm Hex Lock and is not meant to be opened in the field at any time.

WARNING

If the front compartment is opened, follow the instructions for tightening and securing the Rear (Wiring) Compartment lid. Section 6.4.1.

WARNING

OPTICAL BUSHING / MAIN ENCLOSURE - The optical bushing going into the upper main enclosure should not be removed nor turned. There is a locking screw (4 mm Hex) to prevent this.

WARNING

OPTICAL BUSHING / JUNCTION BOX - If the installation requires re-orientation of the junction box, this can be performed in the field. To maintain the safety afforded by this analyzer the instruction found in Section 4.5.1, Orientation of the Junction Box must be followed closely.

WARNING

UNUSED ENTRIES - Unused entries shall be closed with suitable certified Ex db blanking elements with a minimum IP66 rating.

4.5.1 Orientation of the Junction Box - ONLY IF NECESSARY - (Not for Zone 2)

The Junction Box is fitted and located at the bottom of the analyzer with a front-forward orientation as shown in Figure 4. The orientation is locked into position via a Jam Nut and the 3/4" NPT threads (mating to Fiber Optic Bushing) are sealed with a thread-sealant. The orientation can be specifically selected in the ordering process or sent back to the factory for adjustment. Only if J-Box needs re-orientation, see Section 6.4.2

USEFUL INFORMATION

The Junction Box has been fitted and secured at the factory. These removal and installation instructions related to the Junction Box are only necessary if the installation required the Junction Box to be re-orientated (turned).

WARNING

The Junction Box is not to be adjusted, removed or re-installed in the field for Zone 2 applications. Doing so will affect the safety evaluation and certification of the device.

4.5.2 OXYvisor - Pipe-Mount to Vertical Pipe

1. Locate the proper height for the HMI and display so that it is easily accessible for user
2. Install the L-bracket to the analyzer by tightening down the (4) M6 slotted screws.
3. Install the U-bolt around the pipe at the proper height into the L-bracket and tighten the M8 nuts
4. Double check tightness of the screws and bolts

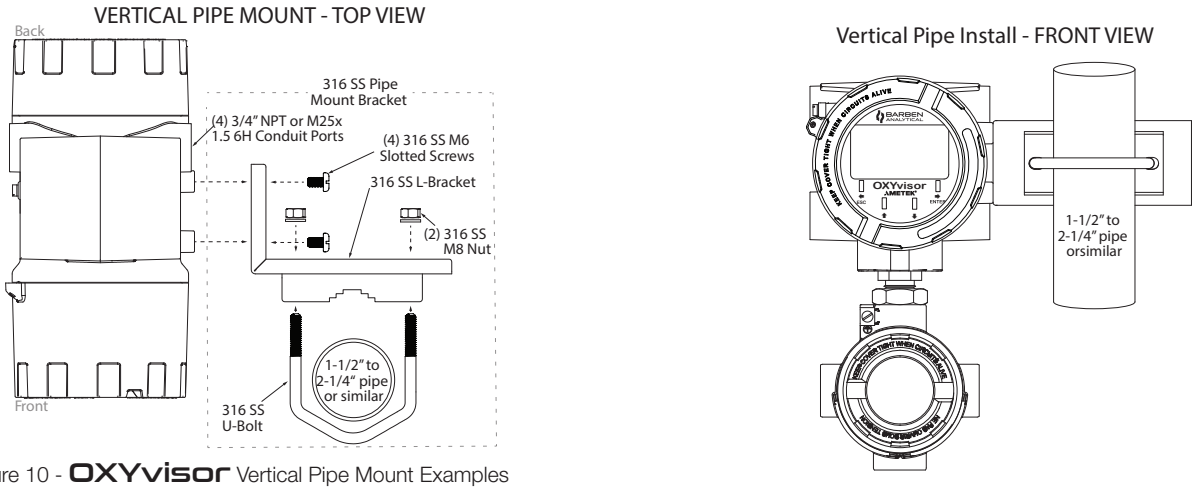


Figure 10 - OXYvisor Vertical Pipe Mount Examples

4.5.3 OXYvisor - Pipe-Mount to Horizontal Pipe

1. Locate the proper height for the HMI and display so that it is easily accessible for user
2. Install the L-bracket to the analyzer by tightening down the (4) M6 slotted screws.
3. Install the U-bolt around the pipe at the proper height into the L-bracket and tighten the M8 nuts
4. Double check tightness of the screws and bolts

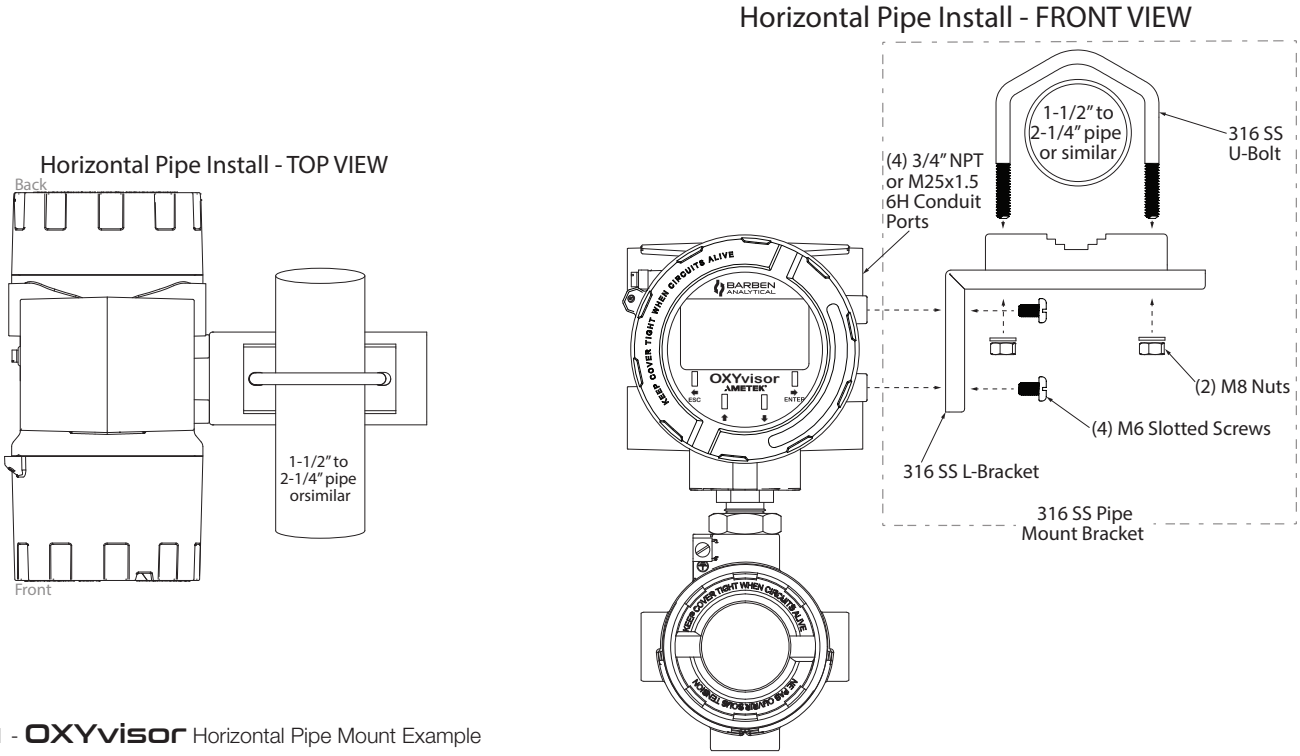


Figure 11 - OXYvisor Horizontal Pipe Mount Example

4.5.4 OXYvisor - Wall 90º Mount Kit, B5008-1145

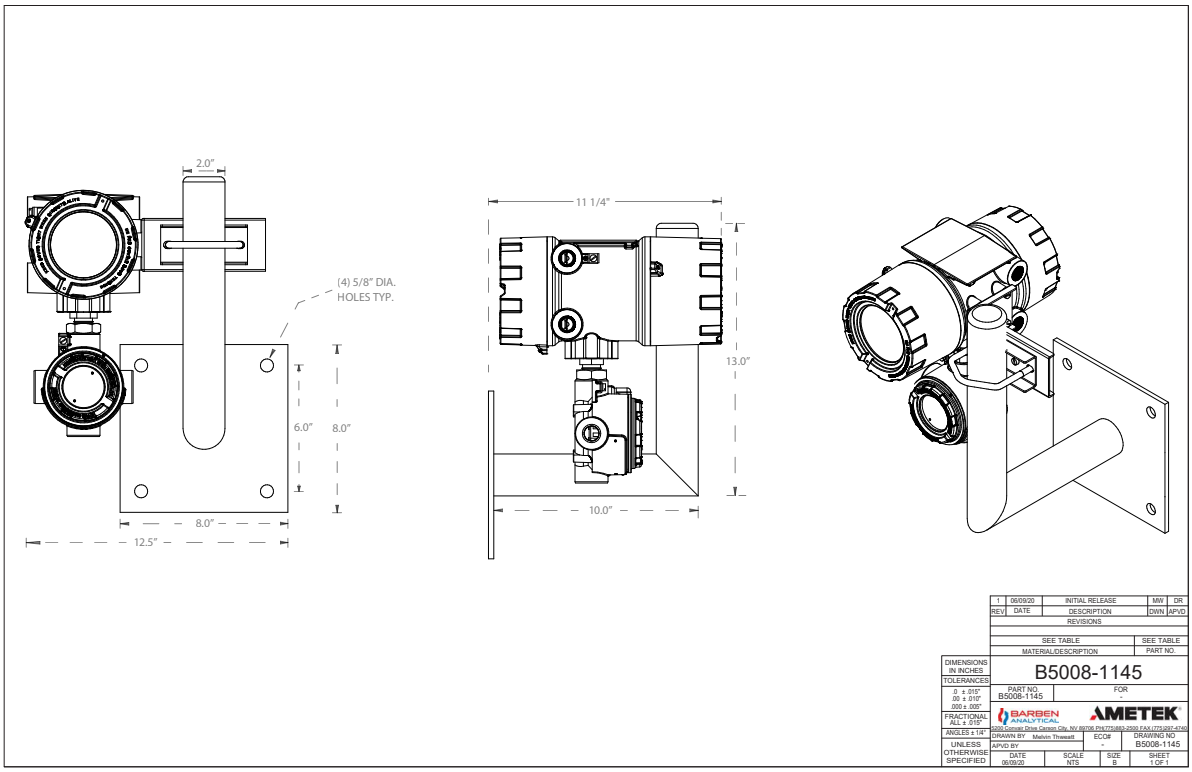


Figure 12 - OXYvisor Optional Wall Mount - 90˚, P/N: B5008-1145

4.5.5 OXYvisor - Wall-Hinge Mount Kit, B5008-1225

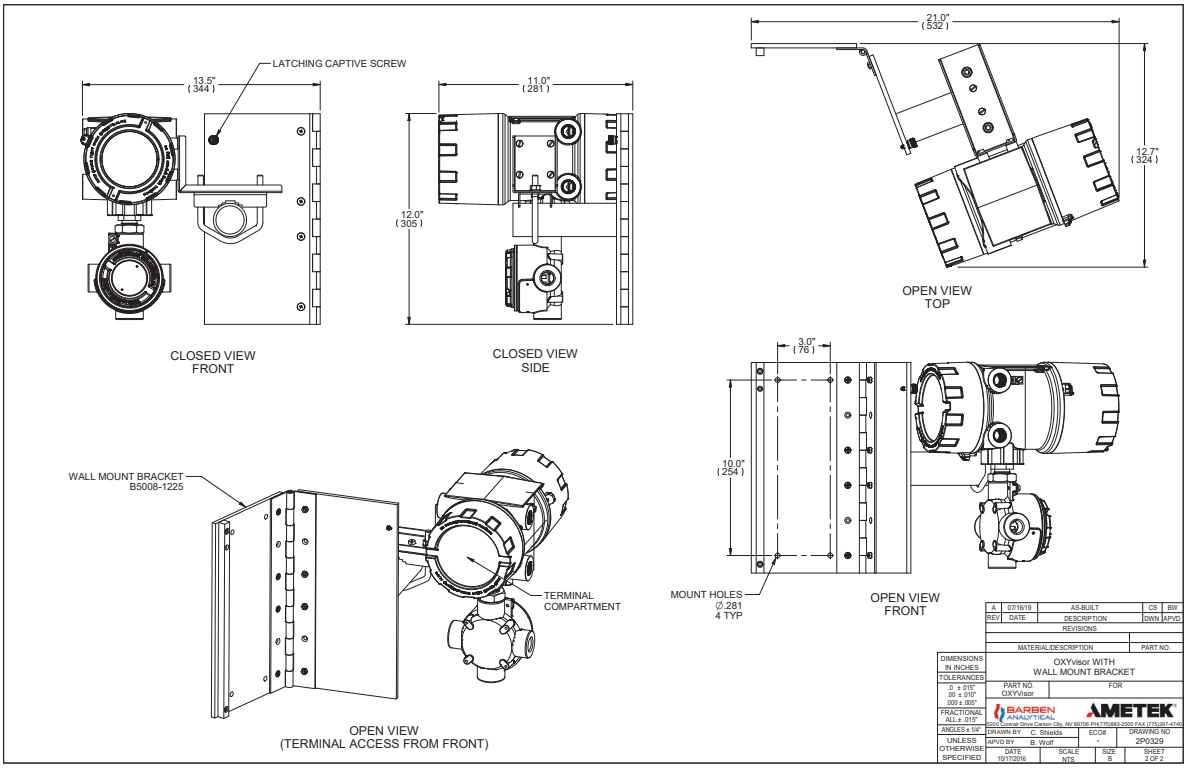


Figure 13 - OXYvisor Optional Wall Hinge Mount Kit, B5008-1225

4.6 Wiring - Power

4.6.1 Protective Ground (Earthing) Screw

The OXYvisor can be ordered with either 120-240VAC input power or 24VDC input power. Before connecting any electrical signal or power, a protective ground on the analyzer enclosure must be connected. Requirements for the Protective Ground conductor are as follows:

- The protective conductor must be of equal or greater size than any other current-carrying wiring.
- The protective conductor must remain connected until all other wiring is removed.

Figure 14 shows the protective ground screw locations.

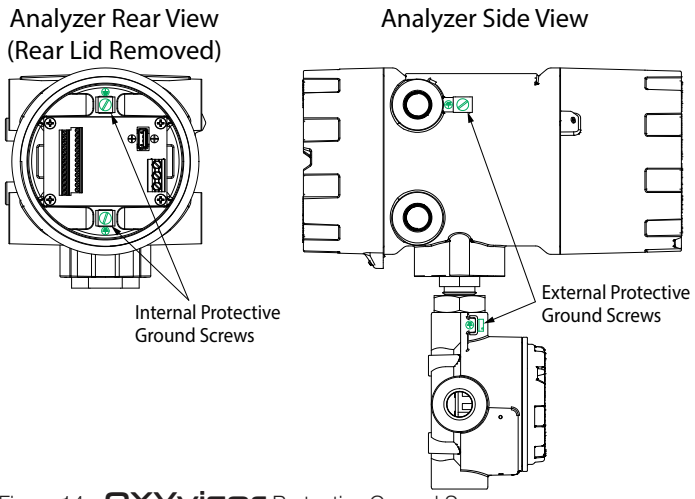


Figure 14 - OXYvisor Protective Ground Screws

4.6.2 AC Powered Analyzer

Analyzer - Mains Supply Connections (AC Version)

The OXYvisor control unit can operate using between 85-240 volts AC, 47 to 63 Hz. There is no power switch or circuit breaker on the control unit, and it must be protected by installing it on a circuit-protected line, with recommended maximum 1 amperes, with a switch or circuit breaker in close proximity to the control unit and within easy reach of an operator. Mark the switch or circuit breaker as the control unit disconnecting device.

Warning - Hazardous voltage and risk of electrical shock - make sure main power is shut off prior to attaching wiring to analyzer.

AC Power

OXYvisor analyzers ordered with AC power input will have a termination board labeled with “Line”, “Neutral”, and “Earth” (Ground) as shown in Figure (15).

Power Supply wiring requirements:

- 24 to 12 gauge (IEC .500 to 2.00)
- Copper, stranded wire
- Minimum 300V Insulation
- Tightened (torque) to 0.5 to 0.6 Nm

4.6.3 DC Powered Analyzer

Analyzer - Power Supply Connections (DC Version)

The **OXYvisor** control unit can operate using 24 VDC +/-10%. When energized by mains the 24 V DC supply must be from a Class2 or LPS source, OR that a fuse (1 A) will be required in the installation.



Please note that the 24VDC version of the analyzer is a 4-wire device. It has separate wiring for power and signal (not a loop powered device).

DC Power

OXYvisor analyzers ordered with DC power input will have a termination board labeled with “24VDC (+)”, “24VDC (-)”, and “Earth” (Ground) as shown in Figure (16).

4.7 Wiring - Input/Outputs

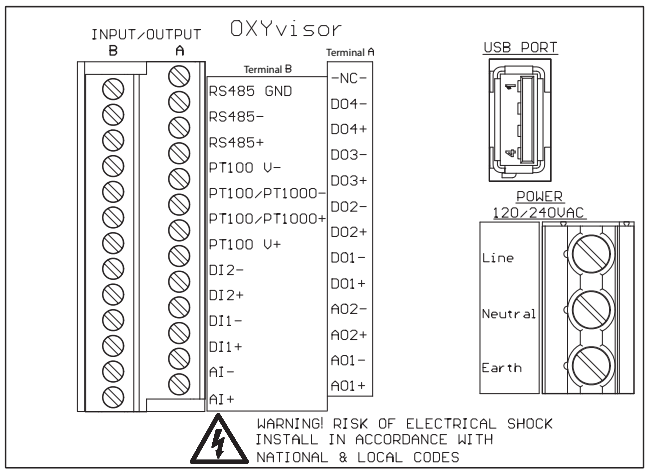
Input / Output Wiring

All Input / Output wiring for the **OXYvisor** analyzer is located on the left side of the board as shown in Figures 15 and 16, below. The wiring assignments, descriptions and functions are shown in Table 9, page 30.



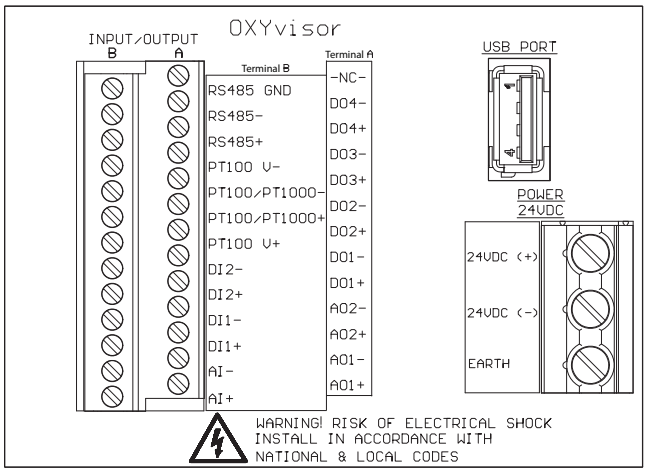
Input / Output wiring requirements:

- 26 to 16 gauge (IEC .400 to 1.25)
- Copper, stranded wire
- Minimum 300V Insulation
- Tightened (torque) to .22 to .25 Nm



AC OPTION

Figure 15 - AC Terminal Board - Located in Rear (Wiring) Compartment



DC OPTION

Figure 16 - DC Terminal Board - Located in Rear (Wiring) Compartment

AC TERMINAL BOARD POWER WIRING

Label	Terminal	Description	Function
Line	Power 120/240VAC	85-240* VAC 47/63Hz Input Power	Line Power Wiring
Neutral	Power 120/240VAC	85-240* VAC 47/63Hz Input Power	Neutral Power Wiring
Earth	Power 120/240VAC	Earth Terminal	Earth Terminal

Table 7- AC Terminal Board Power Wiring

DC TERMINAL BOARD POWER WIRING

Label	Terminal	Description	Function
24VDC (+)	Power 24VDC	21.6 - 26.4 VDC	Positive DC Power Wiring
24VDC (-)	Power 24VDC	21.6 - 26.4 VDC	Negative DC Power Wiring
Earth	Power 24VDC	Earth Terminal	Earth Terminal

Table 8- DC Terminal Board Power Wiring

INPUT / OUTPUT WIRING

Input / Output TERMINAL - A	Label	Description	Function
	-NC-	Not used	Not used
	DO4 -	Relay Output 4 (24VDC, 0.05A pilot duty, 0.4A resistive load)	Programmable, Isolated Relay Negative wire
	DO4 +	Relay Output 4 (24VDC, 0.05A pilot duty, 0.4A resistive load)	Programmable, Isolated Relay Positive wire
	DO3 -	Relay Output 3 (24VDC, 0.05A pilot duty, 0.4A resistive load)	Programmable, Isolated Relay Negative wire, (Process Gas Relay if AutoCal is used)
	DO3 +	Relay Output 3 (24VDC, 0.05A pilot duty, 0.4A resistive load)	Programmable, Isolated Relay Positive wire, (Process Gas Relay if AutoCal is used)
	DO2 -	Relay Output 2 (24VDC, 0.05A pilot duty, 0.4A resistive load)	Programmable, Isolated Relay Negative wire, (Span Cal Relay if AutoCal is used)
	DO2 +	Relay Output 2 (24VDC, 0.05A pilot duty, 0.4A resistive load)	Programmable, Isolated Relay Positive wire, (Span Cal Relay if AutoCal is used)
	DO1 -	Relay Output 1 (24VDC, 0.05A pilot duty, 0.4A resistive load)	Programmable, Isolated Relay Negative wire, (Zero Cal Relay if AutoCal is used)
	DO1 +	Relay Output 1 (24VDC, 0.05A pilot duty, 0.4A resistive load)	Programmable, Isolated Relay Positive wire, (Zero Cal Relay if AutoCal is used)
	AO2 -	Analog Output 2 (4-20mA) Active	Analog Output (Negative wire, Active 24 VDC)
	AO2 +	Analog Output 2 (4-20mA) Active	Analog Output (Positive wire, Active 24 VDC)
	AO1 -	Analog Output 1 (4-20mA) Active	Analog Output (Negative wire, Active 24 VDC)
	AO1 +	Analog Output 1 (4-20mA) Active	Analog Output (Positive wire, Active 24 VDC)

Input / Output TERMINAL - B	Label	Description	Function
	RS485 GND	Serial Communication	Modbus RS485 RTU Common Wire
	RS485 -	Serial Communication	Modbus RS485 RTU Data Negative Wire
	RS485 +	Serial Communication	Modbus RS485 RTU Data Positive Wire
	PT100 V -	PT1000 4-wire or jumper to next terminal	PT100 4 wire RTD input, Drive Voltage negative wire (black)
	PT100/PT1000 -	PT1000 Temperature Sensor	PT1000 negative wire then jumper to PT100 - terminal above
	PT100/PT1000 +	PT1000 Temperature Sensor	PT1000 positive wire then jumper to PT100 + terminal below
	PT100 V+	PT1000 4-wire, 3'rd wire or jumper to above terminal	PT100 4 wire RTD input, Drive Voltage positive wire (red)
	DI2 -	Digital Input 2 (0 VDC)	Powered Digital input, Negative Wire, Connect to external switch for remote Test Gas Insert
	DI2 +	Digital Input 2 (5 VDC)	Powered Digital input, Positive Wire, Connect to external switch for remote Test Gas Insert
	DI1 -	Digital Input 1 (0 VDC)	Powered Digital input, Negative Wire, Connect to external switch for remote AutoCal Initiation
	DI1 +	Digital Input 1 (5 VDC)	Powered Digital input, Positive Wire, Connect to external switch for remote AutoCal Initiation
	AI1 -	Analog Input (0 VDC, 4-20mA)	Analog Input, Negative Wire, 24VDC Powered,. Programmable for Temperature or Pressure
	AI1 +	Analog Input (24 VDC, 4-20mA)	Analog Input, Positive Wire, 24VDC Powered,. Programmable for Temperature or Pressure

Table 9- Terminal Board - Input / Output - Wiring

4.8 Electrical Entries



Unused entries shall be closed with suitable certified, either Ex db or CID2, blanking elements with a minimum IP66 rating.

