Advanced Instruments Inc.

Technical Specifications *

Accuracy:	< 2% of FS range under constant conditions
Analysis:	0-100 PPM, 0-25% Full scale ranges; Optional 0-1000 PPM, 0-25% Full scale ranges
Application:	Oxygen analysis in inert, hydrocarbon, helium, hydrogen, mixed and acid (CO_2 with XLT sensor) gas atmospheres
Area Classification:	General purpose
Calibration:	1 month interval using certified span gas (preferred for fastest online time) or air with O_2 approximating 80% of full scale range balance N2
Compensation:	Temperature Compensated Output
Connections:	Glove box KF-40 flange; Optional Flow Through Housing with 1/8" dia. tube fittings
Controls:	2 Position manual range selector switch
Display:	None
Flow:	Not flow sensitive; 1-2 SCFH flow rate recommended
Linearity:	±2% of full scale
Pressure:	Atmospheric; Flowing system: inlet - regulate to 5-30 psig, vent - atmospheric or return controlled atmosphere
Power:	18-24 VDC two wire loop
Recovery Time:	60 seconds in air to < 10 PPM in < 1 hour on N_2 purge
Response Time:	90% of final reading in 10 seconds
Sample System:	None; optional glove box Sample Calibration Module pictured
Sensitivity:	< 0.5% of FS range
Sensor Model:	GPR-12-333 for non-acid (CO2) gas streams XLT-12-333 for gases containing > 0.5% CO2
Sensor Life:	24 months in < 1000 PPM O2 at 25ºC and 1 atm.
Signal Output:	4-20mA; Optional 1-5 VDC
Operating Range:	-10 ºC to 45ºC (GPR sensor), -20º to 45ºC (XLT sensor)
Warranty:	12 months analyzer; 12 months sensor
Wetted Parts:	Stainless steel

Optional Equipment

Flow Through Housing (shown above right, P/N A-4005)

* Subject to change without notice

GPR-KF40-12
Glove Box
Oxygen Transmitter

18-24 VDC 2 Wire Loop Power
4-20mA or 1-5 VDC

Advanced Galvanic Sensor Technology
Accuracy < 2% Full Scale
Sensitivity < 0.5% Full Scale
Long Life, No Maintenance
Excellent Compatibility with CO_2 (XLT Series sensor)

Optional Flow Through Housing

ISO 9001:2008 Certified
INTERTEK Certificate No. 485

2855 Metropolitan Place, Pomona, CA 91767 USA ♦ Tel: 909-392-6900, Fax: 909-392-3665, www.aii1.com, e-mail: info@aii1.com Rev 07/13

GPR-KF-40-12
Two Wire Loop Power PPM O2 Transmitter

Owner's Manual

Revised July 11, 2013

2855 Metropolitan Place, Pomona, CA 91767 USA ♦ Tel: 909-392-6900, Fax: 909-392-3665, e-mail: info@aii2.com, www.aii2.com

1. Table of Contents

1. Introduction

Your new two wire loop powered oxygen transmitter is a precision piece of equipment designed to give you years of use in variety of industrial oxygen measurement applications. The GPR-KF-40 is the most accurate and cost effective means of measuring % or trace levels of oxygen in industrial gas streams.

The GPR-KF-40-12 in a standard configuration is equipped with two ranges (25% and 1000 PPM). Other PPM range is available on request.

In order to derive maximum performance from your new oxygen transmitter, please read and follow the guidelines provided in this Owner's Manual.

The serial number of this transmitter may be found on the label of the transmitter. You should note the serial number in the space provided and retains this Owner's Manual as a permanent record of your purchase, for future reference and for warranty considerations.

Serial Number: _____

Every effort has been made to select the most reliable state of the art materials and components designed for superior performance and minimal cost of ownership. This transmitter was tested thoroughly by the manufacturer for best performance. However, modern electronic devices do require service from time to time. The warranty included herein plus a staff of trained professional technicians to quickly service your transmitter is your assurance that we stand behind every transmitter sold.

