OPERATING & SERVICE INSTRUCTIONS FOR

AD300

PORTABLE OXYGEN ANALYZER

MD300

PORTABLE OXYGEN MONITOR

P/N M/AD/MD300
06-23-2010

TYPE B EQUIPMENT: Equipment providing a particular degree of protection against electric shock, particularly regarding—

- Allowable LEAKAGE CURRENT
- Reliability of the protective earth connection (if present).

FCC Statement

This equipment generates and uses radio frequency energy, and if not installed and used in strict accordance with the manufacturer's instruction manual, may cause interference to radio and TV communications. It has been type-tested and certified to comply with the limits for a Class A, and exceeds limits for a Class B, computing device pursuant to Subpart J of FCC Rules, which are designed to provide reasonable protection against such interference when installed in a commercial and residential environment. Operation of this equipment in a residential area may cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

Note: The above statement is required by the FCC for any device that incorporates microprocessors.

Warranty

Teledyne warrants that the goods are free from defects of material and of construction for a period of 2 years from the date of shipment from Teledyne. The Class R-17S Micro-Fuel Cell is warranted for two years from the date of shipment from Teledyne. The liability of Teledyne if any; shall be limited solely to the replacement and repair of the goods and shall not include shipping costs or other incidental damages as defined in Section 2-715 of the U.S. Uniform Commercial Code.

This warranty is null and void if any goods are subjected to misuse, negligence, accident, or repairs other than those performed by Teledyne or an authorized service center.

About This Manual

The AD300/MD300 Operator's Manual provides both introductory and detailed information for configuring and operating these instruments. The manual takes you from the time you unpack the instrument until you complete the first gas analysis. The bulk of the manual contains operating procedures and information. There are also cautions, warnings, and guidelines to ensure that your monitor operates normally and to its full potential. A troubleshooting section is available to assist you with common problems and a complete product specifications and spare parts list is included as an appendix.

A Quick start manual is also supplied which provides the minimum information you need to use the instrument immediately.

Chapter 1: An introduction to the monitor and its components, features and applications

Chapter 2: Step-by-step set-up procedures and information

Chapter 3: A guide for daily operational maintenance and troubleshooting

Appendix: Specifications and available spare part options for the monitor, and detailed application considerations to aid in troubleshooting, etc.

How To Use This Manual

This manual is designed to walk you through the initial set-up of the AD300 Portable Oxygen Analyzer and MD300 Portable Oxygen Monitors. It also serves as a quick reference guide to help you with specific questions or operating problems.

Before turning the instrument on, you are advised to read the safety information on the next few pages and the information found in Chapters 1 and 2. These Chapters acquaint the user with the instruments use and operation before placing it into operation.

Safety Messages

Your safety and the safety of others are very important. Please carefully read the following safety messages.

Safety message are indented to alert the user of potential hazards. Each safety message is associated with a safety alert symbol. These symbols are found in the manual and on the instrument. The definition of these symbols is described below:

CAUTION: Refer to the instructions for details on the specific danger. These caution symbols warn of specific procedures, which if not followed could cause bodily Injury, and/or damage the instrument.

WARNING: This symbol is use to alert the operator of a condition that could cause bodily harm.

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

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

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

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Introduction

The Teledyne Analytical Instruments AD300 Oxygen Analyzer here after referred to as AD300 and MD300 Oxygen Monitors with alarms here after referred to as MD300 are portable instruments that provide fast and accurate oxygen monitoring. In addition, the model MD300 incorporates an audio/visual alarm capability. These instruments are designed to monitor up to 100% oxygen concentration in breathable gas mixtures. Because they are microprocessor-based, the AD/MD300 series have a unique combination of features that make them very easy to use. The operator interface is accomplished through a series of buttons located conveniently on the front face of the instrument. The MD300 front face interface is shown in Figure 1-1. The AD300 is similar but without the battery and alarm test buttons is shown in Figure 1-2.

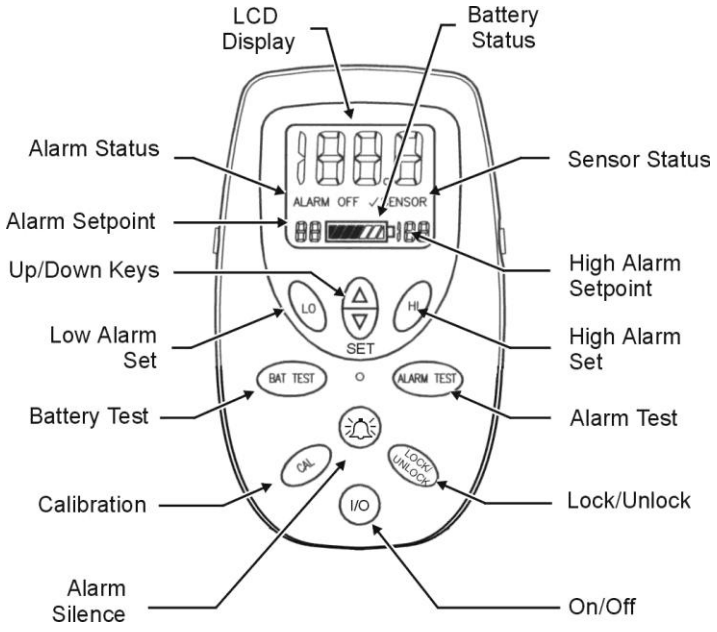

Figure 1-1: MD300 Front View

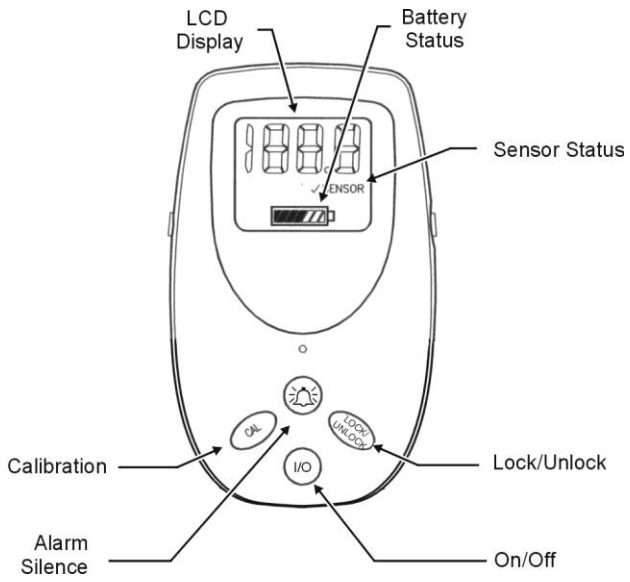

Figure 1-2: AD300 Front View

The LCD display consists of up to 3.5 characters plus a decimal point indicator capable of displaying up to 105%. (See Section 1.2 Options for alternate display configuration). An integral battery life indicator is displayed continuously on the AD300 and "on demand" with the MD300.

