Shearwater Pursuit Manual

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.)

Introduction

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 1.5
- 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 100 hours of diving or 6 months of standby
- CE EN 13319

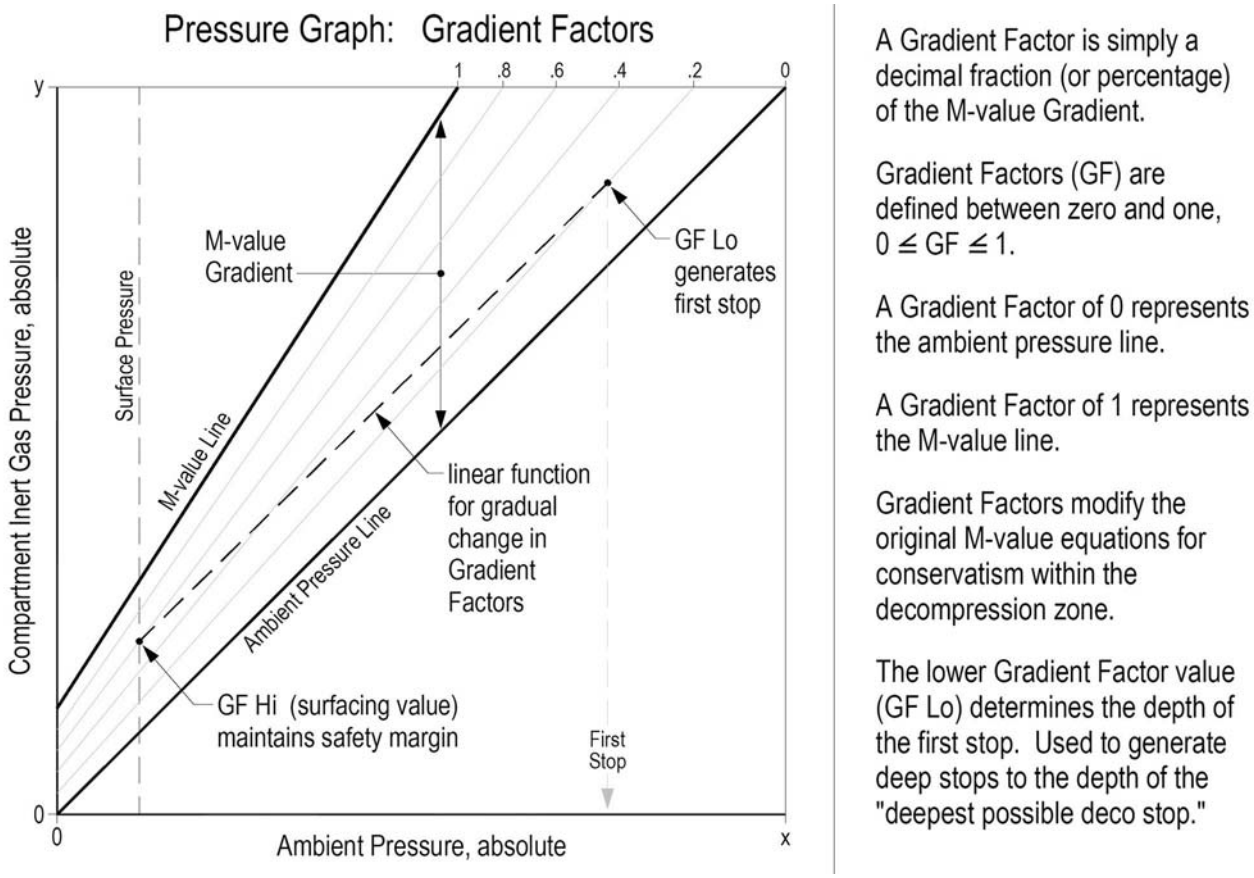
Decompression and Gradient Factors

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.

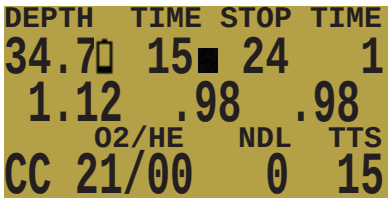
The default of the system is 30/85. The system provides several settings that are more aggressive than the default.

Don't use the system until you understand how it works.



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.

To turn the computer on, press both the MENU and the SELECT buttons at the same time.

Buttons

MENU

- From the default display, pressing MENU brings up the menu.
- Once in the menu system, MENU moves to the next menu item.
- If the current function is an edit, pressing MENU increments the current display.

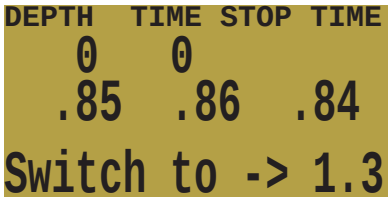
SELECT

- 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

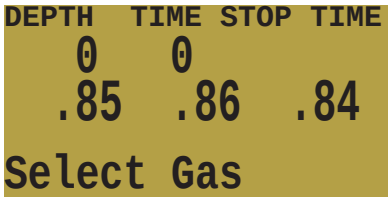
- When the computer is on, pushing both buttons at any time changes the PPO2 display to the mV display.
- When the computer is off, pressing MENU and then immediately pressing SELECT will turn the computer on.

The left button (MENU) can be used to scroll through the menu. When the “Switch Setpoint” menu item is displayed, MENU will move to the “Select Gas” menu item.

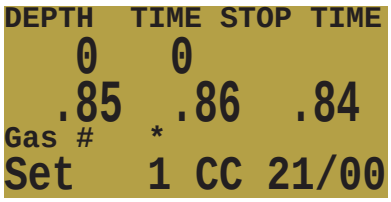


The right button (SELECT) is used to accept the current choice.

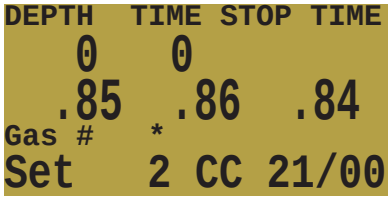
Pressing SELECT with this screen displayed will enter the Select Gas function.



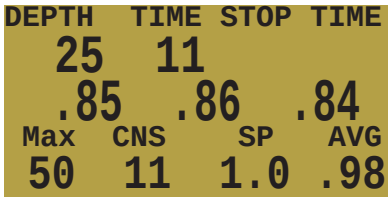
In the “Select Gas” function, MENU increments the gas number.



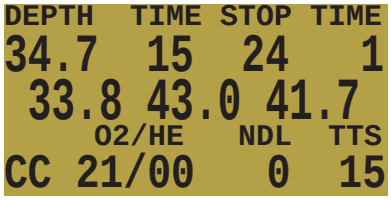
SELECT would select closed circuit gas 2.



When the system is not in a menu, pushing SELECT will bring up information displays with various dive status information. This the first information display showing the maximum depth of the current, the current CNS loading, the setpoint (if applicable), and the current PPO2 being used for decompression calculations.



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

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.

A key characteristic of the menu system is that it is adaptive. It uses the information that it knows about it’s current state to only ask questions or offer menu items that make sense given the current situation.

For example, on the surface, the first menu item you will see is Turn Off. During a dive, the Turn Off menu item doesn’t appear.

The second menu item is Calibrate. That item only shows on the surface. In addition, it only shows on models that have external sensors enabled, and on those models, only when they are in closed circuit mode.

The full menu structure is below:

- **Turn Off**
- **Calibrate**
- **Switch Setpoint**
- **Select Gas**
- **Switch Open Circuit / Closed Circuit (Open Circuit / Semi-Closed Circuit)**
- **Dive Setup**
  - **Edit Low Setpoint**
  - **High Setpoint**
  - **Define Gasses**
  - **NDL Display**
  - **External PPO2 On/Off**
- **Dive Log**
  - **Display Log**
  - **Upload Log**
- **Setpoint -> .19**
- **System Setup**
- **Conservatism**
  - **Auto Setpoint Switch**
    - **Up Enable/Depth**
    - **Down Enable/Depth**
  - **Metric/Imperial**
  - **Backlight**
  - **Set Date**
  - **Set Time**
  - **Flip Screen**
  - **Calibration Percent**
  - **Solenoid Speed**
  - **Load Upgrade**
  - **Clear Dive Log**
  - **Unlock Code**
  - **Semi-Closed/Closed**

The Turn Off, Calibrate, Dive Log, Turn off Solenoid, and System Setup menus are only available on the surface. This is the menu during a dive:

- **Switch Setpoint**
- **Select Gas**
- **Switch Open Circuit / Closed Circuit (Open Circuit / Semi-Closed Circuit)**
- **Dive Setup**
  - **Edit Low Setpoint**
  - **High Setpoint**

- **Define Gasses**
- **NDL Display**
- **External PPO2 On/Off**

The status screens are:

- **Max depth, CNS, setpoint and average PPO2**
- **Diluent PPO2, Current Altitude and Conservatism setting Altitude and ATA in use**
- **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.

On a system with external oxygen sensors, calibrate the oxygen sensors.

In the System Setup menu, select the Auto SP Switch parameters, and set the units to metric or imperial.

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

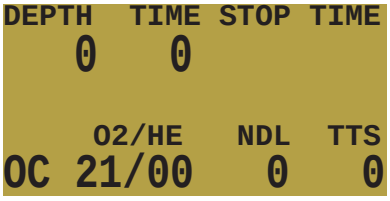
The system will use the closed circuit gasses that are available in the order of oxygen content during the Time To Surface (TTS) calculation. The system will use the next available gas that has a PPO2 of less than 1.0 for closed circuit diving.

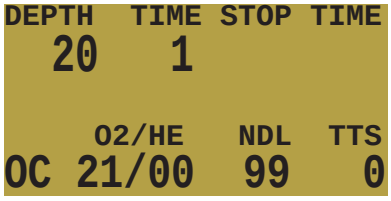
If the system is switched to open circuit during a dive, the system will calculate the TTS based on the configured open circuit gasses that are available. It will use the next available gas that has a PPO2 of less than 1.6 for open circuit diving.