Advanced Instruments Inc. appreciates your business and pledge to make effort to maintain the highest possible quality standards with respect to product design, manufacturing and service.

2. Quality Control Certificate

			Pass
Date:	Customer:		
	Order No.:		
Model	GPR-KF40-12 PPM Oxygen Transmitter	S/N _____	
Sensor	( ) GPR-12-333 PPM Oxygen Sensor ( ) XLT-12-333 PPM Oxygen Sensor	S/N_____	
Accessories	Owner's Manual		
Configuration	A-1205 Rev A PCB Assembly, Main		
	Range: 0-25%, 0-1000 PPM		
	Power: 18-24V DC two wire loop power		
	A-4003-1 Assembly & Interconnection Drawing		
Test - Electronics	Default zero (without sensor) 4mA ± 0.2mA		
	Default span @ specified current output, nominal 17.4 mA @ 600 uA		
	( ) Analog signal output 4-20mA full scale		
	( ) Analog signal output 1-5 VDC full scale		
Test - Gas Phase	Calibrates with adequate span adjustment within +/-30 % FS		
	Baseline drift on zero gas < ± 2% FS over 24 hour period		
	Noise level < ± 1.0% FS		
Final	Overall inspection for physical defects		
Options	Optional Range: 0-25%, 0-100 PPM		
Delivery			

3. Specifications

Advanced Instruments Inc.

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Connections:	Glove box KF-40 flange; Optional Flow Through Housing with 1/8" dia. tube fittings
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Linearity:	±2% of full scale
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Sensor Life:	24 months in < 1000 PPM O2 at 25ºC and 1 atm.
Signal Output:	4-20mA; Optional 1-5 VDC
Operating Range:	-10 ºC to 45ºC (GPR sensor), -20º to 45ºC (XLT sensor)
Warranty:	12 months analyzer; 12 months sensor
Wetted Parts:	Stainless steel

Optional Equipment

Flow Through Housing (shown above right, P/N A-4005)

* Subject to change without notice

GPR-KF40-12
Glove Box
Oxygen Transmitter

18-24 VDC 2 Wire Loop Power
4-20mA or 1-5 VDC

Advanced Galvanic Sensor Technology
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4. Operation

The GPR-KF-40-12 oxygen transmitter incorporates advanced galvanic fuel cell type oxygen sensors. This model provides a 4-20mA signal output proportional to the oxygen partial pressure in the sample gas on the two-wire 18-24 VDC power loop or 1-5 V via a third wire.

Advanced Sensor Technology

The sensors function on the same principle and are specific for oxygen. They measure the partial pressure of oxygen from low PPM to % levels in inert gases, gaseous hydrocarbons, helium, hydrogen, mixed gases, acid gas streams and ambient air.

Oxygen, the fuel for this electrochemical transducer, diffusing into the sensor reacts chemically at the sensing electrode to produce an electrical current output proportional to the oxygen concentration in the gas phase. The sensor's signal output is linear with changes in O2 and remains virtually constant over its useful life. The sensor requires no maintenance and is easily and safely replaced at the end of its useful life.

The expected life of our new generation of percentage range sensors now range from three to ten years (depending on the model selected) with faster response times and greater stability. Another significant development involves expanding the operating temperature range for percentage range sensors from -20°C to 50°C.

Electronics

The signal generated by the sensor is processed by state of the art circuitry. The first stage amplifies the signal. The second stage eliminates the low frequency noise. The third stage employs a high frequency filter and compensates for signal output variations caused by ambient temperature changes. The result is a very stable signal.

Sample oxygen is analyzed very accurately. Response time of 90% of full scale is less than 10 seconds (actual experience may vary due to the integrity of sample line connections, dead volume and flow rate selected) under ambient monitoring conditions. Sensitivity is typically 1% of full scale of the lowest available range.