4.9 Securing the Rear (Wiring) Compartment lid.



After wiring the power and any input / output connections and before powering up the analyzer, the Rear (Wiring) Compartment lid should be installed and fully tightened. Follow the detailed instruction found in Section 6.4.1.

4.10 Sensor Connection Options

Barben Optical Sensors (BOS) connect to the **OXYvisor** through a fiber optic cable connection. The fiber optic cable from the **OXYvisor** is easily mated to the BOS oxygen sensor via a finger-tightened SMA coupler connection, located in the lower sensor junction box (J-Box). The BOS sensor types, FlexSense and SafeTap, each have an option for an integral RTD that may be selected for convenience, depending on the application details and requirements. Both integral and external RTD's can be connected to the **OXYvisor** through the Rear (Wiring) Compartment and via the J-Box when the later connection is available. Figures 17, 18 & 19 show some common arrangements for the **OXYvisor** and BOS sensors.

4.10.1 BOS Sensor with Integral RTD via J-Box

When the BOS sensor is specified with an integral RTD, and the **OXYvisor** model is selected with Agency Approval "2" or "3", the RTD can also be connected through the J-Box via a Molex connector. See Figure 17.

USEFUL INFORMATION

The mating RTD Molex connection in the Junction Box is only available on **OXYvisor** models with Agency Approval selection "2" or "3" (cULus CID2 and ATEX/IEC Zone 2 3G) per **OXYvisor** Configuration - Product Model Selection, Table 3.

USEFUL INFORMATION

Integral RTD's are located within the BOS sensor and may not give the desired accuracy in certain applications. Avoid using integral RTD's in applications with large temperature changes over short periods of time or in streams with low heat capacity (e.g. dry gas streams).

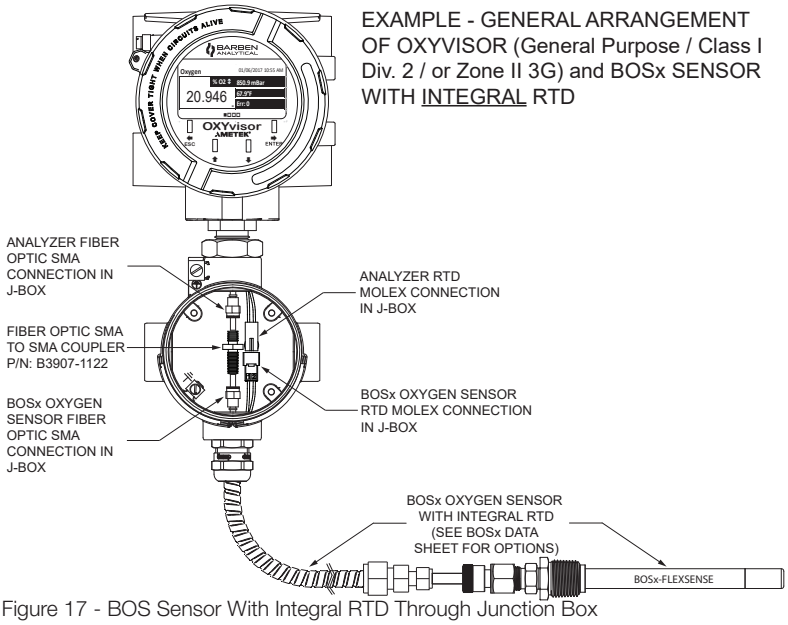


Figure 17 - BOS Sensor With Integral RTD Through Junction Box

4.10.2 BOS Sensor with External RTD's via J-Box

The BOS sensor is commonly specified without an integral RTD for gas phase applications. An external RTD can be placed directly into the process and is preferred for accurate temperature measurement under various process conditions (e.g. process with fast moving temperature, low heat capacity (dry gas) or $T_{Process}$ - $T_{Ambient}$ is large). The external RTD can be connected through the J-Box (Fig 18) or through the Rear (Wiring) Terminal.

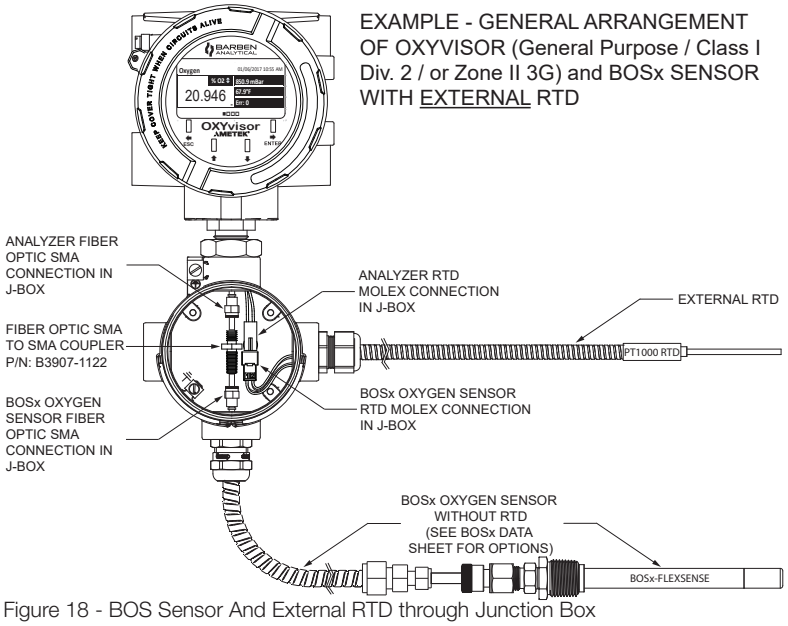


Figure 18 - BOS Sensor And External RTD through Junction Box

4.10.3 BOS Sensor with External RTD via Rear (Wiring) Compartment

For **OXYvisor** installations in Zone 1, where the model is selected with Agency Approval "1", the BOS sensor (as standard) is not allowed to be installed with integral RTD. An external RTD will be the standard recommended installation. For this case, the RTD can be wired through the Rear (Wiring) Compartment as shown in Figure 19.

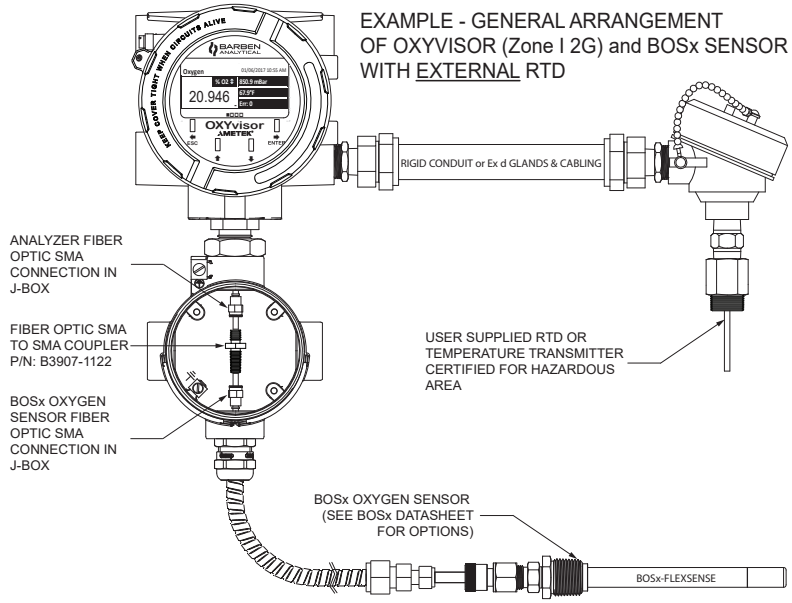


Figure 19 - BOS Sensor And External RTD or Zone 1

4.11 Hazardous Area - Installation & Control Drawings

4.11.1 Zone 1 - Group IIC - 2P0345

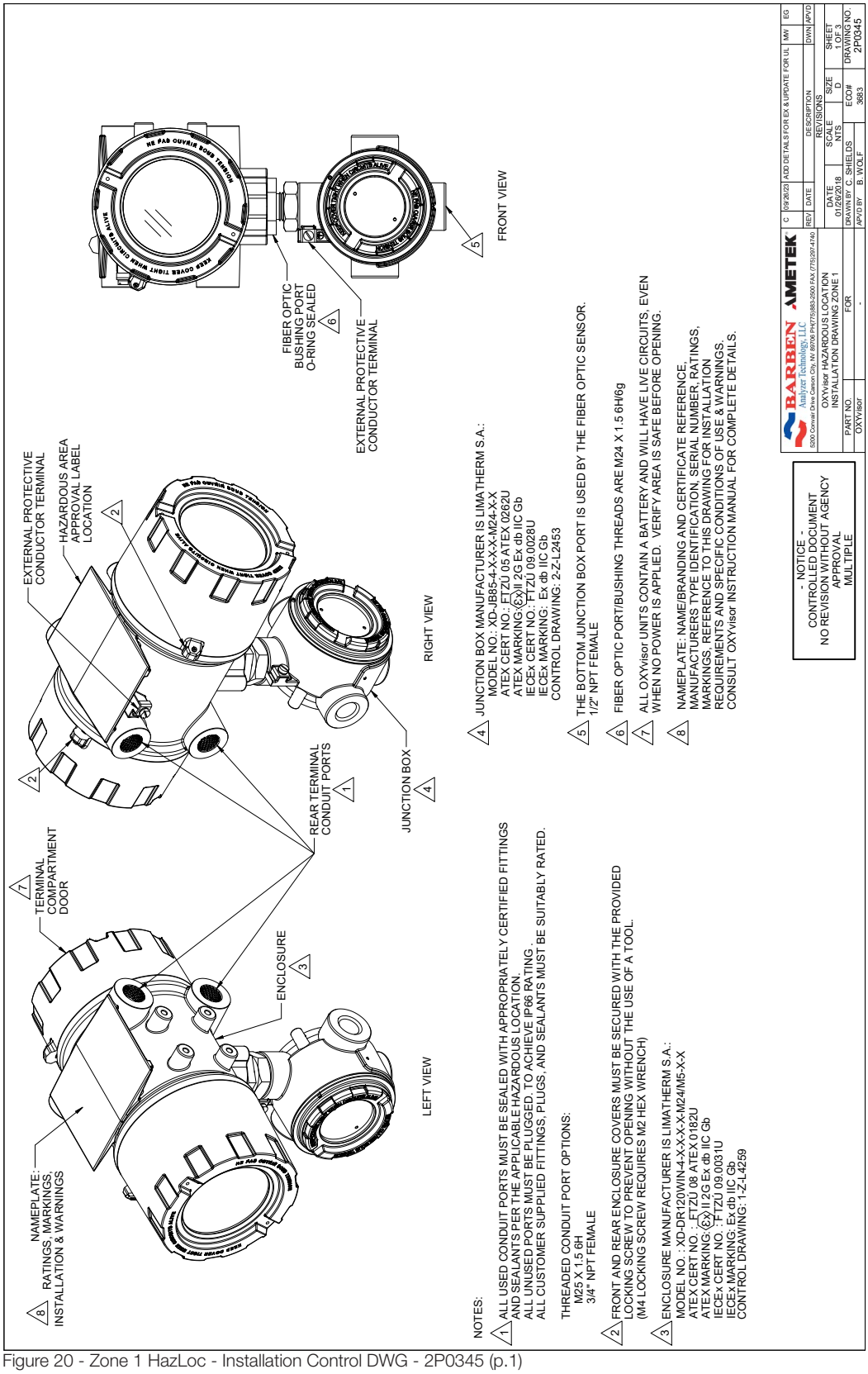


Figure 20 - Zone 1 HazLoc - Installation Control DWG - 2P0345 (p.1)

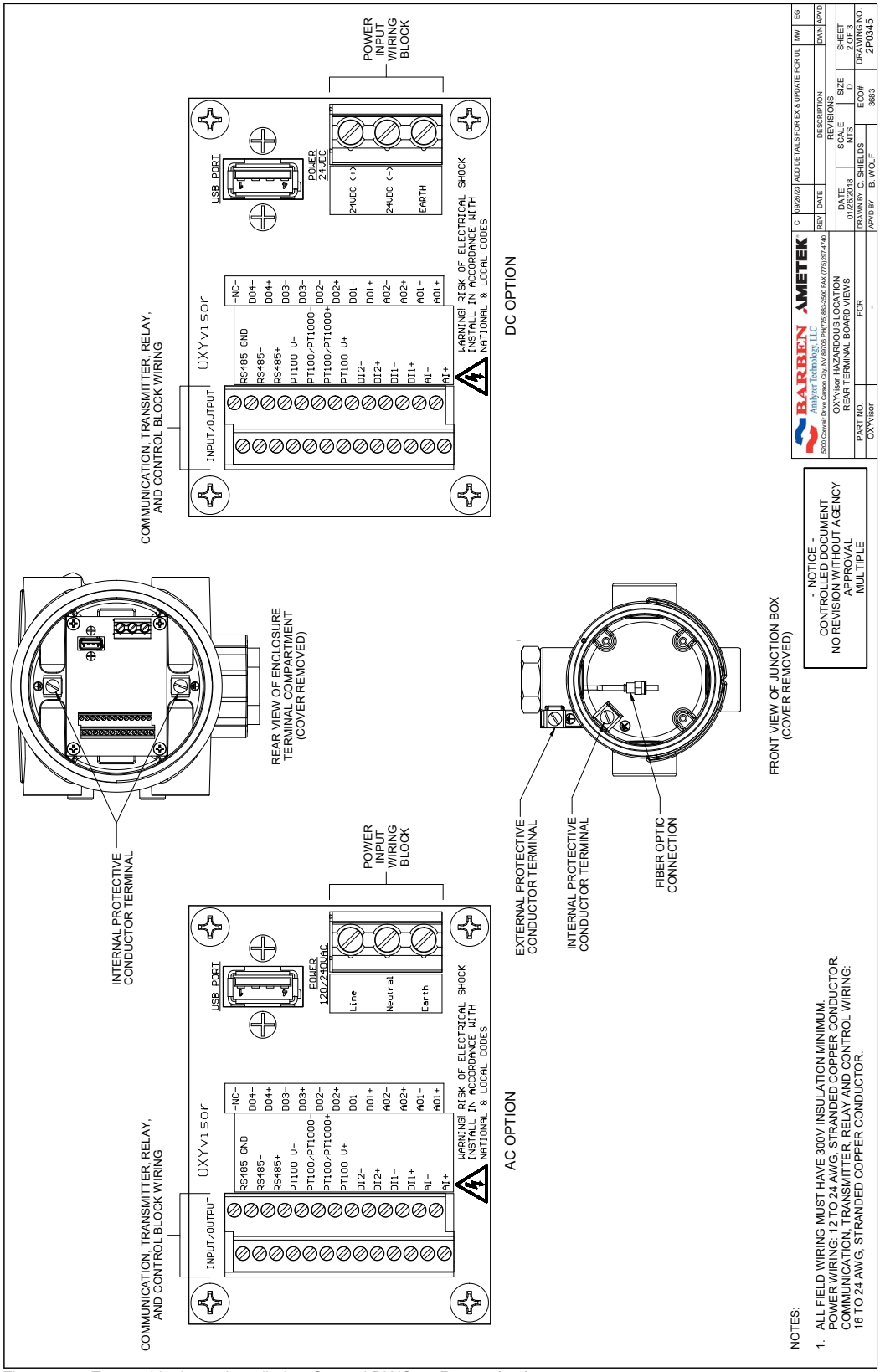


Figure 21 - Zone 1 HazLoc - Installation Control DWG - 2P0345 (p.2)

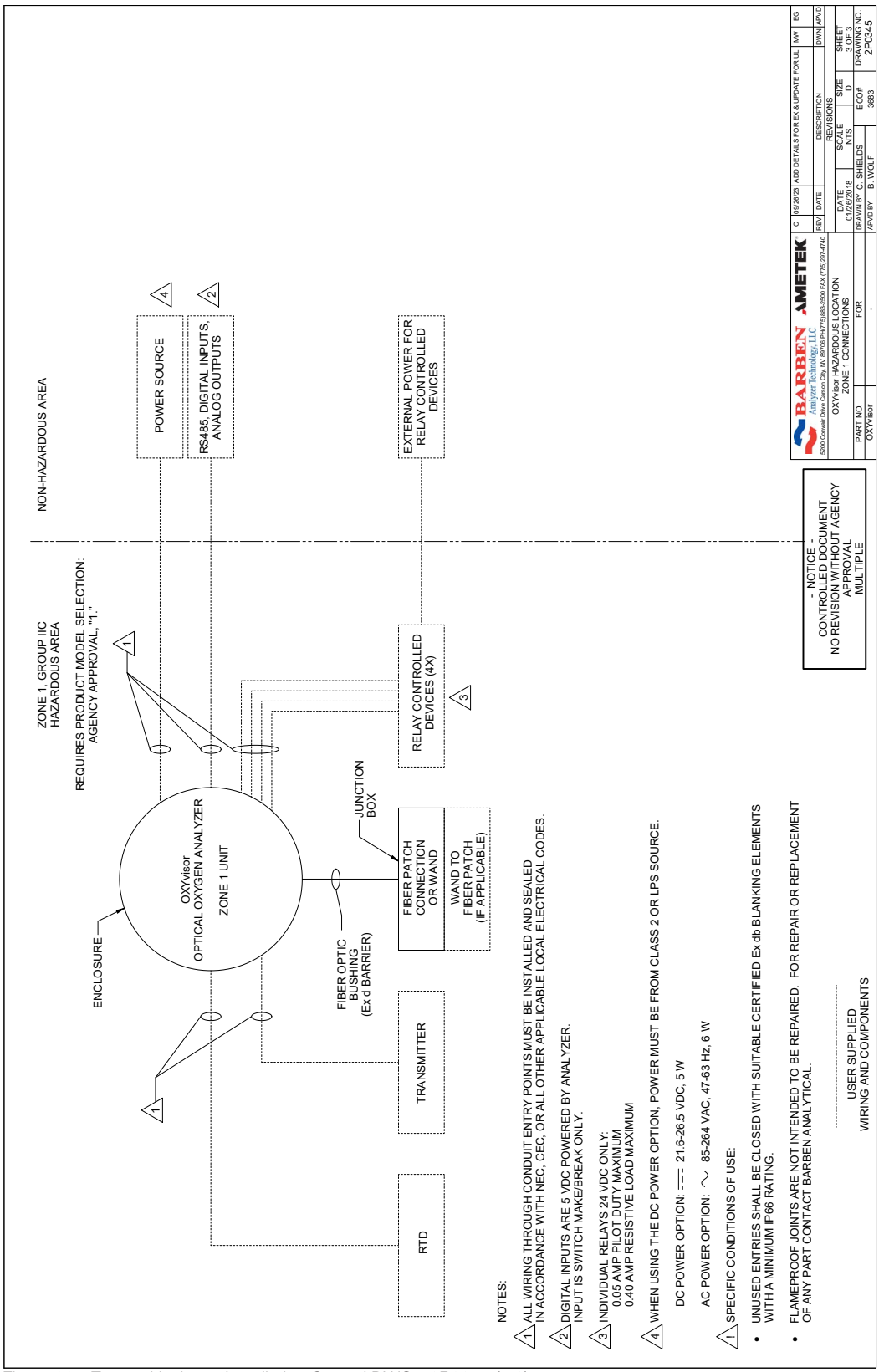


Figure 22 - Zone 1 HazLoc - Installation Control DWG - 2P0345 (p.3)