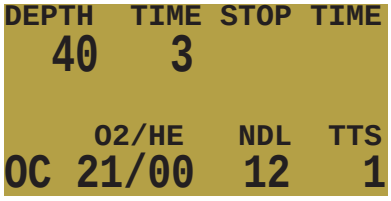
NOTE: These gasses are used automatically only for TTS calculations. The gas used to calculate the current tissue load and the current ceiling is always the gas actually selected by the diver.

Simple Example Dive

Here is an example of a simple air dive. It will help to introduce the screen displays as the diver progresses.



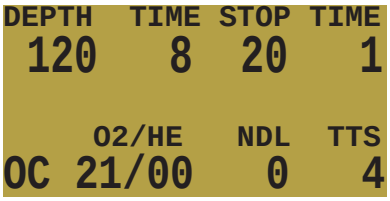


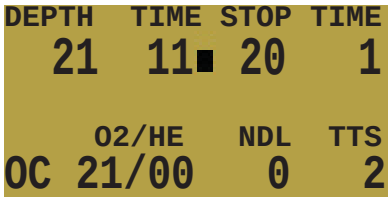


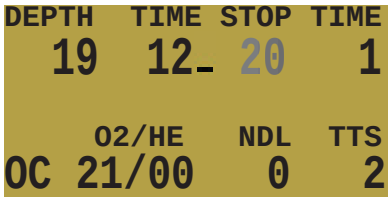
As the dive starts, the depth increases. The display is showing the computer is programmed for open circuit (OC) air.

As we pass through 30 feet, the time-to-surface (TTS) shows one minute. This shows that the computer is expecting the diver to ascend at approximately 30 feet per minute or 10 meters per minute. The dive predictions are based on this ascent rate.

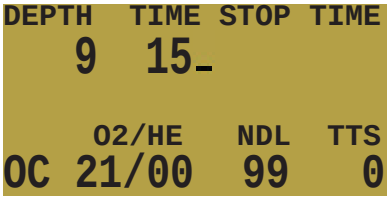
The no-decompression limit (NDL) starts off showing 99, but then starts to show a smaller number as the depth increases. This shows that we will go into deco in 12 minutes.

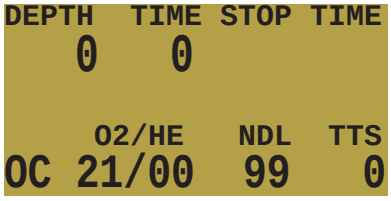






As we ascend, the ascent rate indicator shows about 30 fpm or 9 mpm. When we approach the first stop, our ascent rate slows to about 10 fpm and when we go shallower than our first stop, the stop depth starts to flash.

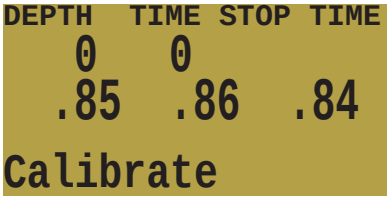


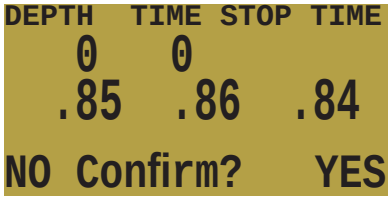


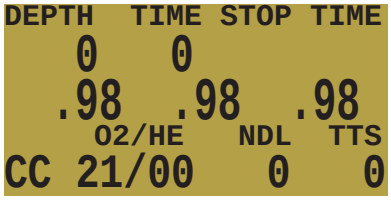
When we clear the last stop, the stop depth and time goes blank, and now we see a NDL of 99 minutes again. Once we surface, the depth is 0 and a few seconds later when the computer comes out of dive mode, the NDL goes to 0 as well.

Complex Example Dive

This is an example of the displays that might be seen on a dive. This example shows a complicated dive with multiple Closed Circuit (CC) gasses and multiple Open Circuit (OC) bail-out gasses. A normal, single gas CC or OC dive wouldn't have any button pushes at all, so there isn'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, SELECT will bring up the confirmation display, and another SELECT will calibrate.

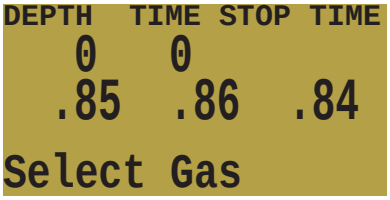


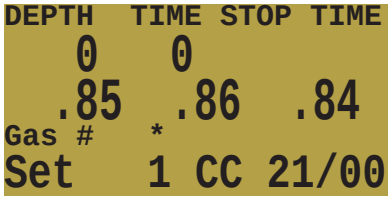


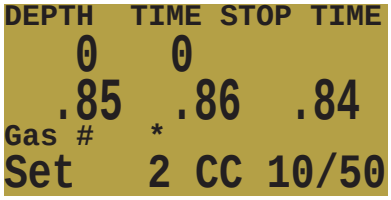


Next, we check the closed circuit gasses that we have programmed.

Entering the gas selection function by pressing SELECT 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. We SELECT gas number 2, the Trimix 10/50.

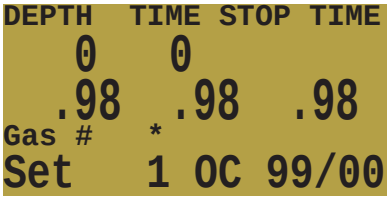


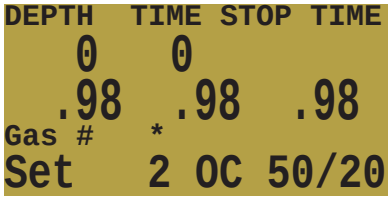


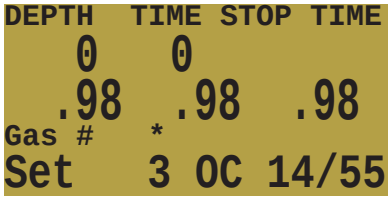


The system will use both of these gasses for our dive when calculating the TTS. It assumes a diluent switch at a PPO2 of 1.0. That means that it will assume that you have switched to an air diluent at 124 feet. This is only for TTS. The computer will aways use the currently selected gas for tissue loading calculations.

Then we switch to open circuit to look at our bail-out gasses. Flipping through the gasses with MENU shows that we have three gasses available. (Whether they are appropriate gasses is a subject for one of the web forums.)







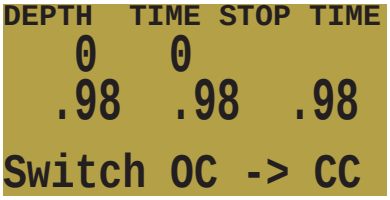
These are the gasses that will be used to estimate TTS in the event that you switch to open circuit during a dive. The computer will assume that you will switch gasses when the PPO2 of the next available gas is less than 1.6.

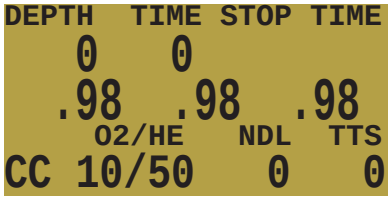
Automatic decisions of when to switch gasses for the TTS calculation means that it is very easy to set up your CC and OC gasses. There is no need to enter a depth or a PPO2 to switch point. There is no need to keep track of which gasses are turned on and of in which mode.

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.

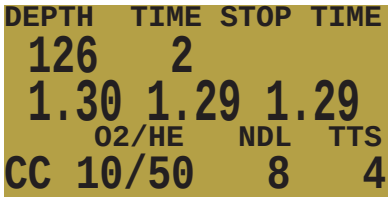
Now switch back to closed circuit and start the dive.



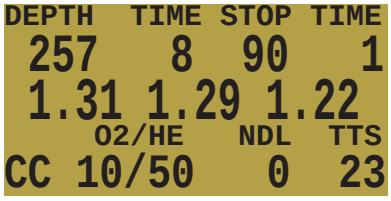


We have reached a depth now that will incur decompression soon. The NDL is 8 minutes, and the TTS is 4 minutes. The TTS just reflects the ascent time at 30 fpm.

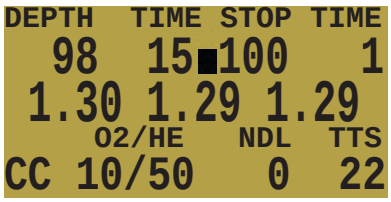
The computer has automatically switched to the high setpoint. This can be disabled if automatic setpoint switching isn't required.



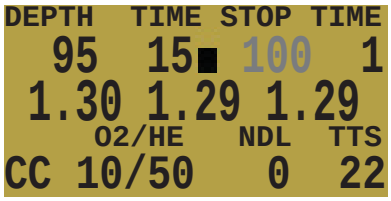
We are now at our maximum depth. Our first stop is at 90 feet.



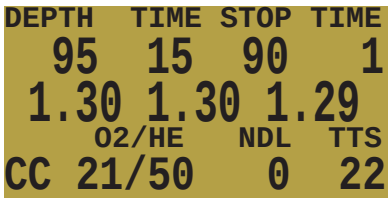
The diver is ascending to the 90 foot stop. Note the ascent rate indicator showing a 30 fpm / 10 mpm ascent rate. Although the ascent rate it 30 fpm now, during the 7 minute ascent, the diver ascended slower than was predicted, and now there is a 100 foot stop.



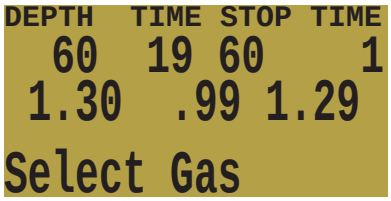
But the diver missed the stop, and has ascended to 95 feet. At this point, the stop depth is flashing on and off to show that the depth is above the recommended stop.



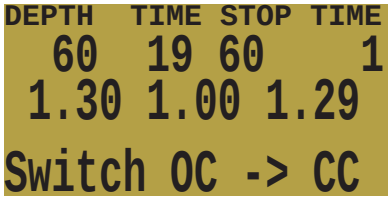
The diver switches to the other programmed CC gas, air. At the same time the 100 foot stop clears. It is common for the first stops to clear in less than a minute. They mainly just slow down the ascent.



