Hardening the Mountain High O2D1 against False triggering

C. Zavatson

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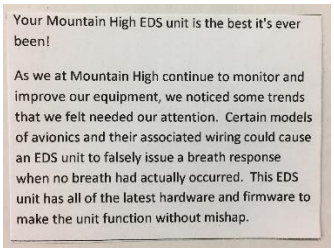
The latest version of the Mountain High pulse demand O2D1 controller has been susceptible to EMI providing false triggers and oxygen delivery. This is unique to the latest version, a compact SMT design. The older analog units did not exhibit this sensitivity.

Figure 1, Mountain High EDS units, original A-1 vs latest O2D1

These units sense the beginning of the inhalation cycle by measuring a drop in pressure in the line. They then provide a shot of oxygen that is scaled in magnitude to the current altitude.

I have used pulse demand EDS units since 1998. After acquiring the first O2D1 unit in 2016, I soon noticed that the unit was providing extra shots of O2 in between inhalation cycles. They seemed randomly timed. The frequency would also vary. I sent the unit in to Mountain High but they could find nothing wrong.

Fast forward two years. I purchased an entire new two-place set-up with two new O2D1 EDS units, a new bottle and four-place regulator. Given the passage of time, I was hoping others might have run into the same issue and Mountain High might have incorporated improvements. The new EDS units actually contained a note confirming my hunch that I may have simply been on the leading edge of this issue. Apparently others had seen the same behavior and Mountain High needed more data points to narrow in on the issue.



Your Mountain High EDS unit is the best it's ever been!

As we at Mountain High continue to monitor and improve our equipment, we noticed some trends that we felt needed our attention. Certain models of avionics and their associated wiring could cause an EDS unit to falsely issue a breath response when no breath had actually occurred. This EDS unit has all of the latest hardware and firmware to make the unit function without mishap.

Figure 2, Note included with new EDS units

Unfortunately, on the first long duration test of approximately 20 hours of flight time, the new units occasionally started acting up randomly. The same random pulses, unrelated to inhalation, began occurring. I eventually determined that the location, and even orientation, in the aircraft cockpit affected the false pulsing. The key ended up being the unit's position relative to the transponder antenna. It was 1090 MHz pulses from the transponder was occasionally triggering an oxygen pulse. Mine is a fiberglass aircraft with the transponder antenna on the belly of the aircraft. A large aluminum ground plane resides on the inside of the fuselage, but the majority of the aircraft is transparent to RF.

In order to both verify the EMI theory and begin work on a solution, I wrapped the unit in aluminum foil. While airborne the EDS unit was flawless. When I removed the aluminum wrap, the false triggering started up. Again wrapping the EDS unit in aluminum foil stopped all misbehavior. This confirmed that the false triggering was indeed related to EMI.

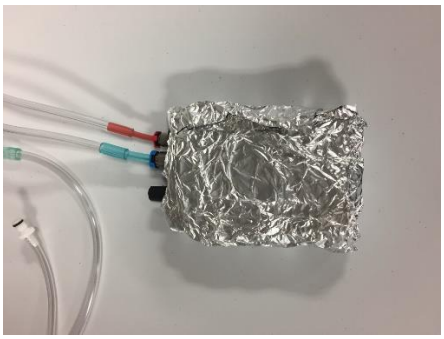


Figure 3, EDS O2D1 wrapped in aluminum foil as an EMI shield

It is worth noting that a the random pulsing issue existed before and after ADS-B upgrades, meaning, two different transponder brands, two different cables and two different antennas. Only the antenna location was the same.

The final solution needed to be more aesthetically pleasing then aluminum foil wrapped around the exterior. I coated the interior of the plastic enclosure with a spray-on nickel based EMI shield. While not as opaque as a full wrap of aluminum foil, it was sufficient to shield the EDS electronics.

Figure 4, MG Super Shield Conductive Coating

This spray on EMI shield is specifically designed for adhering to plastic. Some areas need to be masked off include where the battery terminals clip on and the studs that mount the PCB. As an extra precaution, electrical tape was added were energized metallic components, battery terminals for

example, were in close proximity to the case and could potentially make contact if they moved or slid out of position.

Figure 5, Masked Enclosure

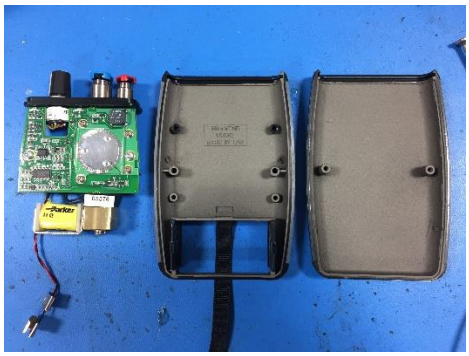


Figure 6, Coated Enclosure ready for reassembly

Figure 7, EDS unit partially reassembled

This has resolved the false triggering that had been taking a toll on oxygen range over the last two years. Somewhere in the evolution from analog to low voltage digital, a sensitivity to radiated 1090MHz emissions was introduced.