Sample System

The GPR-KF-40-12 is supplied without a sample system (the transmitter is designed to mount directly on a pipe with KF-40 flange) in order to provide the users with absolutely most cost effective option for oxygen measurements. However, the sample must be properly presented to the transmitter to ensure an accurate measurement. At a minimum pressure regulation of no greater than 0.5 psig (in the pipe where the transmitter is mounted) and a flow rate of 1-5 SCFH or approximately 2 liters per minute is required.

Users interested in adding additional sample handling or conditioning system are encouraged to consult the factory to ensure all applicable conditions are addressed to ensure proper operation of the transmitter.

Advanced Instruments Inc. offers a full line of sample handling, conditioning and expertise to meet your application requirements. Contact us at 909-392-6900 or e-mail us at aii2@earthlink.net

Controlling Pressure & Flow

All electrochemical oxygen sensors respond to partial pressure changes in oxygen. The sensor output increases with increasing sample pressure. The inlet pressure must always be higher than the pressure at the outlet vent, which is normally at atmospheric pressure, for a positive flow of sample through the transmitter.

Flow rates of 1-5 SCFH cause no appreciable change in the oxygen reading. However, flow rates above 5 SCFH may generate a backpressure and erroneous oxygen reading. A pressure regulator along with a flow meter upstream of the sensor is recommended as a means of controlling the flow rate within the recommended range. A flow rate of 2 SCFH or 1 liter per minute is recommended for optimum performance.

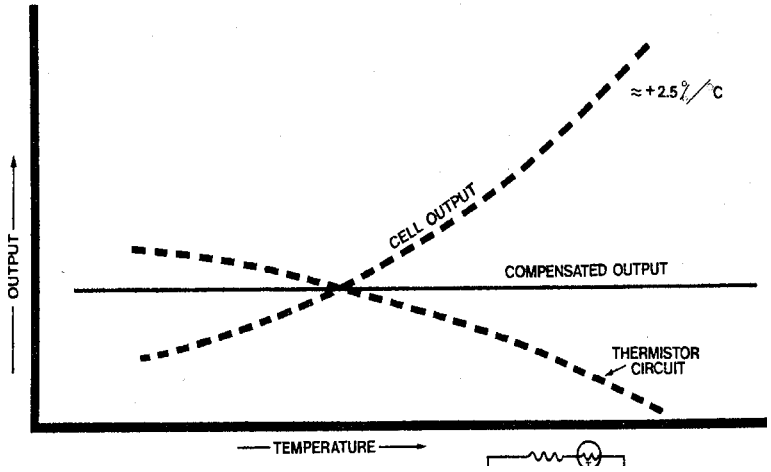
Calibration and Accuracy

Single Point Calibration: As previously described the galvanic oxygen sensor generates an electrical current proportional to the oxygen concentration in the sample gas. In the absence of oxygen the sensor exhibits an absolute zero, e.g. the sensor does not generate a current output in the absence of oxygen. Given the linearity and absolute zero properties, a single point calibration of analyzer is possible.

Pressure: Because sensors are sensitive to the partial pressure of oxygen in the sample gas, their output is a function of the number of molecules of oxygen 'per unit volume' of the sample gas.

For best accuracy, the pressure of the sample gas and that of the calibration gas must be similar (within 2-5 psi) so that when the SAMPLE/SPAN gases are switched, the gas flow rate would not drastically change.

Temperature: The rate at which oxygen molecules diffuse into the sensor is controlled by a Teflon membrane otherwise known as an 'oxygen diffusion limiting barrier. The fact that all diffusion processes are temperature sensitive, the sensor's electrical output also varies with temperature. This variation is relatively constant (2.5% per ºC change in temperature). A temperature compensation circuit employing a thermistor offsets this effect with an accuracy of ±5% of full scale range or better (over the operating temperature range of the analyzer) and generates an output signal that is virtually independent of small ambient temperature variations. To minimize error in oxygen measurement, the calibration of the analyzer should be carried out as close as possible to the temperature during sampling. From calibration temperature, a variation of ~10º F ambient temperature will produce < 2% of full scale error in O2 measurement.