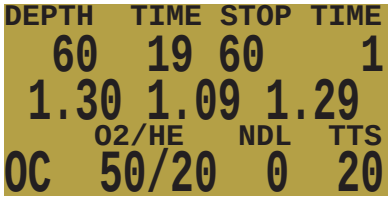
At 60 feet a problem develops that causes the diver to bail out to open circuit. The first push on MENU brings up Select Gas.



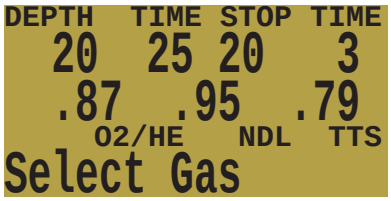
The second push brings up Switch OC -> CC.



A push on SELECT does the switch. The system has switched the gas set from the closed circuit gas set to the open circuit gas set, picked the gas with the highest PPO2 less than 1.6, and recalculated the decompression based on the new profile.

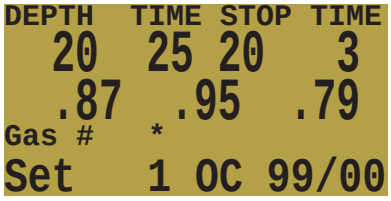


At 20 feet, one push on MENU brings up select gas.



A push on SELECT enters the select gas menu, and another SELECT picks the O2. Since the gases are sorted by oxygen content, the O2 is the first gas offered.

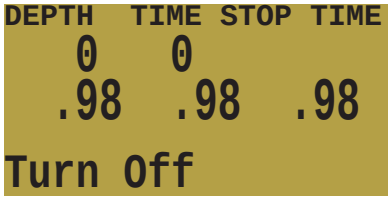
This was a multi-gas trimix dive with a multi-gas open circuit bailout, and it required 9 button pushes.



Menu Reference

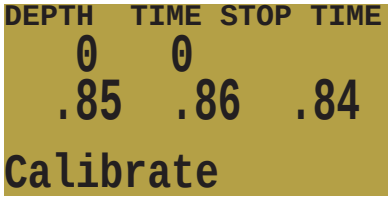
Turn Off

The “Turn Off” item puts the computer to sleep. This menu item will only appear if the water contacts are dry on controllers. While sleeping, the screen is blank, but the tissue contents are maintained for repetitive diving. The “Turn Off” menu item will not appear during a dive. It will also not appear for 5 minutes after a dive to allow for a continuation dive.

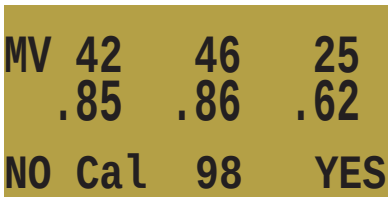


Calibrate

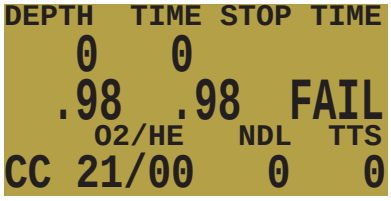
This will calibrate the sensor displays to oxygen. Flood the breathing loop with pure oxygen, SELECT with “Calibrate” in the display, and the confirmation message will display. On the top line, the millivolt reading will show. Good sensors should be in the range of about 35-60 mV at sea level in oxygen.



Pressing the MENU button will prevent the calibration. Pressing SELECT will calibrate the sensor displays. The displays should now all read .98. If any display shows FAIL, the calibration has failed because the mV reading is out of range.

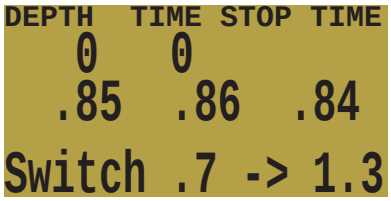


The system defaults to a calibration gas of to a 98% oxygen. This is to compensate for the difficulty in completely filling the loop with 100% oxygen and also to allow for water vapor. If you are using a calibration kit with no water vapor and 100% O2, you can set the calibration gas to 100. It can also be set to other values if pure oxygen is not available.



The calibration takes into account the altitude at which the computer was turned on. For example, if the altitude was 885 mBar or .87 ATA, then with a 98% calibration gas, the sensors would calibrate to .85.

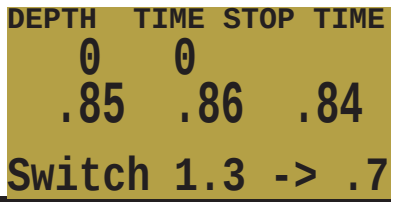
The “Calibrate” menu item will not display during a dive.



Switch Setpoint

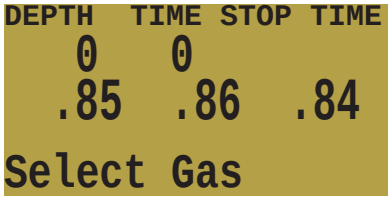
When SELECT is pushed with either of these displays, the displayed setpoint on the right will be selected.

During a dive, the “Switch Setpoint” menu item will be the first item displayed. The “Turn Off” and “Calibrate” displays are disabled.



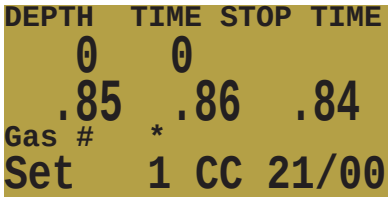
Select Gas

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.



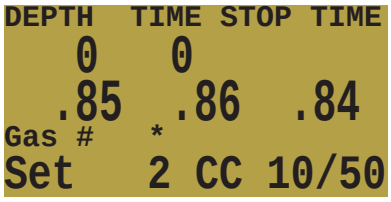
Gasses are always sorted from most to least oxygen content.

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 without changing the selected gas.



Use the “Confirm” button to select a gas. The bottom line of the display shows the selected gas.

Radio Station Gases

For computer models that support open circuit and closed circuit operation, the system maintains two sets of gases - one for open circuit and one for closed circuit.

The way they operated is very similar to the way car radios work with AM and FM stations.

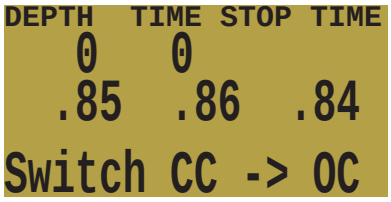
When you are listening to an FM station and you push a station selection button, it will take you to another FM station. If you add a new station, it will be an FM station.

Similarly, if you are in the AM mode, adding or deleting a station would add or delete an AM station.

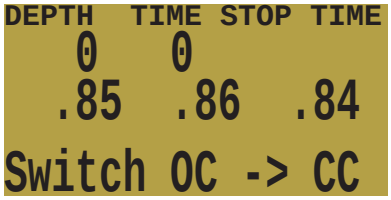
With radio station gases, when you are in open circuit, adding, deleting or selecting a gas will refer to an open circuit gas. Just like the FM stations are selected when your radio is in FM mode, the closed circuit gasses are available in the closed circuit mode. When you switch to open circuit, the gasses available will be open circuit gasses.

Switch to OC/CC

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

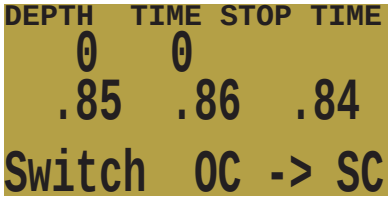


Pressing SELECT will select the displayed mode for decompression calculations. When switching to open circuit while diving, the most appropriate open circuit gas will become the breathing gas for calculations.



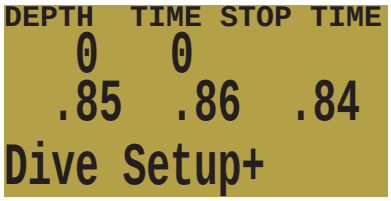
At this point, the diver may want to switch to a different gas, but since the diver may have other things to deal with, the computer will make a “best guess” of which gas the diver would choose.

On computers with external oxygen sensor monitoring, there is also an option to set the computer to calculate decompression predictions using semi-closed circuit. This is enabled in the System Setup menu.



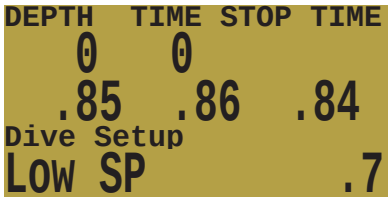
Dive Setup+

Pressing SELECT will enter the Dive Setup sub-menu.

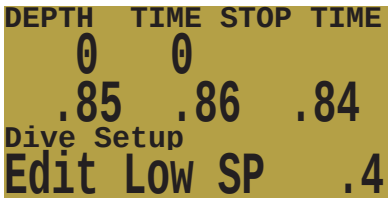


Low Setpoint

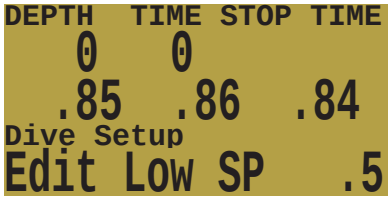
This item allows you to set the low setpoint value. It will display the currently selected value. Values from 0.4 to 1.5 are allowed.



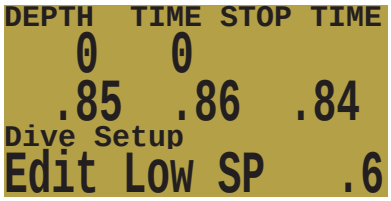
Press the “Confirm” button when “Low SP” is displayed and the edit SELECT display will be shown. It is set at the lowest valid value for setpoint, .4.



A press of MENU will increment the setpoint.

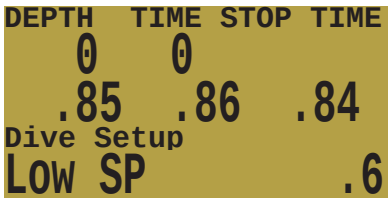


Another press of MENU will increment it again.