The instrument is powered by three AA alkaline batteries and is designed to operate for 2000 hours in Non-alarm State.

Oxygen analysis is linear across the single range of 0-100% using Teledyne's class R17S oxygen sensor. A unique sensor failure alarm is incorporated which warns the user if the sensor signal is lost or low. When this occurs, the √ SENSOR display flashes. The alarm buzzer can be silenced by pressing the ALARM SILENCE key. If the alarm condition is not corrected within 115 seconds the alarm buzzer will reactivate.

The MD300 unit incorporates a dual concentration alarm with individual user-defined set points. The set points are displayed on the lower portion of the LCD display with the low alarm set point appearing at the lower left and the high alarm appearing on the lower right of the display. The alarm circuitry provides both an audible and visual alarm.

1.1 Features

The AD300/MD300 are rugged, versatile instruments capable of rapidly measuring the oxygen content of breathing gases commonly used for diving purposes. Gas analysis is accurate to within ±2% of full scale over the operating range of 0-100% at constant temperature and pressure.

The following features are standard on the AD300 and MD300 instruments:

- Large easy to read 3 1/2 digit LCD display (see options)
- Automatic LCD back lighting upon key press
- Microprocessor controlled
- Up/Down front panel controls
- Sensor fail/disconnect alarm indicator (audible and visual)
- Alarm silence button
- 2000 operating hours from 3 AA alkaline batteries
- Battery status indicator
- Rugged high impact ABS construction
- Splash resistant case.
- Long life (36 months in air) class R17S sensor
- VDC digital output (optional RS-232)

The MD300 features include the above plus:

- User defined set point controlled concentration alarms
- Battery test function

1.2 Options

The following instrument options are available for both the AD300 and MD300 units:

A-Option—3-digit LCD display instead of 3 1/2 digit

B-Option—RS 232 digital output instead of 0-1VDC

Note: Contact the factory for retrofitting an existing instrument for 3 digit LCD display. For RS-232 reconfiguration, see Section 2.1.6.

In addition to the above instrument configuration options, the following optional equipment is available for your instrument:

DIN flow restrictor for sampling gas cylinder directly

P/N (B 75401)

Universal Pole Mounting Clamp (P/N CP 2343)

V-Mount Wall Adapter P/N B 647)

0-1 VDC Interface Cable (P/NB-75554)

RS 232 Interface Cable (P/N B-75555)

1.3 The R17S Sensor—How it works

The AD300/MD300 uses Teledyne Analytical Instruments Patented R17S disposable oxygen sensor. The sensor is made up of a sensing cathode and anode (fuel) immersed in electrolyte and packaged in a small plastic container. Oxygen entering the sensor reacts with the anode and a proportional current is collected at the sensing cathode. This current is sent to the electronics where it is converted into a digital signal and displayed on the LCD Screen.

A flow diverter is supplied with each R17S sensor for use with the blue "T" adapter. The flow diverter threads onto the end of the sensor and facilitates the transport of gas into the sensor.

The diverter should be removed for ambient air sampling such as a diving bell.

CAUTION: **REMOVE AND SAVE THE DIVERTER WHEN THE SENSOR IS USED IN CONFINED VOLUME APPLICATIONS.**

Operation

Note: Upon receipt, INSPECT THE ENTIRE UNIT FOR DAMAGE. Check the unit and all included accessories for broken or loose parts. If damaged, DO NOT USE. Notify the shipper, and consult Teledyne Analytical Instruments.

Note: This equipment is internally powered using 3 AA batteries.

2.1 Setup

To set up and use your AD300 analyzer or MD300 monitor:

1. Install the sensor.
2. Install the batteries.
3. Calibrate the unit.
4. Set the alarms (MD300 only).

The control keys are designed for easy operation. A LOCK/UNLOCK key has been incorporated to prevent accidental changes to critical settings. This eliminates unwanted changes in calibration or alarm settings from accidental touching or bumping of the keys. To further reduce the possibly of incorrect adjustments at least two keys must be pressed in order to modify a critical calibration or alarm set point value.

Note: The ALARM SILENCE (🔔) and BATT TEST key continue to operate normally when the lock feature is activated.

2.1.1 Sensor Installation or Replacement

Note: The R17S oxygen sensor must be installed before the oxygen analyzer/monitor can be operated

1. Remove the new sensor from its protective bag. Inspect the sensor for damage or electrolyte leakage. If the sensor is damaged, obtain a replacement. Do not use the defective sensor as it may damage the unit.

WARNING: ***THE SENSOR ELECTROLYTE IS CAUSTIC. DO NOT LET IT COME IN CONTACT WITH SKIN. IF IT DOES, FLUSH AFFECTED AREA WITH WATER. DO NOT ATTEMPT TO OPEN OR REPAIR THE SENSOR.***

2. Plug one end of the coiled cable into the jack receptacle on the back end of the R17S sensor and secure in place with the capture nut located at the base of the connector. See Figure 2-1.

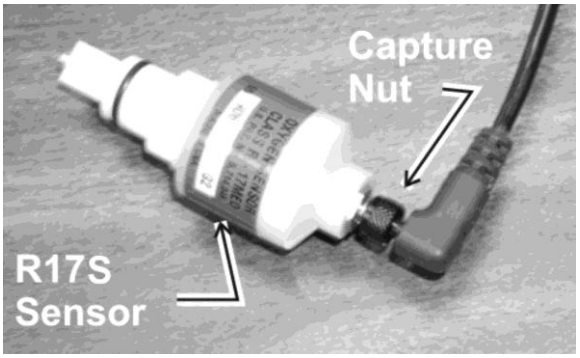

Figure 2-1: Installing the R17S Sensor

3. Plug the other end of the coiled cable into the receptacle located on the right side of the unit and secure it in place using the capture nut. See Figure 2-2.