4.11.2 Zone 2 - Group IIC - 2P0346

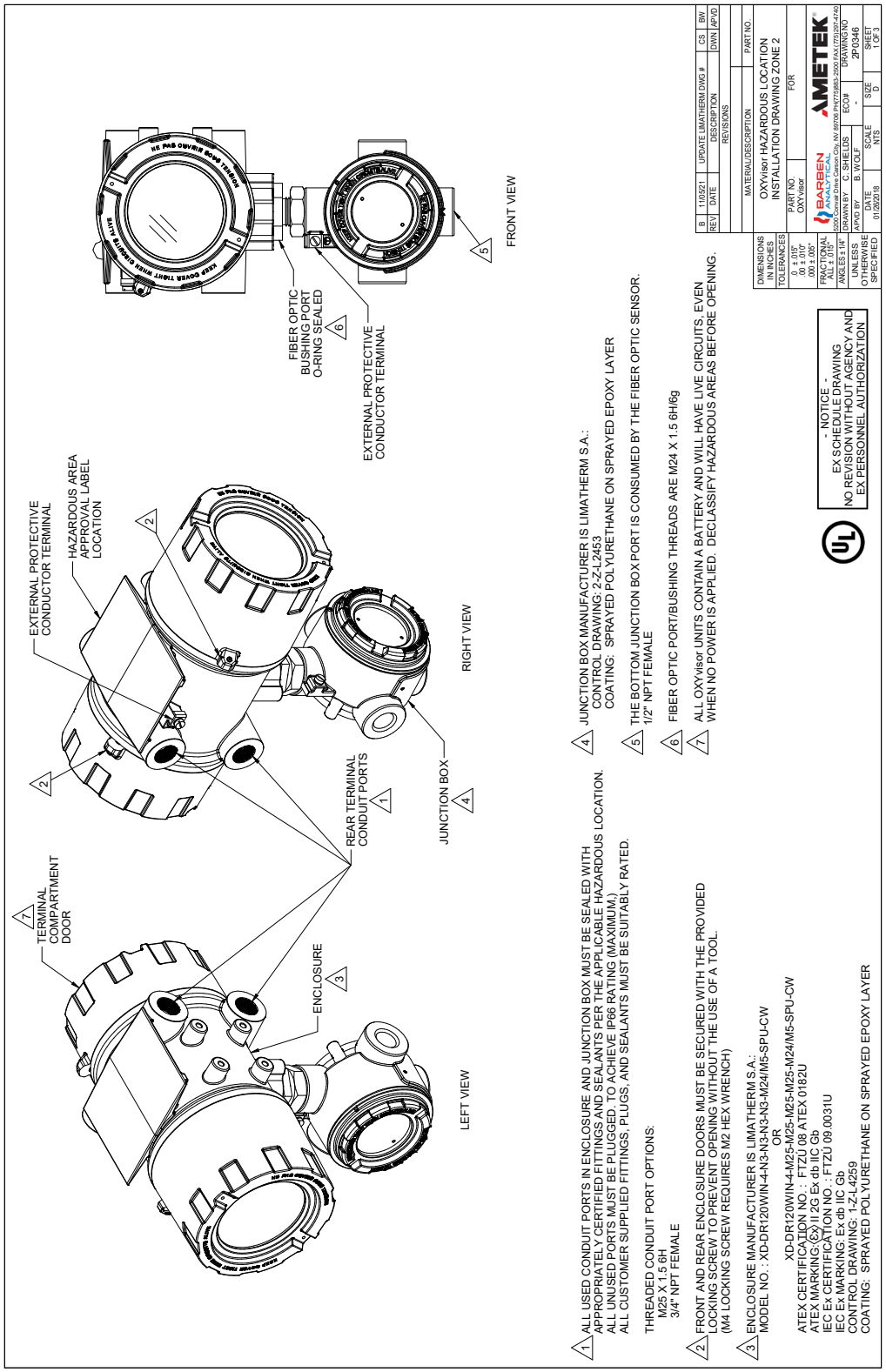


Figure 23 - Zone 2 HazLoc - Installation Control DWG - 2P0346 (p.1)

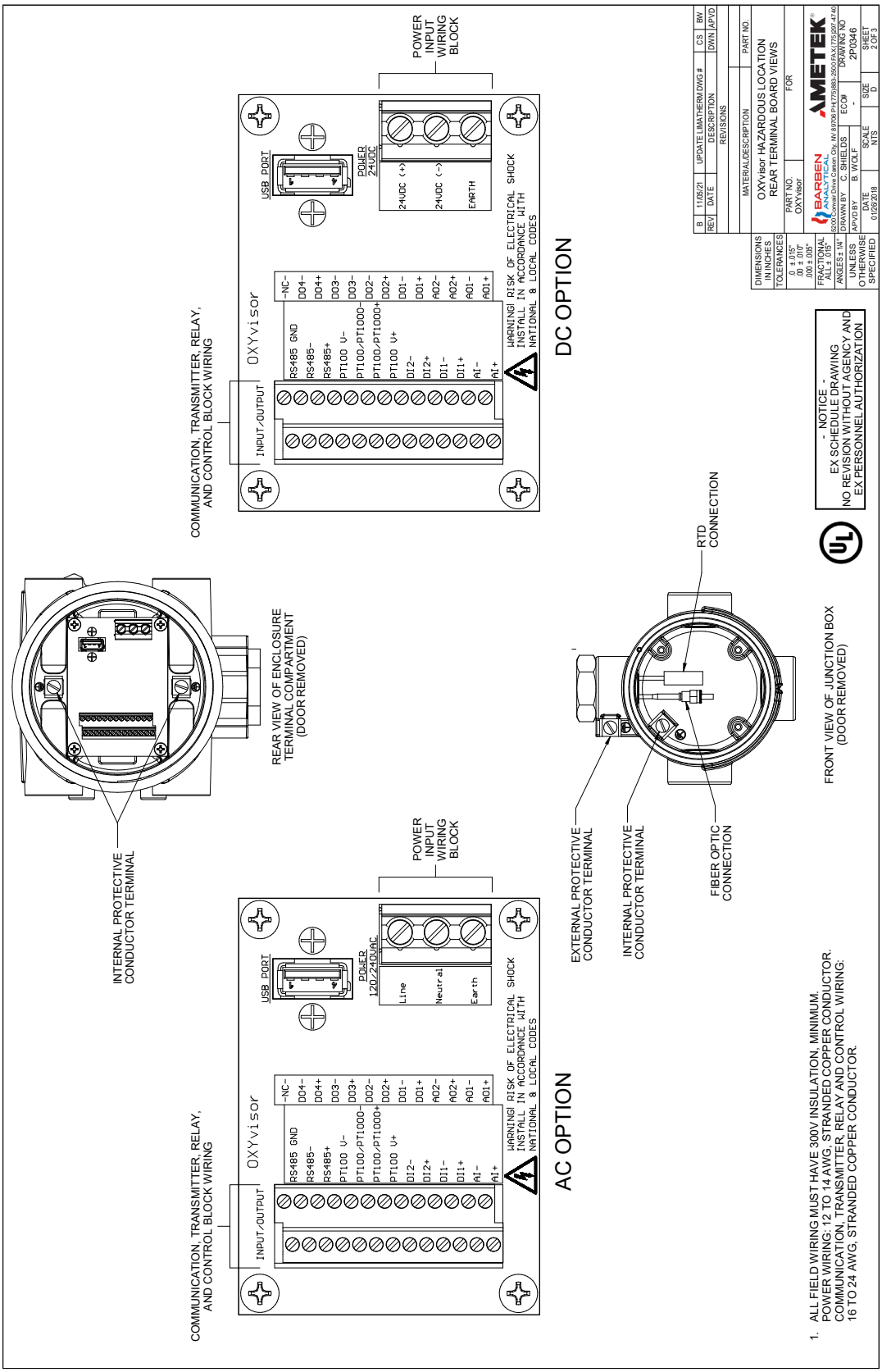


Figure 24 - Zone 2 HazLoc - Installation Control DWG - 2P0346 (p.2)

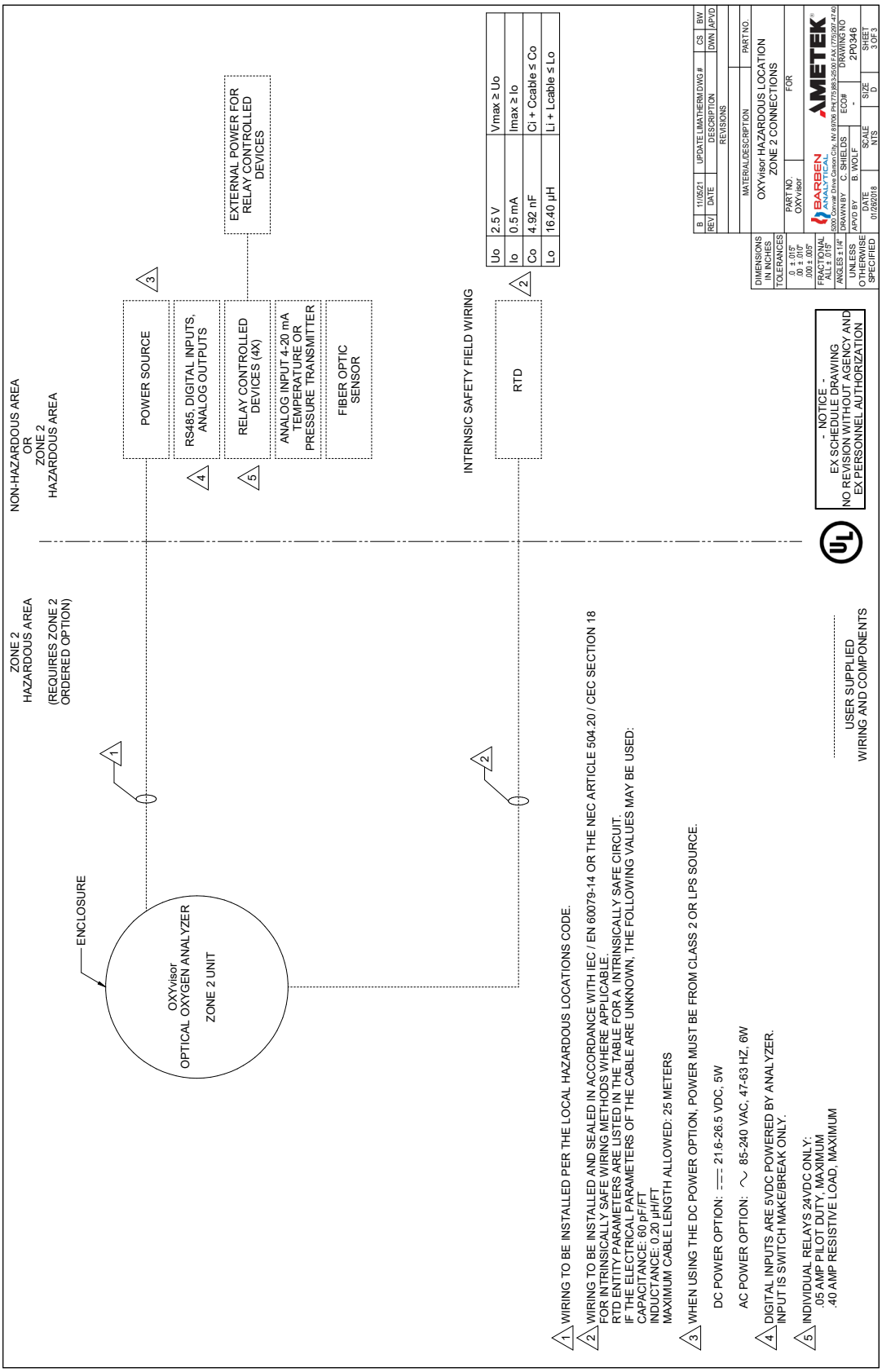


Figure 25 - Zone 2 HazLoc - Installation Control DWG - 2P0346 (p.3)

4.11.3 Class I, Div2 - 2P0335

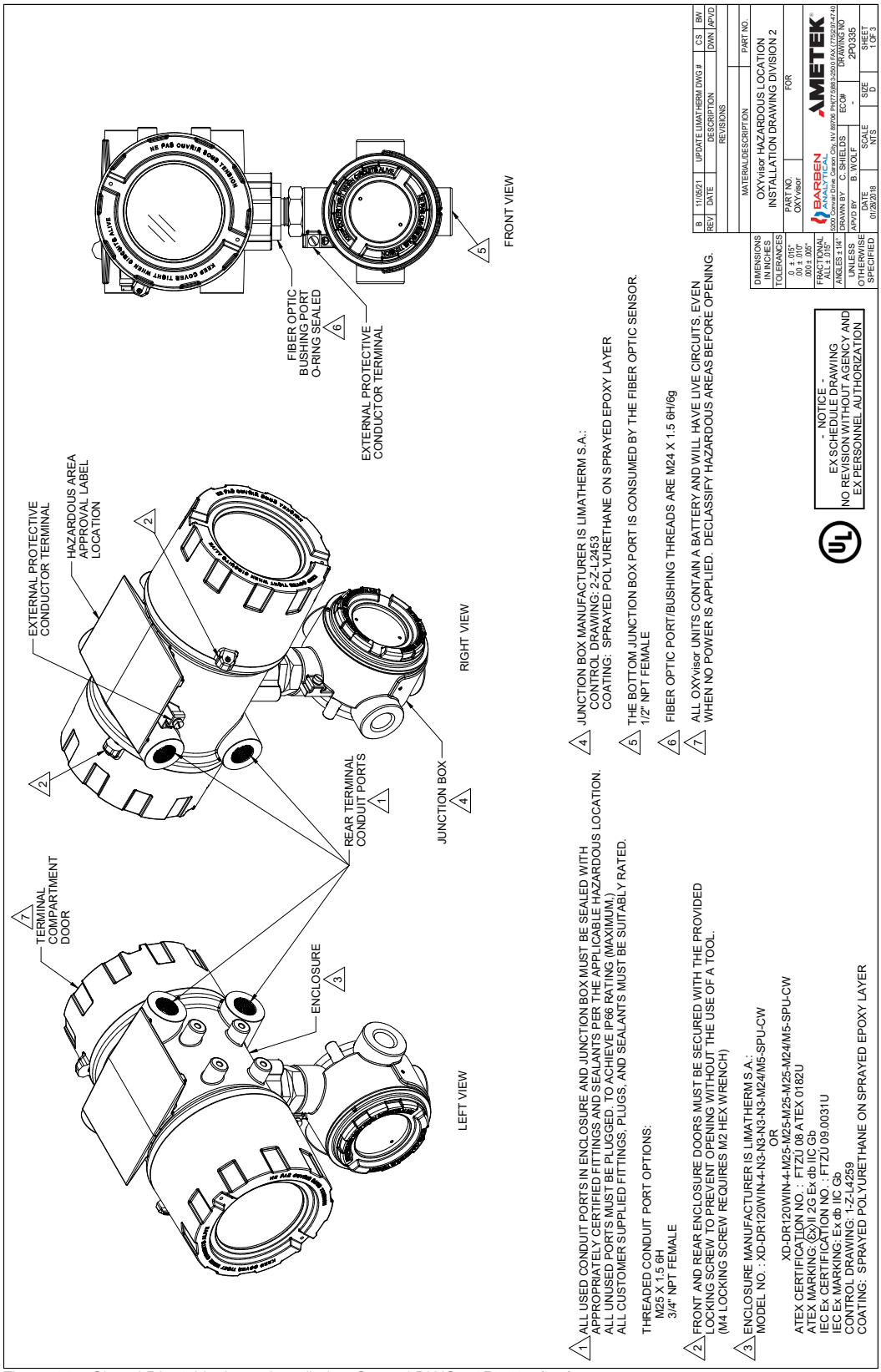


Figure 26 - Class I Div. 2 HazLoc - Installation Control DWG - 2P0335 (p.1)

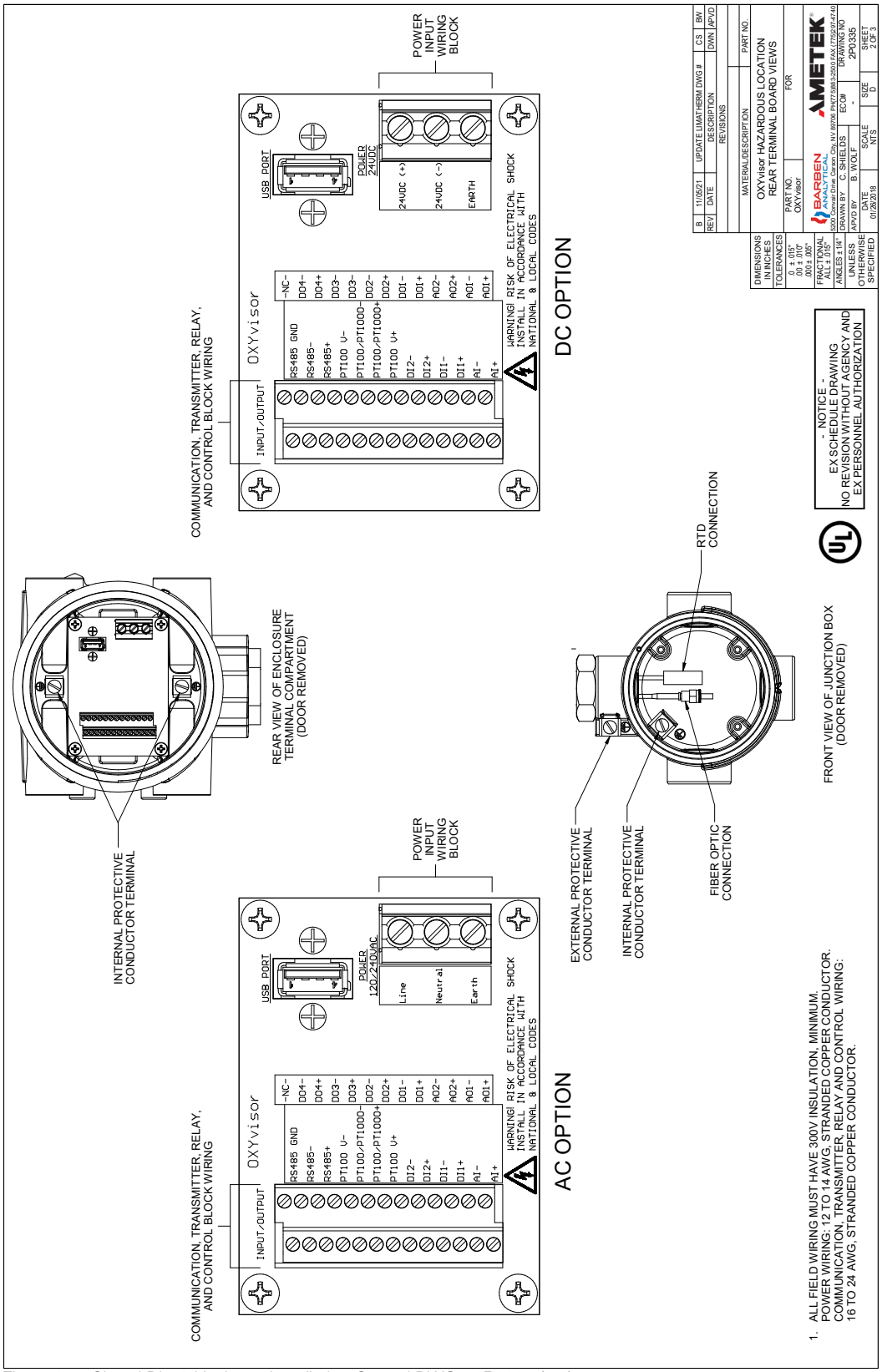


Figure 27 - Class I Div. 2 HazLoc - Installation Control DWG - 2P0335 (p.2)

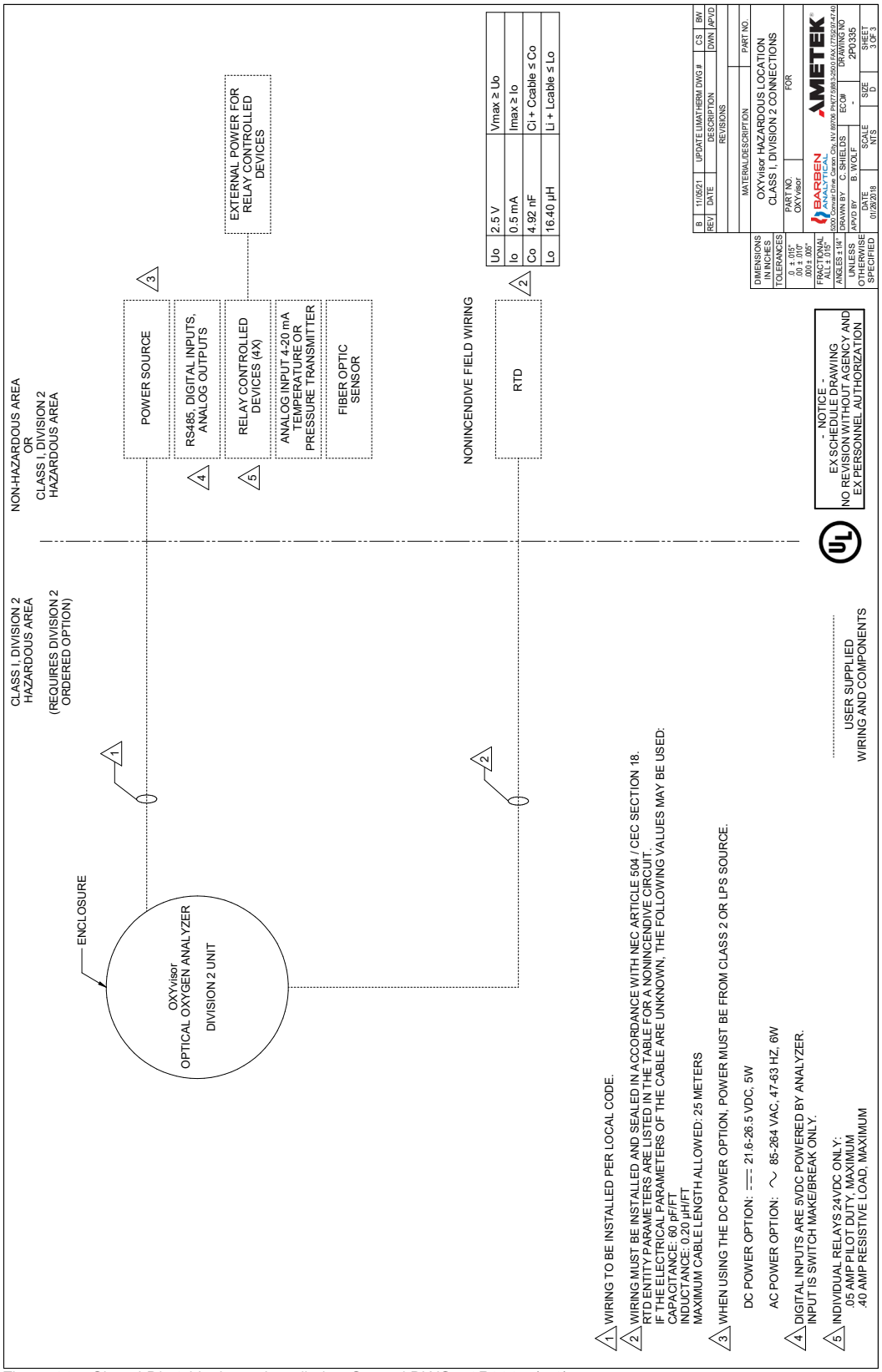


Figure 28 - Class I Div.2 HazLoc - Installation Control DWG - 2P0335 (p.3)

Section 5 - Operations

5.1 Operations Overview

All programming of the **OXYvisor** analyzer can be accomplished either through the keypad or through the **OXYvisor** software provided with the unit. This portion of the instruction manual will provide the basic operation of the keypad, related menus and an overview of the menu flowcharts. Each menu item will then be described in-depth in the related Menu Descriptions.

5.2 HMI - Keypad Overview

Infrared buttons are used to access and navigate menus for input and complete operation, including configuration and calibration, of the **OXYvisor**. These unique buttons accurately detect a finger or other object through the display window of the analyzer. While the buttons are easy to adapt to, users may practice placing their finger in front of the button then moving it back slightly to get the best results.

The infrared buttons are not activated nor interfered with, from sunlight. However, if mounting outdoors, the use of a sun-shade, or other device, to keep direct sunlight away from the keypad, is highly recommended, to ensure long life and great action.

