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Rev. 1 1-09

Rev. 2 5-10

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G2 PPO2 MONITOR KIT SECTION 2



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6. BOARD OPERATIONS

- 6.1. This section covers all board operational functions.
- 6.2. Battery life is driven by many operator selectable functions and quality of battery. Generally, the battery life should range from 5 to 10 hours. **ALWAYS CARRY EXTRA BATTERIES IN YOUR SPARE TOOL KIT.** We recommend Duracell or Energizer brand.
- 6.3. This board utilizes surface mount components, is microcontroller based, and offers users flexibility not previously seen in inexpensive PPO2 monitoring systems. All user functions are accessible through the push of one button. This one button allows users to turn the system on or off, operate the backlight, calibrate the sensors, and program user definable setup options. The board allows users to select the display of one, two, or three sensors on a single Digital Panel Meter (DPM). As the value of each sensor's PO2 reading is displayed (at a user definable time period) an amber LED is illuminated at the top of the board to indicate the sensor being displayed. An integrated onboard Heads Up Display (HUD) utilizing one green and two red LED's are used to indicate a low, high or okay PPO2. The values of these alarms are also user programmable. In addition, the onboard HUD signals are routed to a header connector on the board so that a externally mounted HUD can be interfaced to the display board. Lastly, a red low battery alarm LED is provided which illuminates when the battery voltage reaches 7.2 VDC and below.
- 6.4. Figure 9 above shows the display board and HUD at startup. The DPM is displaying the battery voltage with all LED's lit to verify operation and to provide the maximum load on the battery during the battery voltage test. After the operational test of the display board it then enters normal operation sequentially displaying the PPO2 value of each O₂ sensor programmed by the user to be read. During operation if you tap the control button momentarily the backlight will come on for two cycles of display readings then automatically shut off. To turn the backlight permanently on, press and hold the button until you see all there amber sensor LED's flash and then let go. Repeat this process and the backlight toggles permanently off.
- 6.5. There are two user accessible menus, a sensor calibration menu and a display board setup menu. The *sensor calibration menu* implements a quick and easy method of calibrating the O₂ sensors utilizing the push button while the *display board setup menu* allows users to define values for the number of sensors to display (1, 2, or 3 sensors), the dwell time to display each sensor PPO2 value (1 to 7 seconds), and the High/Low PPO2 Alarm values.
- 6.6. **ATTN: If the PPO2 is above the low PPO2 alarm set point you can only turn on/off the backlight, you cannot enter any other menus. This is to prevent accidental changes to preset values when in use.**

6.7. Board will be shipped preset to the following settings unless otherwise specified by the purchaser.

- Three Sensors with 3 second switching delay
- Low PPO2 warning set at .8 and High PPO2 warning set at 1.4

6.8. DISPLAY BOARD BASICS

Battery & magnetic switches:

The display board uses a magnetic reed switch to turn the display on/off and a Hall Effect sensor to read the button pushes. The magnet used in conjunction with the push button and magnetic switches is located inside the housing in close proximity to the display board and the battery. The metallic battery housing influences the operation of the magnet so the battery must be installed for the switches to function properly.

Turning the display board on/off:

All the display board functions are executed using the push/screw control button. To turn the display board on, rotate the button clockwise until the display board powers up and the button is able to be pushed. You can now access all the functions associated with pushing the button. To turn the display board off, rotate the screw counterclockwise until the display board turns off and then rotate it one more turn. Due to vibration the push button may rotate and turn the display on. If the housing is subjected to long periods of vibration you should check to see that the display board remains off. If you suspect the display board is not functioning correctly, i.e. possibly locked up, you can go through the process of turning the display board off and then back on again to reset it.

Push Button Functions:

All the functions associated with controlling the display board are accessed through the push of a single button. Since there are many options available to the user via this single interface it may be slightly confusing at first, however, after a short period of use the simple logic should be evident.

