Shearwater GF Computer

DANGER

This computer is capable of calculating deco stop requirements. These calculations are at best a guess of the real physiological decompression requirements. Dives requiring staged decompression are substantially more risky than dives that stay well within no-stop limits.

Diving with rebreathers and/or diving mixed gasses and/or performing staged decompression dives and/or diving in overhead environments greatly increases the risk of scuba diving.

You really are risking your life with this activity.

WARNING

This computer has bugs. Although we haven't found them all yet, they are there. It is certain that there are things that this computer does that either we didn't think about, or planned for it to do something different. Never risk your life on only one source of information. Use a second computer or tables. If you choose to make riskier dives, obtain the proper training and work up to them slowly to gain experience.

This computer will fail. It is not whether it will fail but when it will fail. Do not depend on it. Always have a plan on how to handle failures. Automatic systems are no substitute for knowledge and training.

No technology will keep you alive. Knowledge, skill, and practiced procedures are your best defense.   (Except for not doing the dive, of course.)

Overview

Features

- Depth, time and oxygen sensor display

- Buhlmann algorithm with gradient factors conservatism

- Imperial and metric displays

- Two set points, each of which can be set between .4 and 1.4

- A menu system that adapts to diving status

- Automatic turn off after 30 minutes on the surface

- Depth sensor to rated to 450 feet

- Any combination of oxygen, nitrogen, and helium

- Open and closed circuit, switchable during a dive

- 5 CC and 5 OC gasses

- Gasses can be changed and added during a dive

- CNS tracking

- No lockout

- Automatic setpoint switching (configurable)

- Battery life of over 500 hours of diving or years of standby

- Backup battery to allow battery change without losing tissues

Decompression and Gradient Factors

The basic decompression algorithm used for the computer is Buhlmann ZHL-16C. It has been modified by the use of Gradient Factors that were developed by Erik Baker. We have used his ideas to create our own code to implement it. We would like to give credit to Erik for his work in education about decompression algorithms, but he is in no way responsible for the code we have written.

The computer implements Gradient Factors by using levels of conservatism. The levels of conservatism are pairs of number like 30/85. For a more detailed explanation of their meaning, please refer to Erik Baker's excellent articles: *Clearing Up The Confusion About "Deep Stops"* and *Understanding M-values.* The articles are readily available on the web. You might also want to search for "Gradient Factors" on the web.

The default of the system is 30/85. The system provides several settings that are more aggressive than the default.

DO NOT USE THIS SYSTEM UNTIL YOU ARE SURE YOU UNDERSTAND THE SETTINGS.
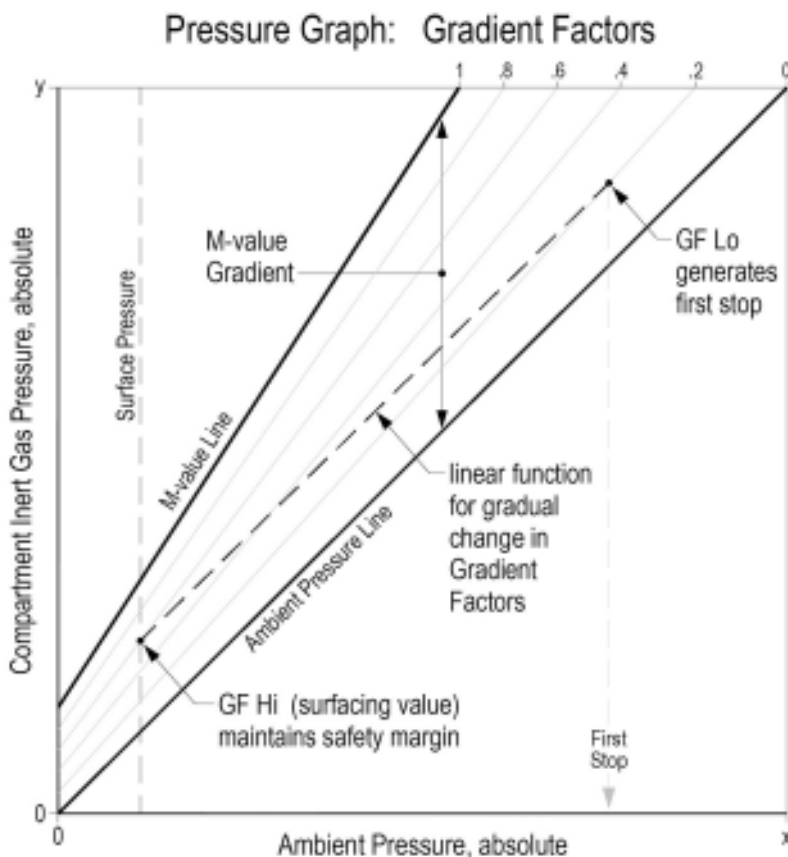
Graph from Erik Baker's "Clearing Up The Confusion About Deep Stops"

Display

The display has five areas.   There are two title areas and three data display areas.

Across the top line is the title for the first row of information. This area only changes during the display of the dive log. The first data area shows depth, battery warning, dive time, ascent rate, first stop depth, and first stop time. It is showing a depth of 34.7 meters, a low battery alarm, 15 minute dive time, a 6 meter per minute ascent rate, and a stop at 24 meters for 1 minute.

The low battery indicator flashes when it is on.

The ascent rate indicator shows 6 levels of ascent rate. Each block represents either 10 fpm or 3 mpm. When the ascent rate is greater than 6 units, the whole block will be filled in, and it will flash.

If you are above the indicated stop depth, the stop depth will flash.

The next line has the three O2 sensor readings. They will show in PPO2 normally, but if both buttons are pushed together, the display will switch to mV for a few seconds. If a sensor is voted out, it will display the current value, but it will flash and the value will not be considered in the average PPO2.

The next area is the title for the bottom line. This title changes frequently in the menu system to provide additional information about the bottom line. The last line shows that the computer is in closed circuit (CC) mode with a gas containing 21% oxygen and 0% helium.
If there is a gas programmed in the current mode (OC or CC) that would normally be used at the current depth, the system will flash the gas contents to remind you to either switch gases, or remove the gas if you aren't using it.
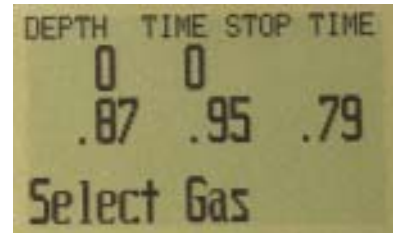
The no decompression limit (NDL) is zero since we are in decompression, and the time to surface (TTS) is 15 minutes.