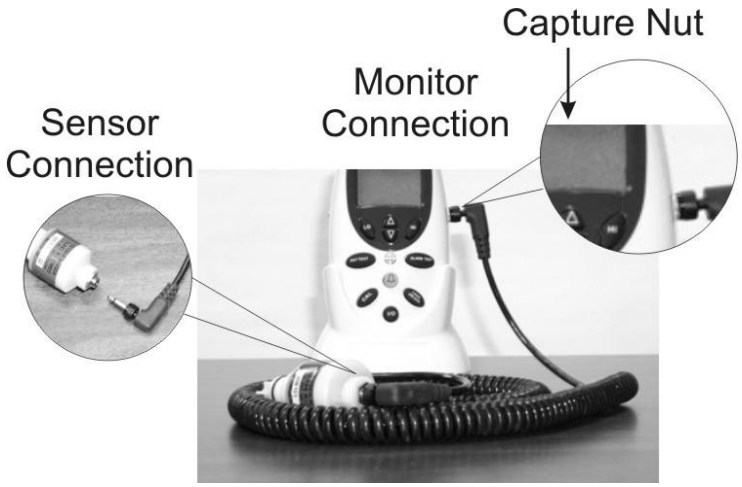

Figure 2-2: Sensor Cable Connection to Monitor

Note: When the AD/MD300 instrument is used for diffusion sampling the plastic flow diverter must be removed from the R17S sensor. If the sensor is used in sample mode the diverter must be used as shown in Figure 2-3.

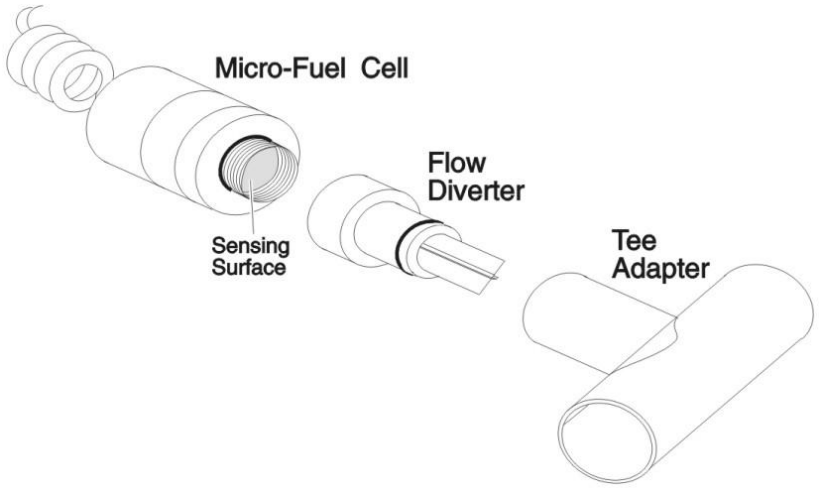

Figure 2-3: Mounting the Sensor in the Tee Adapter

2.1.2 Mounting

The AD/MD 300 can be mounted in several ways depending on the optional equipment ordered at the time of purchase. See Section 1.2.

2.1.2.1 V-MOUNT ADAPTER INSTALLATION

The V-Mount Adapter consists of a matching plastic plate with integral V-grooves that attach to the rear of the instrument.

To install V-Mount Adapter, remove the battery compartment door by prying up the hinged latch at the bottom of the cover, then slide the adapter plate into grooves provided in rear case. Replace the battery compartment door and secure door latch. See Figure 2-4.

Note: The door latch is a tight fit onto the battery cover. Use a coin to gently pry up the latch.

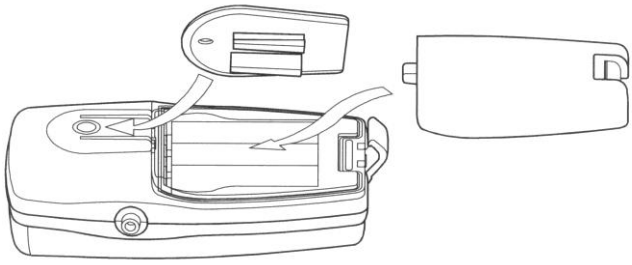

Figure 2-4: V-Mount Adapter Installation

2.1.2.2 UNIVERSAL MOUNTING CLAMP INSTALLATION

The Universal Mounting Clamp is supplied with a 1/4-20 screw for securing the clamp to the rear of the instrument. A threaded brass insert is installed on the back of the instrument for this purpose. See Figure 2-5.

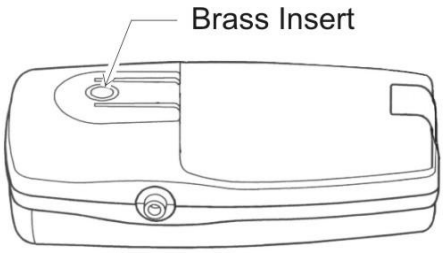

Figure 2-5: Brass Insert for Universal Mounting Clamp

2.1.3 Battery Installation

Note: Three "AA" alkaline batteries must be installed in the unit before the monitor will operate. ***The unit must be recalibrated whenever new batteries are installed****. For the MD300, the HI and LOW alarm set points must be reset to the desired values.*

To install the batteries:

1. Turn the unit off (if it is on).
2. Hold the instrument face down in the palm of your hand. Use a coin to pry up the latch that secures the battery compartment door. Remove the battery compartment door.

CAUTION: **IMPROPER INSTALLATION OF THE BATTERIES MAY RESULT IN DAMAGE TO THE UNIT AND BATTERIES.**

Note: Use alkaline batteries only. Other battery types will produce erroneous battery test readings.

3. Install 3 "AA" alkaline batteries into the holder as shown in Figure 2-6. Each battery has its own slot. To insure proper polarity, place the bottom (flat) or negative end of the battery in the end of the holder marked "–". Place the top (button) or positive end of the battery in the end of the holder marked "+". Do this for each battery.

