Model 221R Area Monitor Manual

AMI, Costa Mesa, CA

Contents

Preface

Thank you

Thank you for purchasing one of Advanced Micro Instruments, Inc.'s range of high-definition oxygen analyzers.

The model 221R is the state of the art in ambient oxygen monitoring. It will provide many years of reliable, accurate and virtually maintenance-free service. It uses a sensor with an expected ten year life, and is suitable for use in extreme environments – for example it can be used in a meat locker below freezing where it may be hosed down. The sensor used is not affected by barometric or temperature changes between 0 and 130°F and is inherently extremely stable so it will not generate false alarms. Please read this manual carefully prior to use, and if you have any questions about the installation or operation, feel free to contact our service department directly via phone.

Initial revision April 2009

Revised August 2009 – modified outline drawing

Revised September 2009 – clarified certain software functions, and deleted the references to calibration above 22%.

Revised November 2009 - multiple text changes to satisfy NRTL documentation requirements.

Revised February 2013 – addition of remote probe comment and limitation of RS485 and remote probe cabling noted. Also CE mark status noted.

Revised August 2013 – additional notes on CE power cords added. Also upgraded to UL61010-1 latest revision.

Revised May 2014 – note about default settings of alarms and silence time out added.

V2 Nov 4 2014 – communications section removed and various formatting changes added

V3 1/27/16 – removed altitude specifications.

Address

Advanced Micro Instruments
225 Paularino Avenue
Costa Mesa, CA 92626
(714) 848-5533
www.***amio2***.com
Last Revised: 11/13/2019

The AMI Area Monitor, Model 221R

Introduction

The 221R Area Monitor is a state of the art oxygen deficiency monitor. It provides warning against dangerously low levels of oxygen with two preset OSHA-standard alarm set points of 20% for caution (Alarm Relay 2) and 19.5% for danger (Alarm Relay 1). Both set points trigger form C alarm relay contacts, and the 19.5% set point also triggers a 95dB audible alarm. In addition the 221R will give an alarm if the oxygen level becomes too enriched at 23.5%, firing the danger relay contact and the audible alarm. It has a red back-lit display that is visible from a distance in a dark area, and it operates off AC power but it also has an internal battery back up that can keep it operational approximately an hour after a power failure. It contains a data-logger, and can be linked to a general monitoring system either through its standard isolated 4-20mA analog signal, or else through a multi-drop RS485 digital communication system. The front panel controls include an alarm silence button.

The alarm settings are by default set to the OSHA specified levels, with a silence time out of one minute. It is possible to change these over the RS485 interface, but a special procedure is required to do it. Please contact the factory if you need to do this.

As an option, a remote probe can be provided that allows the unit to monitor the gas within a separate area up to 300ft away while itself remaining on the wall outside.

Do not mount the model 221R analyzer in a hazardous area, that is to say an area in which explosive gases may be present. The zirconium oxide sensor will ignite flammable gas mixtures.

Features:

- Ultra-stable long-life sensor – typically ten years of life.
- Unaffected by barometric or temperature changes over very wide ranges.
- Sensor protected by hydrophobic membrane.
- Red backlit 3 ½ digit LCD. High-resolution and easy to read from across the room.
- 2-Factory preset oxygen depletion alarms. Set for OSHA standards of 20.0% for CAUTION and 19.5% for DANGER. Relays are Form C contacts. See relay AC specifications.
- Additional standard oxygen enrichment alarm trips DANGER relay at 23.5%.
- 95db audible alarm that sounds when the oxygen level drops below 19.5% danger set point.
- Battery back up in the event of AC power loss.
- User configurable alarm logic: Fail-safe/non-failsafe, energize above/below set point, and latching/non-latching.
- Measurement range is 0-25%. Optional ranges available upon request.
- Data logger. Logs data for 15 days continuously @ 1min intervals, adjustable from 1 minute to 60 minutes via the optional user interface.
- Isolated 4-20mA output.
- RS-485 communications with optional user interface program available.
- Simple, intuitive user interface.
    - Supports data logging of oxygen and voltages
    - Calibration history
    - Many other features
- Customer selectable security lockout feature.
- RFI protected.
- Unmatched 2-year warranty on all components including sensor.
- Sensor life expectancy of ten years.
- Water-proof enclosure may be hosed down.
- Bright status LED for any alarm conditions.
- 1 minute front panel alarm silence button.
- CE marked.

