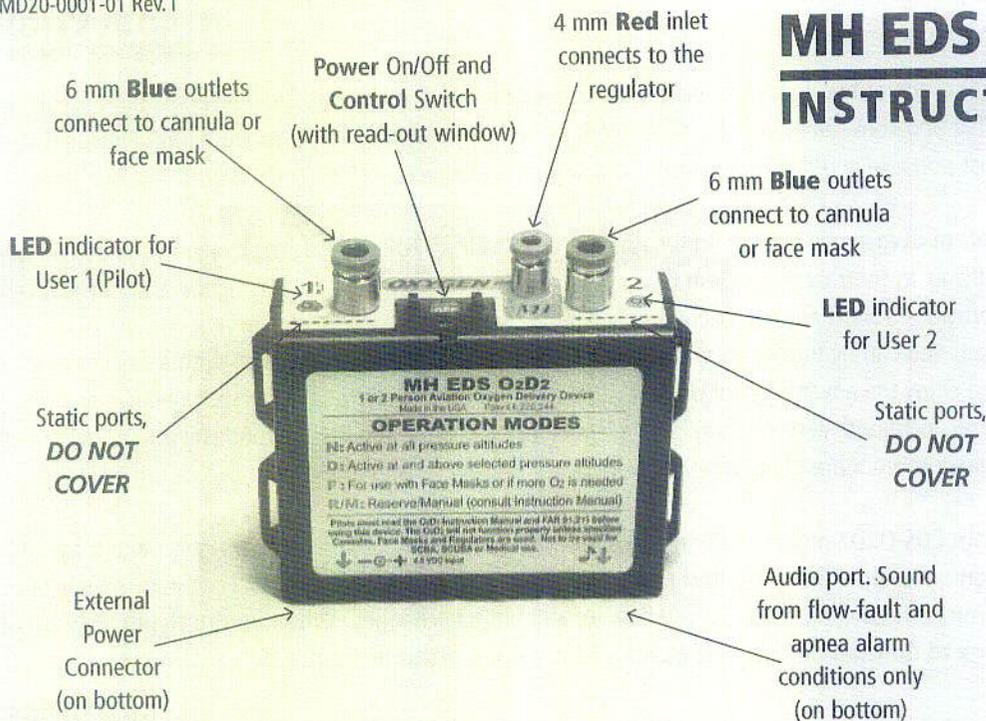


MH EDS Model O₂D₂ INSTRUCTION MANUAL

**1 or 2 Person
Electronic Digital
Pulse-Demand
Aviation Oxygen
Delivery System**

Patent # 6,220,244
Other Patents Pending



THANK YOU for purchasing the MH EDS O₂D₂ Pulse-Demand Oxygen Controller. The EDS O₂D₂ is patented innovative oxygen control technology that allows you and your co-pilot to fly with safety and comfort, knowing it will automatically give the exact oxygen required at the various altitudes. Although the eds O₂D₂ is designed for easy operation, **PLEASE READ THIS INSTRUCTION MANUAL** carefully before use.

WARNING: This MH EDS O₂D₂ is designed to operate with a maximum regulated pressure not to exceed 25 psi. If a regulator beyond this pressure is used, unit will be damaged and your warranty will be void.

