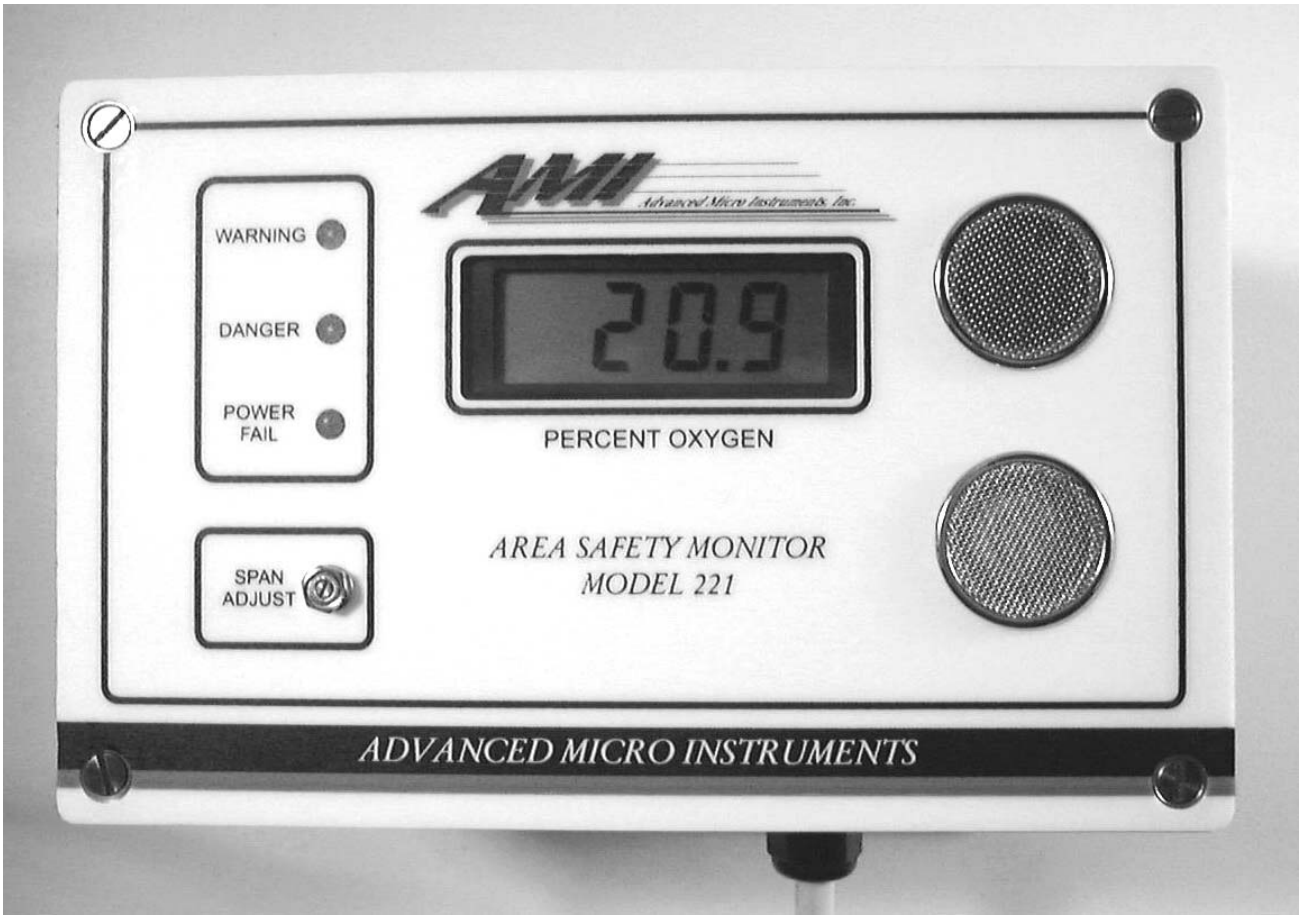
Model 221 Area Monitor Manual



AMI, Huntington Beach

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Preface

The AMI story

The AMI series of analyzers provide the latest in high-definition oxygen analysis. The series includes trace oxygen, percent oxygen and portable trace and percent oxygen models. Most of them share the same basic design, using time proven oxygen sensors and advanced high definition electronics for noise and interference free performance. Certain aspects of the design are the subject of a patent, number 5,728,289.