Oxygen Deficiency Hazard:

This unit warns of low-level oxygen in room air. It is intended for use in situations where some other gas such as nitrogen might dilute the room air to the point that it no longer supports life. For example, a leak in a high pressure nitrogen system or a spill when using liquid nitrogen, might quickly displace room air with nitrogen, causing serious injury or death.

Human lungs are excellent in making the oxygen level of the blood the same as that of the air filling them. This means that a breath of pure nitrogen will strip the blood of all oxygen which will cause immediate unconsciousness, and rapid death. This is unlike what happens when you hold your the breath.
OSHA requires that oxygen content is kept above 19.5% with 20% being the warning point. In point of fact, at sea level a person in good health can tolerate levels as low as 15%, so the 19.5% alarm set point provides a good safety margin. However it takes a lot of diluent gas to bring the oxygen content of a reasonable sized room even to that level, and thus it is best to be safe. For safety reasons the 221R does not allow the alarm set points to be changed other than via the RS485 communication system.
If the alarm sounds, leave the room immediately. It is not possible to be macho or tough in the absence of oxygen! Let the fire department deal with the problem.
It is essential that calibration is only performed on known fresh air or on a known span gas, and by a trained person. Miscalibration will void the effectiveness of this unit, and could result in serious injury or death. A calibration should be performed somewhere between three and six month intervals for best reliability.
By default, the unit will also give an alarm if the oxygen level exceeds 23.5%. Excessive oxygen levels can be a serious fire hazard.

Oxygen sensor:

The model 221R uses a very stable, reliable zirconium oxide sensor. Its output is not influenced by barometric pressure or temperature; it has a ten year life expectancy and is non-depleting.

The sensor is mounted on the upper right hand side of the enclosure, and it may be calibrated by flowing a known span gas or fresh air over it using our special calibration flow-through adapter.

Instrument Warranty:

Any failure of material or workmanship will be repaired free of charge for a period of two years from the AMI ship date. AMI will also pay for one-way ground shipment (back to the user).

Any indication of abuse or tampering will void the warranty.

NRTL approval:

This unit has been approved as meeting the requirements of UL 61010-1, “Electrical Measuring and Test Equipment Part 1: General Requirements” (the applicable UL standard). It also has been shown to meet the appropriate electromagnetic compatibility requirements and is therefore given the CE mark.

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. Do not install it in a hazardous area containing flammable gases. It should be mounted at a suitable viewing level.

The unit is provided with four mounting holes suitable for mounting bolts up to 3/8" diameter. Mount it to a wall such that the mounting is strong enough to withstand the weight of the unit (about 4 pounds). If mounting on drywall use suitable bolt anchors.

It is not good practice to mount it close to sources of electrical interference such as large transformers, motor start contactors, relays etc or where it is subject it to vibration.

It is recommended that you install the monitor close to a potential leak source that might cause the depletion, such as a high pressure cylinder, or a source of liquid nitrogen. If the danger is from a heavy gas such as CO_2 or cold nitrogen from the liquid, 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 be mounted at head height.

The sensor is mounted on the right side of the box. Make sure it is exposed to the potential hazard or close to the personnel to be protected.

If the unit is equipped with a power cord, mount it so that the cord can easily reach a suitable power outlet.

Important:

If the unit is used in a way incompatible with this manual, the protections afforded by the design may be impaired.