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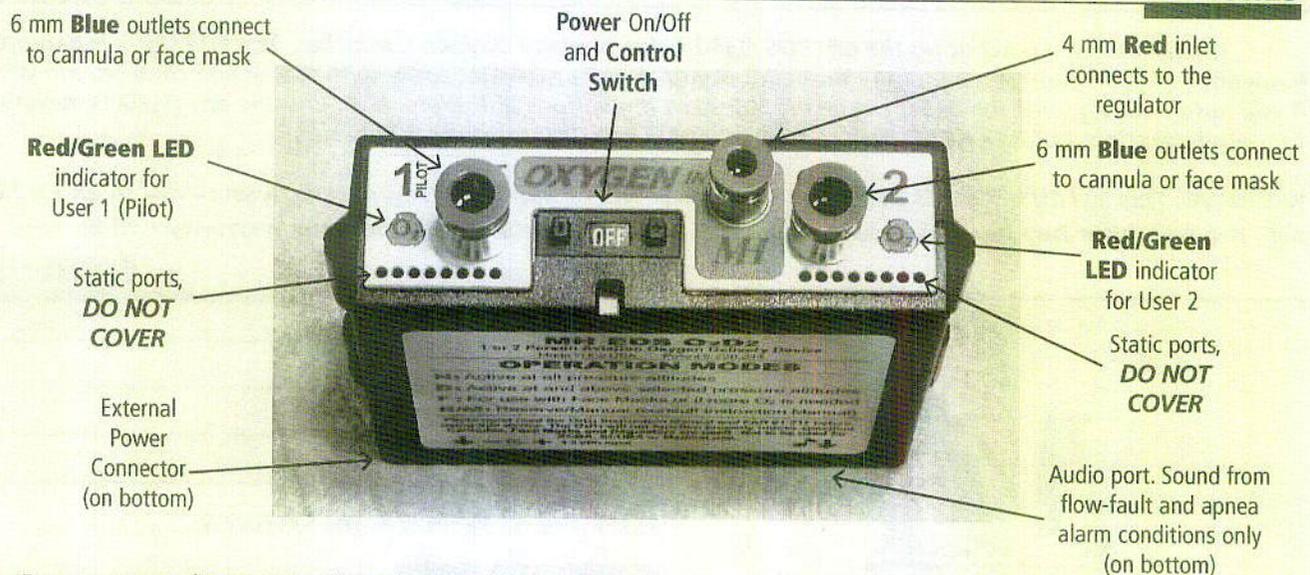
INTRODUCTION

The patented MH EDS-O2D2 is a one or two-user aviation oxygen delivery device. It is designed to deliver aviation oxygen in the most efficient, comfortable and convenient way possible. With its user-selectable settings, apnea alarm and small size, the MH EDS-O2D2 is the most portable and flexible electronic digital oxygen delivery system in the world.

By providing a measured pulse of oxygen every time you breathe in, the MH EDS-O2D2 supplies the oxygen you need to stay alert and comfortable while flying. In contrast to constant flow systems that waste oxygen by supplying more than your body can use, the MH EDS-O2D2 provides a short pulse of oxygen as you inhale, ensuring that your oxygen is used most efficiently. Efficient oxygen delivery means you can fly further on a single oxygen refill or save space and weight with a smaller tank. It also makes it more feasible to enjoy the advantages of oxygen while flying below the altitudes where oxygen is mandated--that can mean fewer headaches, increased alertness, and feeling less exhausted when you reach your destination. Your actual oxygen usage will be determined by your breathing rate and physiological needs at altitude.

The programmability of the MH EDS-O2D2 means that, unlike constant-flow oxygen systems, you can "set it and forget it". By automatically detecting your pressure altitude, the MH EDS-O2D2 can be set to start providing oxygen immediately or at a specified altitude and will automatically adjust the oxygen flow as your altitude changes. **When you're flying, don't you have more important things to do than adjust your oxygen flow during altitude changes?**

FEATURES



- Easy-to-use two-button control, small size and light weight
- Automatically adjusts oxygen flow with altitude
- Provides reduced oxygen consumption through more efficient oxygen delivery than standard constant-flow systems
- Push button control switch allows automatic altitude enable, Night and Day operations and high flow settings
- Green/Red LED's indicate oxygen flow, alarm, and status
- Audible and visible apnea alarm informs user of kinked, pinched, or disconnected oxygen lines, obstructed cannula or mask
- Reduced dry mouth discomfort compared to constant-flow oxygen systems

BASIC SAFETY

Pure oxygen is a highly oxidizing gas and can vigorously accelerate combustion. It can provide a catalyst for spontaneous combustion resulting in personal injury or death if not used properly and with caution. **DO NOT use any type of oil or grease on any of the fittings, valves or cylinders. DO NOT smoke while in use. DO NOT operate near an open flame. DO NOT use the MH EPS (External Power Supply) with the O2D2 as the voltages are not compatible.**

GETTING STARTED

The MH EDS O2D2 is intended to be used with regulators provided by Mountain High. Some third-party oxygen regulators may be used. (See "Using a Third-Party Regulator" for details) Pilots who intend to fly with the MH EDS O2D2 are advised to familiarize themselves and their passenger with the system prior to using it. Three cannulas and face masks are included with the MH EDS O2D2 unit. The cannula may be used for flight operations up to 18,000 ft. Above 18,000 ft., a face mask should be worn. A compatible face mask with a built-in microphone is available from Mountain High.