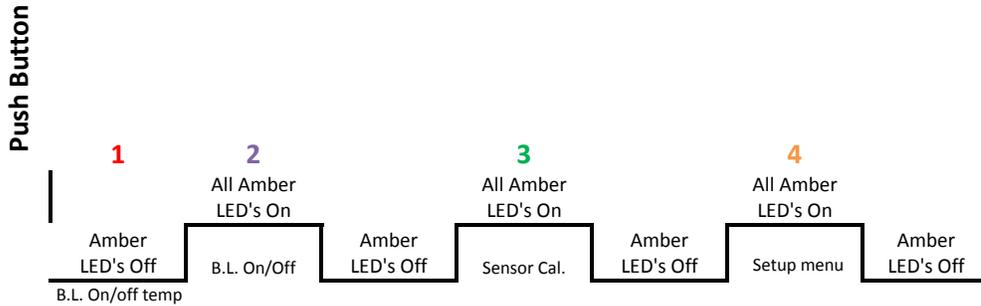
Below is a “wave form” which illustrates how to access the functions using the push button. When the button is first pushed, and held in, a timing sequence is initiated. At what point you release the button, based on visual cues, will determine what action the control system takes. The visual cue you’ll watch are the three amber sensor LED’s.

Let’s walk through the first two options **1 & 2**.

(1): When you first push the button the sensor being monitored will jump to sensor 1 and the Sensor 1 amber LED will light. If you release the button at this point, and before all three amber sensor LED’s light, then the backlight will stay on temporarily for two cycles of sensors reads.

(2): If you do not release the button in step one above and continue to hold the button in, then eventually all three amber sensor LED's will light. At this point if you release the button the Backlight will come on permanently and stay on until you repeat the process.

This process is repeated and with each sequential lighting of the three amber Sensor LED's a release of the button will enter you into a different option or menu.



1. Push and release the button at anytime during this period and the **backlight will come on for two cycles of the sensor display.**
2. Release the button during this time to **turn On/Off backlight permanently.**
3. Release the button during this time to enter **sensor calibration menu.**
4. Release the button during this time to enter **display board options setup menu.**

Note: If the po2 is above the low po2 alarm set point you can only turn on/off the backlight and you can not enter the *Sensor Calibration* or *Display Board Setup Menu*.



The DPM during normal operation will display the decimal point in the first decimal place.



When the button is pressed the decimal will move to the third decimal place. This can be a useful troubleshooting feature if the button or magnet sticks.

Backlight:

Temporally on: While in the normal operating mode momentarily press the button releasing it during time period **1**, and the backlight will come on for two cycles of sensor reads. The display must go through two cycles of sensor reads before the button can be used again.

Permanently on: If the backlight is off, press the button and wait for all three amber sensor LED's to light up, time period **2**, release the button during this time period and the backlight will now be permanently on.

Permanently off: If the backlight is on, press the button and wait for all three amber sensor LED's to light up, time period **2**, release the button during this time period and the backlight will now be permanently off.

Sensor Calibration Menu:

Button function while in the Sensor Calibration Menu:

- Push and hold: Increase/decrease PO2 in large steps.
- 1 momentary push: Increase/decrease PO2 in small step.
- 2 rapid momentary pushes: Toggle PPO2 increase/decrease direction.
- 3 rapid momentary pushes: Advance to next sensor.
- 4 rapid momentary pushes: Exit menu and return to normal operation.

Note: The button needs to be pushed rapidly when pressing it more than once. Currently the system counts the number of button pushes in $\frac{1}{4}$'s of a second and then proceeds accordingly.

To enter the *Sensor Calibration Menu* ensure your PPO2 is below the Low PPO2 Alarm set point and that the Low PPO2 Alarm LED is illuminated. Press and hold the button, release the button when all three amber sensor LED's light up for the second time, during time period **3**. The three amber sensor LED's will flash twice and all three decimal places will be on.

The display board will now be in the *Sensor Calibration Menu* with the Sensor 1 LED illuminated indicating that sensor one is being calibrated. The High PO2 Alarm PPO2 LED will be also be illuminated indicating that when the button is pushed the PPO2 value displayed will increase. Press the button momentarily and you will see the PPO2 Okay LED blink and the PPO2 will increase in a small step. Press and hold the button, you will see the PPO2 Okay LED blink and the PPO2 will increase in large steps.

To decrease the displayed PPO2 value, press the button quickly twice to toggle the increase/decrease direction. The Low PPO2 Alarm LED will now be illuminated indicating that when the button is pushed the displayed PPO2 value will decrease. Press the button momentarily and you will see the PPO2 Okay LED blink and the PPO2 will decrease in a small step. Press and hold the button, you will see the PPO2 Okay LED blink and the PPO2 will decrease in large steps.