The computer works in both metric and imperial for depths and temperatures. The depth shows a decimal point when the depth is between 0 and 99 meters. It shows no decimal point if the display is set to feet.
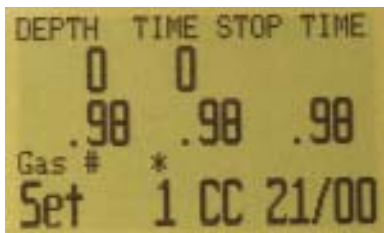
Buttons

Two buttons control the system. The functions can be summarized as follows:

The left button (MENU) is used to scroll through the menu or increment the display. When the "Switch Setpoint" menu item is displayed, MENU will move to the "Select Gas" menu item.

DEPTH TIME STOP TIME
0   0
.87 .95 .79
Switch to -> 1.3

DEPTH TIME STOP TIME
0   0
.87 .95 .79
Select Gas

In the "Select Gas" menu, MENU increments the gas number.
The right button (SELECT) is used to accept the current choice. In some cases that means save the current value, in others, it means execute the command. For

DEPTH TIME STOP TIME
0   0
.98 .98 .98
Gas #   *
Set   1 CC 21/00

DEPTH TIME STOP TIME
0   0
.98 .98 .98
Gas #   *
Set   2 CC 10/50

example, when a gas is displayed in the "Select Gas" menu, SELECT will select the displayed gas. When the "Switch Setpoint" menu is displayed, SELECT will switch the setpoint.

There are several other button pushes that the system recognizes.

To turn the computer on, press MENU then immediately press SELECT.

When the system is not in a menu, pushing SELECT will bring up information displays with various dive status information.

Pushing both buttons at any time will change the PPO2 display to a millivolt (mV) display. The mV display is not subject to calibration. It displays the raw mV on the sensor without regard to whether the sensor is calibrated or whether is has been voted out.

MENU

- In the menu system, the menu button moves to the next menu or increments the current number

- When the computer is off, pressing MENU and then immediately pressing SELECT will turn the computer on.

SELECT

- In the menu system, the confirm button saves the current value or executes the command.

- Out of the menu system, the confirm button brings up information displays.

BOTH BUTTONS

- Pushing both buttons at any time changes the PPO2 display to the mV display.

The computer works in both metric and imperial for depths and temperatures. The depth shows a decimal point when the depth is between 0 and 99 meters. No decimal point is shown if the display is set to feet or if the depth is greater than 99 meters.

Menu

The system is designed to make the selection of the common operational functions while diving easy. The menu selections are separated into two sets. The "Operation" menu is to provide easy access to commonly used functions. The "Setup" menu is to change system settings.

The system will continue to read the sensors and update the sensor display while you are in the menu system.

If no buttons are pushed for a few minutes, the menu system will time-out. Anything that had been previously saved will be retained. Anything that was in the middle of editing will be discarded.

The menu structure is below:

- **Turn Off**
- **Calibrate**
- **Switch Setpoint**
- **Select Gas**
- **Switch to Open Circuit**
- **Dive Setup**
  - **Edit Low Setpoint**
  - **Edit High Setpoint**
  - **Define Gasses**
  - **Extenal PPO2 On/Off**
- **Dive Log**
  - **Display Log**
  - **Upload Log**
- **System Setup**
  - **Auto SP Switch**
  - **Set Conservatism**
  - **Switch to Feet/Meters**
  - **Set Backlight Time-out**
  - **Set Backlight Brightness**
  - **Set Time**
  - **Set Date**

Some menu items are not applicable in some operating modes.

The status screens are:

- **Max depth, CNS, setpoint and average PPO2**
- **Diluent PPO2 and Conservatism setting**
- **Water temperature, loop temperature and voltage**
- **Date and Time**
- **Surface interval**
- **Serial Number, Model, and Version**

Basic Setup

Before using the computer there are several things that need to be configured. This is not an exhaustive list of the pre-requisites for diving the system, but a suggestion of key tasks.

In the System Setup menu, select the Auto SP Switch parameters, and set the units to your preference.

Enter the gasses that you will use for the closed circuit portion of your dive, and enter the gasses for open circuit bailout.

The system will use the closed circuit gasses that are available in the order of oxygen content during the Time To Surface (TTS) calculation. The system will use to the next available gas that has a PPO2 of less than 1.0 for closed circuit diving.

If the system is switched to open circuit during a dive, the system will calculate the TTS based on the configured open circuit gasses that are available. It will use the next available gas that has a PPO2 of less than 1.6 for open circuit diving.

NOTE: These gasses are used automatically only for TTS calculations. The gas used to calculate the current tissue load and the current ceiling is always the gas actually selected by the diver.

Calibrate the oxygen sensors.

Example Dive

This is an example of the displays that might be seen on a dive.

This example shows a complicated dive with multiple CC gasses and multiple OC bail-out gasses. A normal, single diluent CC dive wouldn't have any button pushes at all, so there wouldn't be much to show.

The first step is to calibrate. Since we are on the surface and not diving, MENU will bring up "Turn Off", then "Calibrate." Once the loop is flushed with oxygen, CONFIRM will bring up the confirmation display, and another CONFIRM will calibrate.

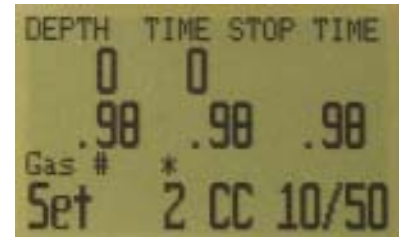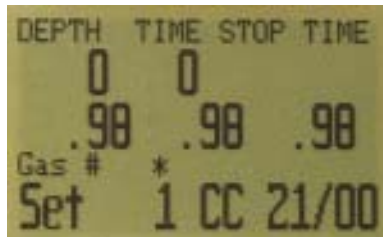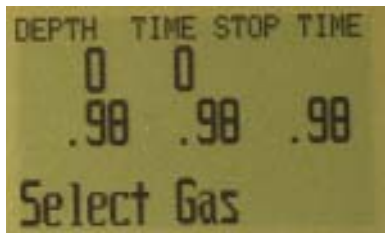Next, we check the closed circuit gasses that we have programmed.