AMI was formed by a group of analyzer professionals with over thirty years of experience between them. The company is dedicated to providing the very best and most cost effective solutions to the oxygen analysis problem with a range of analyzers.

Every effort is made to ensure that AMI products provide reliable, effective performance. However there are many pitfalls in achieving correct oxygen analysis and AMI stands ready to provide a complete solution to the analysis problem. Please feel free to call AMI for help should your results not meet your expectations.

Caution

Read and understand this manual fully before attempting to use the instrument.

Address

Advanced Micro Instruments.

18269 Gothard Street

Huntington Beach, CA 92648

The AMI Area Monitor Analyzer, Model 221

Introduction

The Advanced Micro Instruments Area Monitor is designed for monitoring of ambient air within an enclosed space in order to provide warning of a reduction in oxygen level that may be hazardous to personnel working in that space. It is designed as an entirely self-contained bulkhead or wall mounted unit that contains the oxygen sensor. It is designed for AC power, and it provides three alarm contacts, as well as an internally mounted audible alarm. It contains a set of rechargeable batteries that allow it to continue working for up to 40 minutes after loss of AC power.

Do not use this unit in a harzardous area, that is to say an area in which explosive gases may occur. It is very likely to ignite them.

Features:

- Compact size
- Three alarm contacts (two level alarms, and loss of AC power)
- Single range operation
- Analog voltage output 0 - 1V
- Two fully adjustable alarm relays, SPDT, 110V AC, 24VDC
- One AC power fail alarm relay
- Internally mounted audible alarm
- Internal non-depleting sensor
- Air calibration, no zero or span gases required
- Extremely stable operation
- High accuracy and fast response
- Liquid crystal display
- Battery back up

Options:

- Analog current output 4-20mA isolated

Oxygen sensor:

The model 221 uses a revolutionary zirconium oxide sensor. Unlike conventional electrochemical sensors, it provides a very stable output that is independent of barometric pressure or temperature, and it has linearity of better than +/- 2% of range. It is non-depleting, and so stable that calibration periods of up to a year are practical.

Percent level analyzers are routinely calibrated on air. Air has a reliable 20.94% oxygen in it, when dry. In the case of the area monitor it is advisable to use a known high quality air supply for calibration since the room air may not contain 20.94% of oxygen!

Linearity

The zirconium oxide sensor used has a very predictable output described by the equation:

$I_L = - (I_A / 0.2357) * Ln(1 – O_2/100)$ where I_L is the output current, I_A is the output current on air, and O_2 is the current oxygen level.

Sensor Warranty:

The sensor has a one year warranty, however typical lifetimes are in excess of 5 years. The sensor is permamently mounted to the electronics, so that in the case of any failure the whole unit has to be returned for service.

Instrument Warranty:

Any failure of material or workmanship will be repaired free of charge for a period of one year from the original purchase (shipping date) of the instrument. AMI will also pay for one way shipment (back to the user).

Any indication of abuse or tampering will void the warranty.

NRTL approval:

This unit has been approved to UL 3111-1, “Electrical Measuring and Test Equipment Part 1: General Requirements” (the applicable UL standard) by an NRTL.

Installation and Operation

Receiving the analyzer

Precaution

When you receive the instrument, check the package for evidence of damage and if any is found, contact the shipper.

Installation.

Location:

The unit is designed to be mounted on a bulkhead (wall) in a general purpose area. It is not suitable for installation in either a hazardous area or outdoors. It should be mounted at a suitable viewing level. Refer to the drawing (figure 1) showing the analyzer dimensions and the mounting hole placement required.