5.3 HMI - Keypad Overview

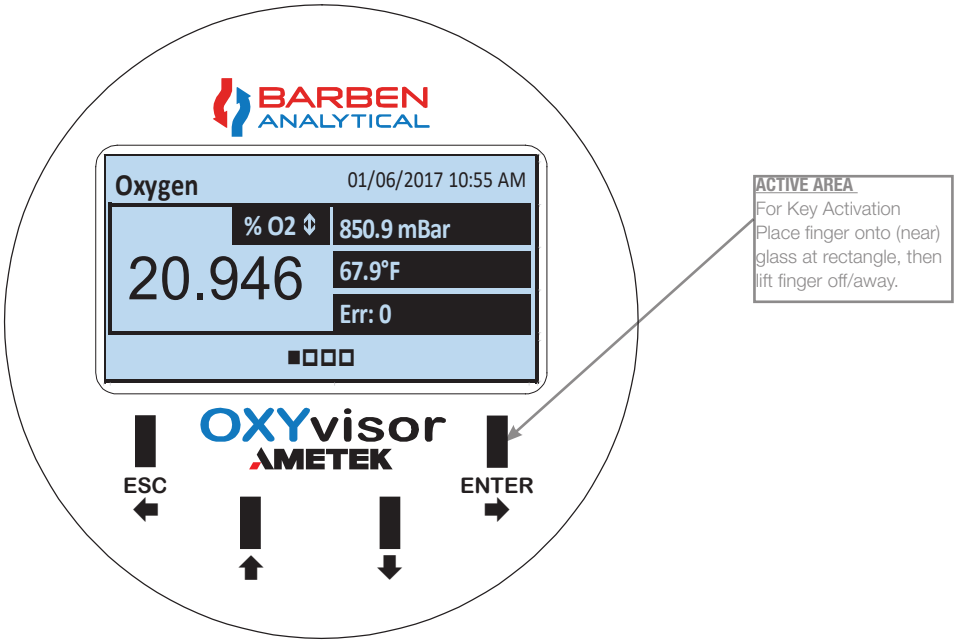
Keypad functions are as follows:

Esc ⬅: Access menus from main display. Moves digit to left when changing numeric values.

Up Arrow ⬆: Moves backwards in menus. Scrolls up in list. Increases numeric values.

Down Arrow ⬇: Moves forward in menus. Scrolls down in list. Increases numeric values.

Enter ➡: Accepts entered values. Moves digit to right when changing numeric values.
Rotates through the Main Display viewing options



OXYvisor KEYPAD & LED DISPLAY

Figure 29 - **OXYvisor** HMI Keypad and LED Display

5.4 Main Display Viewing Options - Overview

The OXYvisor has four main viewing screens shown in Figure 30. These screens can be scrolled through by pushing the ENTER button. To enter the menus simply push the ESC button.

Primary Main Display: This display has the largest displayed Oxygen Value and Oxygen Unit along with temperature, pressure, date and time. It is the most typical for a field analyzer.

Alternate Main Display: This display includes additional diagnostic and useful information such as **Phase Angle**, **Amplitude** (signal strength) and the user selected **Sample Rate**.

Input/Output Display: Convenient screen to confirm status of all the inputs and outputs states or values into and out of the analyzer. For example, the mA values for AO1, AO2 and AI can be observed along with any of the relay states.

Main Trend Display: Allows graphing two PV pairs of parameters vs time. A good tool for diagnosing phenomenon on-site and in real time.

5.5 Menu Screens - Overview

There are five menus and an error code glossary which can be accessed.

Measurement & Units: This menu is used during primary setup of the analyzer. It provides selection of the BOS sensor type, units of measure, sample rate, signal intensity and other important parameters needed for accurate measurement.

Calibration: Factory calibration, manual and AutoCal values are setup within this menu. External temperature and pressure input calibrations are also located here.

Input Output: All analog signals, relays outputs, and digital inputs are programmed within this menu.

Diagnostics Test Security: This menu provides access to test functions for relays and analog output trim. Time/date setup, security passwords for all menus. Firmware update and analyzer reset.

Data logging: Error log and Calibration logs can be viewed here. Setup and operation of on-board memory for data logging and downloading data-logs to USB memory stick is done via this menu.

Error Codes: This menu screen provides a glossary list, of all possible error codes within the analyzer, thus aids in troubleshooting errors that might occur during setup and/or operation.



All or individual Menu Screens may be secured by requiring use of a code for access.

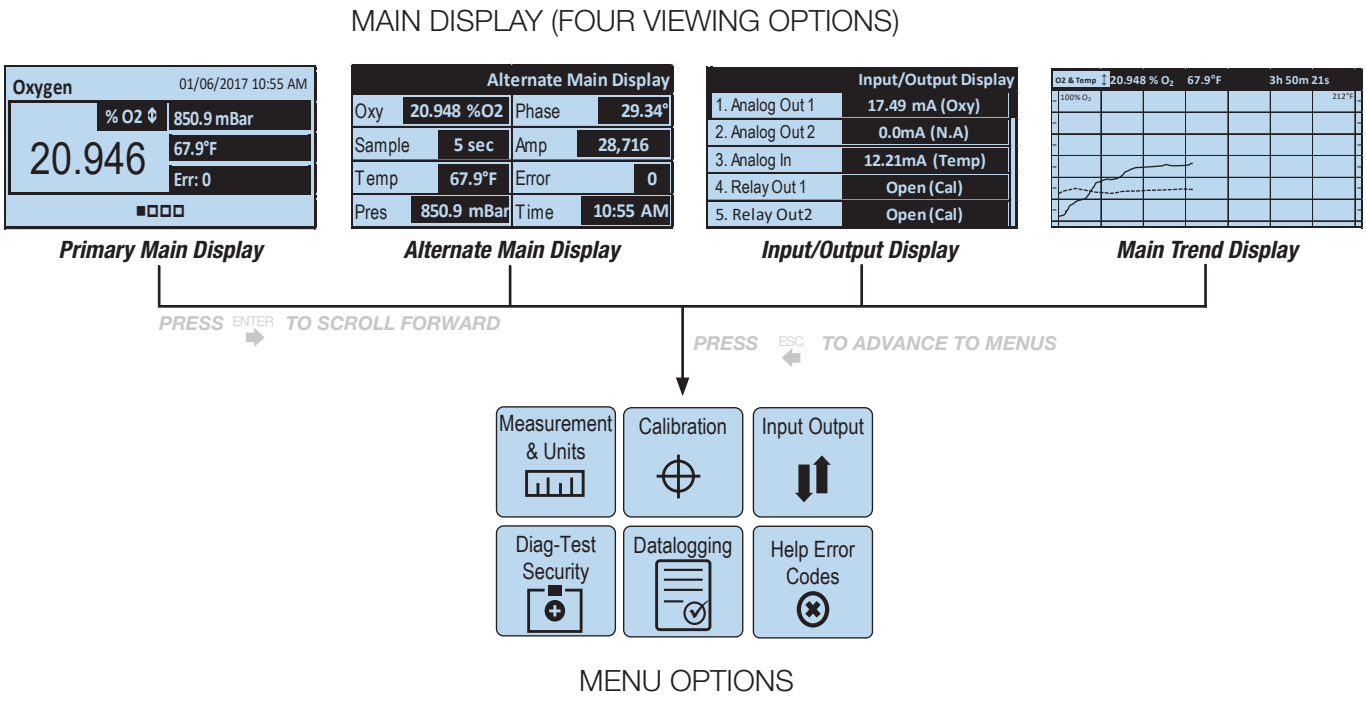
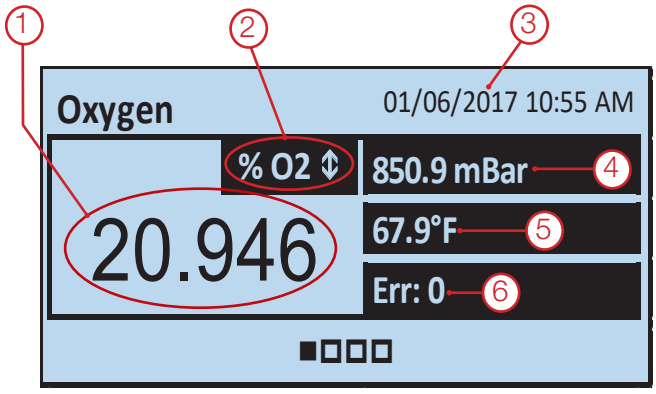


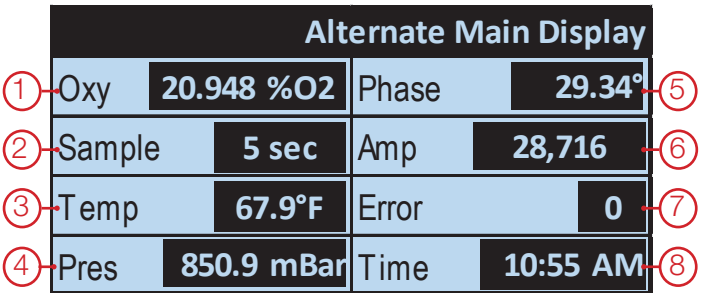
Figure 30 - Main Display (Four Viewing Options) and Menu Options

5.6 Main Display - Functions and Use



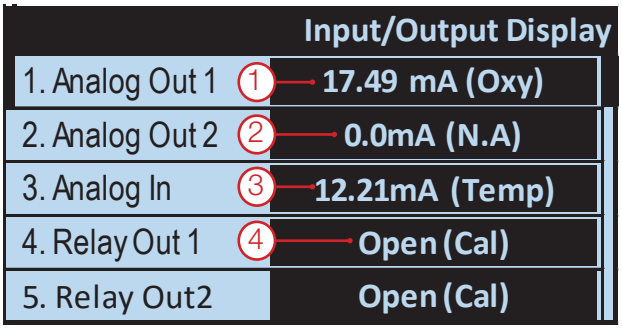
1. **Oxygen measurement** value
2. The **Oxygen Units** can be temporarily changed via the ⬆ and ⬇ arrows for convenience. This does not affect the 4-20 output. The units will reset to the selected parameter upon exiting the screen.
3. Date **MM/DD/YYYY** and 12 hr clock (am/pm)
4. **Pressure** - Measured and Compensated
5. **Temperature** - Measured and Compensated
6. **Error Code** - Will show any error value. If multiple errors exists it will sequentially show each of them. “0” indicates good operation with no errors.

5.7 Alternative Main Display Details - Functions and Use



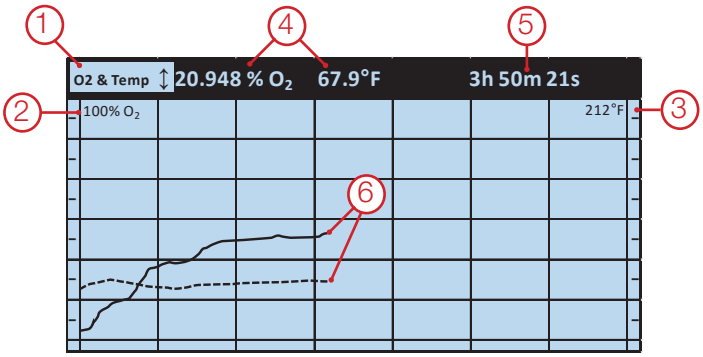
1. **Oxygen measurement** value
2. **Sample Rate** - The current user selected Sample Rate. This programmable rate determines how often the measurement is taken.
3. **Temperature** - Measured and Compensated
4. **Pressure** - Measured and Compensated
5. **Phase Angle** - Measured Phase Angle
6. **Amplitude** - Indicates Signal Strength
7. **Error** - Will show any error value.
8. **Time** - via the 24 Hour Clock

5.8 Main Input / Output Display - Functions and Use



1. **Analog Out 1** - Indicates the AO1 mA output for the related PV. This example shows, 17.49 mA for Oxygen.
2. **Analog Out 2** - Indicates the AO2 mA output for the related PV. This example shows, 0.0 mA for N.A. (Not applicable) for a channel not set up.
3. **Analog In** - Shows the measured mA input from the Temperature or Pressure transmitter.
4. **Relay Out 1** - Show Status of the Relay as Open/ Closed. This example shows an Open (cal) which indicates relay is not active, and is dedicated to AutoCal.

5.9 Main Trend Display - Functions and Use



1. **PV's vs time** - Using the up and down arrows you can select a combination of different PV's vs time to be graphed. Example show O_2 and Temp
2. **PV1 Scale** - This shows the PV, value and unit for the left Y axis of plot (solid line).
3. **PV2 Scale** - This shows the PV, value and unit for the right Y axis of plot (dashed line).
4. **Measured Values of PV1 and PV2** - Shows the current measured values of the selected parameters.
5. **Plot Time** - Amount of time shown on graph
6. **PV's vs Time** - The solid line is PV1 (left Y axis) and dashed is PV2 (right Y axis)

5.10 Overall - Menu Flowcharts

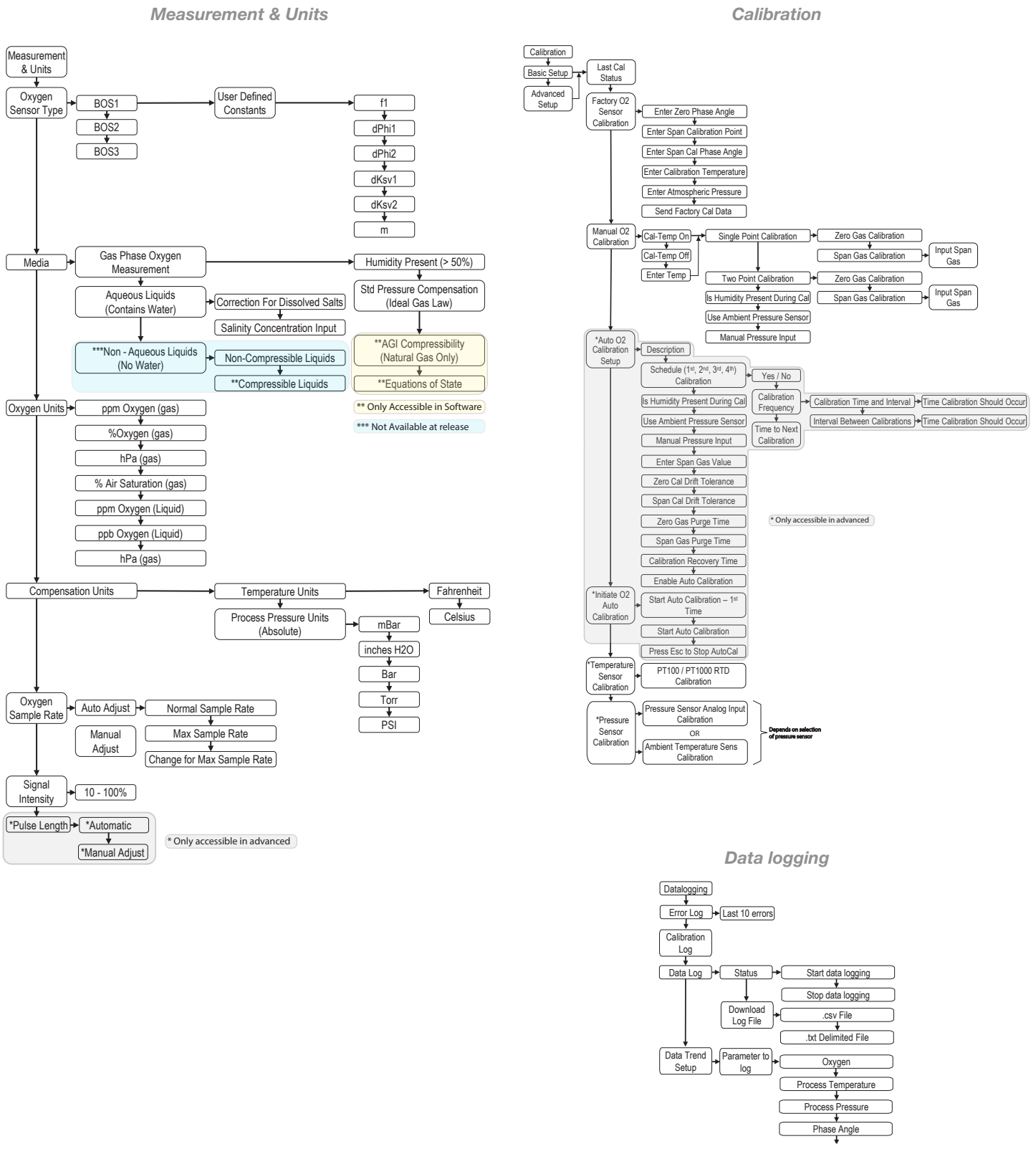
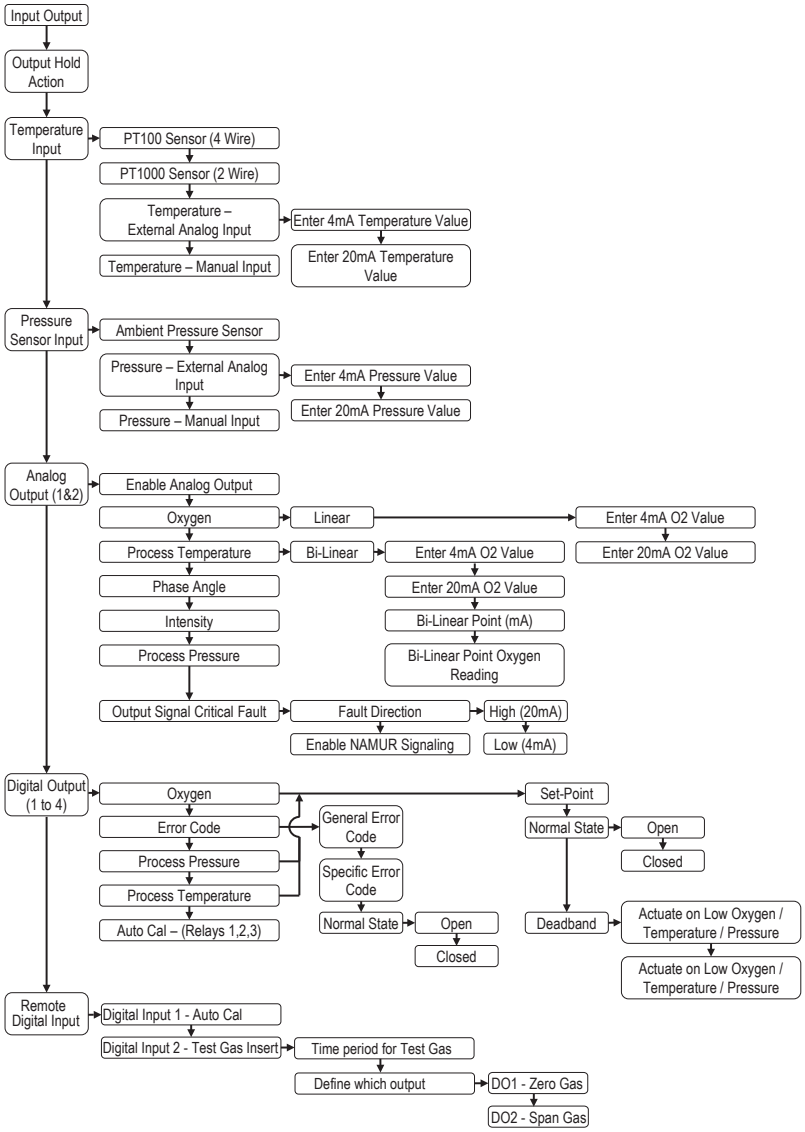
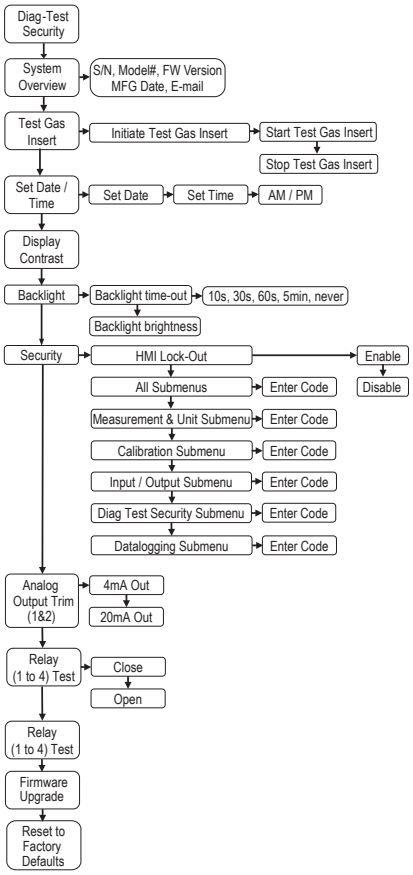


Figure 31 - Programming Menu Flowchart

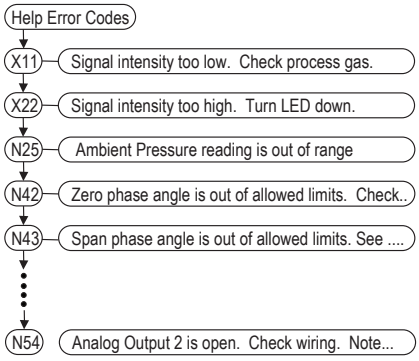
Input / Output



Diagnostic-Test & Security



Help Error Code



5.11 Measurement & Units Menu

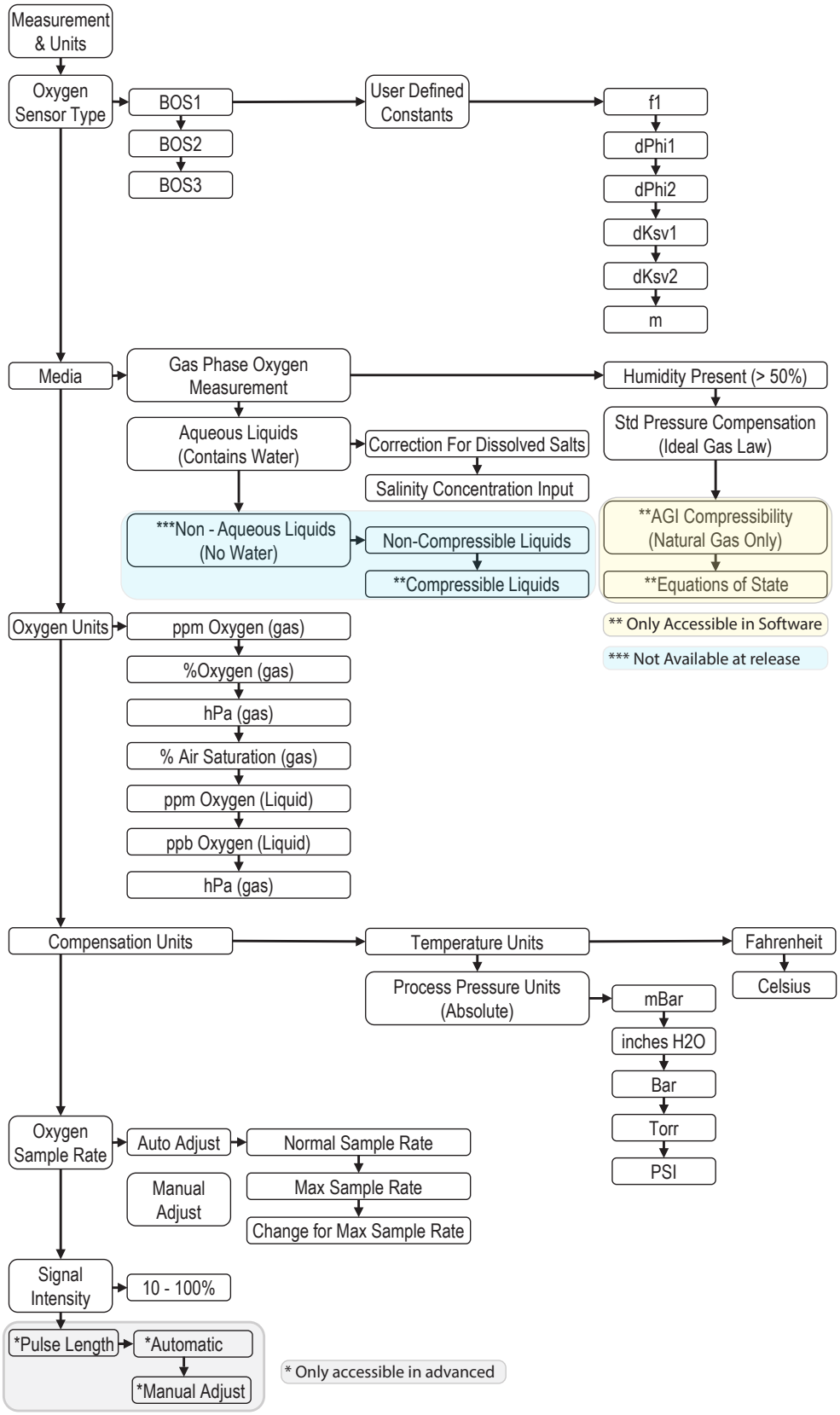


Figure 32 - Measurement & Units Menu



5.11.1 - Measurement & Units Overview

The **Measurement & Units** menu is used during primary setup of the analyzer. It allows selection of the BOS sensor type (BOS1, BOS2, BOS3 or custom), process media (gas or liquid), oxygen units, compensating units (temp and pressure), sample rate, and signal intensity needed for accurate measurement within a specific application.