1. **If** you have not already done so, fill your cylinder with Aviation oxygen. (Many FBOs offer this service.)
2. **Inventory** your system (see photo) and read the front label on the unit.
3. **Per** the instructions provided with your cylinder and regulator, attach the regulator to the cylinder and **hand tighten only (DO NOT use a wrench or pliers—the "O" ring seals the regulator to the cylinder, over tightening will damage the regulator).**
4. **Open** the battery cover on the back of the MH EDS-O2D2 unit, install the 3 AA batteries (supplied) and replace the battery cover. (NOTE: Batteries fit tightly, handle with care.) See next page for detailed instructions.
5. **If** you are using the MH EDS-O2D2 with a Mountain High four port regulator (FPR), locate the oxygen input tube (clear tube with a short red tube on one end) and insert the Red tube into the red "Oxygen In" connector on the MH EDS-O2D2 unit until it stops (approx. 1/8 inch). Then connect the other end of the tube to your regulator. If you are using a MH single port regulator (XCR), use the tube that came with the regulator in place of the tube that came with your MH EDS-O2D2.
6. **Insert** the Blue end of the cannula or face mask tubing into the blue number 1 (Pilot) "Out" connector on the unit. For a second user, repeat with the blue number 2 connector. **Always use the number 1 connector when only one person will be using the system. (CAUTION: DO NOT pinch the Cannula or Facemask tubing when inserting them into the blue "Out" connectors). Use only the supplied MH EDS cannula as other cannulas may not work properly with the MH EDS-O2D2. DO NOT lengthen or shorten the cannula tube.**
7. **Turn** the cylinder valve on.
8. **Push** the "+" power/control button on the MH EDS-O2D2 unit once. This will turn the unit on and set it to "N" mode. A start-up pulse of oxygen, Red light and beeper test will verify battery power.
9. **Don** the cannula or face mask (make sure the face mask seals against the skin) and take a breath. The bright green LED under the #1 should illuminate, and a pulse of oxygen should be delivered. Refer to the card that comes with the cannula and face mask for donning information.
10. **You are ready to fly.**



Comfortable cannula position, looped over ears

O2D2 with two cannulas, regulator connection, regulator and cylinder



INSERTING OR REMOVING THE BATTERIES

Remove the battery door by pressing down gently on the battery cover flange then tip the door out and away from the unit. The EDS-O2D2 unit uses 3 standard AA alkaline (or NiMH or NiCAD) batteries. Insert the batteries as shown (they will be a tight fit), then replace the door by setting the bottom of the door in place and tipping the top in until it snaps in place. Take care when removing and replacing the batteries to not damage the batteries and/or connectors.

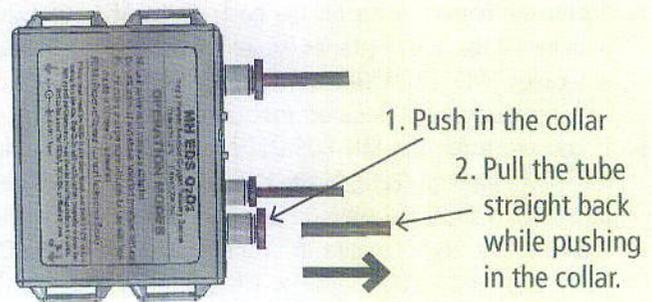
An optional external power connector is available. See our web site or call for additional information. (MH Part Number: 39300 - 1245 - 00)



REMOVING THE TUBING

To Remove the tubing, push in slightly on the tubing, then push in the connector collar while you pull gently on the tubing to remove it.