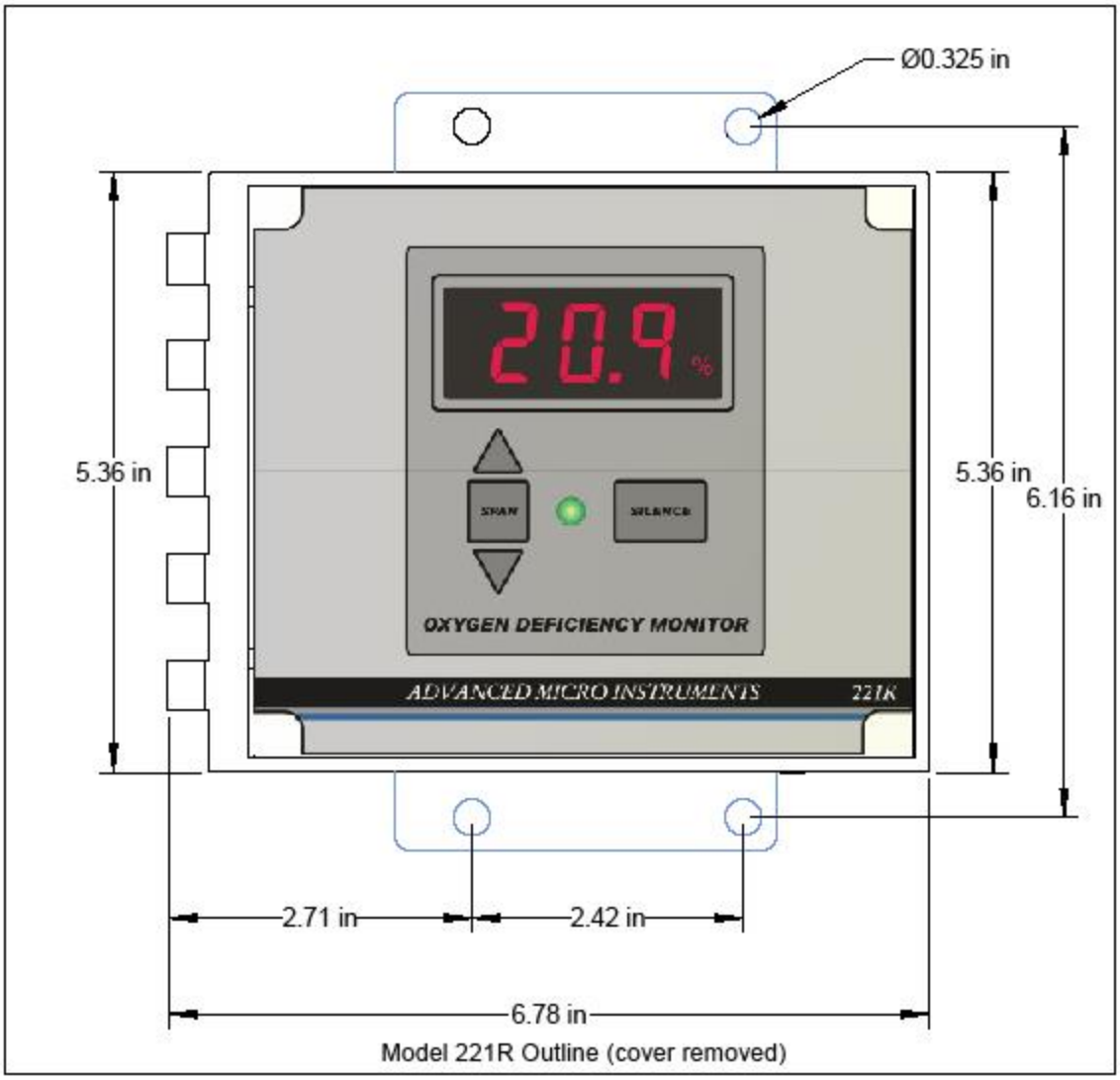

Figure 1. Model 221 Outline Drawing

This Page Left Intentionally Blank

Wiring interconnections:

Symbols used:

The following symbols are used on the unit:

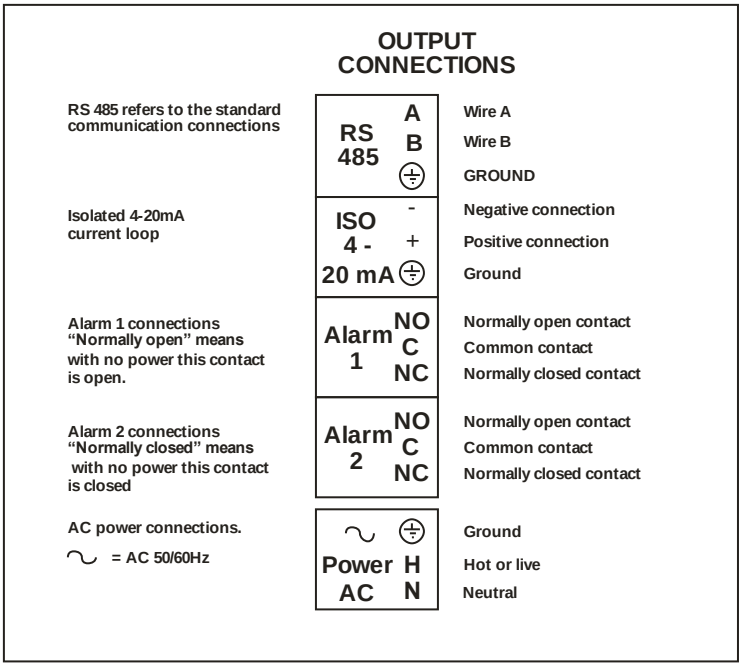

Figure 3. Meaning of symbols used.