Entering the gas selection function by pressing CONFIRM with the "Select Gas" menu item showing, will display the first CC gas that is available. MENU will increment to the next gas available. Another MENU takes us back to the "Select Gas" menu item. Those are the only two gasses configured.

| DEPTH TIME STOP TIME	DEPTH TIME STOP TIME	DEPTH TIME STOP TIME
.0 0	.0 0	.0 0
.93 1.01 .99	.93 1.00 .99	.98 .98 .98
	Calibrate	O2/HE NDL TTS
Calibrate	NO Confirm? YES	CC 21/00 0 0
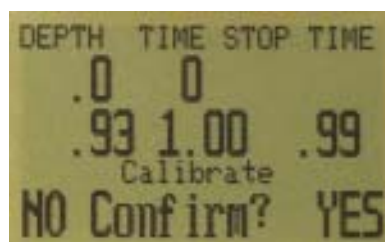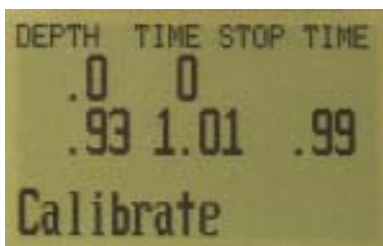
The system will use both of these gasses for our dive when calculating the TTS. It assumes a diluent switch at a PPO2 of 1.0. That means that it will assume that you have switched to an air diluent at 124 feet.

This is only for TTS. The computer will aways use the currently selected gas for tissue loading calculations.
Then we switch to open circuit to look at our bail-out gasses. Flipping through the gasses with CONFIRM shows that we have three gasses available. (Whether they are appropriate gasses is a subject for one of the web forums.)

```
DEPTH  TIME STOP TIME
     0    0
    .98  .98   .98

Select Gas
```

```
DEPTH  TIME STOP TIME
     0    0
    .98  .98   .98
Gas #    *
Set   1 CC 21/00
```

```
DEPTH  TIME STOP TIME
     0    0
    .98  .98   .98
Gas #    *
Set   2 CC 10/50
```

Flipping through the gasses available in the "Select Gas" menu item shows that we have three open circuit gasses available.

```
DEPTH  TIME STOP TIME
     0    0
    .98  .98   .98

Switch CC -> OC
```
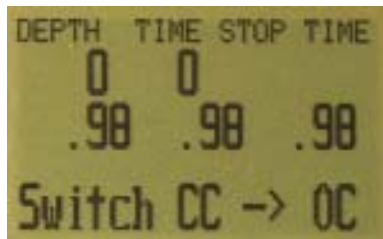
These are the gasses that will be used to estimate TTS in the event that you switch to open circuit during a dive. The computer will assume that you will switch gasses when the PPO2 of the next available gas is less than 1.6.

Automatic decisions of when to switch gasses for the TTS calculation means that it is very easy to set up your CC and OC gasses. There is no need to enter a depth or a PPO2 to switch point. There is no need to keep track of which gasses are turned on and of in which mode.

If a gas is available in the CC gas list it will be used in CC, and it will be used at an appropriate depth. The same is true for OC. It is always configured correctly if you actually have the gasses you have created.

If it is necessary to switch to OC while diving, 4 button pushes will do it. You will be switched to OC and will be using the gas that has the highest PPO2 less than 1.61. Your OC gas list is likely very different from your diluent gas list, but all of the OC gasses are automatically selected and available.

Now switch back to closed circuit and start the dive.
We have reached a depth now that will incur decompression soon. The NDL is 8 minutes, and the TTS is 4 minutes.
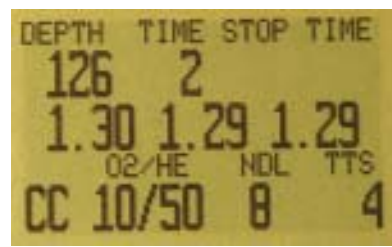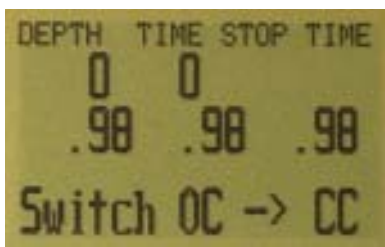
The computer has automatically switched to the high setpoint. This can be disabled if automatic setpoint switching isn't required.

We are now at our maximum depth. Our first stop is at 90 feet.

The diver is ascending to the 90 foot stop. Note the ascent rate indicator showing a 20 fpm / 4 mpm ascent rate. During the 7 minute ascent, the diver ascended slower than was predicted, and now there is a 100 foot stop.

```
DEPTH TIME STOP TIME
 257    8   90     1
1.31 1.29 1.32
     02/HE    NDL   TTS
CC 10/50   0    23
```

But the diver missed the stop, and has ascended to 95 feet. At this point, the stop depth is flashing to show that the depth is above the recommended stop.

```
DEPTH TIME STOP TIME
  98  15.100     1
1.30 1.29 1.32
     02/HE    NDL   TTS
CC 10/50   0    22
```

```
DEPTH TIME STOP TIME
  95  15.          1
1.30 1.29 1.32
     02/HE    NDL   TTS
CC 10/50   0    21
```

The diver switches to the other programmed CC gas, air.

```
DEPTH TIME STOP TIME
  95  15   90      1
1.30 1.29 1.32
     02/HE    NDL   TTS
CC 21/00   0    20
```

At 60 feet we switch to open circuit bailout. The switch requires 4 button pushes.

The system automatically choses the best gas it can find for the depth. It picks %50 in this case.

```
DEPTH TIME STOP TIME
  60  17_  60      1
1.30 1.29 1.32
     02/HE    NDL   TTS
OC 14/55   0    15
```

At 20 feet, we switch to oxygen.

Menu Reference

```
DEPTH TIME STOP TIME
  60  17   60      1
1.30 1.29 1.32
     02/HE    NDL   TTS
OC 50/00   0    20
```

Turn Off

The "Turn Off" item puts the computer to sleep. This menu item will only appear if the water contacts are dry.

The computer never really turns off; it just goes to sleep and blanks the display. While sleeping, the

```
DEPTH TIME STOP TIME
  20  25_  20      3
 .87  .95  .79
Gas #      *
Set     1 OC 99/00
```

screen is blank, but the tissue contents are maintained for repetitive diving.

To turn the computer on again, push MENU then immediately push SELECT. The computer will come on again. The "Turn Off" menu item will not appear during a dive.

Calibrate

This will calibrate the sensor displays to oxygen.

Your instructor will train you in the procedure to flood your loop with pure oxygen in order to get a good calibration.

Once the loop is full of pure oxygen, SELECT with "Calibrate" in the display, and the confirmation message will display.

Pressing the MENU button will prevent the calibration. Pressing SELECT will calibrate the sensor displays. The displays should now all read .98.

The system calibrates to a .98 partial pressure of oxygen. This is to compensate for the difficulty in completely filling the loop with 100% oxygen and also to allow for water vapour.

The "Calibrate" menu item will not display during a dive.

Switch Setpoint

The setpoint display will display the setpoint that isn't selected. At power up, the computer will always select the low setpoint, so the first time the setpoint display is selected, it will show "Switch .7 ->1.3." The 1.3 will be replaced by your high setpoint value.