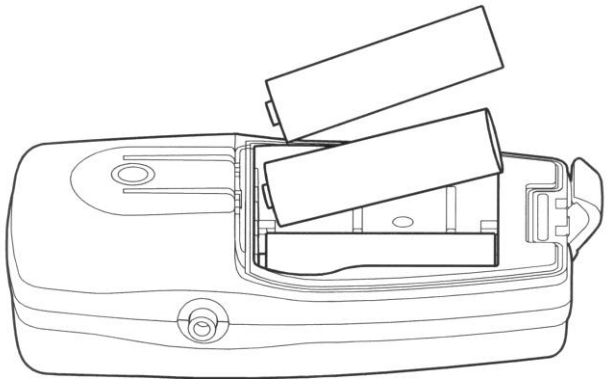

Figure 2-6: Installing Batteries

4. Re-install the battery compartment door. When the unit is first turned on the display will momentarily display all LCD segments. During this period diagnostic tests are being conducted to insure the circuits are functioning correctly. The unit will activate the audible and visual alarms for about 1 second. The LCD will flash continuously indicating the unit is in the unlocked position ready for calibration.

Note: When batteries are first installed or power is lost for any reason the instrument defaults to the calibration mode. All keys except the CAL and ON/Off (I/O) keys are inoperable until a successful calibration is achieved.

5. (**MD300 only**) To test the batteries. Press the BATT TEST key once. The battery display, located below the oxygen

readout display, should show a bar graph of the remaining life to the batteries. In the case of fresh batteries, it should illuminate all 5 segments from the left to the right end of the bar.
(**AD300 only**). The bar graph indicator is on continuously whenever the instrument is powered on.

2.1.4 Calibration

The AD/MD300 should be calibrated before each use.

Whenever new batteries are installed or removed for any reason, the oxygen monitor defaults to the calibration mode with the LCD display flashing 00.0. Only the CAL and ON/OFF (I/O) keys are functional at this point. On the MD300 monitor, the alarm set points will also need to be reset after calibration is completed.

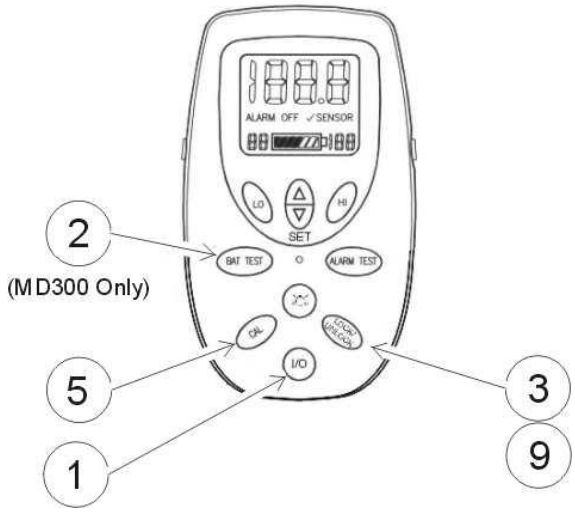

Figure 2-7: Calibration Sequence

Note: For first time and for routine maintenance calibrations, make sure the sensor and sensor cable are installed correctly before attempting to calibrate the instrument

To calibrate the instrument (See Figure 2-7):

1. Turn the unit on by pressing the ON/OFF (I/O) key.
2. Check the batteries by pressing the BAT key.
3. If the LCD is not flashing, press the LOCK/UNLOCK key to unlock the keys. LCD will flash indicating changes can be made to the settings. If the batteries have just been installed the LCD will flash 00.0
4. As with most oxygen analyzer(s) the highest level of accuracy is achieved when calibration is conducted using 100% oxygen. After installing the flow diverter as noted in Section 2.1.1, insert the sensor into the plastic tee and

connect to a supply of pure dry oxygen flowing at 1-2 liters per minute.

5. Wait about 20 seconds to insure the sample line is completely purged with the calibration gas. Press the CAL key. The LCD will count down from 9 to 0. During this time the microprocessor is measuring the sensor output to determine the gas concentration and selects the calibration range i.e. 100% or 20.9%. When the calibration is complete the LCD will display the gas value. Press the LOCK/UNLOCK key to save the calibration data.

Note: The AD300 and MD300 can only be calibrated using 100% oxygen or room air 20.9%. Improper calibration or use of other gas concentrations will activate the √SENSOR indicator. To repeat the calibration press the LOCK/UNLOCK key and press the CAL key.

6. Remove the sensor from the oxygen supply and confirm the LCD reads less than 22% in room air. It is not necessary for it to read exactly 20.9%.
7. It is important to perform the calibration carefully and thoroughly, using calibration gases that are free from contaminates. Wait for a stable reading before locking in calibration point. The accuracy of the instrument is only as good as the procedure used to calibrate it.

Note: A single point air calibration is not recommended unless the sensor can be exposed to a known source of fresh outdoor air. Confined areas such as rooms where high concentrations of oxygen are released may be enriched with excess oxygen, which will introduce errors into the calibration. Air calibration should only be used for monitoring oxygen levels between 21% and 40% and should never be used where a high degree of accuracy is needed.

CAUTION: **DO NOT ADJUST THE CALIBRATION SETTINGS IN AIR AFTER THE 100% CALIBRATION, AS THIS WILL CANCEL THE MORE ACCURATE 100% CALIBRATION. THE 100% CALIBRATION MAY BE REPEATED AS MANY TIMES AS DESIRED.**

8. (**MD300 only**) Adjust alarm set points to desired level according to the procedures in Section 2.1.5.
9. Press the LOCK/UNLOCK key to hold settings. The unit is now ready for use.

2.1.5 Alarms (MD300 only)

Note: Before attempting to change the alarms it is necessary to unlock the control keys by pressing the LOCK/UNLOCK key. When pressed the display will start flashing.

To set the alarms on the MD300 monitor (see Figure 2-8):

1. To set the HI alarm: Press the HI ALARM SET key once. Press the UP and DOWN arrow key until the desired value is displayed in the lower right corner of the display. Press lock key or proceed to LO alarm settings

Note: The HI and LO alarms may be defeated by setting the HI alarm limit one step above 100%. The display will blink ALARM OFF continually in this mode.

2. To set the LO alarm, press the LO ALARM SET key once. Press the UP and DOWN arrow key to select a value. A built-in safety feature will not allow you to select a LO alarm value less than 18%. Press LOCL key to save settings.