AC Power:

The unit is designed to be hard-wired but optionally it may be supplied with a power cord. See AC power specifications.

The connection to the circuit board is made with a Phoenix combination connector hidden behind a small metal shield. Remove the shield for making a hard-wire connection, but it MUST be replaced prior to use.

For use in areas controlled by US (UL) standards, an IEC power cord must be used (if the unit is not to be hard wired). The AMI part number is 3PCD01.

For European areas, a CE marked cord with a "Shuko" connector must be used (if the unit is not to be hard-wired). The AMI part number is 3PCD02.

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 are normally set to energize above set point (known as "failsafe"). See VAC specifications for the

Relays. The connections can accept up to 12AWG wires. Run the alarm contact wiring in the same conduit as the AC power, separate from the 4-20mA output signal.

The alarms are factory set to 20.0% and 19.5%. They may only be changed by use of the RS485 communications. They will also both fire if the oxygen level exceeds 23.5%.

Also, if the user attempts to make the unit read 22% or higher during calibration, the alarms will turn on and will not turn off until the calibration is corrected.

Output connections:

All models are equipped with an isolated 4-20mA self powered current output. Make sure that any output signal connection is kept in a separate conduit from the AC 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 output wiring should be a twisted, shielded pair, with the shield attached to the ground terminal provided on the analyzer output connector. Do not ground the other end.

The positive and negative terminals of the 4-20mA current loop are both floating. When you connect it to a recording device, or the input of a SCADA system or similar, it is necessary to have at least some ground connection. Normally the input of your SCADA system will be grounded, but if it is also isolated, then a ground has to be attached somewhere. In this case, the best thing to do is to ground the negative input of the SCADA device. Don't leave both ends floating.

If the digital connection (RS-485) is going to be used, connect the A terminal on the analyzer to the A terminal on the computer, and the B on the analyzer to the B on the computer. If this doesn't work, you can try reversing the connections.

The communication loop must be set for 9600 baud, 1 stop bit, no parity, and no flow control.

The maximum length for the RS485 cable is 300 ft (92 meters).

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, See specifications for AC power in.

Remote Probe Option:

A special version of the model 65 can be attached in place of the main unit's internal sensor. The maximum length of the connection cable is 300 ft (92 meters). It uses RS485 to get the reading from the model 65, and thus the connection should be essentially free of interference.

Operation

Controls:

The analyzer has four operating controls, expressed as tactile switches on the front overlay.

UP:

This is shown as an upward pointing arrow point. It has two functions – when pressed by itself, it causes the display to show the "span factor", that is, the gain of the system that relates the reading to the sensor output. This is normally a number like 450, and can vary between about 350 and 999. If this number changes significantly after a calibration, it either means that the calibration was bad for some reason or else that the sensor is aging.

When pressed after the SPAN button, it causes the "Span factor" to increase, increasing the reading.

DOWN:

This is shown as a downward pointing arrow point. It also has two functions – when pressed by itself, it causes the display to show the date of the last calibration expressed as mm.yy, that is to say, if the unit was last calibrated in August 2013 it will show 8.13 on the display. This date (along with the span factor and calibration gas) is stored in the "Span history" data accessible through the User Interface.

When pressed after the SPAN button, it causes the "Span factor" to decrease, decreasing the reading.

SPAN:

This button is located between the UP and DOWN buttons. When pressed, it puts the unit into the span mode. The "SPAN" flag will show on the LCD, and the UP and DOWN buttons are enabled to change the span factor. The main display shows the oxygen reading, and the user is expected to adjust either the UP or the DOWN button to make that reading correspond to the oxygen level in the gas seen by the sensor, normally 20.9% for fresh air.

After five seconds of no activity, the unit drops out of the span mode and stores the new span factor along with the date and the reading in the span history.

SILENCE:

If the unit has gone into alarm, such that the audible alarm is sounding, this button will silence the alarm for a period set by the alarm silence variable which is configurable using the User Interface. Normally it is one minute. It also aborts any span function if the unit is in the middle of a span.

Initial test:

Confirm the wiring is correct per the previous chapter.

The unit will immediately power up, but it will take about two minutes for the sensor to warm up completely. During this time the alarms will not sound, the status LED will be blue and the unit will start off by indicating about 0% oxygen. The reading will gradually increase, overshoot and then settle at about 20.9%. After about 20 minutes it will stabilize at its final level of 20.9% (assuming it is exposed to fresh air). Once it has warmed up, the LED will change color to green and the alarms will become enabled. Leave it for about an hour to stabilize and if it doesn't read 20.9%, calibrate it (on fresh air) to 20.9%.