DO NOT pull on the tubing without pushing in the collar; it will damage the connector.



STORING THE MH EDS-O2D2

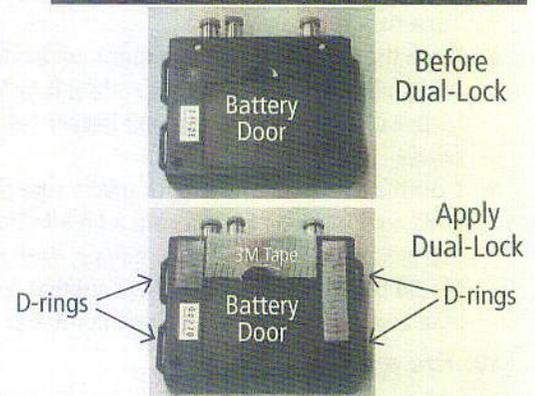
When not being used, the MH EDS-O2D2 unit, oxygen tubes, cannulas, etc., should be disconnected from the oxygen supply and stored in a secure manner to ensure that dirt and debris do not become lodged in the inlet and outlet tubes. The supplied tote bags or a zip-top plastic bag is a good storage container. *If the unit is not going to be used for 30 days or more, remove the batteries. When using the unit for the first time after storage, check the batteries to ensure proper operation. A set of fresh spare batteries should be part of your pre-flight inventory.*

DO NOT store the EDS unit while the inlet is under pressure. Remove all sources of oxygen pressure and secure the unit to ensure it will not become damaged. If the lines are disconnected they must be covered so that debris, dust or dirt can't get in. If the supply line is left hooked to the system, make sure that it is first purged with clean dry air or oxygen before the EDS unit is connected. *If the lines are disconnected they must be covered so that debris, dust or dirt can't get in.*

MOUNTING THE MH EDS-O2D2

You may mount the MH EDS-O2D2 unit to a suitable place using the supplied piece of 3M DUAL LOCK tape. First, cut the piece of DUAL LOCK tape in half, lengthwise, creating two long rectangles. Peel the protective backing off one of the rectangles to expose the adhesive and apply it to the back of the unit above the thumb indent for the battery door. **DO NOT COVER ANY PART OF THE BATTERY DOOR.** When a suitable place to mount the unit has been found, peel off the protective adhesive backing and press the adhesive side to the chosen mounting area.

You may also mount the MH EDS-O2D2 by feeding 3/4" - wide straps (not included) through the D-rings molded into the unit.



MODE CONTROL SWITCH SETTINGS AND MODES OF OPERATION

The MH EDS-O2D2 unit is controlled by two push button control switches. A stop inside the selector switch prevents inadvertently turning the unit off in flight.

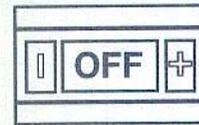
The MH EDS-O2D2 has three main modes of user controlled operation:

1. **Fully-Automatic (D5, D10)**
2. **Semi-Automatic (N and F modes)**
3. **Manual (R/M)**

NOTE: The N and D modes are designed to provide the amount of oxygen needed by an average size and healthy person using a cannula at the given altitudes; your needs may be different. To determine whether you are receiving enough oxygen in a particular mode you will need to use a pulse oximeter (available from Mountain High) to determine your blood oxygen saturation (goal is 90-100%) at any given altitude. The selected MH EDS-O2D2 mode applies to both users and should be set to accommodate the user with the highest oxygen need. In all modes except R/M, the O2D2 provides a pulse of oxygen which increases with altitude, i.e., it is altitude compensating.

Control switch settings

Reverse
(-) Push Button



Advance
(+) Push Button

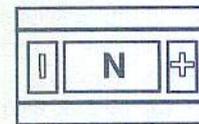
Switch as seen in the "OFF" setting

N MODE: "Night" or "Now"

At this setting the MH EDS-O2D2 will immediately start the standard oxygen flow providing pulses of oxygen appropriate for an average healthy person using a cannula.