If the computer is currently using the high setpoint, it will display "Switch 1.3 -> .7." When SELECT is pushed with either of these displays, the displayed setpoint will be selected.
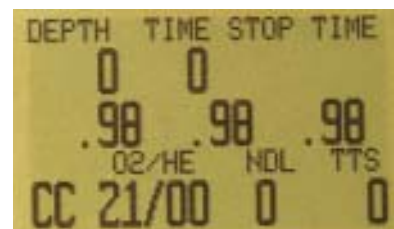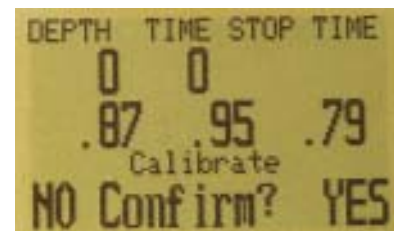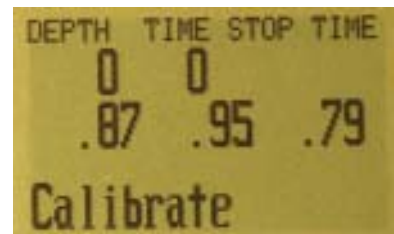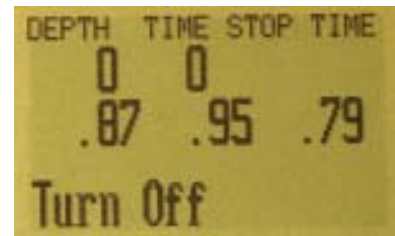
During a dive, the "Switch Setpoint" menu item will be the first item displayed. The "Turn Off" and "Calibrate" displays are disabled.

Select Gas

This menu item allows you to pick a gas from the gasses you have created. The selected gas will be used either as the diluent in closed circuit mode, or the breathing gas in open circuit mode.

Just like the FM stations are selected when your radio is in FM mode, the closed circuit gasses are available in the closed circuit mode. When you switch to open circuit, the gasses available will be open circuit gasses.

Gasses are always sorted from most to least oxygen content.

Press the "Confirm" button when "Select Gas" is displayed, and the first available diluent will be displayed.

Use the MENU button to increment the diluent to the one you want, then press the "Confirm" button to select that diluent.

If you increment past the number of gasses available, the display will fall back out to the "Select Gas" display.

Use the "Confirm" button to select a gas. The bottom line of the display shows the selected gas.
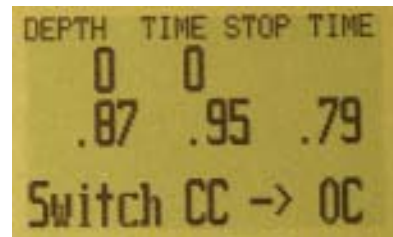
Switch to OC/CC

Depending on the current computer setting, this selection will show as either "Switch CC -> OC" or "Switch OC -> CC."

Pressing SELECT will select the displayed mode for decompression calculations. When switching to open circuit while diving, the most appropriate open circuit gas will become the breathing gas for calculations.

At this point, the diver may want to switch to a different gas, but since the diver may have other things to deal with, the computer will make a "best guess" of which gas the diver would choose.

Dive Setup

Selecting any of the above items will process that setting, and drop out of the menu. If nothing is previously selected, the "Dive Setup" menu will be shown.

Pressing SELECT will enter the setup sub-menu. Pressing the MENU button will move on to the Dive Log on the surface. While diving, the Dive Log and System setup are not available, and pushing the Menu button will exit the menu system.
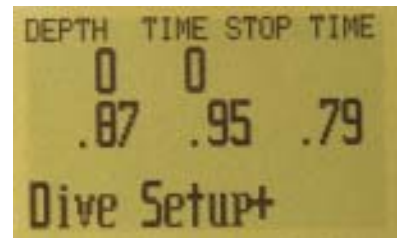
Low Setpoint

This item allows you to set the low setpoint value. It will display the currently selected value. Values from 0.4 to 1.4 are allowed.
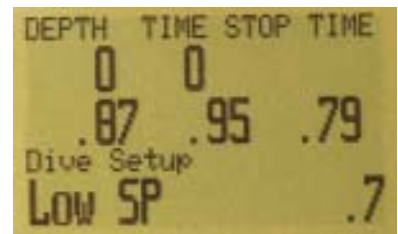
Press the "Confirm" button when "Low SP" is displayed and the edit SELECTdisplay will be shown. It is set at the lowest valid value for setpoint, .4.
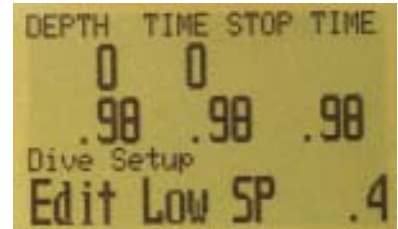
A press of MENU will increment the setpoint.
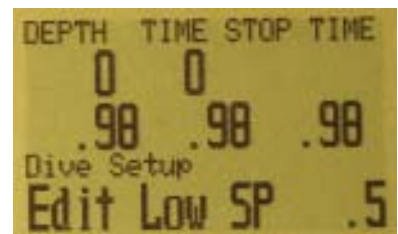
Another press of MENU will increment it again.

If SELECT is pushed, the currently displayed setpoint will be selected, and the display will return to the "Low SP" menu item.
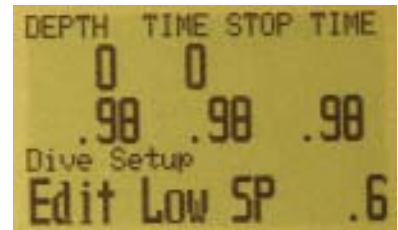
If the highest allowable value, 1.4, has been passed, the menu will also revert to "Low SP" without changing the original setting.
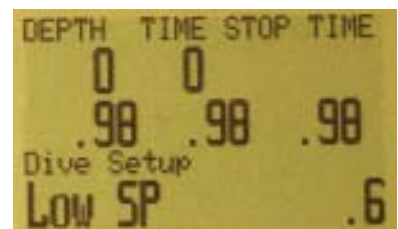
High Setpoint

The high setpoint function works exactly like the low setpoint function.

Define Gas

The function allows you to set up 5 gasses in Closed Circuit and 5 gasses in Open Circuit. You must be in Open Circuit to edit open circuit gasses, and you must be in Closed Circuit to edit closed circuit diluents. For each gas, you can select the percentage of oxygen and helium in the gas.