Although the unit is RFI protected, do not to mount it close to sources of electrical interference such as large transformers, motor start contactors, relays etc. Also avoid subjecting it to significant vibration.

The sensor is not particularly sensitive to temperature changes, but the unit should not be placed in such a position that it will be subjected to sudden drafts of inclement air.

The sensor unit should be mounted where it will sense a representative sample of the room air. It is recommended that you install it in such a way that there is good air circulation, such as by an air conditioning vent or fan. The nature of the possible asphyxiating gas also should affect its placement - if the danger is from a heavy gas such as CO_2 or SF_6, the sensor should be mounted low down so that it detects the gas before people start breathing it. If the gas is light such as helium, the sensor should be mounted higher. Otherwise it should normally be mounted at head height.

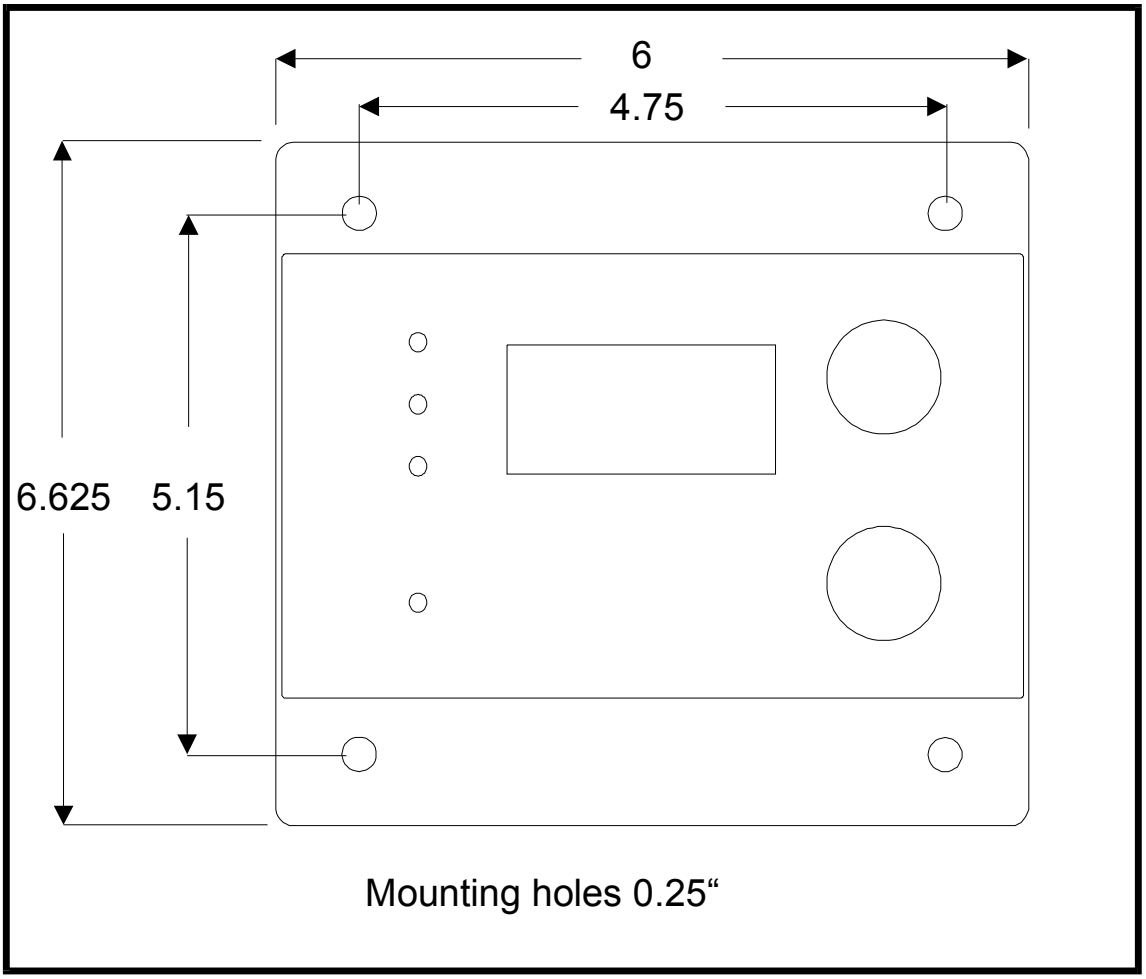

Figure 1. Model 221 Outline Drawing

Power supply connection:

The unit is normally supplied with an attached AC power cord, but it is available with a conduit hole and an internal terminal strip for hard wired connections.

The batteries provide only a short-term backup for momentary power outages. The alarm indication provided to personnel MUST have its own source of back up power, or else a UPS (Uninterruptible Power Supply) should be used to power this unit.

NOTE: The power receptacle MUST have a good ground, and the neutral to ground voltage must be less than a half of a Volt. Violating either of these will give bad readings. The AC power must be within 10% of the nominal voltage, (115/230VAC).

Initial test:

Install the control unit as desired.

Plug the AC cord (provided) into a suitable grounded receptacle. Models with internal power supply connections should be wired up accordingly.

The unit will immediately power up, but it will take about two minutes for the sensor to warm up. During this time the alarms will sound and the unit will indicate about 0% oxygen. After a while, the sensor will warm up to the point that it starts to operate, and the reading will thereupon climb to well over 21%, typically 25% or so. A minute or so later the reading will stabilize close to its final level of 20.9% (assuming it is exposed to fresh air). Leave it for about an hour to stabilize and calibrate it to 20.9%.

Verify that the alarm set points are as desired. They are provided set to 19.5% and 20.0%, and arranged such that the alarm relays are NOT powered below these points so as to be fail-safe. A convenient way to do this is to use the span pot to reduce the oxygen reading, and to note where the alarms come on. The alarm levels are internally adjustable, but you will need to disassemble the unit to change them.

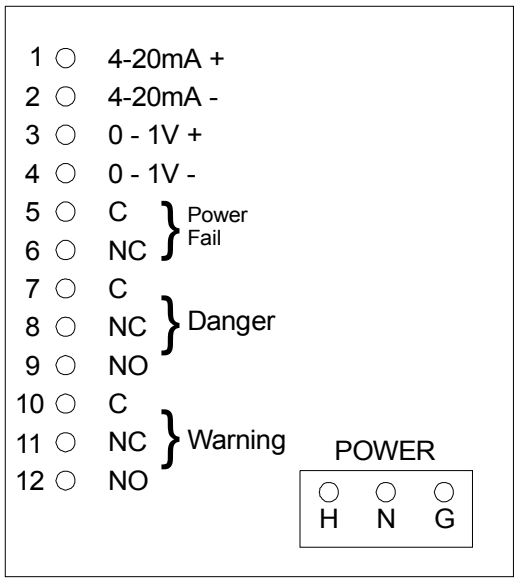

Figure 2. External connections.

Interconnections:

The interconnections are available internally on the back circuit board of the analyzer. To reach them, remove the four screws holding on the front plate, and lift this off. Unplug the ribbon cable, and lay the front aside. The AC terminals are horizontally laid out at the bottom right side of the shielded circuit board now visible, while the interconnections are vertically arranged on the left of the board.

The analyzer has a 0-1V DC output with an optional 4-20mA ouptut and a set of relay contacts. The contacts are rated at 110VAC, but with the following provisos.