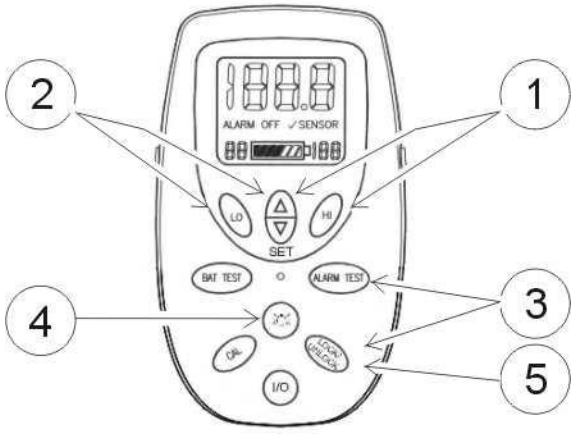

Figure 2-8: Setting the Alarms (MD300)

Note: The MD300 is designed to prevent crossing of HI/LO alarm settings. If you attempt to set the LO alarm higher than the HI alarm, it will push the HI alarm setting up as you continue to rise the LO alarm set point. This also applies when attempting to set the HI alarm lower than the LO alarm.

3. To test the alarms, unlock the controls by pressing the LOCK/UNLOCK key and then press ALARM TEST key. The Lo alarm followed by the HI alarm will blink and the audible visual alarm will are activated for about 1 second.
4. To silence the alarm buzzer for 115 seconds press the alarm silence key (🔕) (flashing red indicator light).

5. To disable the alarms set the high alarm set point above 100%. Press LOCK/UNLOCK key to save settings.

Note: When the alarm is in the OFF condition (set point above 100%) the ALARM OFF status message blinks slowly on the LCD below the oxygen readout.

2.1.6 Output 0-1 VDC or RS232

Both the AD300 and MD300 provide signal outputs for use with recorders and computers. The instruments are supplied standard with a 0-1 VDC output. An optional 0-1 VDC Interface Cable (P/N B-75554) is available from Teledyne for this purpose.

To connect the analyzer to an analog recording device:

1. Insert one end of the interface cable into the output port on the side of the instrument. See Figure 2-9.
2. Insert the other end into the analog recorder device. Make sure the device is equipped to handle a 0-1 VDC signal.

When properly calibrated, the output signal generated by the analyzer is linear and proportional to the oxygen concentration.

If you requested Option-B (RS 232 digital output) at the time of purchase, a digital RS 232 signal is output from the output port shown in Figure 2-9. Use the optional RS 232 Interface Cable (P/N B-75555) available from Teledyne for connection to a standard RS 232 port on a computer or other suitably equipped digital device.

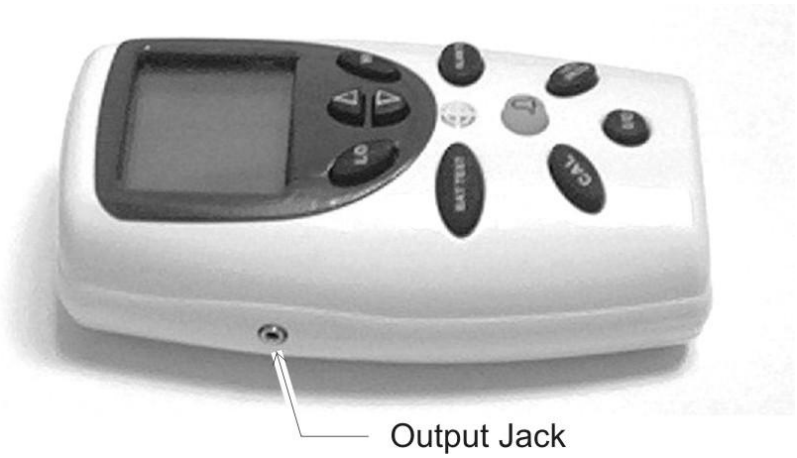

Figure 2-9: 0-1 VDC or RS 232 Digital Output Port

If your instrument is set for analog (0-1 VDC) output, you can reconfigure it to use the digital output by changing a jumper on the internal PC board.

To activate the digital output:

1. Remove the batteries and remove the five screws that hold the case together.
2. Remove the rear case section leaving the PCB in the front half of the case.
3. Remove jumper at position JP3 and reinstall it at position JP7.
4. Replace the rear cover and secure in place with five screws. Install the batteries and recalibrate per Section 2.1.4.

CAUTION: RECORDER/RS232 OUTPUT SIGNAL SHOULD ONLY BE CONNECTED TO AN EN60601-1/IEC60606-1 APPROVED DEVICE.

To reconfigure the analyzer from a digital (RS 232) output to analog (0-1 VDC) output, use the same procedure except in step 3 remove the jumper from JP7 and replace it at JP3.

2.2 Use

2.2.1 Gas Sampling

The AD/MD300 instruments can be used to measure the oxygen concentration in two basic modes:

- From the low pressure inflator hose using the sample adapter as shown in Figure 2-10.
- Directly from the high pressure gas cylinder using the optional DIN restrictor shown in Figure 2-11.

NOTE: Both sample modes require the use of the gas diverter cap and tee adapter as show in Figure 2.3. Make sure you have calibrated the unit before proceeding.

INFLATOR HOSE SAMPLING. Connect the inflator hose adapter supplied with the unit to the tee adapter as shown in Figure 2.10. Open the gas bottle valve and allow gas to flow for approximately 30 seconds. When a stable reading is observed close the cylinder valve. Allow reading to settle for a few seconds. This is the oxygen value of the sample gas.

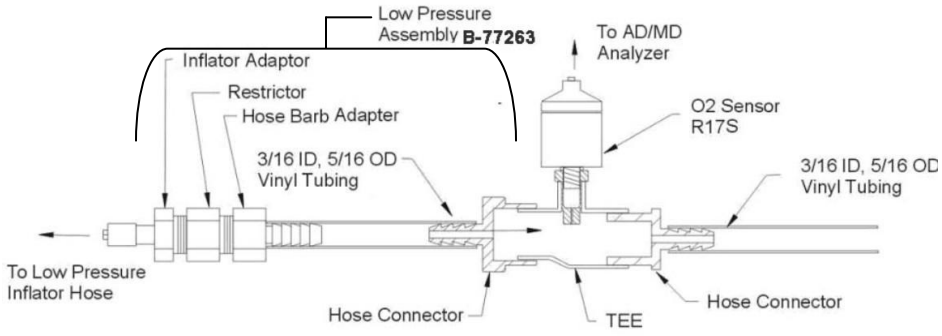

Figure 2-10: Low Pressure Gas Sampling

HIGH PRESSURE SAMPLING. To measure the oxygen concentration directly from the high pressure cylinder. Install the optional DIN connector onto the tank and insert the blue tee adapter and sensor as shown in Figure 2-3. Slowly open the cylinder valve until you detect gas flowing. When a stable reading is observed close the cylinder valve and allow the reading to settle for a few seconds. This is the oxygen value of the sample gas.