To advance to the next sensor quickly push the button three times. If there is more than one sensor programmed to be monitored then the Sensor LED will advance to the next sensor. If you are at the end of your programmed number of sensors the display will wrap back to sensor 1.

To exit the *Sensor Calibration Menu* and return to normal operation quickly press the button four times. The three amber sensor LED's will flash twice, the board will go through its normal startup routine, and resume normal operation.

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Display Board Setup Menu:

Typical Button functions while in the Display Board Setup Menu:

- Push and hold: Increase/decrease value in large steps.
- 1 momentary push: Increase/decrease value in small step.
- 2 rapid momentary pushes: Toggle increase/decrease direction.
- 3 rapid momentary pushes: Advance to next menu item.
- 4 rapid momentary pushes: Exit menu, save setting, and return to normal operation.

Note: The button needs to be pushed rapidly when pressing it more than once. Currently the system counts the number of button pushes in $\frac{1}{4}$'s of a second and then proceeds accordingly.

To enter the *Display Board Setup Menu* ensure your PPO2 is below the Low PPO2 Alarm set point and that the Low PPO2 Alarm LED is illuminated. Press and hold the button, release the button when all three amber sensor LED's light up for the third time, during time period **4**. The three amber sensor LED's will flash twice, you'll now be in the first display board setup menu item, *Number of Sensors to be Used*.

In the *Display Board Setup Menu* the decimal points on the DPM will indicate, in binary code, which menu item you are currently configuring:

1 Number of sensors to be used	2 Dwell time to display each sensor	3 High PO2 Alarm value
4 Low PO2 Alarm value	5 Not currently implemented.	6 Not currently implemented.
7 Not currently implemented.		



Number of sensors to be used:

Button function while in the Number of Sensors Menu:

- 1 momentary push: Increase the number of sensors monitored.
- 3 rapid momentary pushes: Advance to next menu item.
- 4 rapid momentary pushes: Exit menu and return to normal operation

The first *Display Board Setup Menu* item is the *Number of Sensors to be Used* (1, 2, or 3 sensors). This is indicated by which sensor LED is illuminated; the Sensor 1 LED will be illuminated for one sensor, the Sensor 2 LED illuminated for two sensors, and the Sensor 3 LED illuminated for three sensors. To change the number of sensors, momentarily press the button to increment the value. When you reach three sensors and momentarily pressing the button again the value will “wrap” back to one.

To proceed to the **next** menu item rapidly press the button three times. The three amber sensor LED’s will flash twice to indicate you’re moving to the next menu item.

To **exit** the display board setup menu, save the setting, and return to the normal operating mode rapidly press the button four times. The three amber sensor LED’s will flash twice, the board will go through its normal startup routine, and then resume normal operation.



Dwell Time to Display each Sensor:

Button function while in the Dwell time Setup Menu:

- Push and hold: Increase value quickly.
- 1 momentary push: Increase value.
- 3 rapid momentary pushes: Advance to next menu item.
- 4 rapid momentary pushes: Exit menu, save setting, and return to normal operation.

The second display board setup menu item is the *Dwell Time to Display each Sensor*. In this section the amber Sensor LED’s 1, 2, and 3 show the dwell time of 1 to 7 seconds as a binary number. Momentarily pressing the button will increase the value by one until you reach a value of 7 seconds, pressing the button again will wrap the value back to 1 second. Below is a table showing the LED’s lit , not lit , and the values associated with them:

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Amber Sensor LED			
1	2	3	
			One second
			Two seconds
			Three second
			Four seconds
			Five seconds
			Six seconds
			Seven seconds

To proceed to the **next** menu item rapidly press the button three times. The three amber sensor LED's will flash twice to indicate you're moving to the next menu item.

To **exit** the display board setup menu, save the setting, and return to the normal operating mode rapidly press the button four times. The three amber sensor LED's will flash twice, the board will go through its normal startup routine, and then resume normal operation.



High PPO2 Alarm Set Point:

Button function while in the High PPO2 Alarm Set Point Menu :

- Push and hold: Increase/decrease value in large steps.
- 1 momentary push: Increase/decrease value in small step.
- 2 rapid momentary pushes: Toggle increase/decrease direction.
- 3 rapid momentary pushes: Advance to next menu item.
- 4 rapid momentary pushes: Exit menu, save setting, and return to normal operation.