Pushing SELECT when "Define Gas" is displayed presents the function to define gas number 1.
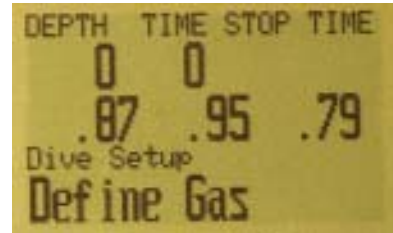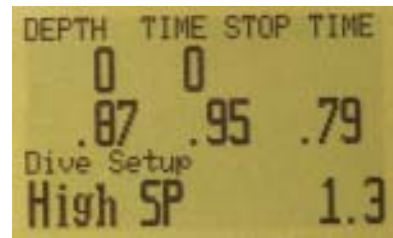
Pushing the MENU button will display the next gas.

Pushing SELECT will allow you to edit the current gas. The gas contents are edited one digit at a time. The asterisk will show you the digit being edited.

Pushing SELECT saves the current digit and moves to the next digit.

Each push of the MENU button will increment the digit being edited. When the digit reaches 9, it will roll over to 0.
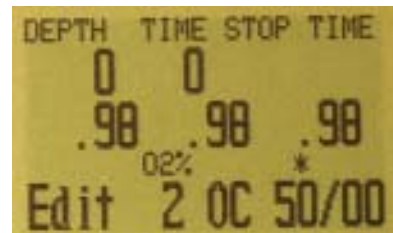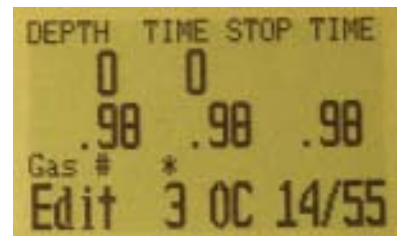
Pushing SELECT will lock in the current digit, and move on to the next digit.
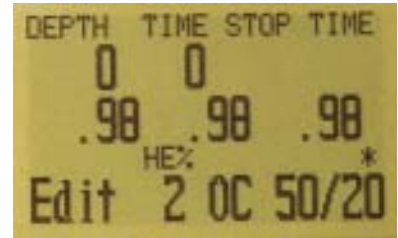
Pushing SELECT on the last digit will finish editing that gas, and bring you back to the gas number. Any gasses that have both oxygen and helium set to 0 will not be displayed in the "Select Gas" function.

Pushing MENU will continue to increment the gas number.

The computer will display all gas entries available to allow you to enter new gasses.

Pressing MENU one more time when the fifth gas is displayed will return you to the "Define Gas" menu item.

VERY IMPORTANT

If you have programmed a gas in the current mode (OC or CC), it will be used in the TTS and time at stop calculations. While this won't result in wrong ceilings, it will cause the predicted times to be wrong. For example, if you have programmed a switch to O2 diluent in CC mode, the system will assume that you are going to switch and will predict that the time at the appropriate stop will use that diluent.

```
DEPTH  TIME STOP TIME
  .0   0
1.31 1.27 1.16
     02/HE   NDL  TTS
OC 50/00  0       0
```



```
DEPTH  TIME STOP TIME
  .0   0

Dive Setup
EXT PO2 Off->On
```
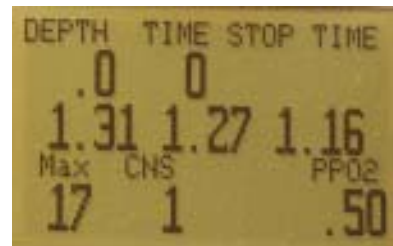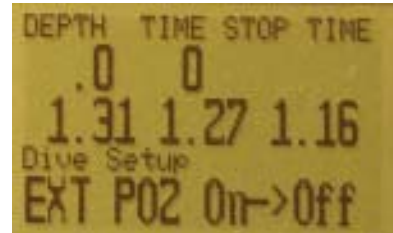
The next menu item is used to turn external ppo2 monitoring on and off. By default, external monitoring is turned off. To turn it on, select this menu item.

Now the ppo2 of the the three sensors is displayed. In the displayed screens, we have three sensors and they have been calibrated at some point.

This system is plugged into three sensors and is the primary display for the system.

Note that since we are in Open Circuit mode, that the ppo2 used to calculate decompression is still the ppo2 of the selected gas at the current depth.


```
DEPTH  TIME STOP TIME
  .0   0
1.31 1.27 1.16
Dive Setup
EXT PO2 On->Off
```



```
DEPTH  TIME STOP TIME
  .0   0
1.31 1.27 1.16
Max  CNS        PPO2
17   1          .50
```

If we switch to Closed Circuit, the ppo2 used for calculation is now the average of the three sensors. Voting logic will apply and any sensors that are voted out will be flashing.


```
DEPTH  TIME STOP TIME
  .0   0
1.31 1.27 1.16
Switch OC -> CC
```
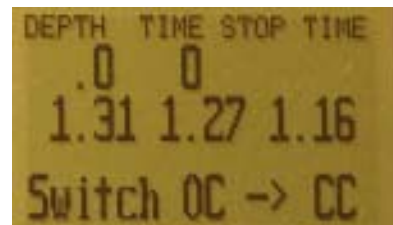
In this case, the sytem is using a ppo2 of 1.25 to calculate decompression and CNS toxicity.


```
DEPTH  TIME STOP TIME
  .0   0
1.31 1.27 1.16
     02/HE   NDL  TTS
CC 21/00  0       0
```



```
DEPTH  TIME STOP TIME
  .0   0
1.31 1.27 1.16
Max  CNS    SP   AVG
17   0     .7  1.25
```
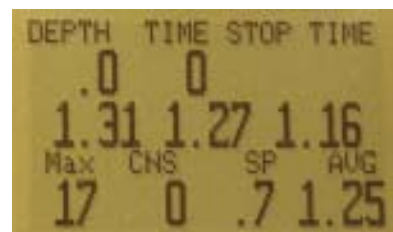
If we now unplug sensors one and three, we simulate the situation with fourth sensor monitoring.

```
DEPTH  TIME STOP TIME
  .0    0
  .00 1.27   .00
     O2/HE   NDL  TTS
CC 21/00   0      0
```

At this point, the system is still averaging the three sensors and is flashing the center sensor. Since it has two sensors that agree the ppo2 is .00, it is voting out the 1.27 sensor. You can see that we have caught the sensor in mid flash.

```
DEPTH  TIME STOP TIME
  .0    0
  .00 1.27   .00
       Calibrate
NO Confirm?   YES
```

After we calibrate, the system will assume we are in single sensor mode and will alter its behavior. It will no longer average the sensors or vote on them.

```
DEPTH  TIME STOP TIME
  .0    0
        .98
     O2/HE   NDL  TTS
CC 21/00   0      0
```