Flow start: All altitudes
Flow amount: Standard

Use with: Cannula
Altitude Compensating?: Yes

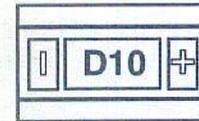


D MODES: "Day" or "Delayed"

The D5 setting will cause the MH EDS-O2D2 unit to delay oxygen flow until it senses a pressure altitude of 5,000 ft. and above. The D10 setting delays oxygen flow until 10,000 ft. and above. NOTE: When the barometric pressure is low, it will start operation at a slightly lower flight altitude than when the barometric pressure is high.

Flow start: D5--5,000 ft., D10--10,000 ft.
Flow amount: Standard

Use with: Cannula
Altitude Compensating?: Yes

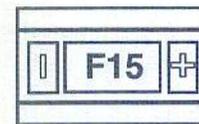


F MODES: "Floor" or "Face Mask"

The F mode settings (F5, F10, F15, and F20) are called the "Floor" or "Face mask" settings. They supplement the standard oxygen flow by adding approximately the selected number of feet (in thousands) to the MH EDS-O2D2's perceived altitude.

Flow start: All altitudes
Flow amount: Enriched:
F5 =Standard+5,000 ft
F10=Standard+10,000 ft
F15=Standard+15,000 ft.
F20=Standard+20,000 ft.

Use with: Cannula or face mask
Altitude Compensating?: Yes



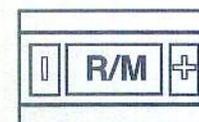
Example: If you are at a pressure altitude of 5,000 ft. and select the F10 setting you will receive the effective flow rate of 5,000 + 10,000 = 15,000 ft. The "F" modes are useful for people for whom the standard oxygen supply does not achieve the desired blood oxygen saturation or for those who prefer to use a face mask rather than a cannula.

R/M: "Reserve/Manual"

This last switch setting, R/M, for "Reserve" or "Manual" provides the maximum oxygen flow regardless of altitude.

Flow start: All altitudes
Flow amount: Maximum

Use with: Cannula or face mask
Altitude Compensating?: No



ALARMS AND ALERTS

The MH EDS O2D2 is equipped with AUDIO-VISUAL ALARMS and ALERTS, designed to bring to the user's attention, any malfunction of the unit. See the following for specifics.

POWER UP

POWER-UP: Red Light flashing on and off with audio chime for ~ two (2) seconds with each initial power-up with pulse of O2 for about 1/2 second.

O2 DELIVERY

O2 DELIVERY: One flash of green LED (~ 1/4 second minimum) for each pulse of O2 from a valid inhalation event, no sound.

FLOW FAULT EVENT

FLOW-FAULT EVENT: Red Light flashing on and off with Hi-Lo audio chime for ~ 2 seconds with every event. This typically means that the oxygen supply is depleted; the supply line has been pinched closed, is plugged up or has come off; or the valve has failed to open.

APNEA EVENT

APNEA EVENT: Flashing Amber Light four (4) discrete times with audio beeps once every four (4) seconds until unit detects a valid inhalation event. Time before Apnea event is ~30 ~35 seconds. This typically occurs for the following reasons: (1) The user has quit breathing for 45 seconds or the cannula/face mask is improperly worn. (2) The outlet tube from the MH EDS-O2D2 to the mask or cannula has become disconnected. (3) The outlet tubing has become pinched closed or is plugged off. The apnea alarm can be used as a "put-your-oxygen-on" alarm once you get to the preset D mode altitude (D5 or D10). In this case, the alarm will not sound if you already have the cannula or face mask on properly.

LOW BATTERY-1 (First Warning)

LOW BATTERY -1: Depending on battery condition, one short flash of Red Light once every second, no sound. The unit will continue to operate properly for about four hours @ 77°F (25°C) after the indicator starts to flash. The EDS-O2D2 will operate for 150 to 200 hours with a fresh set of alkaline batteries under normal operation.

LOW BATTERY-2 (Second Warning)

LOW BATTERY -2: Two short flashes of Red Light, once every second, no sound. The second level warning occurs at approximately 2.5 volts. The Red Lights for each user will flash quickly and a continuous pattern of beeps will be heard. When this alarm occurs, the air flow will stop and batteries should be replaced IMMEDIATELY. The EDS-O2D2 will operate for 150 to 200 hours with a fresh set of alkaline batteries under normal operation.