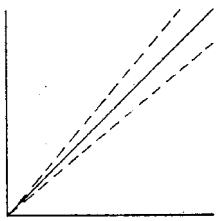


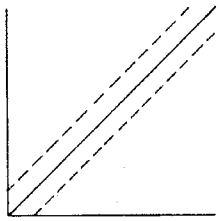
Accuracy: The overall accuracy of an analyzer over its operating temperature is affected by two factors:

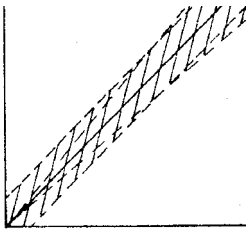
1) 'Percent of reading errors', illustrated by Graph A below, such as ±5% inherited error in the temperature compensation circuit due to the tolerances of the resistors and thermistor used in the temperature compensation circuit.

2) 'Percent of full scale errors', illustrated by Graph B, such as ±1-2% errors associated with actual methods employed during signal processing, measurement and display. This error is generally 'spanned out' during calibration.

Graph C illustrates these 'worse case' errors that are typically used to develop an analyzer's overall accuracy statement of < 1% of full scale at constant temperature or < 5% of full scale over the operating temperature range after the analyzer calibration with a certified span gas.


A. PERCENT OF READING ERRORS


B. PERCENT OF FULL SCALE ERRORS


C. OVERALL ACCURACY

Example 1: Graph A, percent of reading error, Graph B, constant percent of full scale error associated with methods of signal processing, measurements and display, Graph C, combined error as sum of percent of reading and measurement method; central line passing through origin illustrates accuracy after calibration with a certified span gas.

Installation

The GPR-KF-40-12 Oxygen Transmitter is fully operational from the shipping container fully tested with the accompanying oxygen sensor at the factory prior to shipment. The sensor is packaged for shipment in a container to protect the barrier bag containing the oxygen sensor. Do not open or puncture the barrier bag containing the oxygen sensor until such time as the sensor is to be actually installed.

Caution: Exposing a PPM sensor to air for a prolonged period of time during installation will unnecessarily increases the recovery period of sensor (come down from air to low PPM levels). Further, prolonged exposure to percentage (%) levels of oxygen will reduce the expected service life of the PPM sensor.

The transmitter comes with two ranges. The transmitter electronics are set at the factory to provide 20 mA as full scale of the given range by using a nominal signal output from the sensor. However, the signal from the sensor may vary as much as +/-30%. There is a Span adjustment option available with the transmitter. The user must use a span gas about 50-80% of the full scale range (for example 500-800 PPM on 0-1000 PPM range) and check the 4-20 mA signal corresponding to the span gas value. The user may Span potentiometer to obtain a correct mA signal (for example, on a PLC). The mA signal from transmitter will change linearly with oxygen concentration.

Once in service, it is recommended that span calibration rechecked every 30 days.

Considerations:

- Mounting the transmitter and the optional components such as coalescing or particulate filters and pumps.
- Assemble sample system by using stainless steel tubing (for PPM O2 measurements).
- Set the sample pressure and flow as recommended.
- Review the application conditions to ensure the sample is suitable for analysis.
  Temperature: The sample must be sufficiently cooled (ideally less than 35 degree C) before it enters the transmitter and any optional components.
  Moisture & Particulates: Use a coalescing filter to trap excessive condensate and particulates if present in the sample gas.
  Contaminants: Remove any interfering gases such as oxides of sulfur and nitrogen or hydrogen sulfide that can produce false readings and reduce the expected life of the sensor. Consult factory for recommendations concerning the proper selection and installation of coalescing filter.
- Gas connections: There is no Inlet or outlet port (if the transmitter is provided with a KF-40 flow through housing, either port can be used as sample inlet).
- Power connection: Provide the DC power as indicated near the power input terminal and described in this section.
- Output connections. The 4-20mA signal output is on power loop (to measure current insert the measuring device between the negative terminal of the power supply and the terminal marked COMM on the transmitter. Optional 1-5 V output is available between the terminal marked COM and 1-5 V output.