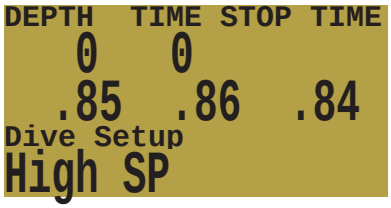
If SELECT is pushed, the currently displayed setpoint will be selected, and the display will return to the “Low SP” menu item.

If the highest allowable value, 1.4, has been passed, the menu will also revert to “Low SP” without changing the original setting.



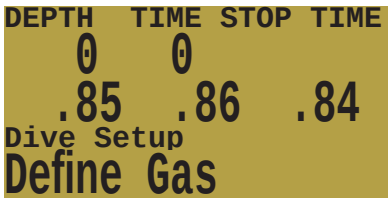
High Setpoint

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

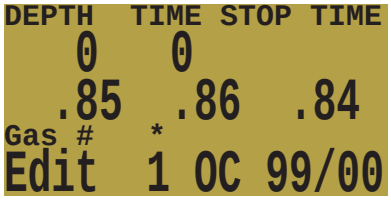


Define Gas

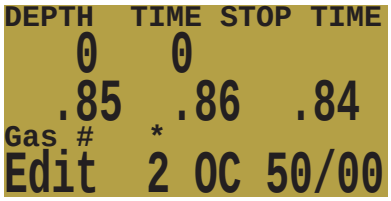
The function allows you to set up 5 gasses in Closed Circuit and 5 gasses in Open Circuit. You must be in Open Circuit to edit open circuit gasses, and you must be in Closed Circuit to edit closed circuit diluents. For each gas, you can select the percentage of oxygen and helium in the gas.



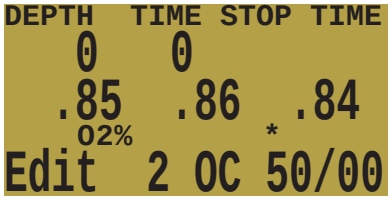
Pushing SELECT when “Define Gas” is displayed presents the function to define gas number 1.



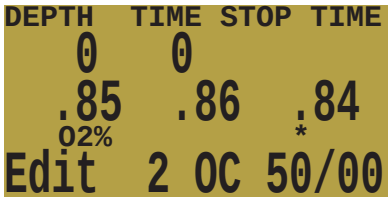
Pushing the MENU button will display the next gas.



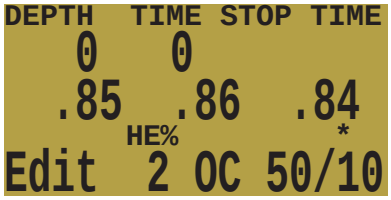
Pushing SELECT will allow you to edit the current gas. The gas contents are edited one digit at a time. The asterisk will show you the digit being edited.



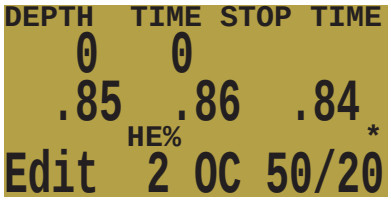
Pushing SELECT saves the current digit and moves to the next digit.



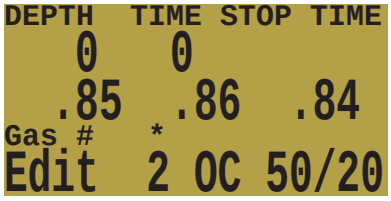
Each push of the MENU button will increment the digit being edited. When the digit reaches 9, it will roll over to 0.



Pushing SELECT will lock in the current digit, and move on to the next digit.

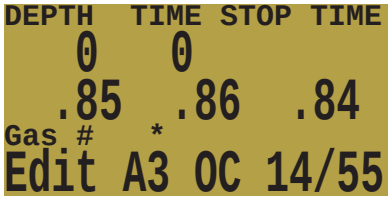


Pushing SELECT on the last digit will finish editing that gas, and bring you back to the gas number.
Any gasses that have both oxygen and helium set to 0 will not be displayed in the “Select Gas” function.



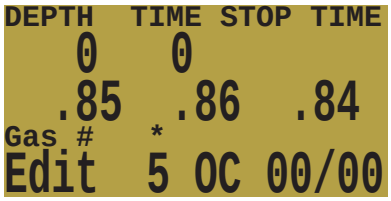
Pushing MENU will continue to increment the gas number.

Note: The “A” denotes the active gas. You cannot delete the active gas. If you try, it will generate an error. You can edit it, but cannot set both the O2 and HE to 00.



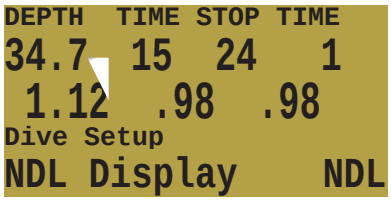
The computer will display all 5 gas entries available to allow you to enter new gasses.

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

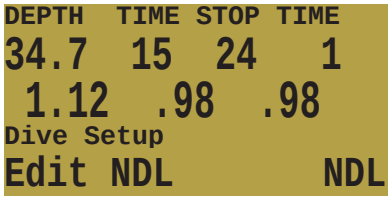


Enter the gases you are actually carrying on the dive. With radio station gases, the computer has a full picture of the OC and CC gases you are carrying and can make informed predictions about decompression times. There is no need to turn gases off and on when you switch from CC to CC, because the computer already knows what the gas sets are. You can still add or remove a gas during the dive if needed.

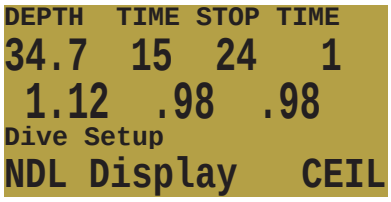
NDL Display



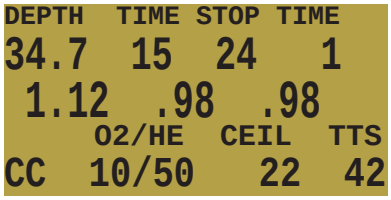
The NDL Display option allows you to display three different values during the dive. The display can be changed during the dive to provide different information.



Pushing SELECT will take you into the edit menu. The first choice available will be NDL. If you select NDL, the NDL will always displayed during the dive whether or not you have a decompression ceiling.

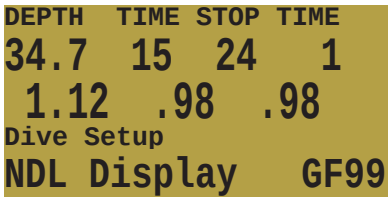


The next selection is CEIL. With this setting, as long as the NDL time is 0 (you have a decompression ceiling), the raw ceiling will be displayed instead of the NDL. This is the equivalent of the 'Man on a rope.' It will show your ceiling without it being rounded up to the next even 10 foot or 3 meter stop. Please note that there is very limited information on the effects of following a continuous ceiling instead of stopping at stops and only moving up to the next stop when the stop has cleared.

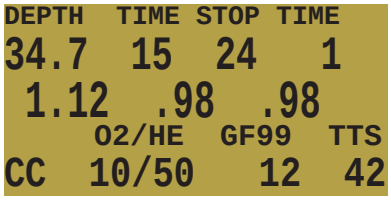


It is the author's opinion that all stops should be honored. It seems intuitive that if you have bubbles, and you stop, you give the bubbles an opportunity to be resorbed. If you continuously ascend, the ambient pressure is continuously reduced which prevents bubbles from shrinking. Because of this belief, the computer will give one Missed Deco Stop message during the dive and one after the dive, and will flash the stop depth as long as your are above the stop depth. It will use the increased gradient though, and your calculated off-gassing will be faster than staying at the stops.

The final option is to display the actual supersaturation gradient for a pure Buhlmann (99/99) profile.



The selection is GF99. With this setting, as long as the NDL time is 0 (you have a decompression ceiling), the gradient will be displayed instead of the NDL.
The number shown is the percentage of supersaturation. The number is calculated by reference to the Ambient Pressure Line and the M-Value line. It can be thought of as the current GF, but it is different in a couple of ways. First, the current GF generates stops rounded to the nearest 10 feet or 3 meters. So a gradient of 40 may reflect a ceiling of 15 feet, but the computer will show a rounded-up 20 foot stop.



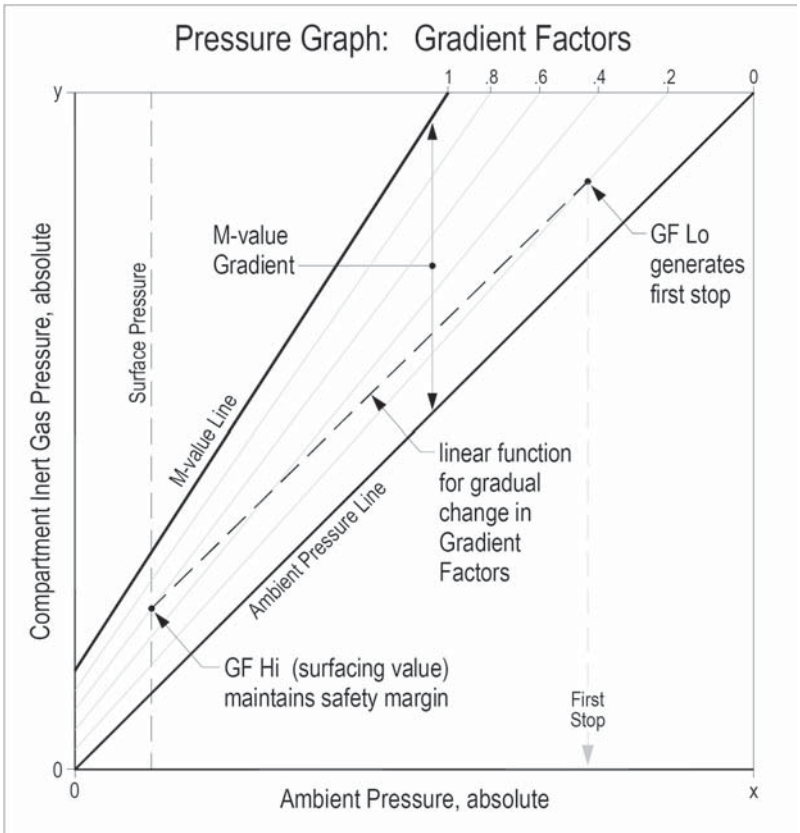
Also, GF draws a line at the beginning of decompression from the deepest stop to the surface. The gradient used for stops is based on that line. The Buhlmann ceiling is a raw supersaturation ratio.