> There is only "basic insulation" (within the meaning of IEC1010) provided between the contacts and the rest of the circuitry. This means that in the event of a single fault, it is possible that 110VAC connected to the relay contacts would be connected to the output connections as well. Any equipment connected to the analyzer output may potentially see this 110VAC. Therefore:
>
> The Output connection is for use only with equipment which has no live parts which are accessible.
>
> The connecting cable and the equipment to which the output is connected must have insulation rated for at least 150VAC, since under a single fault condition the output may be connected to the relay contacts which themselves may be connected to 150VAC.
>
> The connection used at the remote end of the output circuit must be such as to be suitable for 150VAC and must have no accessible live parts.
>
> The equipment connected to the output must either be approved to IEC 1010 or equivalent or must be suitable for use with an input that may potentially be connected to 150VAC, and must not catch fire in this circumstance.

NOTE: Double check that you have used the correct terminals and do not apply a high voltage (e.g. 110V) to the relay contacts before you have verified that the output connections are correct - putting AC on the signal output will destroy the analyzer. **Also, do not connect AC hot and neutral to the terminals in such a way that the relay shorts the hot to neutral when an alarm occurs. The results of doing so void the warranty spectacularly!**

Alarm connections:

Alarm relays are single pole double throw relays. Terminals are identified as NO (Normally Open), C (Common), and NC (Normally Closed). These refer to the state of the contacts with no power applied to the relays. Relays may be set to be energized above or below set point at the factory, though for area safety monitors they are always set to energize above set point. See the specifications section of this manual for their ratings.

The power fail relay provides only the common and normally closed contacts.

Output connections:

All models are equipped with a voltage output. An isolated current output is optional. Make sure that any output signal connection is kept separate from the other connections, so as to prevent possible noise and interference pick up.

The loop resistance in a current output circuit must be less than 600 Ohms. Higher resistances will not allow the full 20mA to flow.

The voltage output circuit is capable of driving an input resistance of 10K Ohms or more. Lower input resistances will degrade the accuracy of the circuit.

Alarm settings

The alarms are factory set to 20.0% and 19.5%. We have deliberately made it hard to change these settings, for safety reasons. If you need to change them, please contact the factory.

Sample connection:

No sample connection is required. The sensor is located immediately behind the lower grill on the front panel.

Sensor Installation:

The sensor is permanently installed in the unit and requires no user installation.

Operation

Calibration:

The sensor will stabilize within a few minutes, and it may be calibrated almost as soon as it has come up to temperature.

Make sure that the sensor is exposed to fresh ambient air, and adjust the span control on the electronics unit until the digital display reads 20.9%. If you are not sure that the air is indeed fresh, you should provide a sample of known oxygen level of around 20% to the sensor and adjust the span control until the display reads the contents of the span gas.

Be absolutely sure that you are using at least a certified, and preferably a primary standard span gas supply as the span gas. Alternatively use known fresh air. So called "Manufactured air" or bottled compressed air often has an oxygen content that is significantly different from its label. I have seen manufactured air contain 15% oxygen - this would be enough to kill you if you used it to span the analyzer at 20.9%, and subsequently the real oxygen content in the room air were to drop so that the analyzer thought the oxygen content was 19.5%. The real oxygen content would now be 14.8%., and if you were present you could asphyxiate.

Be careful you don't breathe on the sensor when you are calibrating it! The sensor will accurately track your breath's oxygen content which may go as low as 10% (if your lungs are in really good shape!). Hold your breath while adjusting the span control.

Maintenance and troubleshooting

Maintenance:

The model 221 is virtually maintenance free other than for periodic calibration.