Mounting the Transmitter

The GPR-KF-40-12 is designed to be mounted directly to a sample pipe with KF-40 flange.
Caution: Before connecting the transmitter to the flange, assure that the pressure and flow is within the recommended range.

Gas Connections

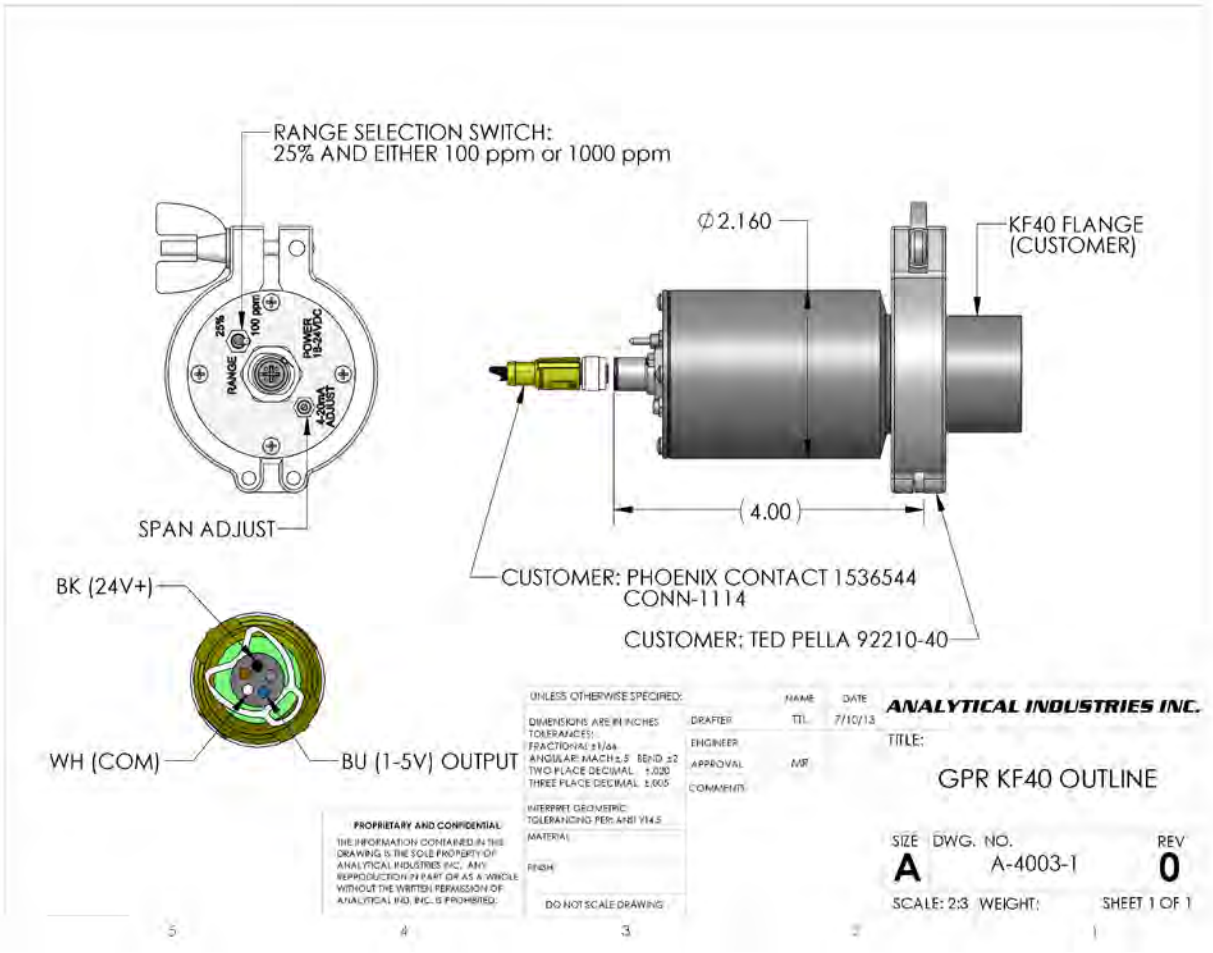
If the transmitter is provided with optional KF-40 flange with a sample flow through design, either of the two tube fitting connectors could be used as “Sample Inlet”. Regulate the sample pressure between 5-30 PSIG and set the flow rates between1-5 SCFH (a flow indicator with an integral metering valve upstream of the sensor is recommended as a means of controlling the flow rate). A flow rate of 2 SCFH or 1 liter per minute is recommended for optimum performance.