5.11.2 - Measurement & Units Overview - Oxygen Sensor Type

Select **Oxygen Sensor Type**: BOS1, BOS2 or BOS3 sensor ranges. The sensor tag will show the sensor type within the model number.

BOSx Oxygen Sensor Ranges		
BOS1 Oxygen Range	0 % to 4.2 % (gas)*	0 ppb to 1.8 ppm (liquid)
BOS2 Oxygen Range	0 % to 25 % (gas)	0 ppb to 22 ppm (liquid)
BOS3 Oxygen Range	0 to 300 ppm with 1000 ppm over range (gas)	

** With over-range to 5 % O_2*





User Defined Constants are for special applications and should only be used with factory recommendation.

Changing Sensor types may change other settings to their defaults if they conflict with current settings. For example, changing to a BOS3 low range gas sensor from a BOS1 set to measure dissolved oxygen in aqueous phase will change the units, the media type and 4-20 output to default BOS3 values.

5.11.3 - Measurement & Units Overview - Media

The Media selection defines the phase in which the oxygen measurement is made. Gas Phase (ppmv), Aqueous liquid (dissolved oxygen) and Non-Aqueous liquid (dissolved oxygen) selections are available.

Gas Phase Oxygen Measurement:

Select this when measuring % to trace (ppm) level oxygen in gas samples or gas processes.

Humidity Present (>50%) - Default is **NO**. Only select **YES**, if special calculation for dry basis measurement is required. The analyzer will calculate the dry O_2 basis by accounting for the expected water vapor based on 100% H_20 saturation and the measured temperature. For most cases, it is useful to know the actual O_2 concentration under the wet process conditions.

Standard Pressure Compensation - This selection calculates the oxygen concentration (% mole or % volume) from the measured oxygen partial pressure utilizing the ideal gas law. This is the proper selection for most all OXYvisor applications, with the exception of in-situ, in-line installations, in high pressure applications that are more than 300+ psig, 20 Bar. See Appendix A.1-1

AGI Compressibility - For measurement in high pressure systems (>300 psig, 20 Bar) a more advanced calculation to account for molecular interactions, non-ideal behavior is available. The calculation uses AGI compressibility data, based on stream composition provided by end user. The AGI compressibility data can only be inputed via a PC from the OXYvisor's Oxygen Analyzer Software. See Appendix A.1-2.

Aqueous Liquid (Contains Water) - D.O. Measurement:

Select this for measuring ppm (mg/L) or ppb (µg/L) dissolved oxygen in aqueous solutions. This selection will convert the partial pressure of oxygen measurement to concentration based on the Bunsen Correlation and the option for a dissolved salt correction. See Appendix A.2.

Correction for Dissolved Salts - For high accuracy at medium to higher ranges of dissolved oxygen in solutions with high salt concentrations, enter the Salinity Concentration in ppt (o/oo).

Non-Aqueous Liquid (No Water) - D.O. Measurement:

The OXYvisor can provide a relative and repeatable concentration measurement for non-aqueous liquids. The sensor is capable to measure the partial pressure of several non-aqueous solutions such as Ethanol, Methanol, hydrocarbons and others. Please consult factory.



The average and normal salinity of seawater is 35 g dissolved salt / kg sea water which is commonly written as 35 parts per thousand or 35 o/oo or 3.5%.

5.11.4 - Measurement & Units Overview - Oxygen Units

User can select the preferred measurement units for the oxygen measurement. The available units are dependent on the Sensor Type and Media selection.

Sensor Type	Media (Phase)	Units Available
BOS3	Gas Phase	ppm O_2
	Aqueous/Liquid Phase	Not Available
BOS1	Gas Phase	ppm O_2, % Oxygen and hPa
	Aqueous/Liquid Phase	ppm Dissolved Oxygen, ppb Dissolved Oxygen
BOS2	Gas Phase	% Oxygen
	Aqueous/Liquid Phase	ppm Dissolved Oxygen, ppb Dissolved Oxygen

Table 10 - Oxygen Measurement Units by Sensor Type

5.11.5 - Measurement & Units Overview - Compensation Units

User can select the preferred measurement units for the secondary PV's, temperature and pressure.

Temperature Units - Available as either °C or °F

Pressure Units (Absolute) - Available as either mBar, inches H2O, Bar, Torr, PSI

5.11.6 - Measurement & Units Overview - Oxygen Sample Rate

User can select the required Sample Rate base on the application requirements. Slower sample rates (longer intervals between measurement) will give less drift on longer sensor life. See Appendix 3 for general estimations of drift vs Sample Rate.

Manual Adjust - Enter the sample rate in seconds. Default is 30 seconds. (Range = 2 to 3600s)

Auto Adjust - Allows for a **Normal Sample Rate** (set to a slow rate) to extend sensor life and reduce drift, however, upon detecting a step-change, (magnitude determined by the end-user) will automatically adjust to a **Max Sample Rate** (fast sample rate) to better measure the event. Once stability is observed again for the duration of the **Normal Sample Rate**, the measurement will return to the **Normal Sample Rate.**

Normal Sample Rate (2 to 3600s): Enter the Normal Sample Rate when process is at steady state. This will be the longest interval between measurements.

Max Sample Rate (2 to 3600s): Enter Max Sample Rate when the process experiences a step change. This will be the shortest interval to track a dynamic process change.

Change for Maximum Sample Rate: Enter the desired magnitude of the step-change required to trigger the Max Sample Rate (oxygen unit is dependent on Sensor Type and Settings).

USEFUL INFORMATION

If **Auto Adjust** is chosen and the step-change is small, then the **Sample Rate** will normally be in the fast, **Max Sample Rate** mode and will not be an advantage with regards to drift and sensor lifetime.

5.11.7 - Measurement & Units Overview - Signal Intensity

User can set the Signal Intensity of the LED (10-100%). The default values are based on the sensor selection and the FlexSense and SafeTap body styles. If the user has a FiberSense the signal Intensity will likely need to be turned down. Recommended Signal Intensity are shown in table below.

Sensor Type	Recommended Signal Intensity	
	FiberSense	FlexSense/SafeTap (Default)
BOS2	8%	15%
BOS1	25%	50%
BOS3	50%	85%

Table 11 - Signal Intensity by Sensor Type

CAUTION

Changes to **SIGNAL DATA** may affect the measurement performance and lifetime of the sensor. Please consult the **OXYvisor** manual for a detailed explanation of when to change these settings and what the recommended values would be for different cases.

CAUTION

If the **OXYvisor** is displaying a X22 error, “Signal intensity is too high” decrease the INTENSITY (signal strength) until the error goes away immediately! Failure to do so will cause damage to the sensor. Consult **OXYvisor** manual for further details and suggestions on properly setting this parameter.

5.11.8 - Measurement & Units Overview - Pulse Length

This feature is only available in advanced mode. The Pulse Length should be left in Automatic unless discussed with the factory. The Pulse length can be adjusted to increase measurement accuracies in specific applications.

5.12 - Calibration Menu

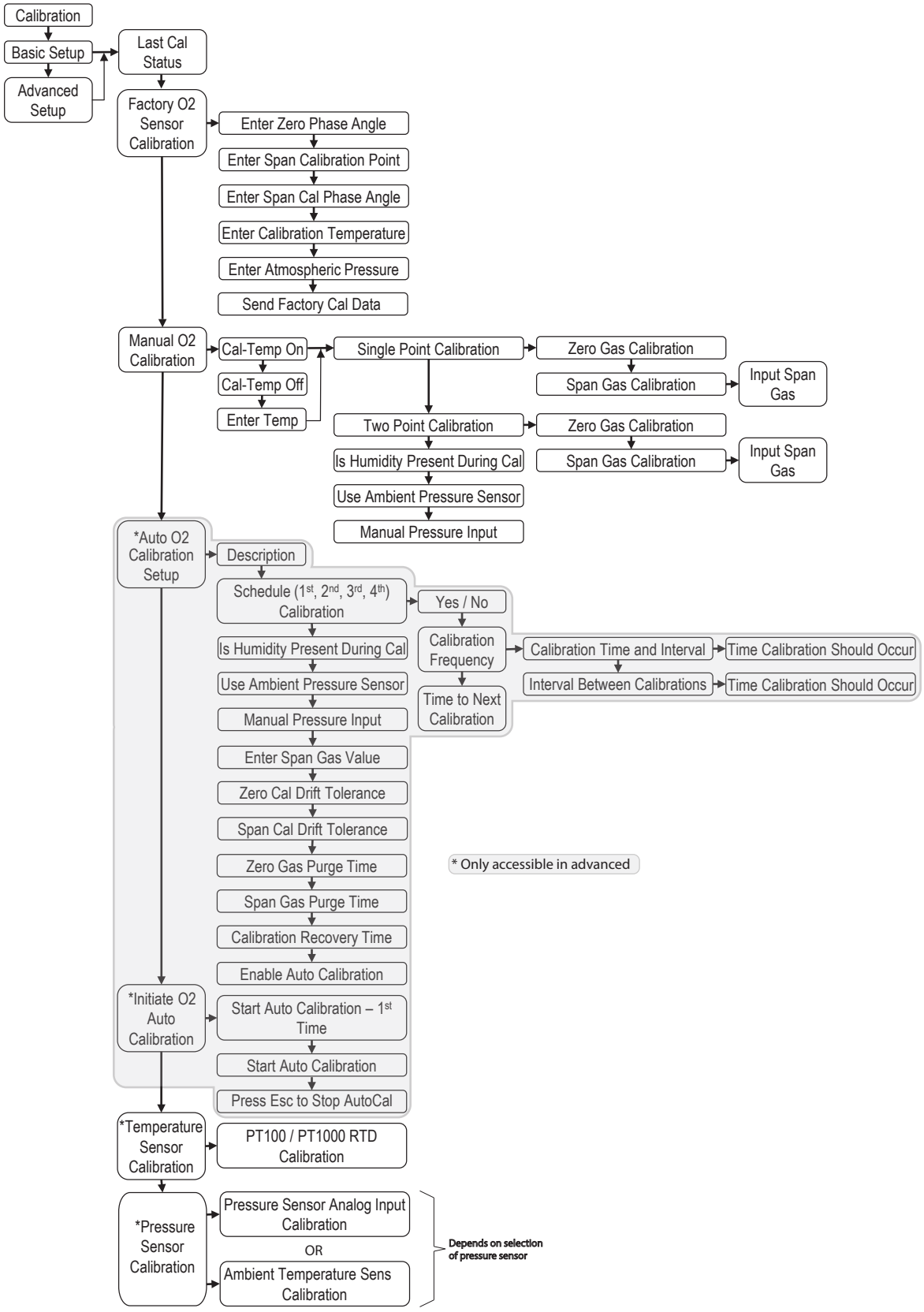


Figure 33 - Calibration Menu

5.12.1 - Calibration Overview

The **Calibration** menu is used to calibrate the sensor. For highest accuracy and performance validation the factory recommends a two-point calibration with an appropriate Zero and Span gas. The two-point calibrations can be performed manually or via AutoCal routine (the latter requires an AutoCal panel with solenoids). The analyzer also allows for single-point calibrations of either the zero or span gas. This allows flexibility if only one calibration gas is available or for special case applications. A factory O_2 sensor calibration is also available for the case when no gases are available and a sensor has been sent from the factory with calibration data.

Calibration Gas - The Zero Gas should be high quality Nitrogen or any other , non-reactive gas with zero oxygen content. Depending on the sensor selection, the range and the application, the nitrogen should be of high purity. The Span Gas should be selected based on the sensor type and the customer requirements. See Tables 12 and 13 for general factory recommendations.

Sensor Type	Low Limit of Detection	Zero Gas Purity Recommendation
BOS2	300 ppm	99.99% Nitrogen
BOS1	20 ppm	99.999% Nitrogen
BOS3	0.5 ppm	99.999+% Nitrogen

Table 12 - Zero Calibration Gas by Sensor Type

Sensor Type	Full Range	Span Gas Recommendation
BOS2	0 to 25% O_2	20.95% O_2
BOS1	0 to 5% O_2	1 to 2% O_2 or 80 - 100% Critical Value
BOS3	0 to 300 ppm O_2	80 - 100% of Critical Value

Table 13 - Span Calibration Gas by Sensor Type

5.12.2 - Calibration - Last Cal Status

The Last Cal Status shows the value recorder during the last successful calibration:

Date, Time, Phase Angle, Pressure, Temperature, Amplitude and **Stability** (during **AutoCal**).



If a single point calibration is performed, the previous data of the non-calibrated Span or Zero stays the same.

5.12.3 - Calibration - Factory O_2 Sensor Calibration

This calibration routine allows for entry of the factory calibration data for the sensor without performing a field calibration. This is convenient for start-ups or new sensors, however it is always recommended for field calibration via two-point method with certified test gases for highest accuracy.

Enter the Factory Calibration Information from the Sensor Calibration Sheet.

Once the data is entered **Send Factory Cal Data** will implement the newly entered information.

5.12.4 - Calibration - Manual O_2 Calibration

The **Manual O_2 Calibration** allows for **Single Point (Zero or Span)** or **Two-Point Calibration (Zero & Span).** The Two-Point calibration is just a combination of the Single-Point Zero and Span Calibrations that are detailed here in step-by-step instructions.

Cal-Temp - The calibration temperature can be chosen as **ON** or **OFF**. Select ON if the temperature sensor (Pt1000/Pt100 RTD) is working and accurately measuring the calibration gas near the oxygen sensor tip. If there is no temperature sensor input or if it is not located in the calibration gas stream near the sensor then select **OFF** and manually enter the temperature.

Step 1. Via the OXYvisor HMI enter the calibration routine ***Calibration Menu/Basic Setup/Manual 02 Calibration***

5.12.4.1 - Manual Cal - Single Point Calibration - (Zero Gas) Step-by-Step

Step 2. Introduce Zero Gas - Isolate the sensor from the process or environment and begin flow of the high quality Zero Gas (e.g. Nitrogen) past the oxygen sensor tip. The sensor measurement technique and accuracy is independent of flow-rate as it has no membrane, diaphragm nor does it consume oxygen. However the factory recommends a flow-rate of around 1.5 SLPM with a minimum of 0.5 SLPM to overcome any oxygen ingress from diaphragms (regulators, etc) and elastomer seals (rotameters, etc.).

Step 3. Select the **Cal-Temp ON** or **OFF**. If **OFF**, enter the correct calibration temperature.

Step 4. Select **Single Point Calibration.**

Step 5. Then select ***Input Zero Gas Nitrogen***

Step 6. The screen will show **"Zero Gas (Nitrogen) Live Values."** The displayed oxygen value (PV) and secondary PV's are now active and will shown the oxygen value as it approaches zero. If the sensor is out of calibration it may not fully reach zero. Once the Phase Angle, Temperature and Pressure have become stable, press ENTER to Store the calibration.

Note: The values should be steady and not trending up or down.
Phase Angle Stability: +/- 0.1° , Temp = +/- 0.2 °C

Note: The 4-20 mA outputs are held once the calibration screens are entered. They are released to the process measurement once exiting the calibration screen or after time-out from inactivity.

5.12.4.2 - Manual Cal - Single Point Calibration - (Span Gas) Step-by-Step

Step 1. Via the OXYvisor HMI enter the calibration routine ***Calibration Menu/Basic Setup/Manual 02 Calibration***

Step 2. Introduce Span Gas - Isolate the sensor from the process or environment and begin flow of the Span Gas past the oxygen sensor tip. The sensor measurement technique and accuracy is independent of flow-rate as it has no membrane, diaphragm nor does it consume oxygen. However the factory recommends a flow-rate of around 1.5 SLPM with a minimum of 0.5 SLPM to overcome any oxygen ingress from diaphragms (regulators, etc) and elastomer seals (rotameters, etc.).

Step 3. Select the **Cal-Temp ON** or **OFF**. If **OFF**, enter the correct calibration temperature.

Step 4. Select **Single Point Calibration.**

Step 5. Select ***Enter Span Gas O2 Concentration*** and then enter the oxygen value of the Span Gas (Save and Exit). The analyzer will always recall the entered Span Gas value until changed.

Step 6. Select ***Input Span Gas***

Step 7. The screen will show **"Span Gas O_2 Live Values."** The displayed oxygen value (PV) and secondary PV's are now active and will show the oxygen value as it approaches the span gas value. If the sensor is out of calibration it may not read the precise span gas value.. Once the Phase Angle, Temperature and Pressure have become stable, press ENTER to Store the calibration.

Note: The values should be steady and not trending up or down.
Phase Angle Stability: +/- 0.1° , Temp = +/- 0.2 °C

Note: The 4-20 mA outputs are held once the calibration screens are entered. They are released to the process measurement once exiting the calibration screen or after time-out from inactivity.

Step 8. Exit via the Escape Key back to the main measurement window.

5.12.4.3 - Manual Cal - Two-Point Calibration - Step-by-Step

Two-Point Calibration [Factory Recommended] - This is virtually a combination of the Single-Point Zero and Span Gas calibrations with an additional rule that all steps must be completed successfully to save and use the calibration.

Step 1. Via the OXYvisor HMI enter the calibration routine ***Calibration Menu/Basic Setup/Manual 02 Calibration***

Step 2. Select the **Cal-Temp ON** or **OFF**. If **OFF**, enter the correct calibration temperature.

Step 3. Follow the **Single Point Calibration (Zero Gas),** Steps 2 through 6 of section 5.12.4.1

Step 4. Follow the **Single Point Calibration (Span Gas),** Step 2 then Step 5 through 8 of section 5.12.4.2

5.12.5 - Calibration - Auto O_2 Calibration Setup

To setup the OXYvisor for Auto-Calibration **(AutoCal)** there are some additional hardware requirements.

- (QTY 3) Low-Watt Solenoid Valves to operate the Auto-calibration panel. One solenoid for the process isolation valve and two for the calibration gases, zero and span.
- External Power Supply with proper Area Classification to power the solenoids. The OXYvisor has non-powered on/off digital relays to control the AutoCal routine.

The AutoCal setup can be setup via the HMI, however it is fairly tedious and it is recommended to use the OXYvisor Oxygen Analyzer software provided with the analyzer to set up this routine. Refer to the OXYvisor Software Instruction Manual for detailed setup instructions.

Basic Arrangement and Wiring Details for an AutoCal panel with the OXYvisor is shown in Appendix

5.12.6 - Calibration - Temperature Sensor Calibration

It is normally not necessary to calibrate the temperature sensor. However, if there is an offset the temperature sensor can be calibrated via a Smart Calibration routine. The routine allows for either a 1-point offset adjustment or a 2-point offset and slope adjustment.

The analyzer always performs an offset unless a successive calibration is performed with a 15° C differential from the first and then is automatically adjust the slope. Details of the calibration logic are shown here:

T_{actual} = Temperature customer knows to be correct
$T_{measured}$ = Temperature from RTD
T_{last} = Corrected temperature (T_{actual}) from last calibration. Default is 25°C (77° F), for first time calibration.

If T_{actual} - $T_{measured}$ < 15°C (59° F), then the difference between the two temperatures is applied across the entire temperature measurement range of -15 to 100°C (5 to 212°F). Additionally, T_{last} should be stored as the last reference point for the temperature calibration.

If T_{actual} - T_{last} ≥ 15C (59° F), then the calibration line should be redrawn (see in green above). The slope of this line can be determined by the two temperature values. Graphically it is shown to the below.