This number can be used in several ways. First, it can be used to calculate an aggressive ascent that still has some justification in decompression science. For example, if a diver were to lose a significant portion of their gas and needed to get shallow fast, they could ascend until they reached a gradient of 90, then stop until it dropped to 80, then ascend to 90 again, etc. That would produce a Buhlmann-like profile with very little conservatism. In an emergency, that may be an acceptable risk.

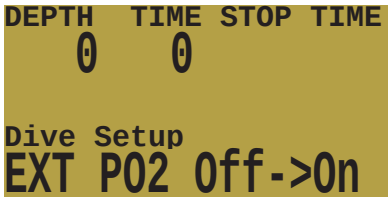
Another use might be to do a slower ascent on a dive to sightsee, but to stay in the decompression zone by keeping the gradient above 0.

Another use would be to observe the rapidly increasing gradient in the last 10 feet to the surface and slow that ascent.

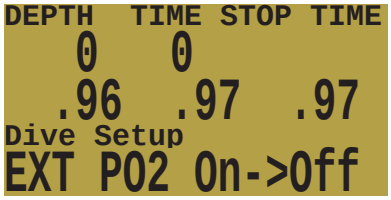
All of this is based on gradient theory that may be completely false. There is significant disagreement in the decompression research community about the nature and practise of decompression. Any techniques described here should be considered experimental, but the concepts may be useful to the advanced diver.



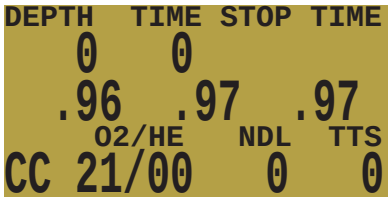
External PPO2 Monitoring



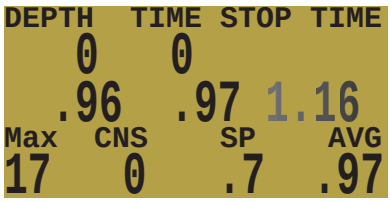
The next menu item is used to turn external ppo2 monitoring on and off. By default, external monitoring is turned off. To turn it on, select this menu item.



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.

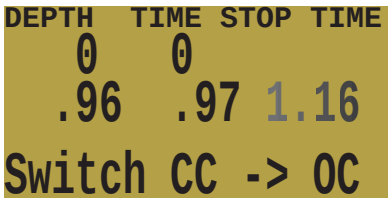


This system is plugged into three sensors and is the primary display for the system.



Note that since we are in Closed Circuit mode, that the ppo2 used to calculate decompression is the average of the three sensors after voting. In this case, sensor three has bee voted out, and the decompression calculation will use the average of sensor 1 and 2.

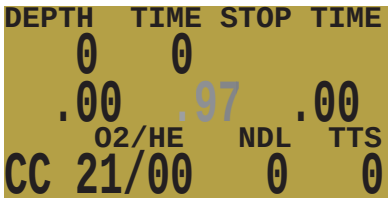
Sensor 3 will be flashing.



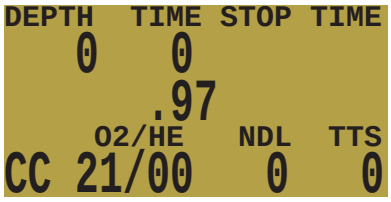
After switching to open circuit,

the ppo2 used for calculation is now is the PPO2 of the selected gas at the current depth.

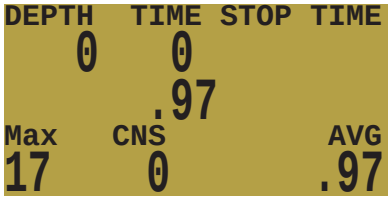
If we now unplug sensor 1 and sensor 3, the computer will use voting logic to pick the two sensors that agree and will think the PPO2 is 0. Sensor 2 will be voted out and flashing. This is one of those times that the user will have to determine which sensors are correct.



With sensors one and three unplugged, we simulate the situation with fourth sensor monitoring. It we calibrate in this situation, the system will assume that this computer is only attached to one sensor, and will re-configure for fourth sensor monitoring.

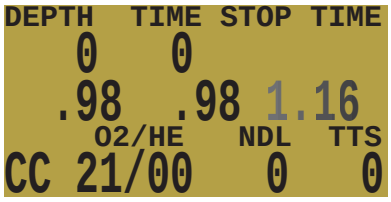


It will no longer average the sensors or vote on them. Now the single sensor is the only one considered and the ppo2 used for calculations is the ppo2 of the single sensor.

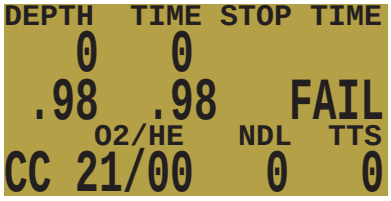


Calibration Problems

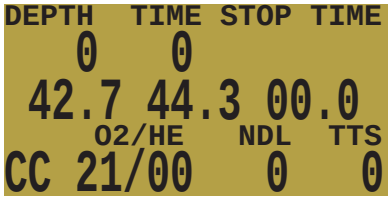
Here are some common calibration problems. In this display, one sensor is flashing. This shows that the sensor is voted out. If it comes back within range, it will be voted back in and stop flashing.



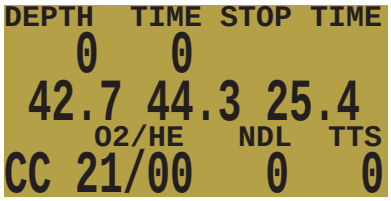
A failed sensor is a different situation. In this case, the sensor failed calibration. Changing the sensor won't make it register again. Once a sensor has failed calibration, the only way to bring it back is to successfully calibrate. If the computer were to display an value with a new sensor, it would be a meaningless value without calibration.



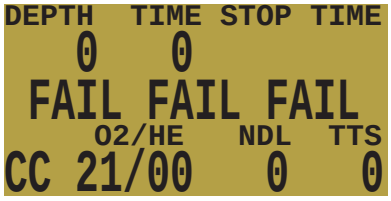
Pressing both buttons at once will show millivolts. Since the sensor is showing 0 mV, it is probably a connection problem or broken wire.



If this was the display, it would indicate a faulty sensor. It is not within the normal range for a sensor in oxygen. The Teledyne R22D sensor is designed to output 10 mV +/- 3 mV in air. If the output is linear, then that translates to a range if about 33 to 60 as valid mV readings in 98% oxygen. The computer will refuse to calibrate outside that range.

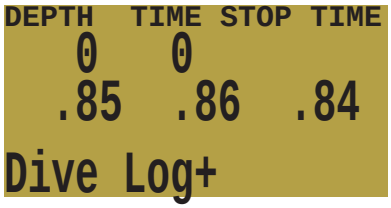


Three sensors all flashing failed is usually caused by an accidental calibration in air, or a calibration with the cable unplugged. Plugging the cable back in won't change anything. Failed calibrations can only be fixed by successful calibrations.



Dive Log+

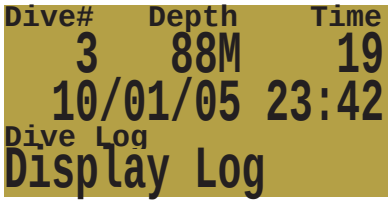
The dive log menu item will not appear during a dive. The log can be examined or uploaded on the surface. The dive log submenu is accessed by pressing SELECT.



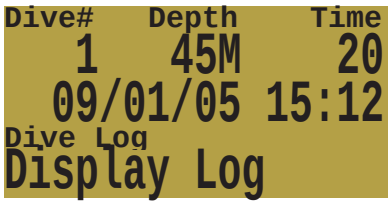
Display Log

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.

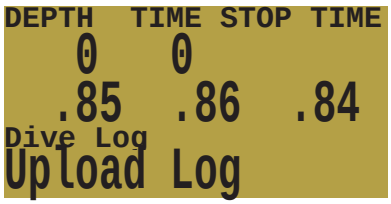


Pressing MENU when the last dive is displayed with exit the menu. Pressing SELECT on any dive will complete the log viewing and move to the next sub menu item.

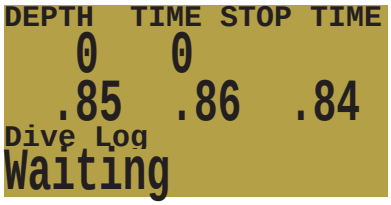


Upload Log

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

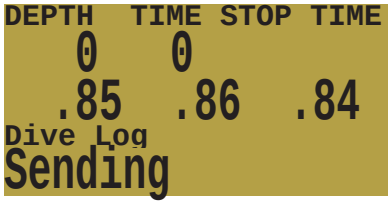


The computer will wait for the external PC to ask for the log. When it starts sending, the “Waiting” will change to “Device Found”, then “Sending.” The transmitting takes a couple of minutes. After the computer has finished transmitting, it will drop the IrDA connection while the PC analyses the data.

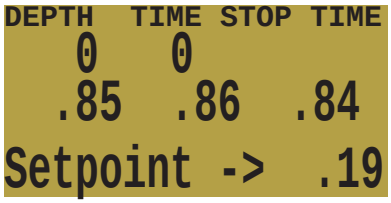


If the upload doesn’t upload 131200 bytes, it means the IrDA transmission had an error and the data validation will fail.

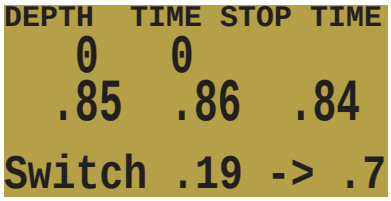
The Windows software can is provided free for download on the Shearwater website.