BAD BATTERY

Bad Battery: Flash Red Light on and off alternately between stations at a one (1) second rate with unit locked out, no sound.

BATTERIES SHOULD BE REPLACED IMMEDIATELY.

EXTERNAL POWER

The MH EDS-O2D2 unit has an optional external power connector which allows the unit to operate from an external power supply (not included) that provides 4.5 volts DC. The inside conductor "tip" is positive (+) and the outside ring is negative (-). The MH EDS O2D2 power input is reverse polarity protected. (MH Part Number: 39300 - 1245 - 00)

Radio Shack Part Numbers: DC/DC Connector - #273-1857 ; Connector - 3273-1711 3.5mm OD, 1.3mm ID

USING THE MH EDS-O2D2 WITH A THIRD-PARTY REGULATOR

If the EDS-O2D2 will not be used with a MH Regulator, the alternate regulator must be able to deliver a pressure of between 15 and 25 psi (static). If the above listed pressure specifications are not met, the EDS-O2D2 may not operate correctly. Lower pressures will result in an inadequate volume of oxygen. Higher pressures will result in a too high volume of oxygen. Excessively high pressures will cause the valve to open spontaneously and leak oxygen.

To use the MH EDS-O2D2 with a third-party regulator or built-in oxygen system with a pressure higher than 25 psi, it is mandatory that you use the MH EDS IN-LINE REGULATOR to ensure correct flow pressure. The EDS-ILR goes between the third-party regulator or built in system and the MH EDS-O2D2 to reduce the flow pressure to an appropriate level.

TROUBLESHOOTING

- **The O2D2 unit emits no sound or start-up oxygen pulse when turned on:**

1. Check batteries to make certain they are fresh.

- **Start-up sound is heard, but no start-up oxygen pulse delivered:**

1. Check oxygen cylinder valve is on.
2. Check oxygen supply tube for proper connection.
3. Check oxygen supply tube for obstructions.
4. Check O2D2 outlet tubing for obstructions.

- **When using the face mask, no oxygen pulse on inhalation:**

1. Make sure the face mask is sealed against the skin.
2. Check for obstructions on the O2D2 outlet tubing.
3. Use only face masks provided by Mountain High Equipment & Supply.

NOTE: EDS face masks DO NOT have a dilution bag attached

- **Oxygen pulses are delivered, but an alarm is heard at the same time:**

1. Check the battery to make certain it is fresh.
2. Check for obstructions in the cannula/mask and tubing.
3. Use only masks and cannulas supplied by Mountain High Equipment & Supply.

- **The O2D2 does not trigger at higher altitudes:**

1. Try using the Flared-Tip cannula included with the kit (MH part number 00EDS-1084-01)

WARNING

DO NOT

increase or decrease length of cannula or face mask supply tubing.

DO NOT

use the MH EPS (External Power Supply) with the O2D2 as the voltages are not compatible.

NOTICE OF NON-LIABILITY

This device is classified as, and is only suitable for use as, a supplementary breathing apparatus (SBA) for aviation use. It is intended to help supply the needed amount of oxygen for persons during flight altitudes where supplemental oxygen is needed. This device is not suitable for any type of life support operations. This device is not suitable for SCBA (Self Contained Breathing Apparatus), SCUBA (Self Contained Underwater Breathing Apparatus) or any medical operations.

Before it is put to use, it is the responsibility of any user who will use this device to become familiar with the operation and safety aspects of this device. Using the system improperly could cause failure and lead to possible property damage and/or personal injury.

Mountain High Equipment & Supply Company assumes no responsibility for property damage, accidents, injury or death that may result from the misuse of this device/equipment. This includes any use of this device/equipment outside the scope of common sense, the Instruction Manual, inserts and other related documentation.