The third display board setup item is the *High PPO2 Alarm Set Point*. When you enter this menu item the High PPO2 Alarm PO2 LED will be illuminated indicating that when the button is pushed the High PPO2 Alarm value will increase. Press the button momentarily and you will see the PPO2 Okay LED blink and the High PPO2 Alarm value will increase in a small step. Press and hold the button, you will see the PPO2 Okay LED blink and the High PPO2 Alarm value will increase in large steps.

To decrease the High PPO2 Alarm value, press the button quickly twice to toggle the increase/decrease direction. The Low PPO2 Alarm LED will now be illuminated indicating that when the button is pushed the High PPO2 Alarm value will decrease. Press the button momentarily and you will see the PPO2 Okay LED blink and the High PPO2 Alarm value will decrease in a small step. Press and hold the button, you will see the PPO2 Okay LED blink and the High PPO2 Alarm value will decrease in large steps.

To proceed to the **next** menu item rapidly press the button three times. The three amber sensor LED's will flash twice to indicate you're moving to the next menu item.

To exit the High PPO2 Alarm set point setup menu and return to normal operation, rapidly press the button four times. The three amber sensor LED's will flash twice, the board will go through its normal startup routine, and then resume normal operation.



Low PPO2 Alarm Set Point:

Button function while in the Low PPO2 Alarm Set Point Menu :

- Push and hold: Increase/decrease value in large steps.
- 1 momentary push: Increase/decrease value in small step.
- 2 rapid momentary pushes: Toggle increase/decrease direction.
- 3 rapid momentary pushes: Advance to next menu item.
- 4 rapid momentary pushes: Exit menu, save setting, and return to normal operation.

The fourth display board setup item is the *Low PPO2 Alarm Set Point*. When you enter this menu item the High PPO2 Alarm PO2 LED will be illuminated indicating that when the button is pushed the Low PPO2 Alarm Value will increase. Press the button momentarily and you will see the PPO2 Okay LED blink and the Low PPO2 Alarm Value will increase in a small step. Press and hold the button, you will see the PPO2 Okay LED blink and the Low PPO2 Alarm Value will increase in large steps.

To decrease the Low PPO2 Alarm Value, press the button quickly twice to toggle the increase/decrease direction. The Low PPO2 Alarm LED will now be illuminated indicating that when the button is pushed the Low PPO2 Alarm Value will decrease. Press the button momentarily and you will see the PPO2 Okay LED blink and the Low PPO2 Alarm Value will decrease in a small step. Press and hold the button, you will see the PPO2 Okay LED blink and the Low PPO2 Alarm Value will decrease in large steps.

To proceed to the **next** menu item rapidly press the button three times. The three amber sensor LED's will flash four time to indicate you're moving to the beginning of the menu, *Number of Sensors to be Used*.

To exit the Low PPO2 Alarm set point menu and return to normal operation, rapidly press the button four times. The three amber sensor LED's will flash twice, the board will go through its normal startup routine, and then resume normal operation.

Wire connections

One green header connector is used for the sensor connections:

+1	-	Sensor 1 positive.
-1	-	Sensor 1 negative.
+2	-	Sensor 2 positive.
-2	-	Sensor 2 negative.
+3	-	Sensor 3 positive.
-3	-	Sensor 3 negative.

The other green header connector is used for 9VDC power and the “Off Board” Heads Up Display.

+9	-	9VDC battery positive.
G	-	9VDC battery negative.
HI	-	Off Board Heads Up Display connection to PO2 High LED.
OK	-	Off Board Heads Up Display connection to PO2 OK LED.
LO	-	Off Board Heads Up Display connection to PO2 LO LED.
G	-	Off Board Heads Up Display ground connection.