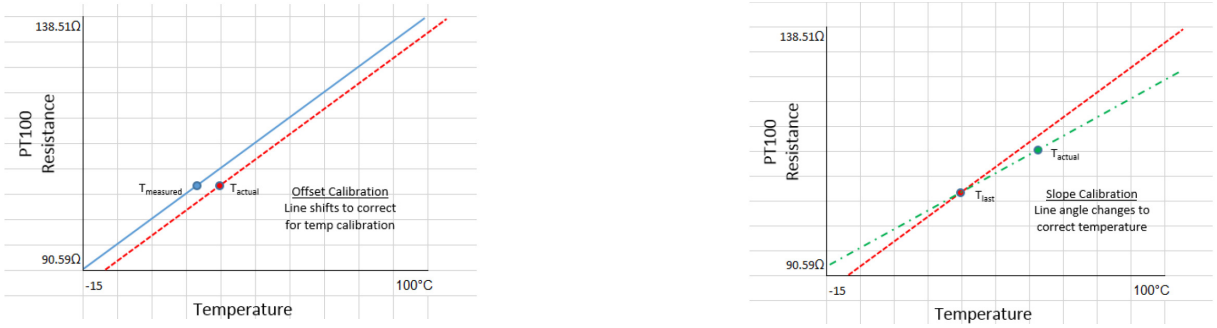


Figure 34 - Temperature Sensor - Smart Calibration

5.12.7 - Calibration - Pressure Sensor Calibration (Ambient or External)

It is normally not necessary to calibrate the ambient pressure sensor. However, if there is an offset the ambient pressure sensor can be calibrated via a Smart Calibration routine. The routine allows for either a 1-point offset adjustment or a 2-point offset and slope adjustment.

The analyzer always performs an offset unless a successive calibration is performed with a <250 mBar differential from the first and then is automatically adjust the slope. Details of the calibration logic are shown:

P_{actual} = Pressure customer knows to be correct
$P_{measured}$ = Pressure from Atmospheric Pressure Sensor on circuit board
P_{last} = Corrected pressure (P_{actual}) from last calibration. Default is 1013 mbar (14.7 psi), for first time calibration.

If P_{actual} - $P_{measured}$ < 250 mBar (3.6 psi), then the difference between the two pressures is applied across the entire pressure measurement range of 500 to 2000 mbar. Additionally, P_{last} should be stored as the last reference point for the Pressure calibration.

If P_{actual} - P_{last} ≥ 250 mbar (3.6 psi), then the calibration line should be redrawn (see in green above). The slope of this line can be determined by the two pressure values. Graphically it is shown above.



Figure 35 - Pressure Sensor - Smart Calibration

5.13 Input / Output Menu

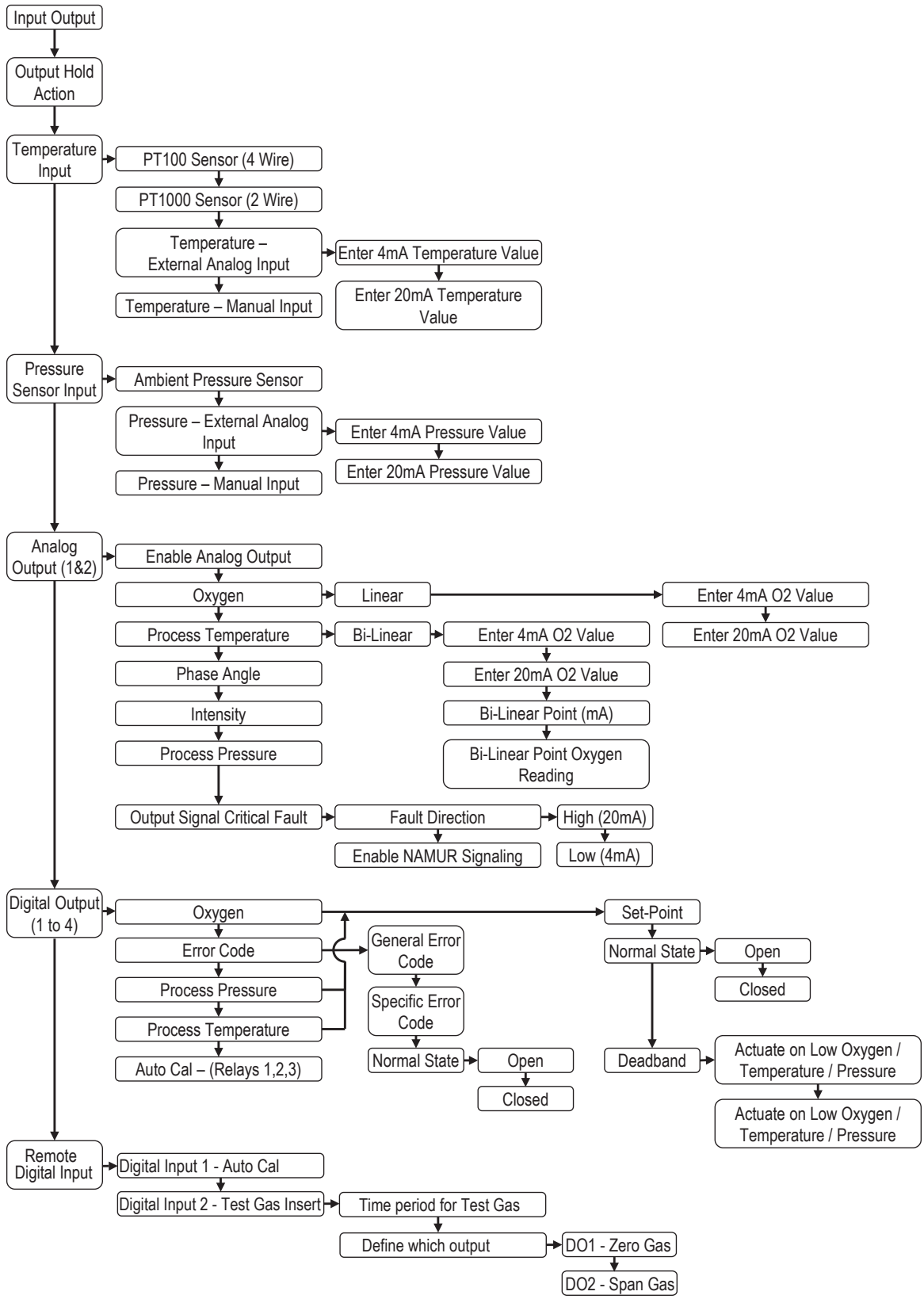


Figure 36 - Input/Output Menu

5.13.1 - Input / Output - Overview

The Input/Output menus allow for setup and configuration of the temperature sensor input, pressure sensor input (analog input), analog outputs, digital outputs, digital input.

5.13.2 - Input / Output - Output Hold Action

This screen allows user to set the Auto Time-Out (1 - 99 min) function. When the user enters any of the menu screens via the HMI, the 4-20 mA output is held. The Output Hold Action determines how much time after inactivity at the HMI to automatically time-out and exit back to the main and alternate measurement screens and release the hold on the 4-20 mA.

5.13.3 - Input / Output - Temperature Input

This screen allows user to select the temperature input from either a RTD (PT100 or PT1000), Temperature-External (Analog Input) and Manual Input.

RTD (Pt100 or Pt1000) - Default is PT1000.

Temperature-External (Analog Input) - This selection will assign the Analog Input (AI) as the temperature input. A 4-20 mA temperature transducer or transmitter is required

Enter the 4-mA and 20 mA points of the transmitter range (valid from 5 - 212 F).

Manual Input - Enter a manual temperature for a static process or temporarily for a failed RTD where the process temperature is know and does not relatively vary much.

5.13.4 - Input / Output - Pressure Sensor Input

This screen allows user to select the pressure input from either the on-board Ambient Pressure Sensor, a Pressure External (Analog Input) and Manual Input.

Ambient Pressure Sensor - This is the default selection. The sensor is located on the boards within the main enclosure and measures the local ambient pressure. This choice is common for installations with sample stream and conditioning panels venting to atmosphere. Be mindful not to install restriction after the oxygen sensor that may create back-pressure during process measurement or calibration.

Absolute Pressure - External (Analog Input) - This selection will assign the Analog Input (AI) as the pressure input. A 4-20 mA pressure transducer or transmitter is required.

Enter the 4-mA and 20 mA points of the transmitter range (valid from 0 to 82737 mBar).

Absolute Manual Input - Enter a manual pressure input for a static process or temporarily for a failed input where the process pressure is know and does not relatively vary much.



5.13.5 - Input / Output - Analog Output (1&2)

This screen allows configuration of the fully programmable Analog Outputs.

Enable Analog Output - This must be selected for the output to be active.

Assign Parameter to the 4-20 mA. Select from O_2, Temp, phase angle, intensity and process pressure.

Assign Critical Fault - Scroll to bottom of AO menu and find **"Output Signal Critical Fault"**

Fault Direction - Select to fail HIGH (20mA) or LOW (4 mA)

Enable Namur Signaling - Yes/No. Select YES will extend the Fault Direction critical failure to HIGH (21 mA) and LOW (3.8 mA).

Linear - **Enter** the 4-mA and 20 mA [range is dependent on Sensor Type and Media selections]

Bi-Linear - **Enter** the 4-mA and 20 mA [range is dependent on Sensor Type and Media selections]. Then enter the Bi-Linear break-point by either the mA value or the oxygen value.

5.13.6 - Input / Output - Digital Output

This screen allows user to set the Digital Outputs as alarm relays assigned to a specific PV, SV, error code or general code. The programming allows for input of a set-point and ability to set the normal state as open or close with dead-band to prevent chatter. If AutoCal routine is enabled then DO1, DO2 and DO3 are reserved for AutoCal until it is inactivated. DO4 is always available as an alarm/relay.

Assign the Relay - Default is **Disabled**. Select from Oxygen, Error Code or Process Temperature

Set-Point - Enter the Set Point for the alarm (either high or low)

Normal-State - Assign Normal State Open or Closed

Dead-band - Assign the set-point as high or low. Enter the Dead-band in % O2.

5.13.7 - Input / Output - Remote Digital Input

(AutoCal must be enabled for this screen to be accessed)

This screen allows user to program the setting associated with the **Test Gas Insert** function otherwise know as **Validation**. The Test Gas Insert allows for remote activation of either the span or zero calibration gas, while isolating from the process and active 4-20 mA outputs. This allows end user to remotely observe dynamic results to a known standard, therefore validating the performance of the analyzer. The Digital Input 1 (DI1) is permanently assigned to AutoCal. DI2 is as follows:

Digital Input 2 - Test Gas Insert

Time Period for Gas - Enter the time for the Test Gas Insert to flow

Define which output - Select the Zero or Span gas

5.14 Diagnostic - Test Security Menu

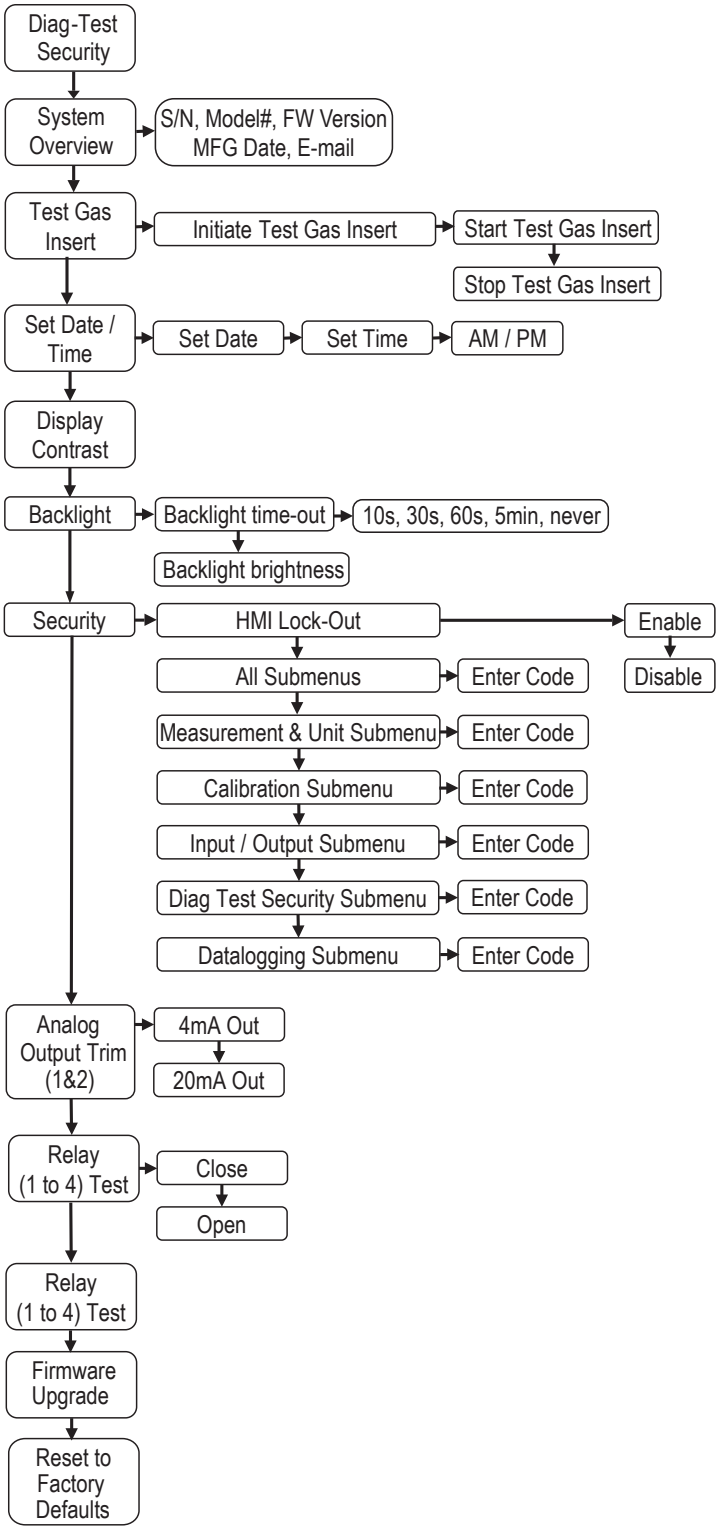


Figure 37 - Diagnostic Test Security Menu



5.14.1 - Diagnostic - Test Security - Overview

This menu allows for diagnostic testing (Test Gas Insert), setting the date and time, adjustment of the display and back-light settings, security locks, analog output trim adjustments, relay testing, firmware upgrades and reset to factory defaults.

5.14.2 - Diagnostic - Test Security - Test Gas Insert

Initiate the Test Gas Insert. Note that the 4-20 mA outputs and any and all alarms are active and live during this analyzer Validation.

Start Test Gas Insert - This will initiate the Test Gas Insert and it will run for it's programmed time.

Stop Test Gas insert - Immediately stops the Test Gas Insert.

Enter the 4-mA (0 to 82737 mBar) and 20 mA (0 to 82737 mBar) points of the transmitter range.

5.14.3 - Diagnostic - Test Security - Set Date and Time

Sets the local date and time for the analyzer.

Date - mm/dd/yyyy

Set Time - 12 hour clock (am/pm)

5.14.4 - Diagnostic - Test Security - Display Contrast

Sets the contrast (10 - 100%).

5.14.5 - Diagnostic - Test Security - Backlight

Set the Backlight Timeout (10s, 30s, 60s, 5min, Never) and Brightness

5.14.6 - Diagnostic - Test Security - Security

This screen allows for security lock-outs from the HMI operation, All menus or specific menus. The HMI lock-out is only intended to protect the "through-the-glass" keypad to be activated by anything other than an end user. The lock-out is removed by following a few on display commands. The menus can be given a code to lock out unauthorized users.

5.14.7 - Diagnostic - Test Security - Firmware Upgrade

If necessary the firmware can be updated via a USB stick and initiated via this screen

5.14.8 - Diagnostic - Test Security - Reset to Factory Defaults

The analyzer can be reset to all of its original default factory settings.

5.15 Data-logging Menu

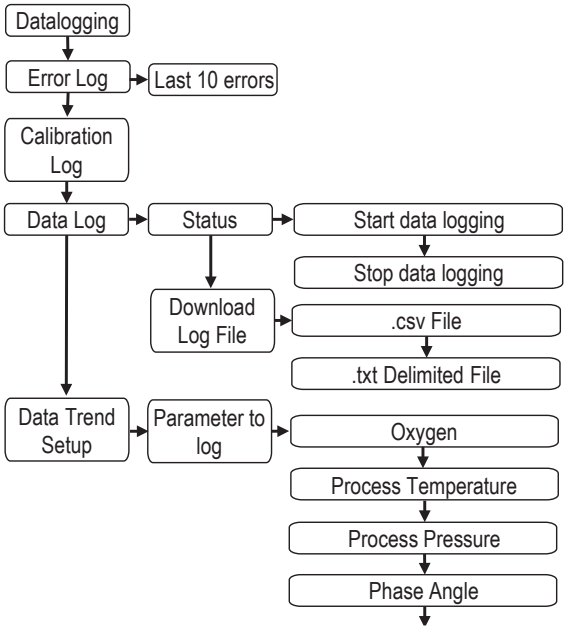


Figure 38 - Data logging Menu

5.15.1 - Diagnostic - Data logging

This menu allows for the user to view the on-board error and calibration logs along with setting up and starting the data-logger

Error Log - Shows the last 10 errors with date and time stamps.

Calibration Log - Shows the last 10 calibrations with date and time stamps.

Data Log - Start or stop the current data logging set.

Download - Either via .csv or .txt file

Data Trend Setup - Select the parameters to download (O_2, Temp, Press, Phase Angle, Signal Intensity).

Deadband - Assign the set-point as high or low. Enter the Deadband in % O2.



5.16 Error Codes Menu

Error Codes

The analyzer will show any active error codes on the active display, along with recording the error into the log and throwing any associated alarm. The error codes are broken into two main groups, “N” for non-critical alarms and “X” for critical. “N” Non-critical alarms, Table 14, indicate an issue that should be immediately investigated and resolved, however it has been determined that the measurement is still likely good and it is unnecessary to fault the output. A “X” critical fault, Table 15, identifies something that likely renders the device immediately faulty and fails the 4-20 mA outputs.

Error Code	N-type (non-critical) Error Description	Trouble shooting and things to check
N12	Optical measurement error. Optical board is not able to perform the calculation from the sensor input available.	Check O_2 sensor connections. Check sensor tip for damage. Place sensor into Zero gas and observe. Consult factory.
N13	Phase Angle “out of range”	This is a common error for BOS3 sensors while exposed to air. Place sensor in zero gas and observe. Check O_2 sensor connections. Check sensor tip for damage. Consult factory.
N15	Data sent to the Optical Board is wrong or out of bounds.	Consult factory.
N21	Data present in flash is in an unrecognized format.	Consult factory. Flash type error. User will be required to roll-back to previous firmware rev or will have to erase the log in order to proceed.
N25	Ambient pressure reading is out of range (500 mBar to 11 mBar).	Check local ambient conditions. Configure for manual pressure input and give best estimate value for measurement and calibration pressure(s).
N35	Modbus validation engine has flagged an error and some unauthorized operation was performed over Modbus.	Check the Modbus master device. If a Modbus to USB cable is being used, check cable requirements and replace.
N36	Unauthorized register was accessed via the Modbus. It can be flagged while writing or reading via Modbus.	Check your Modbus master device and any converters.
N41	Sensor temperature protection. The sensor operating temperature is out of range.	Investigate the process temperature. Process temp must be greater than -10 °C and less than 90 °C. Reduce process or sample temperature.
N42	Zero phase angle is out of the allowed limits (45° to 70°)	Check calibration gas flow during calibration. Check for leaks. Check sensor connections. Error is cleared with a proper calibration.
N44	Auto calibration zero value has crossed the user defined tolerance limit.	Check calibration gas flow during calibration. Check for leaks. Check sensor connections. Error is cleared with a proper calibration.
N45	Auto calibration span value has crossed the tolerance limit.	Check calibration gas flow during calibration. Check for leaks. Check sensor connections. Error is cleared with a proper calibration.
N46	The O_2 reading exceeds the user defined 20mA value.	Check the 20 mA point. Increase the 20 mA point or consider bi-linear 4-20 mA output to account for this high O_2 condition.
N47	The O_2 reading is lower than user defined 4mA value.	Check the 4 mA point. If 4 mA point is set to zero, re-perform a zero calibration.
N51	RTD not detected in the system.	Check the wiring and any jumpers at the termination board. Remove the sensor and check for proper Pt1000 resistance with Multimeter.
N52	Temperature reading is out of user defined 4-20 mA limits	Check the 20 mA point. Increase the 20 mA point or consider bi-linear 4-20 mA output to account for this high O_2 condition.
N53	Analog output 1, AO1, is open circuit.	Check wiring to device. OXYvisor is (active, powered output) so make certain the receiving device is passive (non-powered). If AO1 is not planned to be used, set to inactive
N54	Analog output 2, AO2, is open circuit.	Check wiring to device. OXYvisor is (active, powered output) so make certain the receiving device is passive (non-powered). If AO2 is not planned to be used, set to inactive
N56	Analog input, AI, pressure value is outside of user defined 4-20 mA limits.	Check that process or sample pressure value is within the limits. Check transmitter wiring to the AI terminals. Expand 4-20 input range if required.

Table 14 - “N” Non-Critical - Error Code Table

Error Code	X-type (critical) Error Description		Trouble shooting and things to check
X11	Signal intensity is too low .		
X11	Signal Intensity is too low.		
X14	Spectrometer communication has failed.		Record all errors and consult factory
X16	Spectrometer was disconnected.		Record all errors and consult factory
X21	Signal intensity is too high.		Signal intensity is defaulted for FlexSense style sensors. If you have a Fibersense, turn down the signal intensity. See Table 11 for general recommended values.
X22	Signal is too high.		Record all errors and consult factory.
X23	Spectrometer reference path error.		
X24	Spectrometer EEPROM has failed.		
X31	Spectrometer microprocessor has failed.		
X32	Spectrometer pulse counter overflowed.		
X33	The error indicates that the firmware present in the spectrometer has undergone a reset.		Power OFF and ON. If error is still present, consult the factory.
X34	This error indicates that some component on the main board has failed. The error is never cleared if set. A number is printed on the main display next to the X34 error. This number can be used to identify the cause of failure. The bitmap shown below can be used to identify the component that failed.		Record the details of error, "X34 - Bit YZ" and consult the factory
	0	Bit 0 - ADC Communication Failure	
	1	Bit 1 - Altimeter wrong manufacture ID	
	4	Bit 2 - Altimeter Disconnected	
	8	Bit 3 - DAC 1 Communication Failure	
	16	Bit 4 - DAC 2 Communication Failure	
	32	Bit 5 - Reserved	
	64	Bit 6 - Non Volatile Memory ID Failure	
	128	Bit 7 - Non Volatile Memory Communication Failure	
	256	Bit 8 - Flash ID Failure	
	512	Bit 9 - Flash Memory Type Failure	
	1024	Bit 10 - Flash Memory Capacity Failure	
	2048	Bit 11 - FRAM Communication Failure	
	4096	Bit 12 - RTD ADC Communication Failure	
	8192	Bit 13 - UI Board Reset Error	
	16384	Bit 14 - Flash Data Corruption Error	
X55	The error indicates that the system has encountered a power failure. This error is cleared once the user acknowledges this . This error is not set for software resets.		Indicated the analyzer lost power. Check wiring. Check power source.