Setpoint -> .19



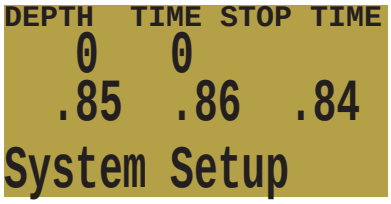
This menu item will only be displayed on controllers and only on the surface. It allows the solenoid to be turned off while on the surface when the loop is exposed to air. This prevents the solenoid from firing continuously. It is mainly used while uploading logs or other maintenance functions.



To switch back to normal low setpoint, select the Switch Setpoint menu item. The setpoint will also switch to normal low setpoint if a dive is started with the .19 setpoint selected.

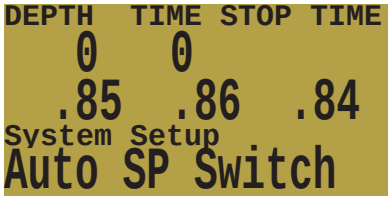
System Setup+

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.

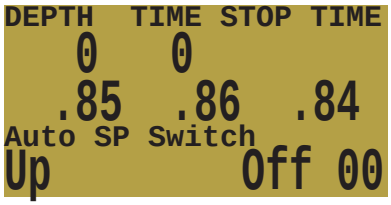


Auto SP Switch

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

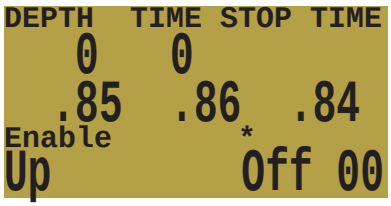


Pushing the confirm button will go into the setup for the switch up function.

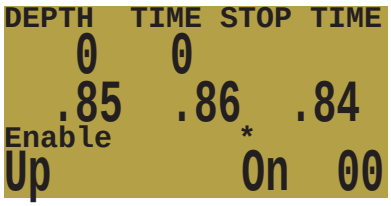


This configures the switch up from the low set point to the high setpoint. Pushing SELECT will enter the edit mode.

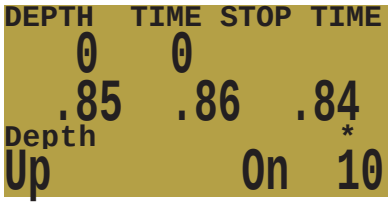
An asterisk shows which item is being edited. On first entry to edit mode, the "On/Off" position will be selected.



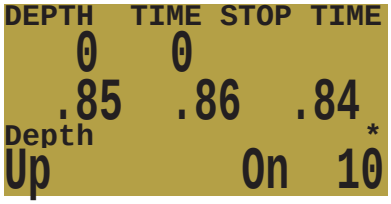
Pushing MENU switches it back and forth between "On" and "Off." Pushing SELECT moves to the next edit item.



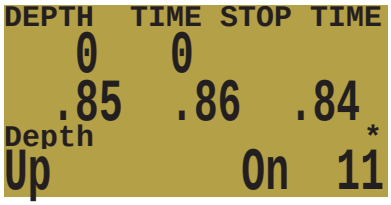
We are now editing the first digit of the switch depth. Pushing SELECT increments the digit.



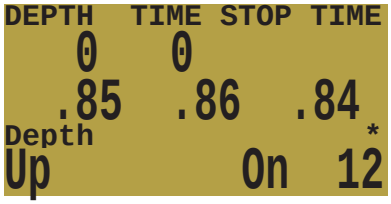
Pushing SELECT moves to the second digit.



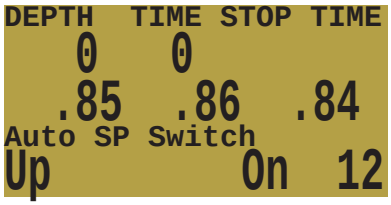
A push on MENU increments the digit.



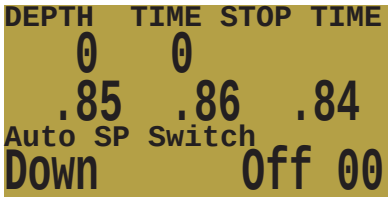
Another push on MENU increments the digit.



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.



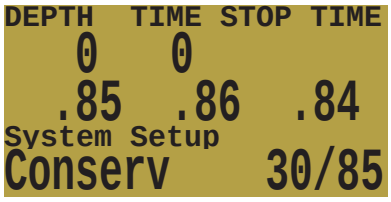
Either switch can be turned on or off independent of the other switch.

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.

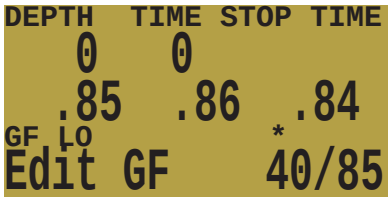
Conservatism

The 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.

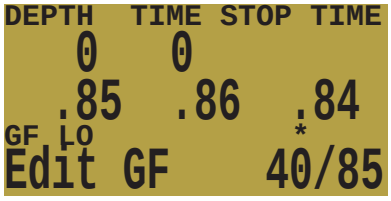


Pressing SELECT will enter the GF edit mode.

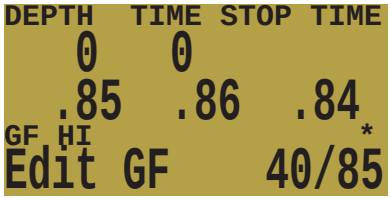
Pressing MENU will increment the digit.



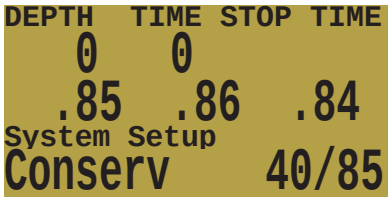
SELECT will save the current digit and move on to the next digit.



SELECT on the last digit will save the new conservatism setting

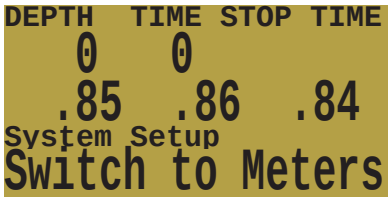


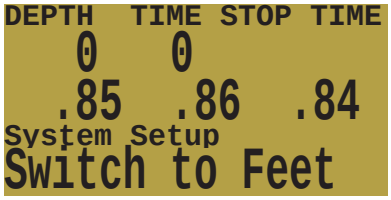
and return to the Conservatism menu item.



Metric/Imperial

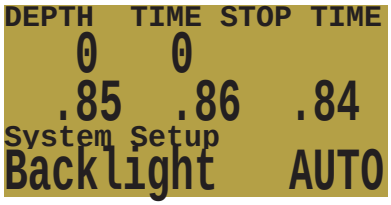
Each push of SELECT switches back and forth between meters and feet. It also switch the temperature scale. The menu item always shows the destination. If the display is “Switch to Meters”, then the current setting is feet.





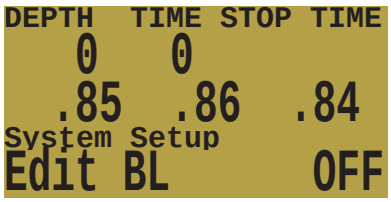
Backlight

The Backlight function allows you to scroll through the four possible settings for the backlight:



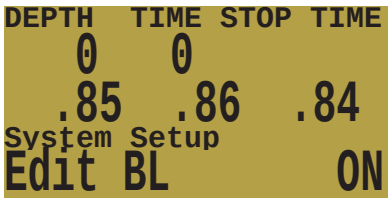
AUTO

The AUTO setting uses the internal ambient light sensor to turn the backlight on and off as required. If you are swimming in bright water, the backlight will be off. If you swim into a wreck, the backlight will automatically come on.



OFF

The OFF setting disables the backlight.



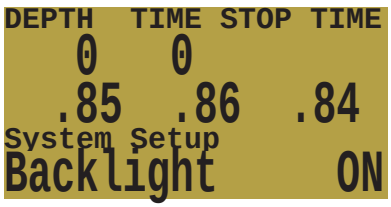
ON

The ON setting leaves the backlight on all of the time.

TIMED

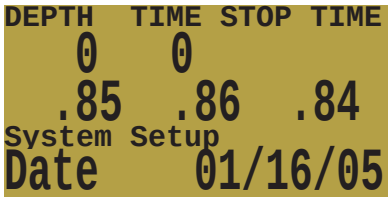
The backlight comes on for 5 seconds each time a button is pushed.

SELECT locks in the currently displayed setting.

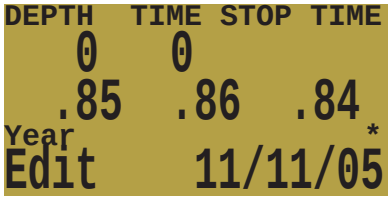


Date

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.

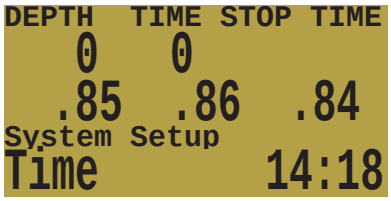


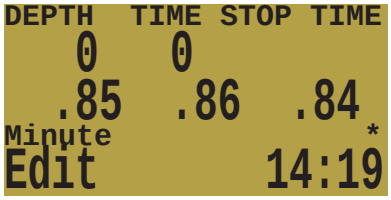
The date and time will have to be re-entered after a battery change.



Time

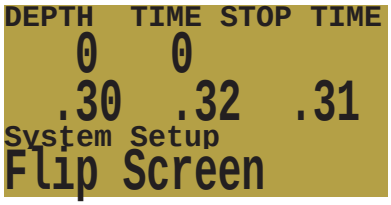
The time menu item allows the time to be set. Enter the edit function by pressing SELECT. The time is edited like other items by using the MENU button to increment and the SELECT button to accept the digit.