Battery replacement:

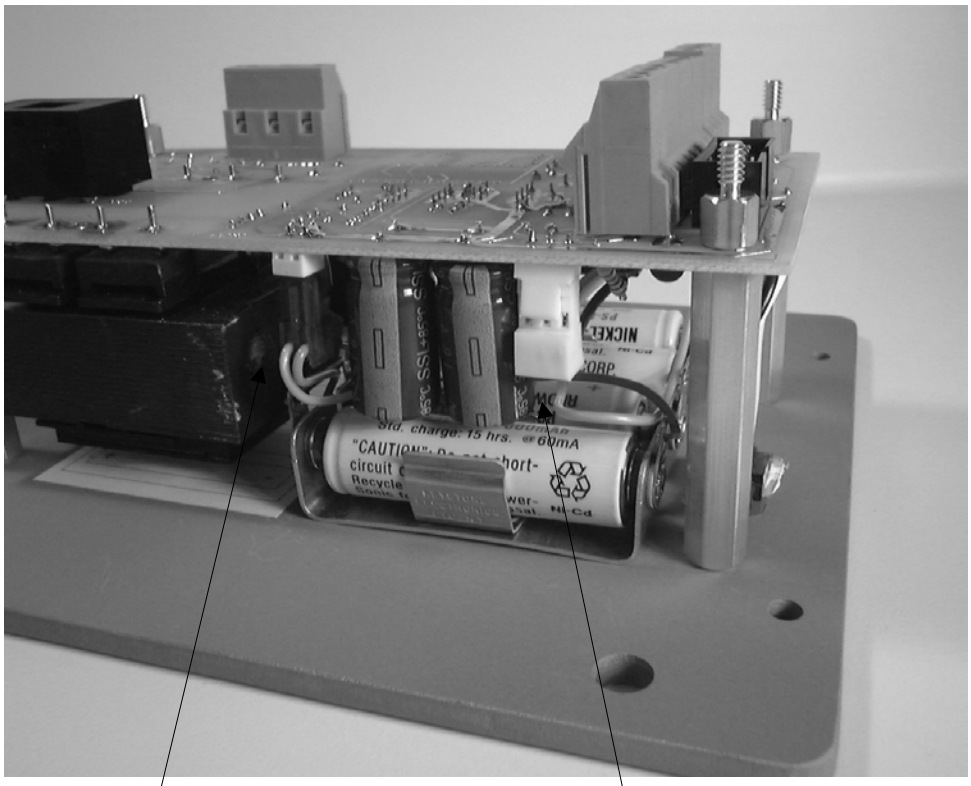

Figure 3. Location of battery connections

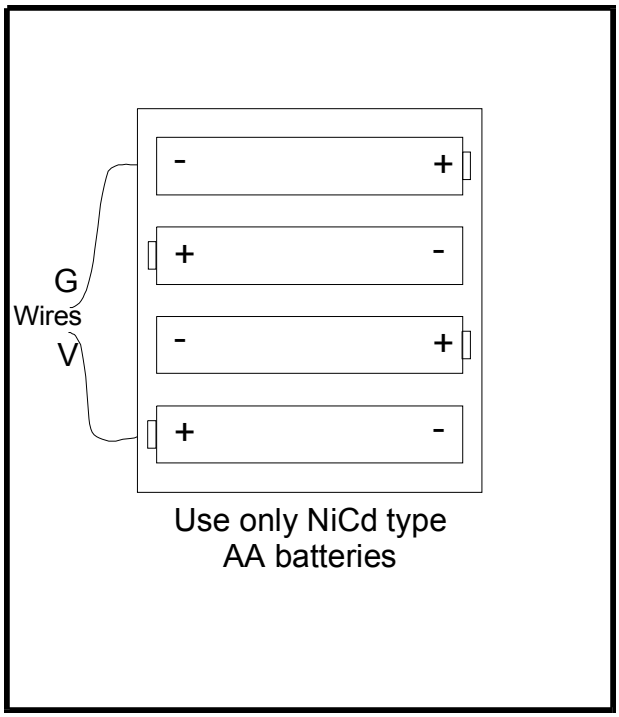

Figure 4. Battery orientation

The four AA NiCd batteries used for short-term battery back up may fail as part of the natural way of NiCd batteries. If so the unit will instantly die as soon as power is removed. To replace them, follow the following procedure:

1. Remove power
2. Remove the front cover
3. Unplug the ribbon cable
4. Turn the unit over
5. Remove the four corner 8-32 flat-head screws holding on the main enclosure
6. Remove the four 6-32 flat head screws holdin on the power circuit board stand-offs.
7. Turn it over again, and lift off the enclosure and the power circuit board.
8. Unclip the old batteries and replace them ONLY with size AA NiCd batteries. Other battery types may cause a risk of fire.
9. Wait for about ten minutes for the sensor to cool down, and and then reassemble everything. Make sure you put the ribbon cable back so it is not twisted!
10. Apply power and leave it overnight for the batteries to get charged
11. Verify that the batteries hold a charge by temporarily removing the AC power and verifying that the unit remains on for a few minutes. Then re-apply power.

Periodic Calibration:

The analyzer should be calibrated about once every six months to obtain the best accuracy. The sensor is essentially perfectly stable, so a six monthly calibration is usually satisfactory. Use in a particularly aggressive environment may degrade the sensor faster: in this case calibrate more often.

Sensor replacement:

The sensor should never need replacement, but if it should fail the whole unit must be returned to the factory.

Calibration:

The sensor will stabilize within a few minutes, and it may be calibrated almost as soon as it has been turned on.

12. Either expose the sensor unit to known good fresh air, or using a user-supplied valve, flow a known good span gas past the sensor.
13. If calibrating on air, adjust the span potentiometer so that the reading on the LCD is 20.9%.
14. If using a calibration gas, read the value on the gas bottle label.
15. Adjust the span potentiometer until the reading on the LCD display corresponds to the value on the gas bottle.

NOTE: Alarms are not disabled during this process. Take any precautions necessary to avoid false alarm indications.

Troubleshooting

Analyzer does not power up.

1. Check that the power cord is plugged into a receptacle and that the receptacle is itself powered.
2. Remove the front cover of the analyzer (4 screws).
3. Check that the PC boards within the analyzer are intact and correctly mounted.
4. Check that the ribbon cable connecting the two boards inside the module is plugged in at both ends.

Analyzer reads too low

1. Sensor is not calibrated. Flow span gas through the sensor unit (or expose it to known good air) and adjust the span potentiometer until the analyzer reads appropriately.
2. If you cannot adjust the span potentiometer enough to accomplish this, try with real fresh air, and if still no joy, return the unit to AMI.

Analyzer reads too high

1. Verify the analyzer calibration using air as the span gas.

No voltage or current output to recording device

1. Verify the connections on the output terminal block.
2. Verify that the model you have ordered does in fact have the correct output.
3. Verify that the output connections are not shorted all the way back to the recording device. Disconnect the wires from the analyzer and use an ohmmeter to check for shorts or opens.

No output alarm indication

1. Verify the alarm set points are correct – adjust the span pot until the appropriate alarm LED comes on, and verify the LCD reading..
2. Verify the connections on the output terminal block.
3. Verify that the output connections are not shorted all the way back to the recording device. Disconnect the wires from the analyzer and use an ohmmeter to check for shorts or opens.

Incorrect readings

1. Verify that the span gas bottle is correctly marked by comparing its reading when the analyzer has been spanned on air to what it actually says.
2. If spanning on air, verify that the air source is free of water vapor (humid air will contain about 3% less oxygen than expected, depending on temperature), and that bottle air does actually contain 20.9% oxygen. Manufactured air often does not!

Still no correct operation

1. Call AMI at 714 848-5533, and ask for Service.

Specifications and Disclaimer

Specifications:

Standard ranges:

Area Monitor: 0 - 25%

Sensitivity: 0.5% of full scale

Repeatability: +/- 1% of full scale at constant temperature

Operating temperature: 5 - 45°C

Humidity: < 85%, non-condensing

Operational conditions: Pollution degree 2, Installation category I I.

Drift: +/- 1% of full scale in 4 weeks at constant temperature (dependent on sensor)

Expected cell life: 5 years.