CAUTION: **MAKE SURE YOU DO NOT PRESSURIZE THE SENSOR DURING CALIBRATION OR USE, AS THIS WILL PRODUCE ERRORS IN THE READINGS.**

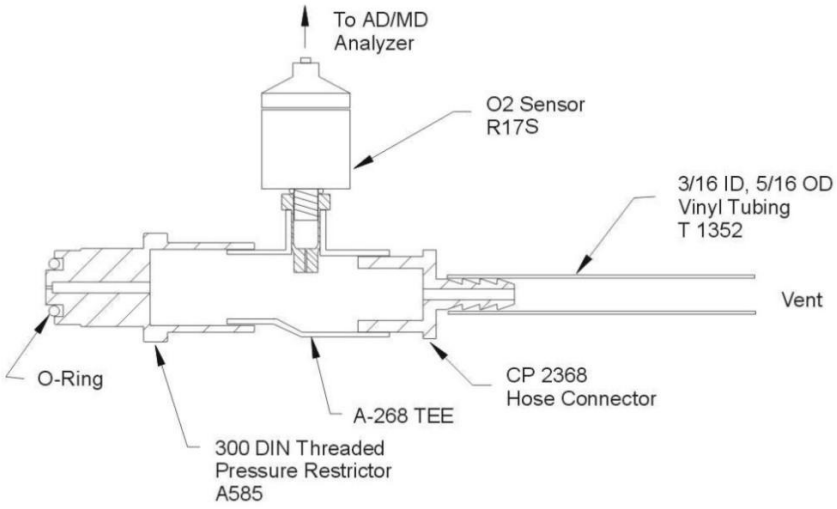

Figure 2-11: High Pressure Gas Sampling

When monitoring for oxygen in confined volumes such as a diving bell, the flow diverter must be removed from the R17S sensor so that it does not interfere with the rapid exchange of gases to and from the sensing surface of the sensor.

CAUTION: FAILURE TO REMOVE THE DIVERTER IN THESE APPLICATION AREAS WILL RESULT IN A MARKED LOWERING OF THE RESPONSE TIME OF THE SENSOR.

The LOCK/UNLOCK key can be used to prevent accidental changes to the front panel key adjustments. The LOCK/UNLOCK key acts as a toggle, pressing LOCK/UNLOCK once renders inactive all keys except the ALARM SILENCE (🔔) and BATT TEST (MD300 only) keys. Pressing LOCK/UNLOCK a second time unlocks the keypad.

2.3 Gas Sampling/Sensor Issues

2.3.1 Temperature

The R17S oxygen sensor adjusts for ambient temperature changes in the range of 0–40°C (32–106°F). However, a small thermal tracking error may be encountered when the sensor is subjected to sudden changes in temperature. For example removing the sensor from an air conditioned car to a hot environment. Holding the sensor in your hand

for more than a few minutes can also affect the temperature tracking which appears as a slow drift on the LCD. No adjustments should be made during this period since this error will correct itself in about 30 minutes.

2.3.2 Pressure

Virtually all gas sensors and monitors measure the partial pressure, not the percentage, of the gas that they sense. The only time that these instruments can accurately read percentages is when the total pressure does not vary over time between calibrations and use. This is way it is important to calibrate the AD/MD300 oxygen sensor at regular intervals. It is recommended that the unit be calibrated prior to each use or every 8 hours.

When the sensor is connected to sample gas that is flowing under pressure, the sensor may read high. In reality, the percentage of oxygen is not changing; it is the total pressure that is increasing, producing a corresponding increase in the partial pressure of oxygen. A hundred centimeter of water pressure pulse will produce a 0.11 atmosphere, or an 11% increase in the total and therefore partial pressure of oxygen. An un-pressurized reading of 50% oxygen will increase to 55.3% if the sensor is subjected to a pressure of 100cm H_2O. The reading will rise proportionally less for smaller pressures.

2.3.3 Humidity

Humidity does not directly affect the accuracy of the sensor's measurement. However, when a nebulizer or other device is used to increase moisture levels in gas mixtures, the moisture actually dilutes the mixture. This dilution effect decreases the oxygen concentration.

For example, if an 80% oxygen gas mixture is humidified to saturation at room temperature, the resulting gas mixture will contain only 77.5% oxygen. Your portable oxygen monitor accurately measures decreases in the oxygen concentration due to the dilution effects of moisture added to gas mixtures.

As with all oxygen sensors, excessive condensation on the sensing surface of the R17S will block the diffusion of oxygen to the sensor, rendering it inoperative. We recommend installing the sensor on the dry side of the breathing circuit at all times.

2.3.4 Discrepancy in Readings

When a discrepancy in oxygen readings is suspected, the oxygen analyzer readings should be verified by checking the AD/MD300 battery condition and calibration using 100% oxygen. If the monitor can be calibrated, the unit can be assumed to be in good working order and capable of providing readings to specification. If, after checking the unit, the discrepancy in oxygen readings persists, the gas being analyzed should not be used. Further investigation should be made until the discrepancy in readings is resolved. The troubleshooting section of this manual may provide additional assistance in locating the problem.

2.4 Do's and Don'ts

– DO –

Read all of the directions before using for the first time.

Calibrate before every use.

Visually inspect the sensor for leakage before each use.

Calibrate using 100% oxygen and check in air.

Check the HI and LO alarm settings prior to each use.

Test batteries regularly and replace when battery indicator shows low battery (no bars remaining)

Make sure keys are locked by using the LOCK/UNLOCK key feature.

Keep the unit, sensor and connections dry.

Recalibrate after replacing the batteries.

Recalibrate after replacing the sensor.

Use properly installed alkaline batteries only.

Make sure the R17S sensor is properly attached.

Remove the plastic flow diverter when analyzing non-flowing samples.

Remove and save the plastic flow diverter when using the sensor in non-flowing applications.

(MD300 only) Perform an alarm test before each use (press the ALARM TEST key).

– DON'T –

Use this monitor if you suspect any malfunction.

Do not use the instrument if the oxygen readings are drifting.

Use the instrument in the presence of flammable liquids or gases.