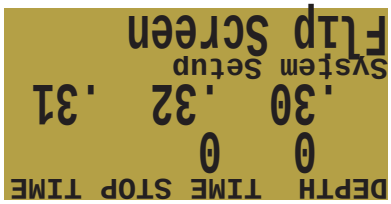




Flip Screen

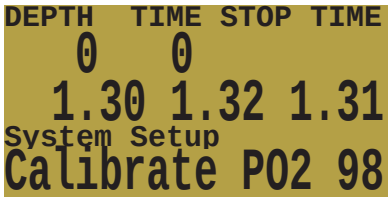
This function displays the contents of the screen upside down. This is used for systems with a permanent connection to a rebreather. It allows the computer to be worn on the right arm.



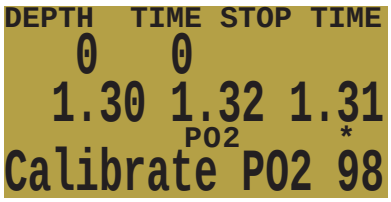


Calibrate PPO2

This allows the user to set the expected PPO2 for calibration. It is used in three situations. The first is for calibration at altitude. In that case the expected percentage of O2 should be adjusted for the actual atmospheric pressure.



The second is when pure oxygen isn't available and the oxygen is being generated by a membrane system. The oxygen in that case might be 96% O2 and a few percent of Argon.

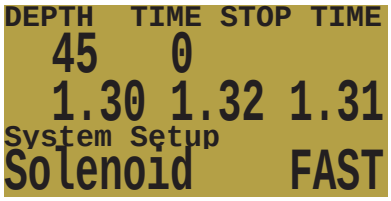


The third situation is for Semi-Closed rebreather use. SCR users may not have oxygen available. If the SCR identity is selected, the computer may be calibrated in air.

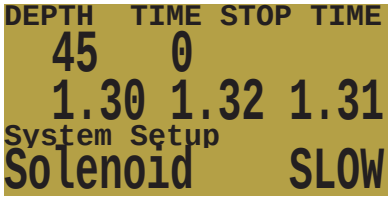
If any change is made in this screen, the current calibration will be discarded. The computer must be re-calibrated with the new settings.

Solenoid Speed

The firing pattern of the solenoid can be changed between fast and slow on controllers. The FAST setting uses frequent short injections of oxygen and is generally more accurate.



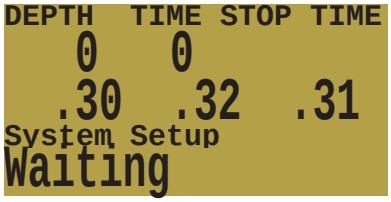
The SLOW setting is more familiar to many users.



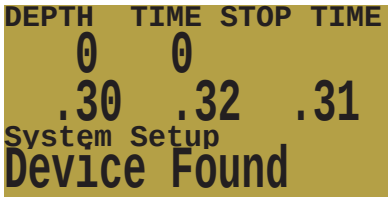
Load Upgrade

This function is used to load software updates.

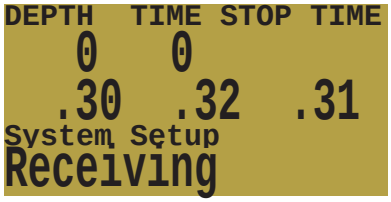
Press SELECT while in the Load Upgrade screen and the system will wait for and IrDA connection. Load the PC software included with the update. The the Device ID “Generic IrDA” is displayed on the PC, click on Connect.



When the connection is made,

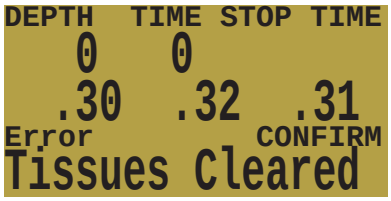


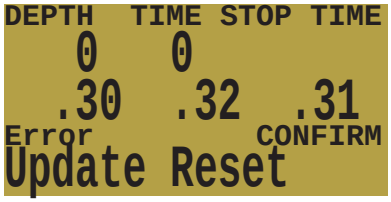
click on “Upgrade Computer.”



After it has loaded the software, it will decrypt it and load it. This will take about 30 minutes.

The computer will then display the “Tissues Cleared” and “Update Reset” messages.

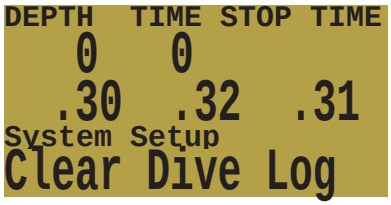


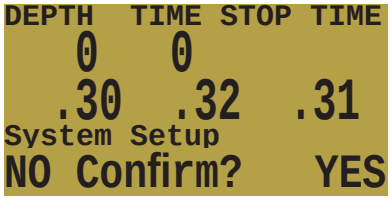


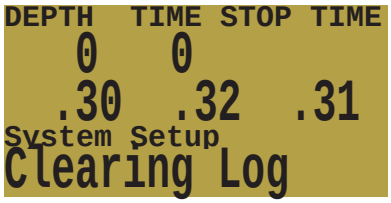
Clear Dive Log

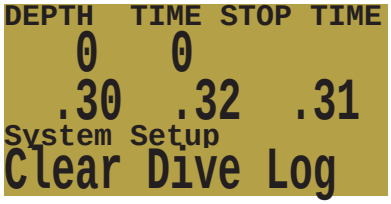
In the past, we were forced to convert from an EEPROM to a FLASH memory for dive logs. There were some instances of log corruption during the conversion, and the Clear Dive Log function is available to remove the incorrect data.

This function will be remove in the future.







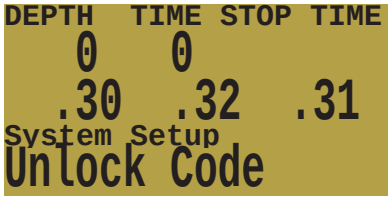


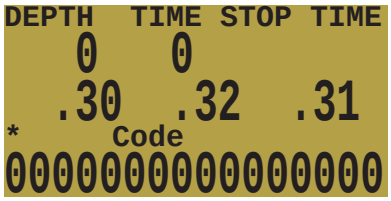
Unlock Code

The unlock code is entered to change models and to set other features. It serves a variety of purposes. It can change a nitrox computer into a Trimix computer for example. It can also be used for customization.

As in other functions, MENU increments and SELECT saves and moves to the next digit. SELECT on the last position ends the function. Invalid codes are rejected without changing the existing features.

The numbers are in the hexadecimal system. The digits are 0-9 and A-F. They represent a base-16 number system commonly used to represent large numbers compactly.

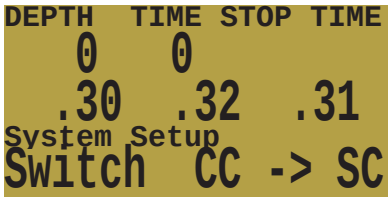


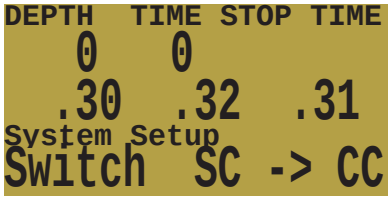


Set SC identity

This function is used to switch between Semi-Closed circuit and Closed circuit operation. It allows the computer to make accurate projections based on the way the PPO2 changes during ascents. It allows much more accurate predictions for Time To Surface (TTS) for Semi-Closed circuit divers.

It also allows SCR divers to set their calibration percentage to .21.



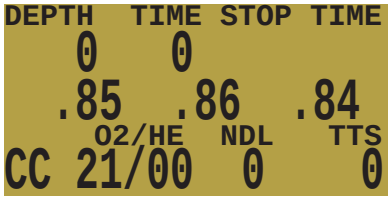


Altitude

The Pursuit reads the

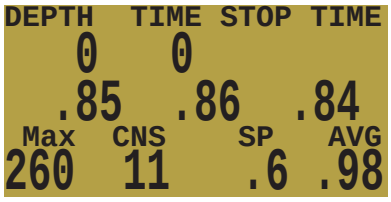
Status Displays

Pushing SELECT when not in a menu will bring up the status displays. There are several 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 status displays will time-out after about 6 seconds and return to the primary display.

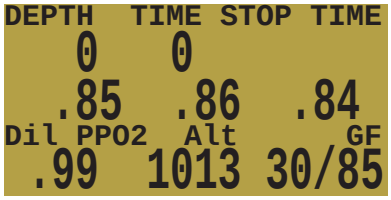


The status displays vary depending on the model. For example, the OC versions don't show the diluent PPO2 since it is the same as the Average PPO2 shown on the first status display.

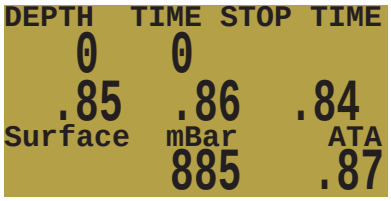
The first display shows the maximum depth on the current or previous dive, the current CNS exposure, the current setpoint, and the current average PPO2. The setpoint only displays if it is appropriate.



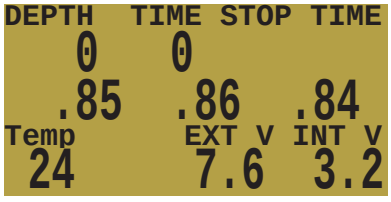
The next display shows the PPO2 of the current diluent gas, the barometric pressure in millibars, and the conservatism setting.



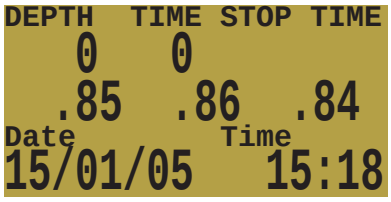
The next display shows the altitude that the computer was at when it was turned on. This altitude is saved and used for depth, O2 sensor calibration, and decompression calculations. It is important to turn the computer on before diving to adjust the altitude.



The next 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.

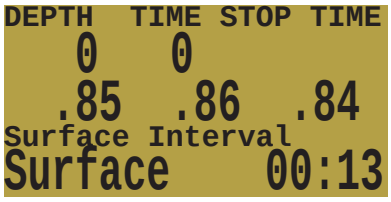


The fourth display shows the date and time.

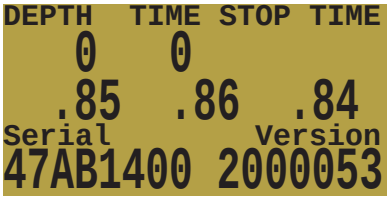


The next two displays do not show during a dive. They are available on the surface only.