LIMITED WARRANTY

Mountain High Equipment & Supply Company warrants your MH EDS-O2D2 unit against defects in materials and workmanship for two (2) years from date of purchase invoice. The warranty is non-transferable. Should any part of the MH EDS-O2D2 become defective within the warranty period return the EDS Unit with a description of what/why it is not functioning and we will repair or replace it, at our discretion, free of charge (you pay only shipping to MH).

Return the Unit to:

Mountain High Equipment and Supply Company

RRO Department

625 SE Salmon Avenue Suite 2

Redmond OR 97756-8696

This warranty is non-transferable and only valid if Mountain High Equipment & Supply Company determines that the system and its components have not been damaged due to improper use, been submerged in fluids, dismantled or abused. Mountain High Equipment & Supply Company reserves the right to determine if repairs are to be done under warranty or at a nominal charge. **To activate warranty coverage, you must complete and return your owner's enclosed EDS Registration Card.**

SPECIFICATIONS

The O2D2 Specifications, performance standards and limits are derived from actual units tested, characterized or calculated. Specifications are subject to change without notice.

Allowable respiration rates: Adaptive: up to 43 bpm. And down to ~ 5 bpm. (two persons independently)

Apnea time-out envelope: Adaptive: ~40 sec Pa. 0-12 K ft., ~30 sec. Pa. 13-18 K ft., 20 Sec. at and above Pa. 18 K ft. Apnea alarm does not respond if in any of the 'D' modes and while below that pressure altitude threshold.

Operating inlet pressures: 15 psig. (1 bar) DYNAMIC (flowing) through cannula and 1.5 meters (5 ft.) of 4 mm. inlet tubing. 25 psig. (1.72 bar) .

Operating & storage temperatures, altitudes, vibration @ humidity, (assumes nominal operating voltage):

Temp range @ ~10% RH: -40° to +60° C. (Storage for complete unit less battery)

Temp range @ ~25% RH: 0° to +60° C. (Operating with std. valve)

Temp range @ ~100% RH NC: +5° to +60° C. (Operating with std. valve) **Unit is not water-proof, keep it dry from spray & rain.**

Altitudes @ up to ~100% RH: -100 to +30 K ft. Pressure Altitude range @ +5° to +60° C. (Operating with std. valve)

Vibration: Random vibration 5 to 500 Hz, 15 minutes per axis @ 2.5 g. (rms) sin wave.

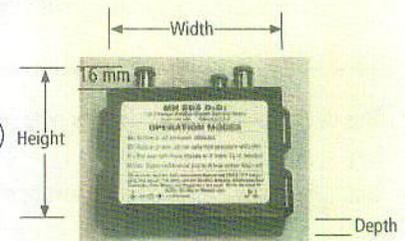
Physical characteristics (EDS-O2D2 unit only):

Width @ widest point: 4.21" (107 mm);

Height, including connectors: 3.73" (94.75 mm.);

Height, enclosure only: 3.18" (80.7 mm); Thickness, front to rear: 1.25" (31.75 mm)

Weight: 11.2 Oz. (0.317 kg.) with batteries



Operating Voltage & Current @ 25° C. @ ~25% RH.

(Measured in the 'N' mode setting @ 15 RESP/ typical.):

Battery types: 3 ea. Standard 1.5 volt alkaline type 'AA' or equivalent. Use only alkaline type batteries.

Battery Life: 100 to 150 Hrs. @ ~25° C. @ ~25% R.H. Measured from mean, assuming fresh alkaline batteries operating under normal operating conditions.

Make sure alkaline batteries are used and removed during long-term storage.

External Power: 4.5 VDC external power jack with auto battery disconnect with series diode is provided. No internal regulation or over voltage protection is provided.

External Audio output: 3 mm stereo type jack provides audio output at ~40 mv. RMS into 600W L&R independent. Suitable for most aircraft Integrated Communication Systems (ICS).

Nominal battery voltage: ~4.25 VDC @ 4.30 ma. Idle. 220 ma. Peak (~50 ms. max), 3.25 ma. Average.

Min. start-up voltage: ~2.80 VDC ± 40 mv.