Response times:

Percent: 90% of full scale < 30 seconds

Outputs: 0 - 1 VDC, optional 4 - 20 mA isolated.

Alarm contacts: SPDT 3A 24V DC / 115V AC

Power requirements: 115/230 VAC +/- 10%; 50/60 Hz; less than 20 W

Box dimensions: 6.625"h x 6”w x 4.35”d

Weight less than 10 lbs

Disclaimer

Although every effort has been made to assure that the AMI analyzers meet all their performance specifications, AMI takes no responsibility for any losses incurred by reason of the failure of its analyzers or associated components. AMI's obligation is expressly limited to the analyzer itself.

In particular, the AMI analyzer is designed for operation with non-flammable samples in a general purpose, i.e. non-hazardous area. Any damage resulting from its use in a hazardous area or with flammable or explosive samples is expressly the responsibility of the user.

The AMI analyzer is not designed as a primary safety device, that is to say it is not to be used as the primary means of assuring personnel safety. In particular it is not designed to act as a medical instrument, monitoring breathing air for correct oxygen concentration, and should not be used as such when it is the only safety device on the gas system.

Glossary of Terms

Accuracy

A loose term. In general with analyzers when we use the word "accuracy" we really mean "repeatability", the degree to which an analyzer can repeat the same measurement reading on the same gas. All analyzers really compare the measured gas against a known standard, and the accuracy of their measurement is therefore dependent upon this standard.

Bulkhead

Refers to a method of mounting an analyzer where the back of the analyzer is mounted flush against a panel or wall, while the body of the analyzer extends out in front of it, like a box hung on a wall's surface rather than inset.

Come-down

A term referring to the operation of an analyzer reducing its reading from a high level to a low or zero level. For trace analyzers this can be quite long, as it can take a long time for the final traces of oxygen to diffuse out of the gas sampling system.

Electrochemical

A type of chemical reaction which produces an electrical current as part of the reaction. In this case, the oxygen sensors produce an electrical current in proportion to the amount of oxygen present at their membrane surface.

LCD

Liquid Crystal Display - a form of digital display suitable for reading in bright light conditions. The display degrades below about -20C and above about 60C.

Membrane

A thin layer of permeable material (normally Teflon or a similar flouro-carbon) that controls the rate of diffusion of oxygen into the electrochemical sensor. It also controls the rate of diffusion of electrolyte out of the sensor. If the membrane is torn the sensor must be discarded.

Output - voltage or current

An analog voltage or current proportional to the oxygen measurement as a percentage of range, suitable for driving a chart recorder or computer input. A current output is preferred as it is less subject to interference than a voltage signal.

Panel

A type of mounting where the analyzer is inserted into a vertical panel so that the face plate is visible on the panel, while the body of the analyzer extends behind it.

Process

Refers to the sample that is supposed to be analyzed. Typically an analyzer measures the product of a chemical or physical process, and this is generally referred to as the "Process"

Range

The operational range of measurement of the analyzer. This is set by its amplifier sensitivity. Oxygen levels higher than the range full-scale will not be measured accurately. Normally the analyzer should be measuring oxygen concentrations between 20 and 80 percent of its range.

Response

The response time of an analyzer is defined as the time taken to go from the beginning of a noticeable change to 90% of the final level. The beginning is often defined as 10% of the final level. This is also called the "t90" time. The transit time of the gas is not included in this measurement.

RFI

Radio Frequency Interference. All analog circuits are prone to interference from high lervel radio frequencies, and special precautions must be taken to prevent this. The quality of such design is referred to by the acronym EMC, or electromagnetic compatibility - the property of being compatible with any practical electromagnetic environment.

Span

To calibrate the upper end of the range of measurement, as opposed to the bottom end or zero. Generally this is done by exposing the sensor to a gas of known concentration, and making the analyzer read that value.

Zirconium oxide

A style of oxygen sensor that uses the electrochemical action of this material to measure oxygen