The fifth display shows the current surface interval.



The last display shows the serial number, model and version of the computer. The version is in three parts. The first number is the model. The three models are 1 for display, 2 for computer, and 3 for controller. The next 4 digits are feature configuration. For example they control whether helium is enabled. They also control customization. The last two digits are the software version.



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.

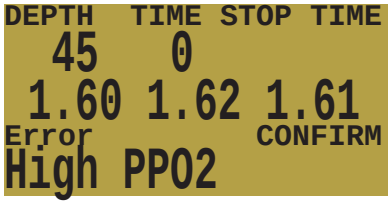
For example, if an alarm is silent when it is not in alarm and is silent when it is broken, then there is no way to be sure that the alarm isn't broken.

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.

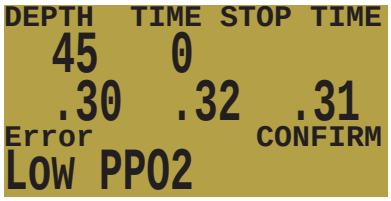
Other functions continue to operate as normal, so that the MENU button will take you into the menu, and a push on both buttons will show the millivolt display. The error message will keep returning until it is dismissed with a SELECT.

This message will appear if the average **PPO2** goes **above 1.6** for more than 10 seconds. It will come back after being dismissed if the situation occurs again.

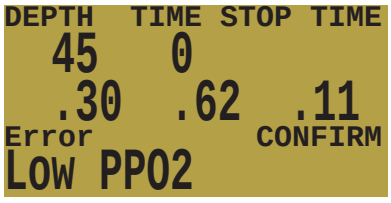


This message will appear if the average **PPO2** goes **below 0.4** for more than a few seconds. It will come back after being dismissed if the situation occurs again.

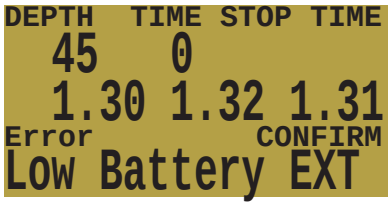
It is not unusual to get this error immediately after submerging with a manual CCR and a hypoxic mix. The first breath after submerging floods the loop with low PPO2 gas. The situation is usually resolved by increasing depth such that when the error is noticed, the PPO2 is no long low.



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.



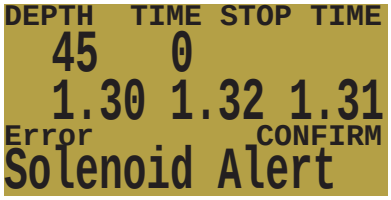
This alarm appears when the voltage on the external solenoid battery is low (controller only). The solenoid may still be firing, but the battery must be replaced before any further diving.



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.

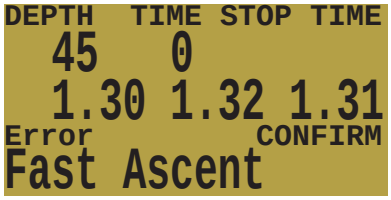
This alarm alerts that the battery is not supplying enough power for the solenoid to fire correctly, or the solenoid has failed, or the connection to the solenoid has failed. (controller only)



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.

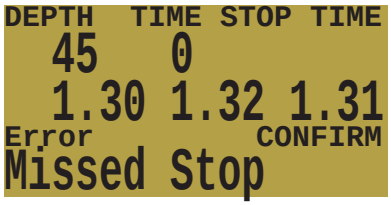
This alarm will only appear once during a dive. When it is dismissed, it will not return during the current dive.

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.



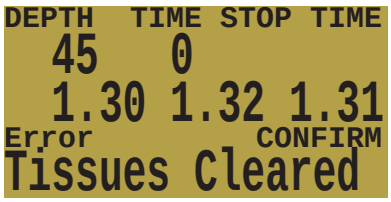
This alarm may return after being dismissed if the condition occurs again.

The alarm occurs when the diver has been above the minimum depth for a decompression stop for more than one minute.

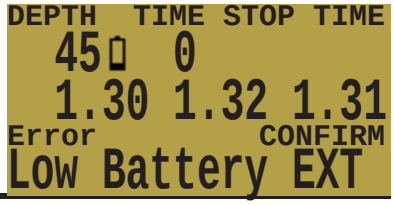


This alarm will only appear once during a dive, but it will also appear once on the surface after the dive.

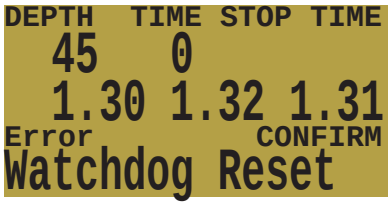
This alarm will show every time the computer loses power. All decompression information has been lost.



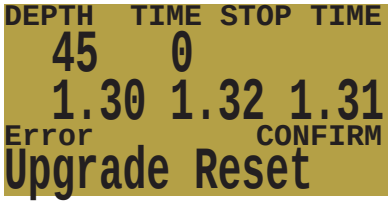
This alarm shows the the internal battery in the Pursuit needs to be changed. The computer will flash the battery symbol and show a text message.



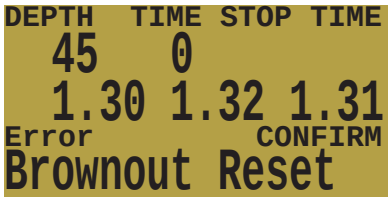
This alarm happens when the computer does not complete all of it's tasks in the time allotted. I can happen occasionally from a transient problem like a battery bounce after an impact. It can also be the result of a hardware problem.



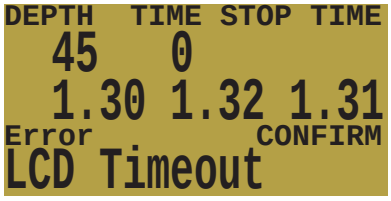
This reset is shows up after a software update. This is the normal event that shows the computer has been rebooted after the software update.



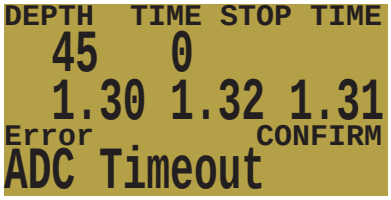
This error usually occurs when the battery dies while the computer is asleep. If the battery gets too low to maintain system integrity, the hardware will force the system into reset.

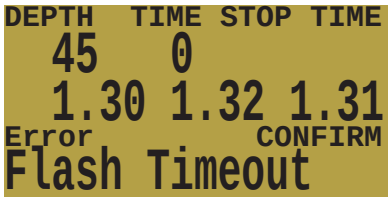


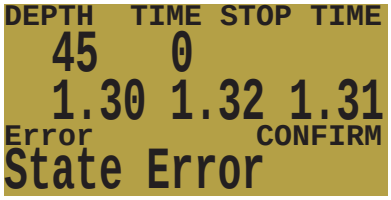
The following messages are reporting internal hardware failures. The system will continue to retry and may recover, but they would normally mean that something that should never happen, has happened. These messages should always be recorded and reported to the factory or your local service center.



This is not an exhaustive list. There are other errors that could be reported and more checks are added with each software update.







Battery Change

The Pursuit has a battery compartment in the side of the case.

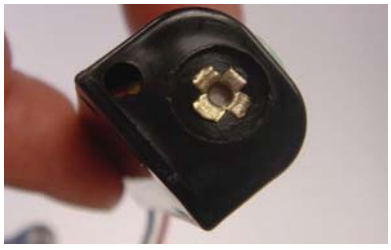
With a large coin unscrew the battery cap.

Carefully pull out the battery holder. To prevent battery bounce and rattling, It's a fitted tightly, so you will need something like a dental pick or a paper clip to pull out the holder.

Pull our the battey holder and change the battery. The battery is a Saft 14500

The wires come from the main compartment of the computer through to the battery compartment on one side of the battery compartment.

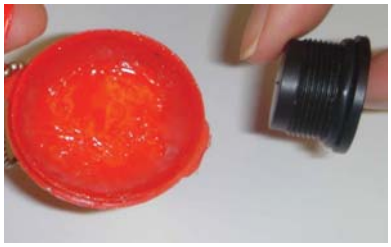
The bottom of the battery holder is flat.



The bottom needs to be aligned with the wires as they feed through the case. Carefully fold the wires along the bottom of the holder and insert back into the compartment. Care must be taken not to pinch and score the wires.

Inspect and, if necessary, apply a light coat of silicone to the O ring in the battery cap. Reinstall the battery cap taking care not to pinch or deform the O ring.

Finger tighten with a coin.



Specifications

- Atmospheric Range: 800 - 1050 mbar
- Oxygen gas supply content 96-99%
- Batteries: SAFT LS-14500 3.6v AA size Lithium Ion 2250mAh
- Crush depth Limits:

o Handset 185m

- Display accuracy: ± 5%
- Display resolution: 0.03 bar
- Oxygen warning level (Low): 0.4 bar
- Oxygen warning level (High): 1.6 bar
- Operating Temperature Range: +4ºC to + 32ºC
- Short term air storage (hours): -10ºC to +50ºC
- Long term storage: +5ºC to +20ºC
- Weight:
- Transducer depth range: 14ATA
- Transducer depth accuracy: +/-2.5%
- Maximum submergence: 300 mins
- Dive time start and stop: 1.6m & 0.9m

CE EN 13319

Maintenance

This instrument should be returned to the manufacturer or their authorized repair centre for service annually. A check for accuracy, water tightness and functions will be carried out aswell as replacement of ‘O’ rings and other wear parts.

Storage

The Pursuit dive computer should be stored dry and clean. Do not allow salt deposits to build up on your dive computer. Wash your computer with fresh water to remove salt and other contaminants. Do not use detergents or other cleaning chemicals. Allow to dry naturally before storing.
After cleaning, store the apparatus upright, out of direct sunlight in a cool, (5-15oC), dry and dust free place. Avoid exposure to direct ultra-violet radiation and radiant heat.