7. MAINTENANCE and SERVICING

- 7.1. This monitor requires only basic maintenance and servicing to work correctly.
- 7.2. Housing should be protected against scratches and damage when not in use. A bottle drink huggie works well.
- 7.3. If the monitor assembly is subjected to salt water environments, it should be soaked in clean fresh water after each exposure.
- 7.4. Continued use in salt water will require periodic oiling of magnet through the control button hole. This is to insure that the magnet does not excessively corrode and lock up. Remove control button by unscrewing counter clockwise. Place several drops of light oil into hole. Install control button and activate button numerous times until magnet moves freely. Repeat as needed. Wipe off excessive oil. Rapidly pressing the button while the housing is submerged in water will help to evacuate small particles.
- 7.5. The most frequent maintenance item is changing the battery. Replace as follows:
 - 7.5.1 Verify that the power is off to the board.
 - 7.5.2 Unscrew the retainer cap.
 - 7.5.3 Carefully remove the internal housing from the outer housing. DO NOT pull on HUD cabling to remove internal housing.

- 7.5.4 Be sure to keep your hand under the battery when removing the internal housing as the battery may fall out.
- 7.5.5 Inspect the o-rings, internal housing, and outer housing for any damage of dirt. Replace o-rings with V-126 as needed.
- 7.5.6 Clean all sealing surfaces.
- 7.5.7 Gently remove the battery just enough to disconnect the battery clip.
- 7.5.8 Hold the clip steady and disconnect the battery.
- 7.5.9 Install new battery and verify no wires are protruding outside the internal housing.
- 7.5.10 Lubricate the sealing area inside of the outer housing and o-rings with O2 compatible grease. CAUTION: Not lubricating O-rings will make removal of the internal housing from the outer housing more difficult.
- 7.5.11 Install the internal housing assembly into the outer housing.
- 7.5.12 Visually inspect all sealing areas to insure wires were not pinched in the o-rings.
- 7.5.13 Install the retaining cap.
- 7.5.14 Power up the board to insure it is working properly and verify battery voltage is 9 volts on the display.
- 7.5.15 Battery life is driven by many operator selectable functions and quality of battery. Generally, the battery life should range from 5 to 10 hours. **ALWAYS CARRY EXTRA BATTERIES IN YOUR SPARE TOOL KIT.** We recommend Duracell or Energizer brand.

- 7.6. O-rings should be inspected, cleaned, and lubricated every time the internal housing is removed from outer housing. Replace O-rings with V-126 as needed.
- 7.7. Terminal screws on board should be checked periodically to insure wires do not become loose. **DO NOT** over tighten screws.
- 7.8. Contact Gorilla Diving Products for any spare parts. To ensure you receive the correct replacements parts, please inform the company representative with the manual number shown in the upper right corner of each page. Ex. ML-004-2

8. TROUBLE SHOOTING

- 8.1. Display will not power up:
 - 8.1.1. Check battery voltage. Battery will not power up board if below minimum allowable voltage.
 - 8.1.2. Check battery wire connector for loose wire.
 - 8.1.3. Check for loose battery wires at board terminal.
 - 8.1.4. Check for corrosion on wires and connections.
- 8.2. Display powers up but shows no reading:
 - 8.2.1. Verify correct wiring procedure for sensors is being followed. See Board Operation section for correct procedures.
 - 8.2.2. Check voltage output of sensor.
 - 8.2.3. Check for corrosion on wires and connections.
 - 8.2.4. Check for stuck magnet. Oil control button hole with light oil and recheck.
- 8.3. Display powers up but shows only the value of 1:
 - 8.3.1. Verify correct wiring procedure for sensors is being followed. See Board Operation section for correct procedures.
 - 8.3.2. Check for any loose wire connections.
 - 8.3.3. Check for corrosion on wires and connections.
 - 8.3.4. Check sensor voltage.
 - 8.3.5. Check for stuck magnet. Oil control button hole will light oil and recheck.
- 8.4. Display will not calibrate:
 - 8.4.1. Verify correct procedure is being followed. See Board Operation section for correct procedures.
 - 8.4.2. Check for low battery voltage.
 - 8.4.3. Check sensor output.
 - 8.4.4. Check sensor wires and connections at sensor and board.
 - 8.4.5. Magnet may be stuck. Oil control button hole will light oil and recheck.
- 8.5. Display reading fluctuates:
 - 8.5.1. Check for low battery voltage.
 - 8.5.2. Check sensor output. Sensor may be old.
 - 8.5.3. Check sensor wires and connections at sensor and board.
 - 8.5.4. Verify that pressure around the sensors is steady. Fluctuations in air pressure around sensors will cause fluctuations in display reading.

9. REFERENCES

www.gorilladiving.com
www.ppo2.com

10. CONTACT INFORMATION

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