Now the single sensor is the only one considered and the ppo2 used for calculations is the ppo2 of the single sensor.

```
DEPTH  TIME STOP TIME
  .0    0
        .98
 Max  CNS   SP   AVG
  17   0   .7   .98
```
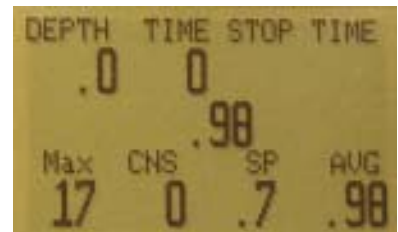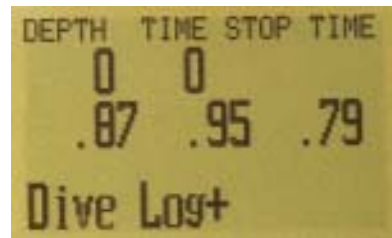
If we switch back to Open Circuit, the sensor(s) continue to display, but the ppo2 used for calculations is once again the ppo2 of the selected gas at the current depth.

```
DEPTH  TIME STOP TIME
  .0    0
        .98
Switch CC -> OC
```

```
DEPTH  TIME STOP TIME
  .0    0
        .98
     O2/HE   NDL  TTS
OC 50/00   0      0
```

```
DEPTH  TIME STOP TIME
  .0    0
        .98
 Max  CNS        PPO2
  17   0          .50
```

Dive Log+

The dive log menu will not appear during a dive. The log can only be examined or uploaded on the surface.

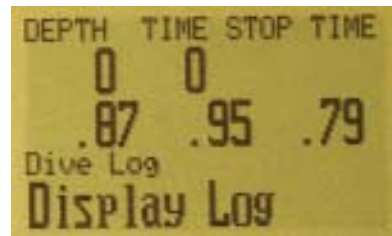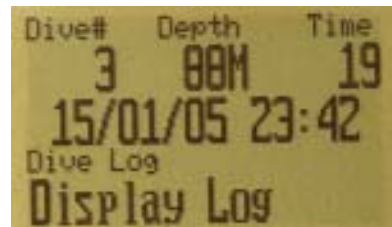The dive log submenu is accessed by pressing SELECT.

Display Log

The first menu item within the "Dive Log" menu is the "Display Log" item. Pressing SELECT will display the last logged dive.

Each time MENU is pressed, the computer will display an earlier dive until all of the stored dives have been displayed. The system will store about 20 hours of dives.

Pressing MENU when the last dive is displayed with exit the menu. Pressing SELECT on any dive will complete the log viewing and move to the next sub menu item.
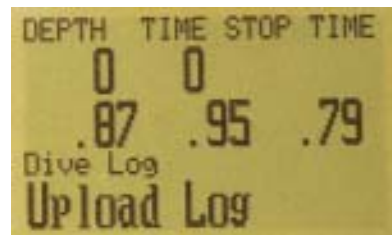
Upload Log

The second menu item is "Upload Log." Pressing CONFIRM will set up the system to upload the stored log information across the IrDA port.

The computer will wait for the external PC to ask for the log. When it starts sending, the "Waiting" will change to "Sending." The transmitting takes a couple of minutes.

Windows software can be purchased at
http://www.hhssoftware.com/shearwater/
for a small fee.

System Setup+

System Setup contains configuration settings that are only set between dives. This menu item doesn't appear during dives.
Each of the items in the System Setup menu can only be accessed on the surface.

Auto SP Switch

Auto setpoint switch configuration sets up the setpoint switching. It can be set up to switch up only, down only, both, or neither.

Pushing the confirm button will go into the setup for the switch up function.

This configures the switch up from the low set point to the high setpoint. Pushing SELECT will enter the edit mode.
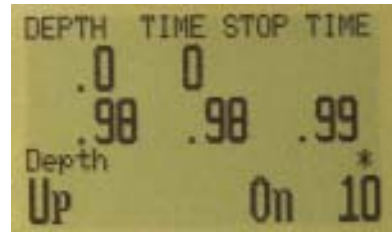
An asterisk shows which item is being edited. On first entry to edit mode, the "On/Off" position will be selected.

Pushing MENU switches it back and forth between "On" and "Off." Pushing SELECT moves to the next edit item.

We are now editing the first digit of the switch depth. Pushing SELECT increments the digit.
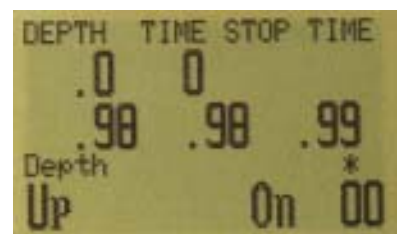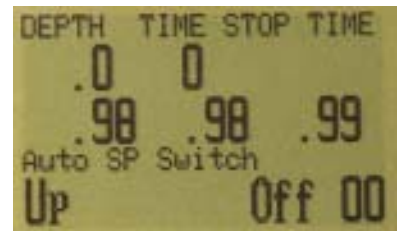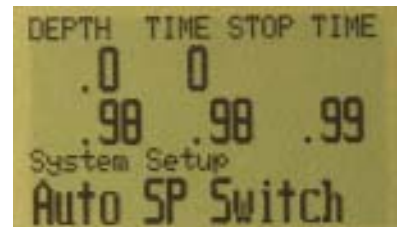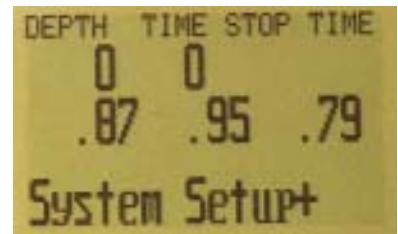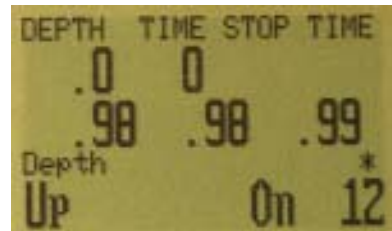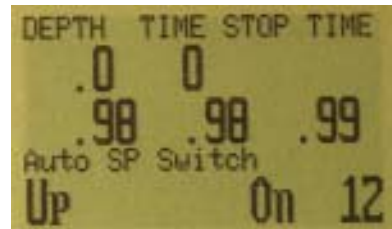
Pushing SELECT moves to the second digit.
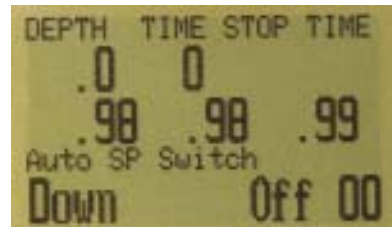
MENU increments the digit.

Another push on MENU increments the digit again.

SELECT on the last edit position saves the settings and exits the edit function.

This item configures the switch from high setpoint to low setpoint. You configure it the same way as the "Up" setting.

Either switch can be turned on or off independent of the other switch.

The system limits the allowable setpoint settings. Switching up is allowed from 20-999 feet and from 6-999 meters. Switching down is allowed from 9-999 feet and from 2-999 meters.