It may be appropriate to test the overall alarm system by breathing into the sensor and verifying that all the alarm indications work correctly.

Calibration:

The analyzer may be calibrated after approximately an hour of operation. It has been calibrated at the factory, but elevation changes may require a new calibration.

Make sure that the sensor is exposed to fresh ambient air, either by making sure that its environment contains fresh air, or by applying a certified span gas though the optional calibration adapter (sold separately).

To calibrate, press the SPAN button, then the up or down buttons 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 20.9% to the sensor and adjust the span control until the display reads the contents of the span gas. A practical means of doing this is to physically take the unit outside, relying on the batteries to keep it operating while you do so.

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 less oxygen content than its label suggests.

Recommended calibration of the MODEL 221R is once per year.

Be careful you don't breathe on the sensor when you are calibrating it using fresh air! The sensor will accurately track your breath's oxygen content, which may go as low as 10%. Either breathe away from the sensor or hold your breath while adjusting the span.

Alarm silence:

If the alarm is sounding, you can press the "Silence" button to quiet the audible alarm for (by default) one minute.

Calibration information:

Calibration factor:

You can see the calibration "span factor" by pressing the UP arrow. This number is equivalent to the span pot setting on an old-fashioned analog analyzer. This number will be changed each time you perform a calibration, and by tracking its value you can get an idea of the sensor life. As the sensor ages, after several years the number will start to increase. As it approaches 1000, the oxygen sensor is nearing the end of its life.

Date of last calibration:

You can see the year and month of the last time it was calibrated by pressing the DOWN arrow. It is in mm.yy format, and is updated every time the unit is calibrated. Through the user interface you can see the current span factor and also the span factor of the previous calibration (as long as it was last calibrated at least a month before the current calibration).

Status light:

There is a multi-color LED just below the LCD panel. It changes color to indicate the analyzer status as follows:

Color	**Definition**
Red	DANGER alarm
Red + Green (looks yellow)	WARNING alarm
Green	Normal operation
Blue	Warming up - alarms disabled
Red flashing	AC power lost
Red flashing, and no LCD back light	AC power lost, and batteries almost dead

Security:

It is possible to set the unit so that it is impossible for a casual user to calibrate it by using the optional user interface with the RS-485 communication. See later under the "Communications" section. This keeps people from deliberately setting the calibration high so as to avoid alarms. We have included the miscalibration alarm to help avoid this too.

Alarms:

If the unit detects an oxygen level less than 20%, alarm relay 2 will de-energize, and the LED on the front panel will change from green to yellow.
If it detects an oxygen level below 19.5%, alarm relay 1 will de-energize, the LED will change to red, and the audible alarm will sound. The audible alarm is rated at 95dB. It may be silenced for one minute by pressing the "Silence" button on the front panel. Don't take risks if the oxygen level is low – leave the room immediately.
If the oxygen level exceeds 23.5%, or 22% during calibration, the alarms will also fire and the audible alarm will sound.

For advanced users, the alarm levels, and general operation can be changed over the RS485 network, so it is possible to make the unit respond to different levels of oxygen if desired.

Power failure:

If the AC power fails, the internal batteries will keep the unit working for about an hour. During this time the LED backlight of the LCD panel will flash, and the status LED will turn red and flash.
After about an hour, the batteries will start to die, and the LED back light will turn off, though the LED will continue to flash. The sensor heater will be turned off, the oxygen reading will drop to zero, and the unit will go into alarm.
Eventually the computer will be unable to operate, and the LED will cease to flash, and the relays will be unpowered (by default, indicating an alarm condition).
If the AC is turned back on, the unit will operate normally unless the batteries have died, in which case it will turn off alarms (i.e. power up the relays), and warm up for two minutes before it starts operating normally again.
The batteries will take about 24 hours to achieve a full charge once they have been discharged.

Cleaning:

Do not mount attempt to clean the unit with an organic solvent like isopropyl alcohol. The sensor may ignite it and it will certainly cause an alarm.