Table 15.2 - “X” Critical - Error Code Table

Section 6 - Maintenance / Repair / Service

6.1 Safety Instructions



Only use original accessories or original spare parts as described within this instruction. Observe all relevant installation and safety instructions described in the instructions for the device or enclosed with the accessory or spare parts.



If an error message exist: (1) Check the gravity of the error, (2) Correct the error, and (3) If the device is faulty take out of operation.



There is a danger of explosion when carrying out repairs and maintenance on the device in a hazardous area. Isolate the device from power and ensure the atmosphere is explosion-free (hot work permit) before opening the analyzer.



Danger of explosion in areas subject to explosion hazard. Connect the device correctly after maintenance. Close and seal the device after maintenance work.

Technical Assistance -

Sales.Barben@Ametek.com

6.2 Maintenance Overview

The OXYvisor analyzer has minimal maintenance requirements. As good practice, from time-to-time it is recommended to:

- Visually inspect the analyzer and its components for any damage
- Check the Alarm Log for any conditions and take actions if they persist
- Wash the analyzer clean with water to remove any buildups of corrosive components

Maintenance for the BOS oxygen sensors are not covered in this manual. Please consult the BOS maintenance manual.

6.3 Repairs

The OXYvisor is not intended for field repair, except a few minor direct part replacements. The only field components allowed for replacement are the Rear (Wiring) Compartment lid and the Junction Box.



Flameproof joints are not intended to be repaired. For repair or replacement of any part, contact Barben Analytical.

6.4 Service

This section covers removal and installation of field removable or replaceable items.

6.4.1 - Removing and Replacing Rear (Wiring) Compartment Lid



There is a danger of explosion when carrying out repairs and maintenance on the device in a hazardous area. Isolate the device from power and ensure the atmosphere is explosion-free (hot work permit) before opening the analyzer.

The Rear (Wiring) Compartment lid can be removed by:

1. Using a tool (2 mm Hex), unlock the Rear (Wiring) Compartment 2 mm Hex Lock.
2. Turn the Rear (Wiring) Compartment lid by rotating counter-clockwise



It is important to be careful when screwing the rear lid cover on or off. Thread surface should be free of any grains, pellets and other impurity, which cause seizing, and thread could be damaged. Never screw on the cover forcefully !

The Rear (Wiring) Compartment lid can be installed and secured by:

1. Turn the Rear (Wiring) Compartment lid by rotating clockwise
2. Ensure lid threads completely, compresses o-ring and no gap exist between lid and main enclosure.
3. Secure the lid by tightening the 2 mm Hex Lock with tool.

6.4.2 - Removing / Replacing Junction Box

The Junction Box is fitted and located at the bottom of the analyzer with a front-forward orientation as shown in Figure 4. The orientation is locked into position via a Jam Nut and the 3/4" NPT threads (mating to Fiber Optic Bushing) are sealed with a thread-sealant. In most cases it will not be necessary to re-orientate the Junction Box, however if it is required follow the instructions in this section.



The Junction Box has been fitted and secured at the factory. These removal and installation instructions related to the Junction Box are only necessary if the installation required the Junction Box to be re-orientated (turned).

Removing the Junction Box:

1. Loosen the Jam Nut
2. Unthread the Junction Box from the Fiber Optic Bushing.

It is important to be careful when screwing on or undoing the Junction Box Thread surface should be free of any grains, pellets and other impurity, which cause seizing, and thread could be damaged. Never screw on the cover forcefully !

Installation of the Junction Box:

1. Put the jam nut (B4711-1004) about 2/3 of the distance onto the exposed bushing threads. Apply a small bead of Loctite 577 (B8008-1014) thread sealant to the first two threads on the bushing around the full perimeter. A finger may be used to smear the sealant to fully cover the first two threads.

2. Carefully thread the junction box onto the bushing without damaging the fiber optic cable or the RTD cable, if applicable. If a sensor wand is used, fully extend the wand and gently thread it through the junction box M24 hole and opposite 1/2" NPT hole. Screw the Junction Box onto the bushing with 5 to 7 full turns. Leave the junction box opening facing the same direction as the opening of the big compartment on the main enclosure. Apply a small drop of Loctite 577 thread sealant, or use excess from previous, to the first couple of exposed threads beyond the junction box interface. Secure the jam nut to the junction box and tighten to approximately 25 foot-pounds of torque.

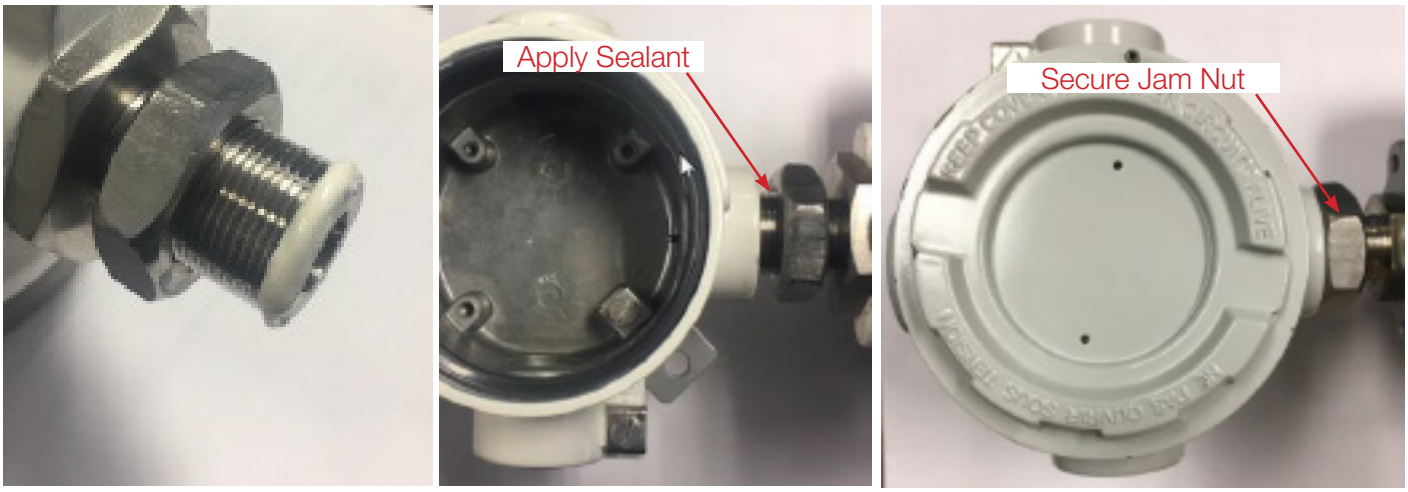


Figure 39 - Installation of Junction Box

APPENDIX No. 1 - Partial Pressure of Oxygen Measurement

A1 - Partial Pressure of Oxygen - Gas Phase

The **OXYvisor** measures the absolute partial pressure of oxygen in the system of interest. This important physical property can be measured and outputted directly from the **OXYvisor** as hPa or mbar (Oxygen Unit). Most applications in gas phase measurements requires the oxygen to be reported in concentration values. The **OXYvisor** uses Equation of States to calculate the concentration. The standard method is the ideal gas law and the advanced method uses AGI compressibility method. The standard method is most often within the accuracies of the device, over the standard temperature ranges and for pressures up 300 psig (20 barg). The basic calculations for each method are shown below.

To complete the calculations, it is important to know the pressure of the system at which the measurement is made. This can be done manually for processes with know static pressure or dynamically via the 4-20 mA input, with an in-situ pressure transmitter, or the RS 485 Modbus for processes with a variable pressure range.

A1.1 - Standard Pressure Compensation - (Ideal Gas Law)

$$P_{O2} = x_{O2} * P_{sys}$$

Where:
P_{O2} = partial pressure of oxygen
x_{O2} = mole fraction of oxygen
P_{sys} = pressure of the system

The **OXYvisor** measures the partial pressure of oxygen at the conditions of interest. The total pressure of the system is either known or measured. Therefore the concentration can be calculated by,

$$x_{O2} = P_{O2} / P_{sys} * 100$$

A1.2 - AGI Compressibility Overview

An advanced routine for calculating concentration at higher pressures is available via the AGI Compressibility selection. This routine uses physical compressibility data (Z factor) entered by the end user respective of the specific gas composition. The data can only be entered by using the **OXYvisor**'s Oxygen Analyzer software.

Rules and Calculations

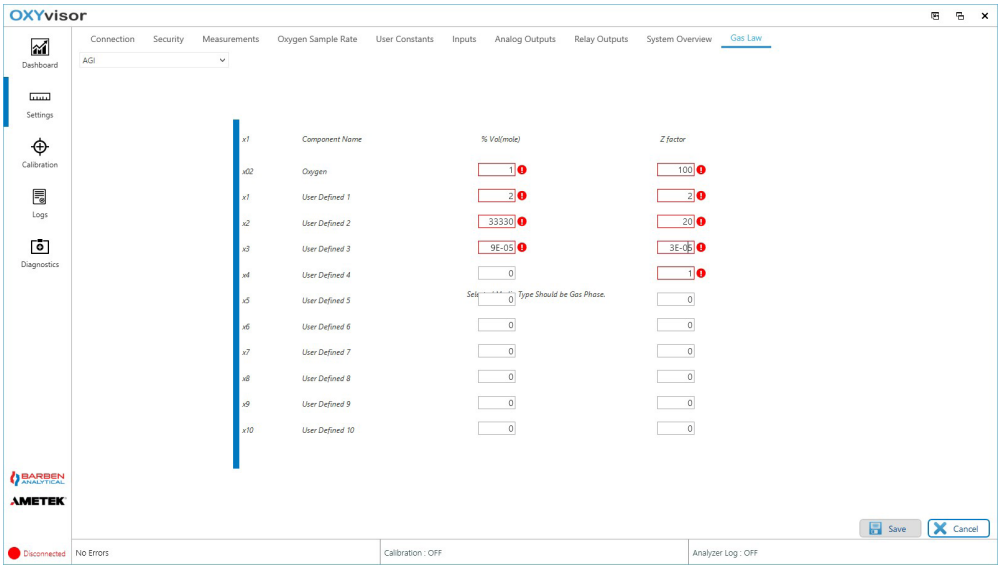
$\%\ Vol_{Total} = x_{O2}+x_1+x_2+.....x_{10} = 100.000\%$

$Z_{totsys} = (x_{O2} * z_{02}) + (x_1*z_1) +... (x_{10}*z_{10})$

Calc for concentration (ppm or $\%O_2$)

$X_{O2} = (P_{O2} / P_{sys}) * (Z_{totsys} / Z_{O2})$

Where:
$P_{O2} = O_2$ (hPa), EOM O_2 value
P_{sys} = Pressure (hPa) (AI or manual input)
Component $Name_n$, X_n and Z_n values - User



APPENDIX No. 2 - Dissolved Oxygen Measurement (Calculations)

A2 - Dissolved Oxygen

The OXYvisor measures the partial pressure of oxygen. Normally the requirement is to measure concentration in ppm (mg/L) or ppb (ug/L) of aqueous, water-based, solutions and therefore the concentration must be calculated from the measured partial pressure of oxygen and temperature of the solution. The OXYvisor calculates the oxygen concentration using the Bunsen Absorption Coefficient. The results closely follow 1984 Benson Krause Method and the IEC 62703 method.

Bunsen Absorption Coefficient

The solubility of the oxygen in water is temperature-dependent and can be described using the Bunsen absorption coefficient α(θ) and the oxygen partial pressure $P(O_2)$. With increasing temperature, the solubility of oxygen in water decreases.

$$c_S(P,T) = \frac{P(O_2) - P_W(T)}{P_N} * \alpha(T)$$

$c_S(P,T)$: temperature-dependent solubility of oxygen in water, given in (cm^3 (O_2) / cm^3)
$P(O_2)$: oxygen partial pressure
$P_W(T)$: temperature-dependent water vapor pressure
P_N: standard pressure (1013 bar)
α(T): Bunsen absorption coefficient, given in (cm^3 (O_2) / cm^3)

The OXYvisor can also account for the affects high salt concentrations on the dissolved oxygen concentration with the following correction factor:

$$S = 1.805[Cl^-] + 0.03$$

where S is the salinity in [$^0/_{00}$] or [g/1000g].

APPENDIX No. 3 - Drift and Sample Rate

A3 - Drift and Sample Rate

Sample Rate - [Menu Structure: Measurement/Sampling Rate]

The sample rate determines how often the measurement will be taken. The rate can be set to take a measurement every 3 seconds to once every hour. It is beneficial to set the sample rate as slow as possible to minimize measurement drift between calibrations and extending the life of the sensor. Measurement drift and sensor life are directly affected by the sample rate due to the photo-bleaching of the measurement element. Photo-bleaching occurs every time the blue LED light flashes to take a measurement. The factory recommends a sample rate of every 60 seconds unless the application requires a quicker measurement. A table is shown here as an example of estimated drift between calibrations as a function of sample rate. Please note, that this is just an estimation based on common operating conditions.

BOS3 Sensor (ppm gas phase)		
Sample Rate Time (seconds)	Estimated shift from Zero (ppm)	Estimated Time between Calibrations (days)
300	< 1.5 ppm	135
60		28
30		15
10		5
5		2.5
3		1.5
300	< 3 ppm	270
60		56
30		30
10		10
5		5
3		3

Table 16 - Drift and Sample Rate Examples

BOS2 - Sensor		
Sample Rate Time (sec)	Estimated shift from Zero (% O2, gas phase)	Estimated Time between Calibrations (days)
60	0.05%	35
30		17
15		8
60	0.10%	70
30		30
15		15

BOS1 - Sensor Calibration Frequency			
Sample Rate Time (seconds)	Estimated shift from Zero (ppb, aqueous)	Estimated shift from Zero (% O2, gas phase)	Estimated Time between Calibrations (days)
60	< 2	< 0.0042%	30
30			15
15			7
60	< 4	< 0.0084%	60
30			30
15			15

APPENDIX No. 4 - AutoCal General Arrangement and Wiring

A4 - Drift and Sample Rate

Auto O_2 Calibration Setup

To setup the **OXYvisor** for Auto-Calibration **(AutoCal)** there are some additional hardware requirements.

- (QTY 3) Low-Watt Solenoid Valves to operate the Auto-calibration panel. One solenoid for the process isolation valve and two for the calibration gases, zero and span.
- External Power Supply with proper Area Classification to power the solenoids. The **OXYvisor** has non-powered on/ off digital relays to control the AutoCal routine.

The AutoCal setup can be setup via the HMI, however it is fairly tedious and it is recommended to use the **OXYvisor** Oxygen Analyzer software provided with the analyzer to set up this routine. Refer to the **OXYvisor** Software Instruction Manual for detailed setup instructions.

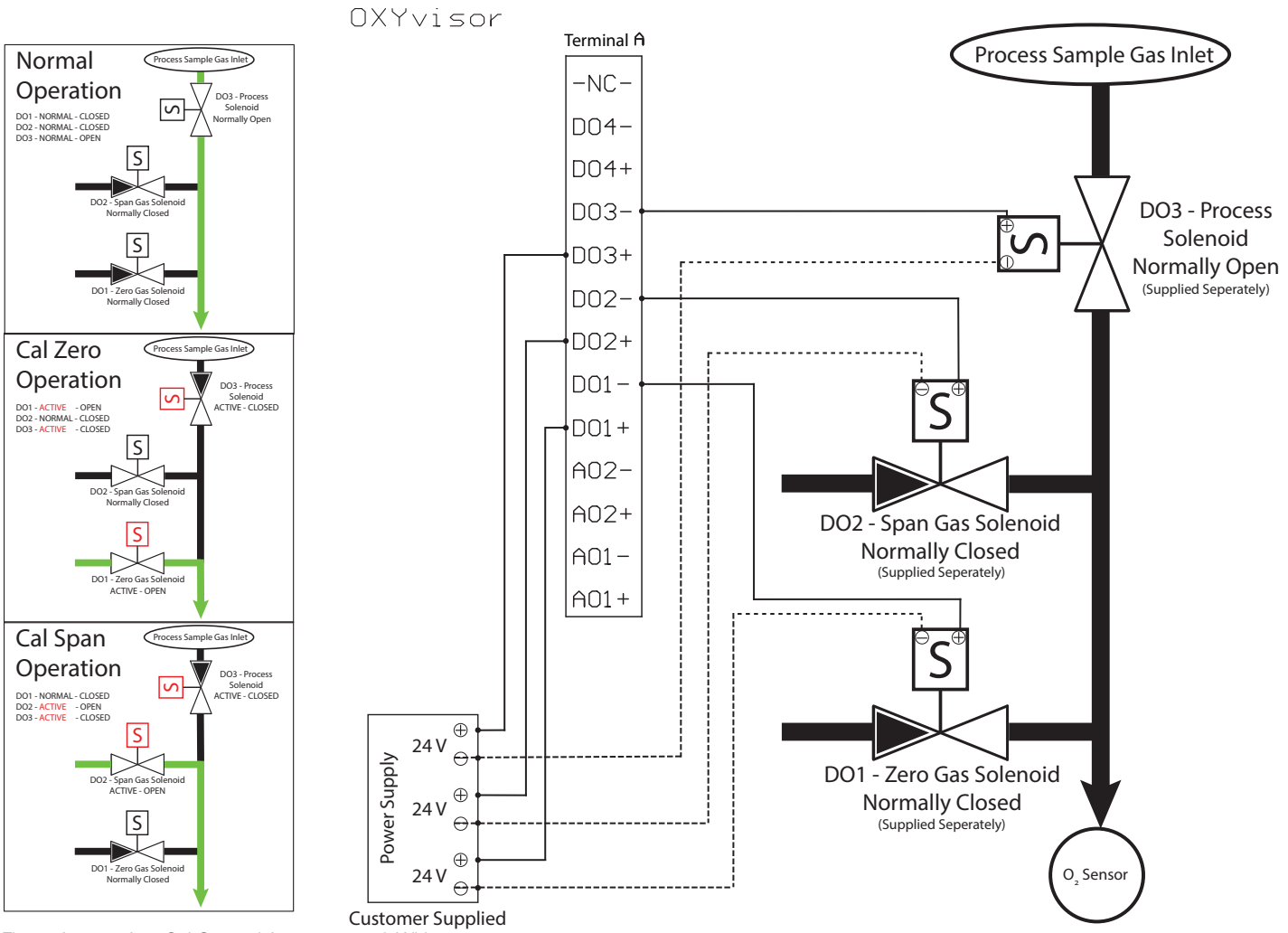


Figure A4.38 - AutoCal General Arrangement & Wiring

APPENDIX No. 5 - BOSx Sensors Phase, Amp and Values

A5 - Common Graphs

Phase/AMP vs O2 - BOS3, BOS2, BOS1 in gas phase and aqueous

APPENDIX No. 6 - Default Configuration Settings

A6 - Default Configuration Settings

At any point in time the analyzer may be set to its original default configuration settings. This can be done via the menu **Diagnostic - Test Security / Reset to Factory Defaults.** This may be requested during troubleshooting with factory personnel to get rid of bad calibration or other undocumented changes and to start over with a known starting point.

DEFAULT CONFIGURATIONS

APPENDIX No. 7 - RS485 Modbus Communications

A7 - Modbus RS-485 Communications with OXYvisor

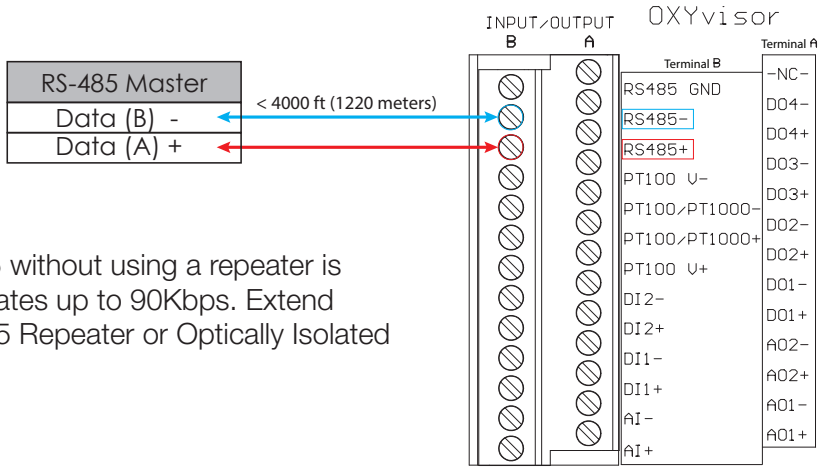
The **OXYvisor** is equipped with two-way serial communications via RS-485 Modbus. The Modbus communications can be used to remotely read and write to the analyzer. Read registers carry the primary and secondary PV's, diagnostics information and alarm codes. Write registers allows for changing of key parameters such as alarm set-points and operation of Auto-Calibration and Test Gas Insert functions. Full configuration is still best performed via the HMI or the provided software (via Modbus 485).

A7.1 -RS485 Schematic Termination and Wiring to OXYvisor

Remote communications on the **OXYvisor** is handled by the RS485 communication module that plug directly into the back-termination board. A PLC or a computer (with USB-RS485 converter) can be used as a Master and the **OXYvisor** as a slave device. RS485 connections can be wired in a 2-wire arrangement as shown in the schematic below. This simple protocol can be used for exchange of data between the **OXYvisor** (Slave) and PLCs/Computers (Master).



When connecting to a computer, a USB-RS485 converter with a CH340 chip is recommended over a FTDI USB-RS485 converter cables for MODBUS communication. USB-RS485-WE - (Web link for www.ftdichip.com)



USEFUL INFORMATION

The maximum distance of RS-485 without using a repeater is 4000 feet (1220 meters) at baud rates up to 90Kbps. Extend that distance by adding an RS-485 Repeater or Optically Isolated Repeater every 4000 feet.

Figure A7.34 - Modbus Connection

A7.2 - Configuration

A7.2.1 - Settings

The following setting are used to communicate with the OXYvisor as a Slave Device.

Setting	Value
Mode	RTU
Baud rate	115200
Data Bits	8
Stop Bits	2
Parity	None
High Byte First	✓
Slave ID	01, 02, …

Table A.17 - Configuration Setting

A7.2.2 - Function Codes

The OXYvisor Modbus RTU protocol uses a subset of the standard Modbus RTU function codes to provide access to process-related information. Several standard function codes are employed and supported, shown in the table below. These standard function codes provide basic support for IEEE 32-bit floating point numbers and 16-bit integer register representation of instrument's process data.