Use anything but alkaline batteries.

Freeze the sensor or instrument.

Open or try to repair a leaking or broken sensor.

Immerse the unit or sensor in any liquid.

Pass hot or cold gas mixtures over the sensor.

Adjust the reading in air after 100% calibration

Use cleaning agents or liquids in the cable receptacles or around the battery compartment.

Store the unit in hot or humid environment.

Expose the LCD to excessive sunlight.

Service Manual

3.1 General Service Information

The Teledyne Model AD300 and MD300 series of portable oxygen monitors are designed to be robust yet compact in size. In order to achieve maximum reliability in a microprocessor-based instrument, a single PC board is used which relies exclusively on surface mount technology. Without access to specialized probes and test equipment, troubleshooting and repair of circuit board components are not feasible. A factory replacement of the entire PC board is more cost effective than a field repair of an individual component

With the exception of replacing the sensor or batteries there are no user-serviceable components inside the unit. There are no potentiometers or other adjustments to be made within this instrument. If a problem arises with either of these models that cannot be corrected by recalibration, changing the batteries, or replacing the sensor as described elsewhere in this manual, the unit must be sent back to the factory for repair or replacement. See Section 3.9 for instructions on obtaining a Return Merchandise Authorization (RMA) number before sending a unit back to Teledyne for repair.

3.2 Overall Maintenance

The AD/MD 300 series of instruments require very little maintenance, other than calibration, checking and changing the batteries and sensor, and cleaning the plastic housing. Occasional cleaning of the plastic surface can be done with isopropyl alcohol. Should any part of the instrument malfunction or fail to perform, the unit should be removed from service. There are no user-serviceable components within the instrument.

3.3 Battery Maintenance

DO: Test batteries regularly (replace immediately when all 5 bars are missing).

DO: Always use alkaline batteries.

DO: Recalibrate after replacing batteries.

The MD300 instrument incorporates a battery test feature that indicates the approximate amount of useful life remaining on the set of batteries. Excessive alarm activation will wear down the battery faster than usual. The AD300 instrument continuously displays the battery status bar graph. There is no BATT TEST key on the AD300.

The minimum detectable change in battery voltage corresponds to an increment of about 50 hours, meaning that the battery voltage reading may not change for several hours at a time.

If the monitor is not used for a period of 30 days or more, the batteries should be removed prior to storage.

3.4 Sensor Maintenance

DO: check the sensor for damage or leaks before use.

DO: recalibrate after replacing the sensor.

DON'T: immerse the R17S sensor in liquid.

DON'T freeze the R17S sensor.

DON'T: open or try to repair the sensor.

Before every use, the sensor, cable and connections should be checked. Check the sensor for leaks and condensation. Check the cable for splitting or cracked insulation. Make sure the connections are tight and dry.

In the event that the sensor has been damaged, consult the Material Safety Data Sheet available from the factory or online at www.teledyne-ai.com for handling guidelines.

3.5 Gas Sampling

3.5.1 Discrepancy in Readings

The AD300/MD300 instrument should be used to measure the oxygen concentration exiting gas cylinder or another or life support system. When a discrepancy in oxygen readings is detected, the oxygen analyzer readings should be verified by checking the AD/MD300 battery condition and calibration using 100% oxygen. If the monitor can be calibrated, the unit can be assumed to be in good working order and capable of providing readings to specification. If, after reinstalling the

unit, the discrepancy in oxygen readings persists, the problem is most likely elsewhere. Further investigation should be made until the discrepancy in readings is resolved. The troubleshooting section of this manual may provide additional assistance in locating the problem.

Note: The MSDS on this material is available upon request through the Teledyne Environmental, Health and Safety Coordinator at (626) 934-1592 or can be viewed and downloaded from our web site at www.teledyne-ai.com.

3.6 Troubleshooting

The AD300 and MD300 oxygen monitors provide a variety of built-in safety features that prevent its use when a fault is detected. When a unit displays the message √ SENSOR and sounds the audible and visual alarm continuously, it is an indication of a faulty connection between the sensor and the unit or an expired or faulty sensor. To determine where the difficulty lies, refer to the following guidelines in Table 3-1.

Table 3-1 Troubleshooting

Symptom	Why	What To Do
New sensor responds slow or drifts.	If the sensor is new and was just removed from its sealed bag it may need to run for several hours.	A) Wait 30 minutes and recalibrate.
Sensor will not read below 22 % after calibration in 100% O2.	Calibration in 100% was invalid or the room air is contaminated with excess oxygen.	A) Recalibrate using dry gas making sure the reading stabilizes before making any adjustments. B) Make sure that at least 6" (30 cm.) of tubing is attached to the exhaust side of the tee adapter to prevent back filling. O2 flow rate should not exceed 5 l/min. C) Oxygen concentration at the sensor is significantly

Symptom	Why	What To Do
		higher than 21%. Take the instrument to a well-ventilated area and check the reading again. D) Try calibrating with a known good sensor; if this fails, see symptom "Reading drifts over 2–3%..."
The display is flashing √ SENSOR	The unit has detected a fault in the signal from the sensor. Sensor has expired. The sensor has been exposed to a gas containing little or no oxygen.	A) Check sensor cable connections and make sure they are completely inserted into the mating connector and the capture nut is firmly in place. B) Expose the sensor in 100% O2 and check calibration. C) The sensor output has fallen to a level where it is no longer usable. Replace sensor.
The oxygen reading fluctuates or appears to be incorrect.	Like all O2 sensors, the R17S detects the changes in the partial pressure of O2.	A) During calibration, make sure there is no restrictions on exhaust side of sensor. If the reading changes with flow, the sensor is pressurized or there may be a leak in the system. B) If a high degree of accuracy is desired, or the concentration of O2 is in excess of 40%, calibration with 100% is recom-mended.