It is not normally necessary to clean the unit, but if it is desired to do so, be aware that any solvent will be oxidized by the sensor and might catch fire – and it will certainly cause the sensor to read low and generate an alarm.
Use a normal glass cleaner like Windex to clean the surfaces, but be careful not to spray it into the black sensor holder on the right side of the unit. The sensor is

protected by a permeable plastic shield, but the ammonia will be somewhat aggressive to the sensor and might degrade its life.
The unit may be hosed down as long as the door is closed and latched, the cover plate is firmly screwed down with its O ring in place, and the conduit entries are sealed.

Service:

The unit has no serviceable parts inside. If it shows signs of needing repair, contact the factory for an RMA.

Communications

Basics

The 221R supports RS485 over a network. It supports the proprietary AMI protocol, and AMI provides a program on a CD that interfaces with the analyzer. Alternatively it is possible for someone familiar with communications on a PC to directly use the protocol.

The RS485 port is located at the top of the series of Phoenix connectors in the pocket on the left side of the analyzer. It runs at 9600 Baud. If you are using it with a standard PC, you will need a USB-to-RS485 adapter.

Note that the definitions of the two wires (A and B) can be inexact. If the adapter doesn't seem to work, try swapping them over.

We recommend that you use the AMI communications program for reading from and setting up the analyzer.

- Use the latest software Interface. It supports the new analyzer features mentioned below. Please contact our sales team if you are interested in the software interface program.
- See the AMI Communications Manual for details. This manual is available from our sales team.

Specifications and Disclaimer

Specifications:

Measurement range: 0-25%
Sensitivity: 0.05% Full scale
Repeatability: ±0.1% of oxygen reading at constant temperature
Display: Large 3 ½ digit red backlit LCD
Approved Operating temperature range: 41-104°F
(Unit has been routinely tested over the range 0-130°F).
Diurnal temperature specification: 0-130°F, < ±0.2% of scale
Humidity: Maximum relative humidity 80% for temperatures up to 31°C, decreasing linearly to 50% relative humidity at 40°C
90% Response times: <15 seconds
Alarms (standard):
2-oxygen concentration alarms.
Form "C" contacts. 5A @90 - 240VAC
Isolated output signal: 4-20ma (self powered)
Maximum length of interconnection (RS485 / remote probe) wiring:
82 feet (25 meters).
Power requirements: 90-240VAC 50/60Hz <11W
Mains supply voltage fluctuations up to +/-10% of the nominal voltage acceptable.
Area classification: Approved as meeting General Purpose UL 61010-1 standard for indoor use.
CE marked.
Pollution degree: 2 (Normally only non-conductive pollution occurs. Temporary conductivity due to condensation is to be expected.)
Dimensions:
7.0"W x 5.75"H x 4.5"D.
Weight: 4lbs
Sensor type: Zirconium oxide
Sensor life: 2-year warranty, 10-year life expectancy

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 model 221R is designed to be used as a primary safety device for monitoring ambient air, where personnel are potentially exposed to inadequate (or excessive) oxygen levels. It is not designed as the **sole** controller of oxygen level in a system with no natural source of air, and in such a case should be used with a backup unit.

MET LABORATORIES, INC.
CERTIFICATION RECORD

The applicant named below has been authorized by MET Laboratories, Inc. to represent the product(s) listed in this record as "MET Certified" and to mark this these product(s) according to the terms and conditions of the MET Mark Utilization Agreement, MET Listing Reports, and the applicable marking agreements. Only the product(s) bearing the MET Mark and under a follow-up service are considered to be included in the MET Certification program. This certification has been granted under a System 3 program as defined in ISO Guide 67.

FILE NUMBER: 212383

APPROVAL DATE: January 25, 2010

REVISED: May 21, 2010

PRODUCT(S)	MODEL(S)	ELECTRICAL RATINGS
Oxygen Deficiency Monitor	221R	100-240VAC, 60Hz, 15W

STANDARD NUMBER	STANDARD TITLE	EDITION
UL 61010-1	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use	2nd

MET LABORATORIES, INC. requires that any and all changes proposed in the previously identified product(s), that affects the information contained in the above referenced listing report, must be submitted to MET for evaluation prior to implementation to assure continued MET Certification status.

The above identified product(s) has/have been submitted by the applicant:

APPLICANT:

Advanced Micro Instruments, Inc.
18269 Gothard Street
Huntington Beach, CA 92648

The covered products shall be subjected to follow-up inspections to ensure that the Certified product(s) are identical to the representative product sample evaluated by MET LABORATORIES, INC. and that all manufacturer's responsibilities are being fulfilled as specified in the MANUFACTURING RESPONSIBILITY section of the Certification report.

Rick Cooper
Director of Laboratory Operations,
Safety Laboratory