Power Connections

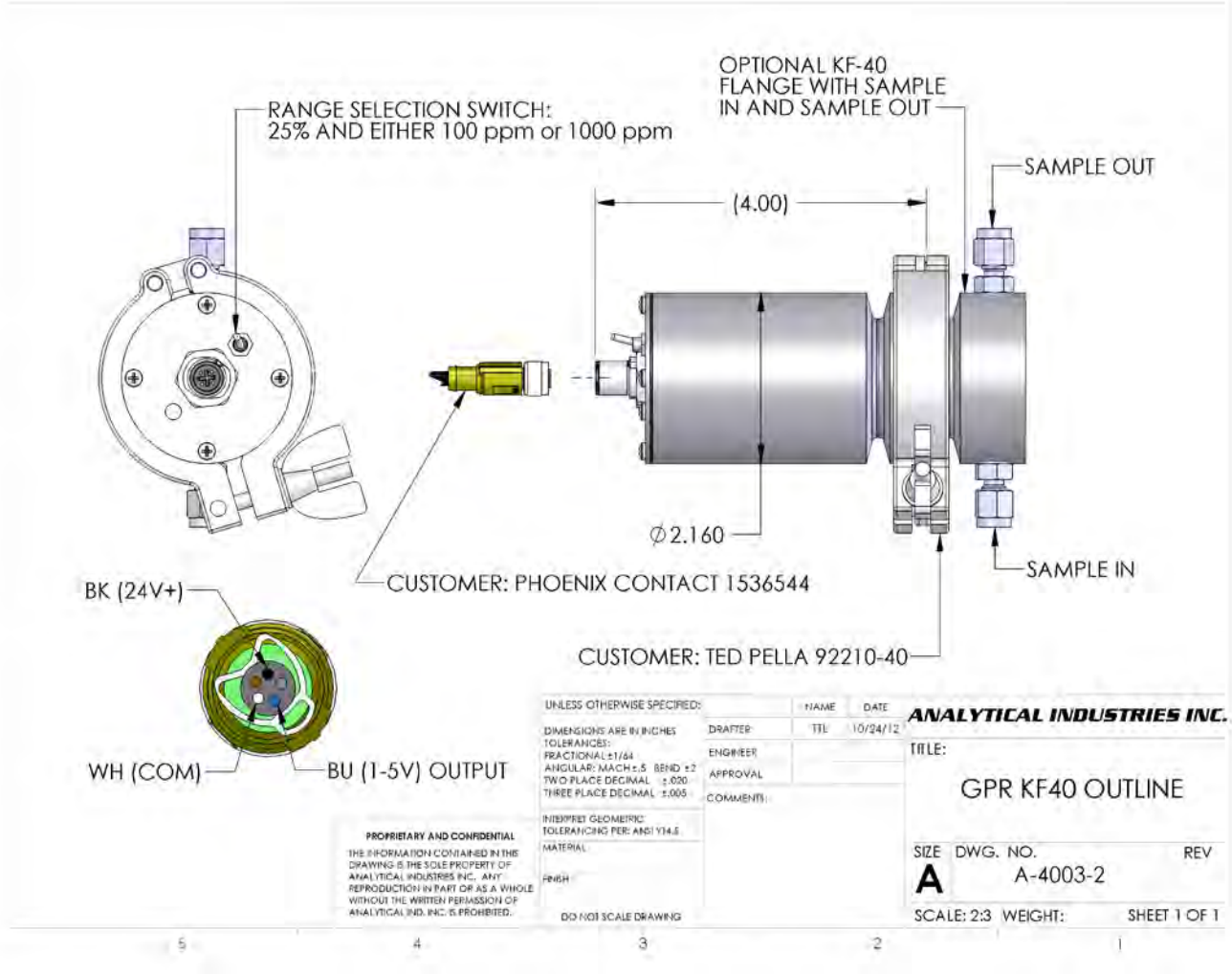
Power to the transmitter must be provided by using Phoenix Contact cable Part Number 1536544 (supplied with the transmitter). Supply 18-24V DC with negative ground to the designated wires (Black positive and White negative (COM).