If you enter a setting that is outside the allowed range, the exisiting (valid) setting is retained with no change.

Conservatism

The conservatism prompt shows the current conservatism setting.

Pushing SELECT when the "Conservatism" prompt is displayed will enter the "Set Conserv" function.

```
DEPTH  TIME STOP TIME
    0    0
   .87  .95   .79
System Setup
Conserv      30/85
```

The function will display the lowest conservatism setting available.

```
DEPTH  TIME STOP TIME
    0    0
   .98  .98   .98
System Setup
Edit Cons    10/95
```

Each press of the MENU button will increment the conservatism setting.

```
DEPTH  TIME STOP TIME
    0    0
   .98  .98   .98
System Setup
Edit Cons    10/90
```

The settings vary the high and low settings, but are not necessarily in order of conservatism. Although there are many opinions, no one really knows which settings are more or less conservative. The settings near the beginning will tend to give less deco, and the settings near the end will tend to give more deco time.

```
DEPTH  TIME STOP TIME
    0    0
   .98  .98   .98
System Setup
Edit Cons    20/90
```

Pressing SELECT will select the currently displayed conservatism and return to the "Conserv" menu item.

```
DEPTH  TIME STOP TIME
    0    0
   .98  .98   .98
System Setup
Edit Cons    20/75
```

```
DEPTH  TIME STOP TIME
    0    0
   .98  .98   .98
System Setup
Conserv      20/75
```

If you increment past the last choice, the system will return to the "Conservatism" prompt without changing the conservatism.
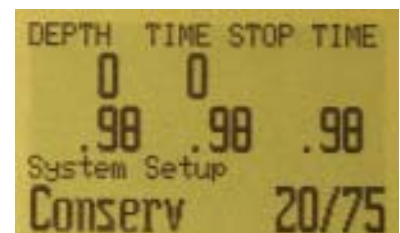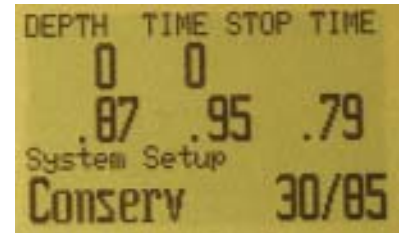
The computer implements Gradient Factors by using levels of conservatism. For a more detailed explanation of their meaning, please refer to Erik Baker's excellent articles: *Clearing Up The Confusion About "Deep Stops" and Understanding M-values.* The articles are readily available on the web. You might also want to search for "Gradient Factors" on the web.

The default of the system is 15/85. The system provides several settings that produce less decompression time than 15/85.

DO NOT USE THIS SYSTEM UNTIL YOU ARE SURE YOU UNDERSTAND THE SETTINGS.

Switch to Feet/Meters

Selecting this function will switch the unit to feet or to meters. This will change the decompression factors, tissue loading, and displays into the appropriate units.

The depth display in feet has no decimal place. In meters, the depth display shows one decimal place up to 99.9 meters.

Backlight

The "BL Timeout" menu item shows the current backlight time setting. Pressing SELECT will enter the edit function.

The backlight increases the system power usage. You should keep both the backlight time-out and the backlight brightness set at an optimal level.

The backlight timeout can be set to any digit from 0 to 9, then 99. A setting of 0 means that the backlight will never come on. A setting of 99 means that the backlight will stay on whenever the computer is on. Any other setting will keep the backlight on for the number of seconds selected.

If you regularly dive in dark water, a setting of 99 works well.

Each push of MENU will increment the "seconds" digit.

Pusing SELECT will save the current setting.

The system displays the new setting.
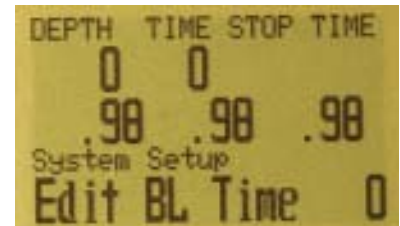
Backlight Brightness

If you need to make the backlight brighter, press SELECT on the "BL Brite" menu item.

Once in the edit menu, each press of MENU will increment the brightness setting. As the settings are increased, the brightness of the display will increase.

The backlight increases power usage about 10-15%. Don't set it any higher than you need.

Date

The date menu item allows the date to be set. Enter the edit function by pressing CONFIRM. The date is edited like other items by using MENU to increment and the SELECT button to accept the digit.

The date will be retained as long as the battery lasts. In addition, when the battery is changed within 5 minutes, the date, and decompression tissues will be saved.
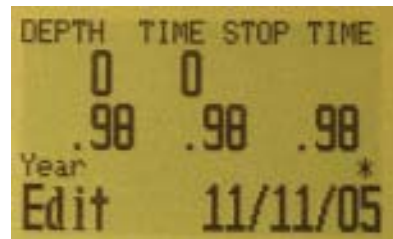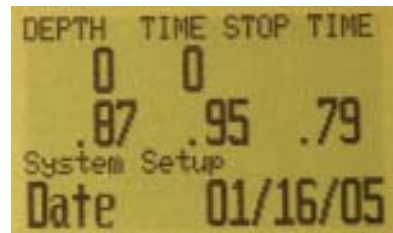
Time

The time menu item allows the time to be set. Enter the edit function by pressing SELECT. The time is edited like other items by using the MENU button to increment and the SELECT button to accept the digit.

The time will be retained as long as the battery lasts. In addition, when the battery is changed within 5 minutes, the time and decompression tissues will be retained.
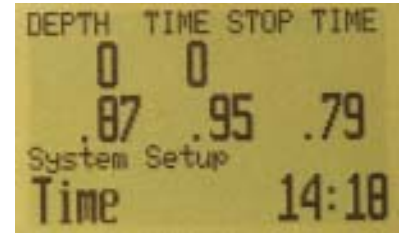
Status Displays

Pushing SELECT when not in a menu will bring up the status displays. There are six status displays, and each push SELECT will move to the next display. Another SELECT push with the last display shown will return to the primary display.