Function Code	Name	Usage
03	Read Holding Registers	Read Data in 16-bit Register Format (high/low). Used to read integer or floating-point process data. Registers are consecutive and are imaged from the instrument to the host.
04	Read Input Registers	
06	Write Single Register	Write Data in 16-bit Integer Format (high/low) ONLY.
16	Write Multiple Registers	Write Data in 16-bit Format (high/low). Used to write integer and floating-point override data. Registers are consecutive and are imaged from the host to the instrument. ***Note: Can write floating point data using this Function Code***

Table A.18 - Function Codes for Read / Write Access

A7.3 - Read Registers

A7.3.1 - Input registers with Read-Only access.

Below are some of the register addresses to read what the current process variables are, the last calibration values and to see if there are any errors logged.

Base Address	Register Name	Size	Type
Process Variables			
30002	ProcessVariable.oxyVal	4	float
30004	ProcessVariable.phaseVal	4	float
30006	ProcessVariable.ampVal	4	uint32
30020	ProcessVariable.processPressure	4	float
30022	ProcessVariable.processTemperature	4	float
30024	ProcessVariable.ErrorCode	4	uint32
Calibration Log			
31003	zeroCalibrationLogData.phaseAngle	4	float
31009	zeroCalibrationLogData.timeStamp	4	uint32
31012	spanCalibrationLogData.oxygenValue	4	float
31015	spanCalibrationLogData.phaseAngle	4	float
31021	spanCalibrationLogData.timeStamp	4	uint32
Error Log			
33000	errorLogData.timeStamp	4	uint32
33002	errorLogData.errorCode	2	uint16

Table A.19 - Input Registers



The “minus offset” should be 30000 for all the above read only registers.

A7.3.2 - Input registers with Read-Only access.

Base Address	Register Name	Size	Type	
Process Variables				
40130	configVar.CalibrationConfigVars.autoO2SenCal.humidityStatus	2	uint16	0x01 = Dry Gas; 0x02 = Humid Gas
40131	configVar.CalibrationConfigVars.autoO2SenCal.autoCalEnable	2	uint16	0x01 = enable; 0x02 = disable
40132	configVar.CalibrationConfigVars.autoO2SenCal.calibrationFrequency[0].calibrationIntervalActivated	2	uint16	0x01 = enable; 0x02 = disable
40138	configVar.CalibrationConfigVars.autoO2SenCal.calibrationFrequency[0].calibrationInterval	4*	uint32	0 - 5184000 (Seconds)
40140	configVar.CalibrationConfigVars.autoO2SenCal.calibrationFrequency[0].firstCalibrationTime	4*	uint32	Current time (UTC**) value in seconds +time delay (seconds)
40142	configVar.CalibrationConfigVars.autoO2SenCal.calibrationFrequency[1].calibrationIntervalActivated	2	uint16	0x01 = enable; 0x02 = disable
40148	configVar.CalibrationConfigVars.autoO2SenCal.calibrationFrequency[1].calibrationInterval	4*	uint32	0 - 5184000 (in seconds)
40150	configVar.CalibrationConfigVars.autoO2SenCal.calibrationFrequency[1].firstCalibrationTime	4*	uint32	Current time (UTC**) value in seconds +time delay (seconds)
40152	configVar.CalibrationConfigVars.autoO2SenCal.calibrationFrequency[2].calibrationIntervalActivated	2	uint16	0x01 = enable; 0x02 = disable
40158	configVar.CalibrationConfigVars.autoO2SenCal.calibrationFrequency[2].calibrationInterval	4*	uint32	0 - 5184000 (in seconds)

Table A.20-1 - Holding Registers

Base Address	Register Name	Size	Type	
40160	configVar.CalibrationConfigVars.autoO2SenCal.calibrationFrequency[2].firstCalibrationTime	4*	uint32	Current time (UTC**) value in seconds +time delay (seconds)
40162	configVar.CalibrationConfigVars.autoO2SenCal.calibrationFrequency[3].calibrationIntervalActivated	2	uint16	0x01 = enable; 0x02 = disable
40168	configVar.CalibrationConfigVars.autoO2SenCal.calibrationFrequency[3].calibrationInterval	4*	uint32	0 - 5184000 (in seconds)
40170	configVar.CalibrationConfigVars.autoO2SenCal.calibrationFrequency[3].firstCalibrationTime	4*	uint32	Current time (UTC**) value in seconds +time delay (seconds)
40185	configVar.CalibrationConfigVars.autoO2SenCal.zeroPurgeTime	4*	float	1-30 (in minutes)
40187	configVar.CalibrationConfigVars.autoO2SenCal.spanPurgeTime	4*	float	1-30 (in minutes)
40189	configVar.CalibrationConfigVars.autoO2SenCal.recoveryTime	2	uint16	1-120 (in seconds)
40408	configVar.DiagAndTestConfigVars.testGasInsert.timePeriodForTestGas	4*	float	1-100 (in minutes)
40410	configVar.DiagAndTestConfigVars.testGasInsert.outputDefine	2	uint16	0x01 = Zero Gas; 0x02 = Span Gas
44000	calibrationStateWriteRegister	2	uint16	0X04 = Start Auto Calibration; 0X05 = Stop Auto Calibration
RAM Locations				
44000	calibrationStateWriteRegister	2	uint16	0X04 = Start Auto Calibration; 0X05 = Stop Auto Calibration
44009	testGasInsertStatus	2	uint16	0x01 = start test gas insert, 0x02 = stop test gas insert
44010	relayTestNumberStatus	2	uint16	1,2,3 and 4 for the corresponding relay
44011	relayTestPositionStatus	2	uint16	0 - open and 1 - close
44012	relayTestStatus	2	uint16	1- Activate and 2 - deactivate

Table A.20-2 - Holding Registers



Note: The “minus offset” should be 40000 for all the above read/write only registers.

*Addresses which are 4bytes long, needs 2 registers updated at once and function code 16 must be used.

** Current UTC time in seconds can be found on https://www.epochconverter.com/

A7.4 - Communication Guide

A7.4.1 Reading Process Variables:

To interrogate process variables such as oxygen, pressure, temperature, phase, amplitude, etc. refer to Table A.19, for Base Addresses, then implement the offset, function code and choose data type as shown in the example below. For basic Modbus RTU configuration settings, refer to Table A.20.

PROCESS VARIABLE	FIRST REGISTER	MINUS OFFSET	FUNCTION CODE	DATA TYPE	RESULT (EXAMPLE)
Oxygen	30002	30000	4	Float	20.97
Amplitude	30006	30000	4	Uint32	14671
Temperature	30022	30000	4	Float	69.89

Table A.21 - Process Variable registers

A7.4.2 Turning on Relays

The 4 relays in OXYvisor can be activated one at a time manually. Follow the steps below to specify, start and stop individual relays. Until one relay is not deactivated, the other relay cannot be written to.

1. Set the relay test number (Register Address : 44010). The values can be set to 1 , 2 , 3 or 4 for the corresponding relay.
2. Set the relay test position (Register Address : 44011). The value can be set to 0 to OPEN and 1 to CLOSE the relay. (Note: The relay will not open or close unit you activate it in the next step.)
3. Activate the relay status (Register Address : 44012). To activate, set the relay status value to (0X01).
4. To deactivate the relay set the relay status (Register Address : 44012) to (0x02).

RELAY REGISTERS	FIRST REGISTER	MINUS OFFSET	FUNCTION CODE	DATA TYPE	VALUE TO WRITE
Relay Test Number	44010	40000	6	Uint16	1,2,3 or 4 for corresponding relay
Relay Test Position	44011	40000	6	Uint16	0=Open; 1=Close
Relay Test Status	44012	40000	6	Uint16	1=Activate; 2=Deactivate

Table A.22 - Relay registers

A7.4.3 Configure and Trigger Test Gas Insert

Follow the steps below to configure and trigger the Test Gas Insert feature of the **OXYvisor**. If you have already setup the Test Gas Insert previously, via the software or the HMI, you can proceed to steps 3 and 4 to activate and deactivate this feature manually.

Before configuring the Test Gas Insert, ensure that the auto calibration has been enabled [Address- 40131 (1 to activate and 2 to deactivate)].

1. To set the test gas insert time, set the value in minutes between 1-100 to address 40405
2. Set the test gas insert output to either Zero Gas (0X01) or Span Gas (0X02) to address 40407
3. Activate test gas insert (0x01), address 44009.
4. Deactivate/stop the test gas insert before specified time, set value (0x02) to address 44009.

REGISTER NAME FOR TEST GAS INSERT	FIRST REGISTER	MINUS OFFSET	FUNCTION CODE	DATA TYPE	VALUE TO WRITE
Time Period	40408	40000	16	Float	1-100 (in mins)
Define Output	40410	40000	6	Uint16	Zero Gas (0X01) or Span Gas (0X02)
Activate/Deactivate	44009	40000	6	Uint16	Start (0X01) or Stop (0X02)

Table A.23 - Configure and Trigger Test Gas Insert

A7.4.3 Configure and Trigger Test Gas Insert

The Auto-Cal feature in the **OXYvisor** has 4 different schedules. Each schedule can be activated/deactivated, set up for 1st calibration time and calibration interval individually. First Schedule = [0], Second Schedule = [1], Third Schedule = [2], Fourth Schedule = [3]

Follow the steps below to setup and trigger the Auto-Cal feature of the **OXYvisor**. If you have already setup the Auto-Cal previously or via the software or the HMI, you can proceed to steps 15 and 16 to activate and deactivate this feature manually. [Address- 44000 (write 4 to activate and 5 to deactivate)].

1. Set the auto calibration type (Register Address: 40130). The value can be either Dry Gas (0X01) or Humid Gas(0x02).
2. Turn off auto calibration (Register Address: 40131). The value should be set to (0x02).
3. Deactivate each calibration schedule (Register Address: 40132, 40142, 40152, 40162). The value should be set to (0x02).
4. Set the calibration interval for each schedule (Register Address: 40138, 40148, 40158, 40168). The value should be between 0 – 5184000 which is 60days in seconds. For example, calibration interval of 1 calibration a day is 86400 seconds. Calibration interval of once a week is 604800 seconds. The value to write to the register is in seconds.
5. Set the first calibration time for each schedule(Register Address : 40140, 40150, 40160, 40170). The value should be between the current time in seconds (UTC time) + the UTC time within the next 60 days. For example, if the current date and time is February 13th, 2018 – 5:00PM, the UTC value in seconds is

1518541200. To set the first calibration time at February 13th, 2018 – 5:30PM the UTC value in seconds will be 1518543000. The register will accept values from 1518541200 (Current date and time in seconds) to 1523725200(Current date and time in seconds + 60 days in seconds).

6. Activate each calibration schedule(Register Address : 40132, 40142, 40152, 40162). The value should be set as (0x01).
7. Set the pressure sensor status (Register Address : 40175). Set it to either ambient sensor(0x01) or manual pressure input(0x03). If manual pressure input is selected, then set the pressure value (Register Address : 40172) and pressure unit(Register Address : 40174). The pressure value can only be set when auto calibration is disabled. The pressure unit can be mBar(0x01), inch H20(0x02), Bar(0x03), Torr(0x04), PSI(0x05).
8. To set the Span gas oxygen value and unit, use the Register Address 40177 to set the oxygen value. Then set the span gas oxygen unit (Register Address : 40176). The value can be PERCENTAGE (0x01) or PPM (0x02).
9. Set zero drift tolerance, first set the zero-drift tolerance unit (Register Address : 40181). The value can be PERCENTAGE (0x01) or PPM (0x02). Then set the zero-drift tolerance value (Register Address : 40179).
10. Similarly, to set span drift tolerance, first set the span drift tolerance unit (Register Address : 40184). The value can be PERCENTAGE (0x01) or PPM (0x02). Set the span drift tolerance value (Register Address : 40182).
11. Set zero purge time (Register Address : 40185). The value should be between 1 and 30 in minutes.
12. Set span purge time (Register Address : 40187). The value should be between 1 and 30 in minutes.
13. Set recovery time (Register Address : 40189). The value should be between 1 and 120 in seconds.
14. Enable auto calibration (Register Address : 40131). The value should be set to (0X01). At this point the AutoCal is activated and will start according to the schedule set.
15. To manually start the auto-cal, set register address 44000 to 0X04 to activate.
16. To stop the auto-cal before its time expires, set the same register address 44000 to 0X05.

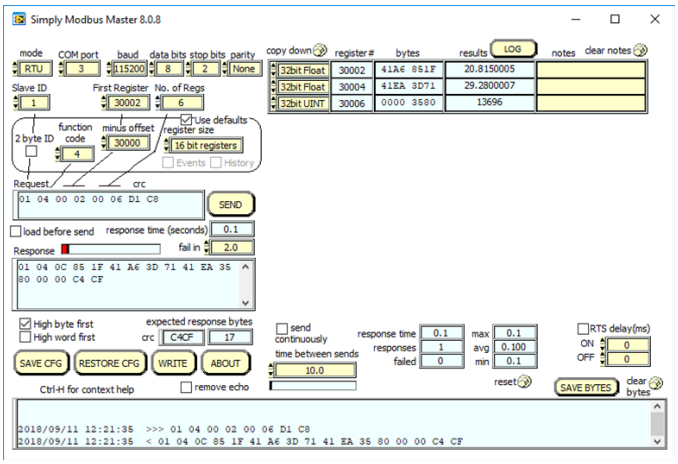
Register Name for AutoCal Setup	First Register (Minus Offset = 40000)	Function Code	Data Type	Value to Write
Auto-Cal Type	40130	6	Uint16	1=Dry Gas; 2=Humid
Auto-Cal Enable/Disable	40131	6	Uint16	1=Enable; 2=Disable
Calibration Schedule	40132 (1st Schedule) 40142 (2nd Schedule) 40152 (3rd Schedule) 40162 (4th Schedule)	6	Uint16	1=Enable; 2=Disable
Calibration Interval	40138(1st Schedule) 40148(2nd Schedule) 40158(3rd Schedule) 40168(4th Schedule)	16	Uint32	Enter: 0 – 5184000 (0-60 days in seconds)
First Calibration Time	40140(1st Schedule) 40150(2nd Schedule) 40160(3rd Schedule) 40170(4th Schedule)	16	Uint32	Enter: Current UTC time in seconds + start time in seconds within next 60 days. Refer to Step #5 above- Page 76
Pressure Sensor	40175	6	Uint16	1=Ambient Sensor; 2=Manual Pressure Input
Manual Pressure Input	40172 (Pressure Value) 40174 (Pressure Unit)	16 6	Float Uint16	1=mbar; 2=inch H20; 3=bar; 4=Torr; 5=PSI
Span Gas Input	40177 (Oxygen Value) 40176 (Oxygen Unit)	16 6	Float Uint16	1=% Oxygen; 2=PPM
Zero Drift Tolerance	40179 (Oxygen Value) 40181 (Oxygen Unit)	16 6	Float Uint16	1=% Oxygen; 2=PPM
Span Drift Tolerance	40182 (Oxygen Value) 40184 (Oxygen Unit)	16 6	Float Uint16	1=% Oxygen; 2=PPM
Zero Purge Time	40185	16	Float	Enter: 1-30(in mins)
Span Purge Time	40187	16	Float	Enter: 1-30(in mins)
Recovery Time	40189	6	Uint16	Enter: 1-120(in secs)
Start/Stop Auto-Cal Manually	44000	6	Uint16	4=Start ; 5=Stop

Table A.24- Set-Up and Trigger AutoCal

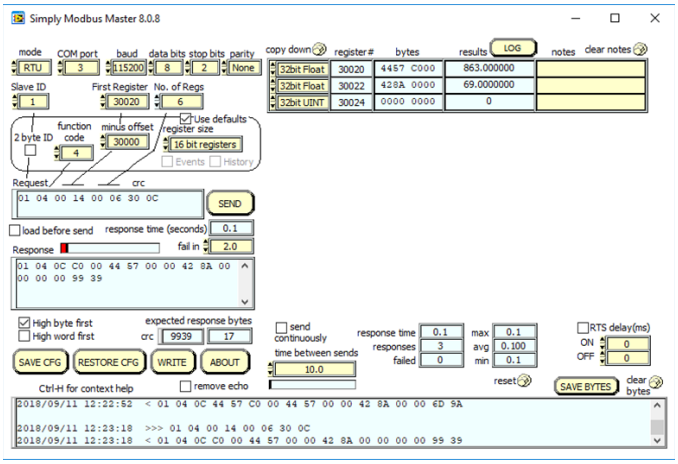
A7.5 - Communication Examples

A7.5.1 Read Process Variables:

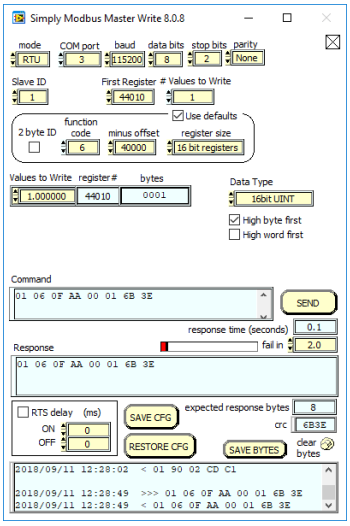
To interrogate process variables such as oxygen, phase angle and amplitude



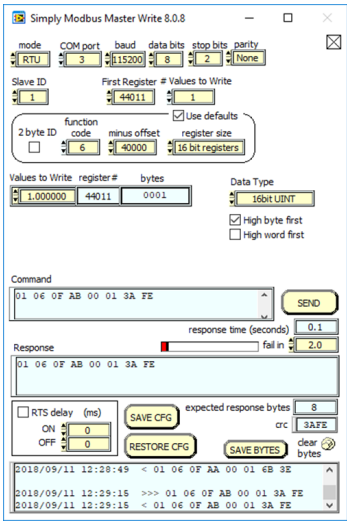
To read Process Pressure, Process Temperature and any error codes present



A7.5.2 Turning On Relays

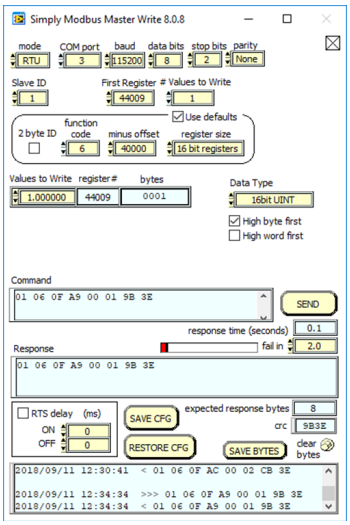


To turn ON Relay #1, Write the value 1 to register 44010. This will select Relay number as 1.

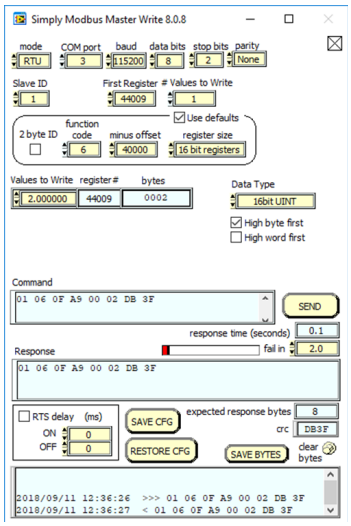


Now select the Test position of the Relay using register 44011. Usually the Relays are “Normally Open”. So to activate Relay #1, we need to close it. The Value to Write is 1 to close. (0 for open in case the relay is “normally closed”)

A7.5.3 Triggering Test Gas Insert (TGI) - Remote Validation



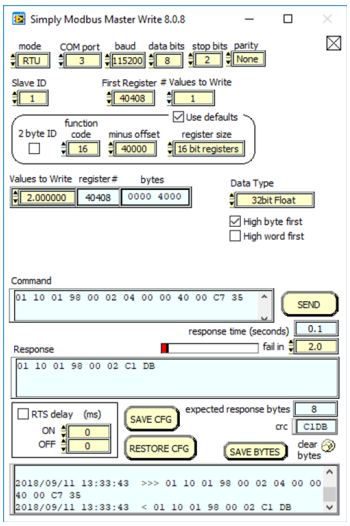
If the TGI has already been previously setup and you want to simply trigger it, write 1 to register 44009



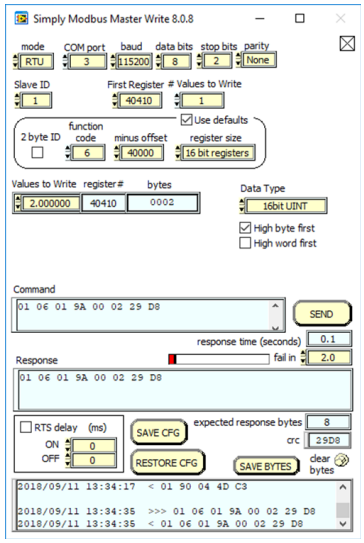
The test gas will automatically stop after the “time period” set during the configuration of the TGI. If you want to stop the TGI before the time period is up; write value 2 to the same register 44009.

If the TGI has not been configured, by default the “Time period” = 3 mins and the “Output Gas” is set to Zero Gas. Also, the TGI will not trigger if the Auto-Calibration has not been enabled.

A7.5.4 Setting Up Test Gas Insert



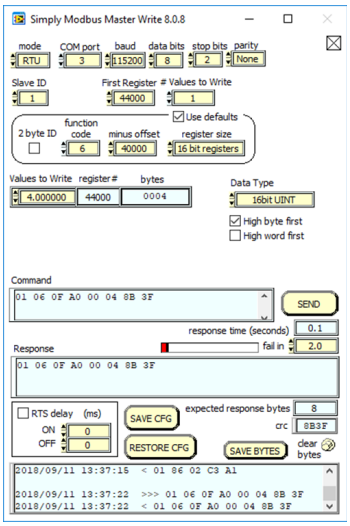
First set up the “Time period”. If you want to TGI to run for 2 minutes, write 2 to register 40408.



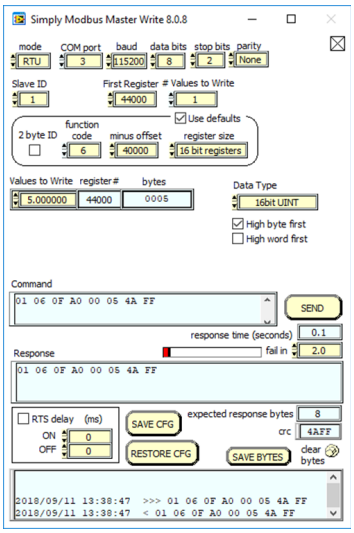
To define the Output gas as “Span Gas”, write 2 to register 40410.

Once the TGI has been configured to the desired time and output, follow steps in section 5.3 to trigger it.

A7.5.5 Remotely start AutoCal



If the auto-calibration has been previously setup and you want to initiate an auto-cal, write 4 to register 44000.



To manually stop the auto-cal before it is completed, write 5 to the same register 44000 to disable auto-cal.

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