Signal Output

For most applications, the transmitter will be powered through a PLC and the 4-20 mA signal will be on the same loop. If the transmitter is not powered through a PLC, the 4-20 mA signal can be measured independently. To measure the 4-20 mA current, connect a current meter between the negative terminal of the power supply and transmitter terminal marked COM.
For 1-5 V output, connect a voltmeter between the transmitter terminal marked 1-5 V (Blue) and COM.



KF-40 Transmitter shown with KF-40 customer provided flange



KF-40 Transmitter shown with optional KF-40 flange with sample and vent tube fitting connections

See below the sensor installed in a KF-40 flange integral to a pipe and in optional flow through flange with 1/8 compression type connections

Upper section, the clamp, sensor holder and flange o-ring

Upper section with sensor holder containing sensor and the flange o-ring ready to be installed on the flange of a pipe

Optional flow through KF-40 flange shown with sensor

Range Selection

The transmitter is equipped with two ranges; 25% and 1000 PPM. The 25% range is for trending only. Use the 25% range when senor is exposed to air. Failure to do so will cause the electronics to saturate that may adversely affect the response/recovery time of the sensor. Select the 1000 PPM range when sensor is exposed to low PPM O2.

Installing the Oxygen Sensor

The oxygen sensor requires installation and its signal output should be checked in ambient air to assure that the sensor has output within the recommended range. Once in service, it is recommended that the sensor output verified every 1-3 months interval.

In air (20.9% O2) the 4-20 mA signal is typically 17.4 mA (plus or minus 30% due to the sensor output variation in air). If the 4-20 mA output is less than 13 mA, replace the sensor.

Without making any Span Adjustment (through a Span Adjust Potentiometer accessible on the top of transmitter) when 4-20 mA signal output in air is measured at 17.4 mA, the signal output with 1000 PPM oxygen would be 20 mA. The 4-20 mA signal ratio (air:1000 PPM) would be the same regardless of the sensor's current signal in air. For example, let's say with sensor A, the signal in air is 16 mA, the signal with 1000 PPM would be ((16-4)/(17.4-4) x 16) + 4 = 18.32 mA. With sensor B, the signal in air is 18 mA, the signal with 1000 PPM would be ((18-4)/(17.4) x 16) + 4 = 20.71 mA .

Adjusting 4-20 mA Signal

The 4-20 mA signal may be adjusted by using the "Span Pot" accessible on top of the transmitter. Before making any adjustment,

1) introduce a know/certified span gas to the transmitter, 2) allow the transmitter to stabilize with the span gas, typically 5-10 minutes and 3) use a small screw driver and adjust Span Pot to get the desired mA signal.

CAUTION: Near end of its useful life, the sensor will lose its signal output. When the output falls below 30% of the signal observed at the time of installation, the user must replace the sensor.

5. Spare Parts

Recommended spare parts for the GPR-KF-40-12 PPM Oxygen Transmitter:

Item No.	**Description**
GPR-12-333	PPM Oxygen Sensor for inert gases
XLT-12-333	PPM Oxygen Sensor for gases containing CO2

Other spare parts:

Item No.	**Description**
FITN-1018	Connector SS 1/8” MNPT to 1/8” Tube
CONN-1114	Cable connector for KF-40 Transmitter
A-1109 Rev A-12	PCB Main 25% and 1000 PPM