The first display shows the maximum depth on the current or previous dive, the current CNS exposure, the current setpoint, and the current average PPO2.
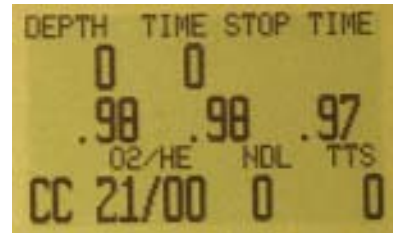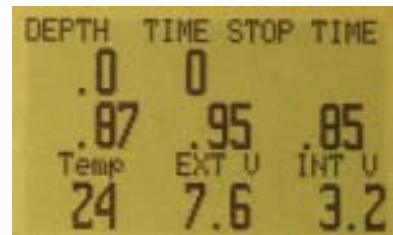
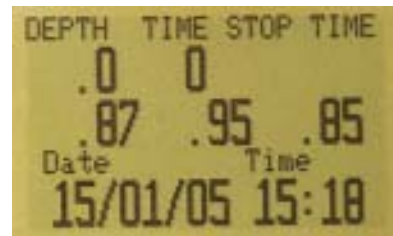The second display shows the PPO2 of the current diluent, and the conservatism setting.
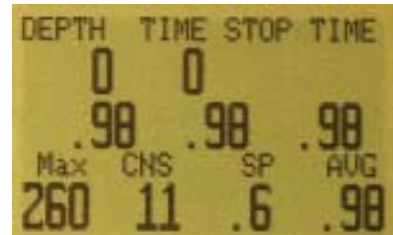
The third display shows the water temperature, the voltage of the external 9V solenoid battery (controller only), and the voltage of the internal 3.6V lithium battery.
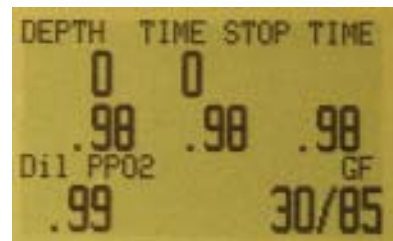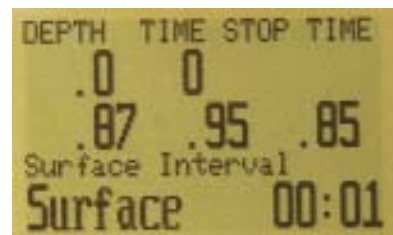
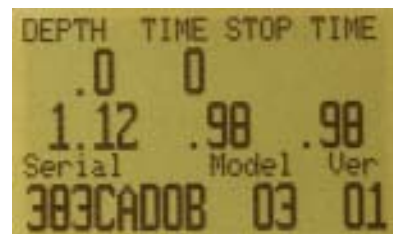The fourth display shows the date and time.

The next two displays do not show during a dive. They are available on the surface only.

The fifth display shows the current surface interval.

The last display shows the serial number, model and version of the computer.

Millivolt Display

The display will show the sensor readings in millivolts when both buttons are pushed at the same time.

The PPO2 display mode shows 2 places after the decimal point, and the mV display shows 1 place.

The millivolt display is not calibrated with oxygen. It is calibrated at the factory.

It allows you to see that sensor 1 is not putting out as much voltage as the other two sensors, in spite of the fact that they display the same PPO2 in oxygen.

Error Displays

The system has several displays that alert an error condition. All of these displays share a common limitation of error alarms. There is no way to distinguish between an error alarm that is not in alarm and an error alarm that is broken.

For example, if an alarm is silent when it is not in alarm and is silent when it is broken, then there is no way to be sure that the alarm isn't broken.

So by all means respond to these alarms if you see them, but NEVER depend on them.

Each of the alarms will display the message and flash the backlight until dismissed. The error is dismissed by pressing SELECT.

Other functions continue to operate as normal, so that the MENU button will take you into the menu, and a push on both buttons will show the millivolt display. The error message will return until it is dismissed with a SELECT.

This message will appear if the average PPO2 goes above 1.6 for more than a few seconds. It may come back after being dismissed if the situation occurs again.

This message will appear if the average PPO2 goes below 0.4 for more than a few seconds. It may come back after being dismissed if the situation occurs again.
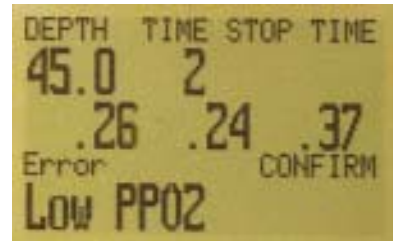
This condition will also cause the "Low PPO2" display to appear. Here, the computer does not have two sensors that have confirming values. There is no way to know the actual PPO2, and the average PPO2 will be calculated as 0.00.
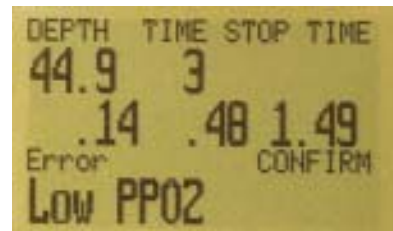
This alarm appears when the voltage on the external solenoid battery is low (controller only). The solenoid may still be firing, but the battery must be replaced before any further diving.

The battery is measured during load, so it may appear even though the battery looks good on a voltmeter.

This alarm will only appear once during a dive. When it is dismissed, it will not return during the current dive.

This alarm alerts that the battery is not supplying enough power for the solenoid to fire correctly, or the solenoid has failed, or the connection to the solenoid has failed. (controller only)
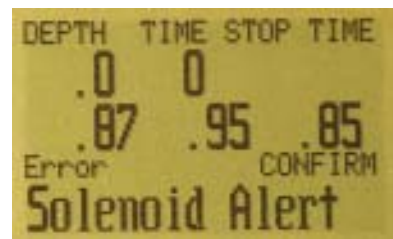
If this alarm occurs, corrective action must be taken at once. Even if the solenoid can be heard to fire, it is not functioning correctly.

This alarm will only appear once during a dive. When it is dismissed, it will not return during the current dive.

This alarm is a notification that there has either been a very fast ascent for a short period of time, or that there has been an ascent of more than 66 fpm / 20 mpm maintained for over a minute.

This alarm may return after being dismissed if the condition occurs again.
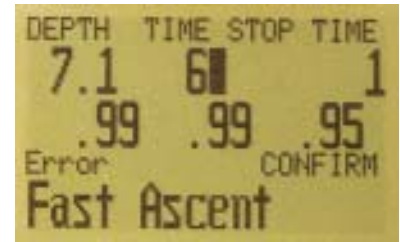
The alarm occurs when the diver has been above the minimum depth for a decompression stop for more than one minute.

This alarm will only appear once during a dive.

This alarm will show every time the computer loses power.

That will only occur if the battery is allowed to be in low voltage for a long time before the battery is changed.   If the battery is changed when the low battery indicator comes on, and the new battery is put in after less than 5 minutes, the tissues should never be cleared.
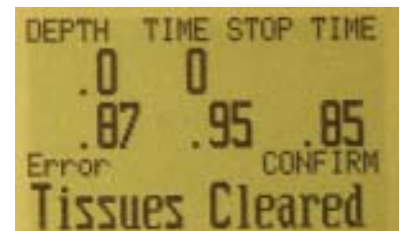
The computer battery should last for several years of diving, and there is a backup battery to allow battery changes without losing the tissues, so it is unlikely you will ever see this display.