Low-battery cut-out: < 2.5 VDC ± 40 mv. (Red light on steady unit in non-responsive state 'dead')

Very low battery signal: ~3.0 VDC ± 40 mv. (Red light winking 2/sec.) ~5 Hrs. of service left.

Low battery signal: ~3.3 VDC ± 40 mv. (Red light winking 1/sec.) ~12 Hrs. of service left.

Notes:

The low battery cut-out feature provides a known state of action if the batteries are depleted to the point of inadequate power to operate the unit to any of the declared specifications. In addition, this feature was found to be prudent because, while many of the specifications may stay intact, false triggering of the valve may confuse the operator of a problem other than low batteries. The minimum 'start-up' voltage is where the unit will initiate the built-in test and commence operations. However, it should be noted that, during this operation, if the batteries are then measured to be too low the lock-up feature may then shortly ensue. This should help the operator in determining if the unit is bad or if the batteries are too low. A unit that has low batteries that cause 'lock-up' will most likely initially start-up if left off for some time. Alkaline type batteries have so-called self-rejuvenating properties that may cause the user to stall battery replacement. Obviously, dead batteries will yield no action.

**Maintenance Program, for O2D1 & O2D2
PULSE DEMAND™ Portable Systems**

- Q. I have one of your portable MH-EDS PULSE DEMAND™ units. They seem to be operating just fine, should I send it in for any type of routine service or testing?
- A. Yes. Even though your pulse demand unit will generally let you know if there is a problem and has been designed to be relatively maintenance free, except for batteries, it should be sent in on a regular basis for performance inspection and service. This includes the in-line or screw-on regulator you use with the EDS. Think of it like performing an annual inspection on your aircraft.
- Q. Why has this not been mentioned before and how often does MH recommend this be done?
- A. This service program has been derived from usage and servicing data acquired during the last 20 years the technology has been in production and fielded. From this, Mountain High has recently decided on a routine service program that should be accomplished once every two years, (biannually). This must include the regulator you are currently using with the EDS unit(s).
- Q. What is done to my EDS unit and regulator when I send them in for service.
- A. From time to time we make engineering improvements during our production. These improvements may include changes to hardware or firmware or both. This is our way of passing on our latest improvements to you. Also routine service parts such as seals, seats, O-rings and filters are inspected and replaced. Your EDS unit(s) and regulator(s) are then thoroughly inspected and tested on our ATP test set to ensure they are operating to specified standards. This will help to ensure your system is operating properly and upgraded to the latest specifications.
- Q. How much does it cost me?
- A. The cost for this service is US \$75.00. This includes all firmware and hardware upgrades. Routine service parts are also included. Any other parts replaced due to damage or field use would be subject to an additional charge.
- Q. What about shipping costs and how long should I expect this service to take?
- A. You pay only the shipping to us, and in the continental US we pay UPS ground shipping back to you. International shipping is to be paid by customer. Once we receive your unit, in-house turn around time is generally five to ten working days.
- Q. I have sent my EDS unit(s) back once before for a problem of leaking or not responding at certain altitudes, but it came back with the same problem. Why ?
- A. Many problems perceived to be with the EDS unit(s) have in fact turned out to be with the regulator. This has mostly been the case if you are not using the regulator designed for the EDS or are connecting directly to a built-in system installed in your aircraft. *This is why you must include the primary reducing regulator you are using (ours or not) or tell us that you are connecting the EDS unit(s) directly to your aircraft's built-in system without our inline regulator.* Many other regulators do not regulate the pressure adequately for the EDS unit(s) to operate and deliver the proper amount of oxygen. Damage can be done to the breathing sensor in the EDS unit(s) if the operating pressure is too high. Additionally, we have seen many situations where customers connect the EDS unit(s) to the connectors and tubing that came with their aircraft. Then plug them into the high-pressure outlets in the aircraft. This has caused a lot of confusing problems because these connectors generally have flow restriction orifices. In many cases this has allowed the EDS unit(s) to check out okay at ground level when the pulse response is low, but then complain with flow fault alarms at higher cruising altitudes. Additionally, this problem can be difficult to reproduce because the EDS unit(s) operate with pressure altitude and not barometrical corrected altitude.