Symptom	Why	What To Do
The unit has stopped working and the LCD is displaying alphanumeric figures.	The AD300/MD300 instruments are equipped with an electronic "watch dog," which monitors the circuitry within the unit for potential faults and renders the unit inoperable until the condition is corrected. (See Watch dog section below) Several conditions can activate the "watch dog." Dropping the unit, poor battery connections, and radio frequency interference are the most common causes. See the watch dog section for additional information	A) Disconnect the batteries and inspect the contacts for corrosion. Reconnect the batteries. If the unit functions properly, calibrate the unit and reset the alarm values. B) Try a new set of batteries. C) Increase the distance between the unit and any source of radio frequency interference. The sensor cable is a prime source of pickup as it can act like an antenna. Relocate the sensor cable and if possible change its coiled length to “de-tune” its antenna effect. Placing the cable in a different position may also help.
Alarm sounds/flashes continuously.	A) (MD300) Readings are outside alarm limits.	A) Adjust high and low alarm setting to be above and below O2 value being displayed.
No display.	A) Batteries expired. B) Bad battery connection.	A) Check/replace batteries. B) Check battery connections. C) Calibrate.
Keys inoperable/cannot turn unit off	The LOCK/UNLOCK key is activated which is preventing key operation	A) Press LOCK/UNLOCK key once. LCD will flash indicating keys are active.

Symptom	Why	What To Do
Cannot adjust calibration or alarm settings	Critical settings require two keys be pressed in a specific order. LOCK/UNLOCK key is active	A) If display is not flashing press lock key once to activate keys. Press desired function followed by the Up and Down key.

Note: In the event that none of these procedures produce desired results, remove the batteries and return the unit to Teledyne for repair.

3.7 Watchdog

The AD300/MD300 is equipped with a watchdog circuit that continuously monitors the electronics for proper operation. If the watchdog detects a failure, one of the following codes will appear on the LCD.

The error codes can appear on the LCD when batteries are first installed, during normal operation or if the unit is subjected to extreme shock. In some cases an additional digit is used in the error code to supply additional information. For example, the error code 6 and 7 are followed by another digit listed as (N) in Table 3.2. The error code 65 would indicate that a key is stuck and this key is the Silence key.

In addition to supplying visual error codes, the audio device will beep a number of times to indicate the general error in case the display is not functional.

NOTE: *To reset the watchdog error code. Remove one battery for 5 seconds and replace. If the error persists contact your locale representative or Teledyne for assistance.*

Table 3-2 Error Codes

Error Code	Audio Beeps	Error
Indeterminate	2	The watchdog timer has timed out indicating a serious software error
30	3	Analog output is different from the expected value. May indicate a shorted or over-loaded analog output or a failure of the analog to digital converter or digital to analog converter circuit.
50	5	The ADC circuit failed during POST.
6 (5)	6 (There is no indication of which key is stuck)	A stuck key has been detected. The second digit, in this example (5), on the display shows which key is stuck: 0 - Low Alarm 1 - Batt 2 - Cal 3 - Up 4 - Down 5 - Silence 6 - High Alarm 7 - Alarm Test 8 - Key Lock
7(2)	7 (There is no indication of the type of DAC failure)	A failure has occurred during the automatic calibration of the digital to analog converter (DAC) circuit. The second digit, in this example (2), shows the type of digital to analog failure. 0 - Measurement 1 - High Test 2 - Low Test 3 - Offset Cal 4 - Gain Cal

3.8 Other Problems with the Instrument

Most other problems arise from either mechanical damage from the instrument falling from a bench or table, or electronic component failure. In these units, repair or troubleshooting the PCB or individual component on the board is not feasible. It requires specialized test equipment and probes not generally available to the public. Under most circumstances a replacement of the entire PC Board is recommended. The instrument must be returned to the factory for PCB installation.

Occasionally, depending on the environment of use, keys can become stuck or function erratically due to contamination. Use a mild non-abrasive cleaner solution to periodically clean the keypad and screen. An aerosol jet spray of the type commonly used to clean computer keyboards can be used to dislodge dirt and accumulations from the keypad.

The Error Code Table (Table 3-2) includes a description of certain fault codes which are diagnostic of some common (usually electronic) problem with the instrument. Some of these codes refer to specific components on the PCB that are problematic or have failed. These codes are useful in reporting a problem with your instrument to Teledyne Customer Service. If an error code is indicated on your monitor record the number and report it to the Customer Service Department at the address below.

3.9 Return Authorization for Service

For any service beyond sensor and battery replacement, the instrument must be returned to the factory. A return merchandise authorization (RMA) number must be obtained from Teledyne Analytical Instruments prior to returning an instrument for service. You can request a RMA number via email by contacting us at:

tetci_customerservice@teledyne.com

You can also contact us at the address below.

Customer Service Department
TELEDYNE Analytical Instruments

16830 Chestnut Street
City of Industry, CA 91749-1580 USA

Phone (626) 934-1500, Fax (626) 961-2538
Or via the web at: www.teledyne-ai.com

Appendix

A.1 Specifications

Range:	0-100% Oxygen
Accuracy:	±2% of full scale (at constant temperature and pressure)
Response Time:	90% in less than 8 seconds at 25 °C
Battery Life:	Approximately 2000 hr. continuous use in a non-alarm condition
System Power:	3 AA alkaline batteries.
Sensor Type:	Class R17S
Expected Life:	36 months in air
Dimensions:	2.5" W × 1.25" D × 4.5" H (66 mm x 33-mm × 111.5 mm)
Sensor Cable:	Retracted: 2 ft / Extended: 10 ft.
Storage Temp.	10-30 °C (continuous), 5-50 °C (Intermittent)
Operating Temp:	0-40 °C
Alarm ranges:	HI alarm: 19 to 100 Percent
	LO alarm: 18 to 99 %
Alarm accuracy:	Alarm thresholds are digitally stored and alarm affectivity is digitally compared against the value calculated by the microprocessor. Hence, the accuracy of the alarms is the same as the accuracy of the unit as specified above.

A.2 Spare Parts List

QTY	PART NO	DESCRIPTION
1	C72144-R17S	Micro-Fuel Cell R17S
1	B50057	R17S flow diverter
1	A268	Tee adapter (22 mm)
1	CP 2367	22 mm female tube adapter
1	CP 2368	22 mm male tube adapter
1	B75401	Inflator sample adapter assembly
3	B99	"AA" size alkaline battery
1	C74721	Sensor cable assembly

A.3 Optional Accessories

1	A585	DIN 300 flow Restrictor
1	CP2345	Universal Mounting Clamp
1	CP2344	"V" mount Pole Clamp
1	B647	"V" mount Wall Adapter
1	B-75554	0-1 VDC Interface Cable
1	B-75555	RS 232 Interface Cable

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

Orders should be sent to:

TELEDYNE Analytical Instruments

16830 Chestnut Street
City of Industry, CA 91749-1580

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

Or your local representative.