



# **Rechargeable Batteries**

User Instruction Manual

## Contents

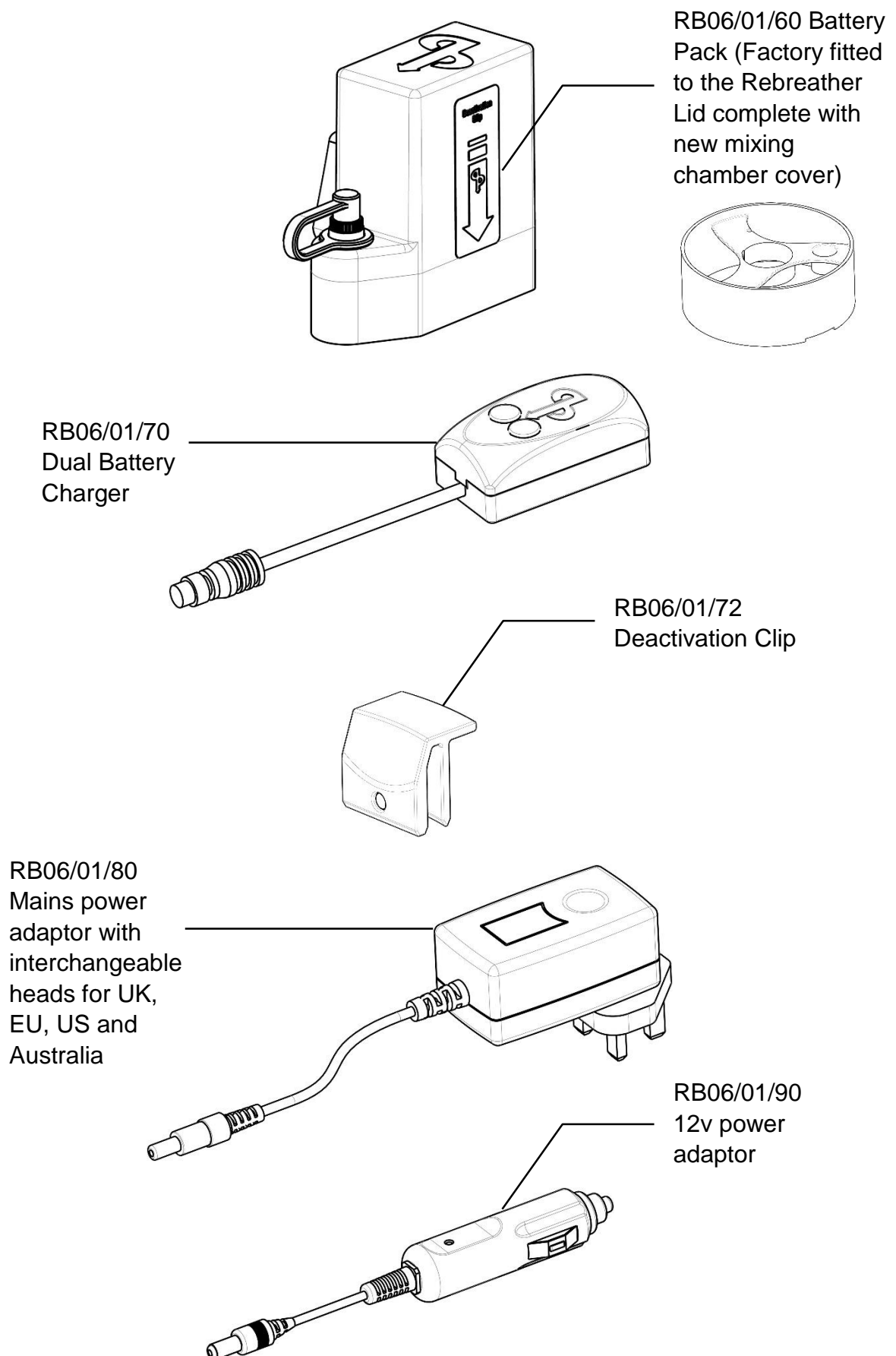
Rechargeable Battery Features.....	3
Parts Supplied.....	4
Rechargeable Dual Battery Configuration.....	5
Important Information .....	6
Intelligent Dual Battery System.....	7
Rechargeable Battery Charging .....	8
Initial Switch-On Tests.....	11
Normal Pre-Dive Operation .....	13
Dive Mode Operation .....	16
Low Battery Warning .....	17
Battery Warning Suppression .....	18
Post Dive.....	18
Maintenance.....	22
EC TYPE Approval.....	22
EC PPE Article 11B Approval.....	22
Technical Data .....	23
Manufacturer .....	24

## Rechargeable Battery Features

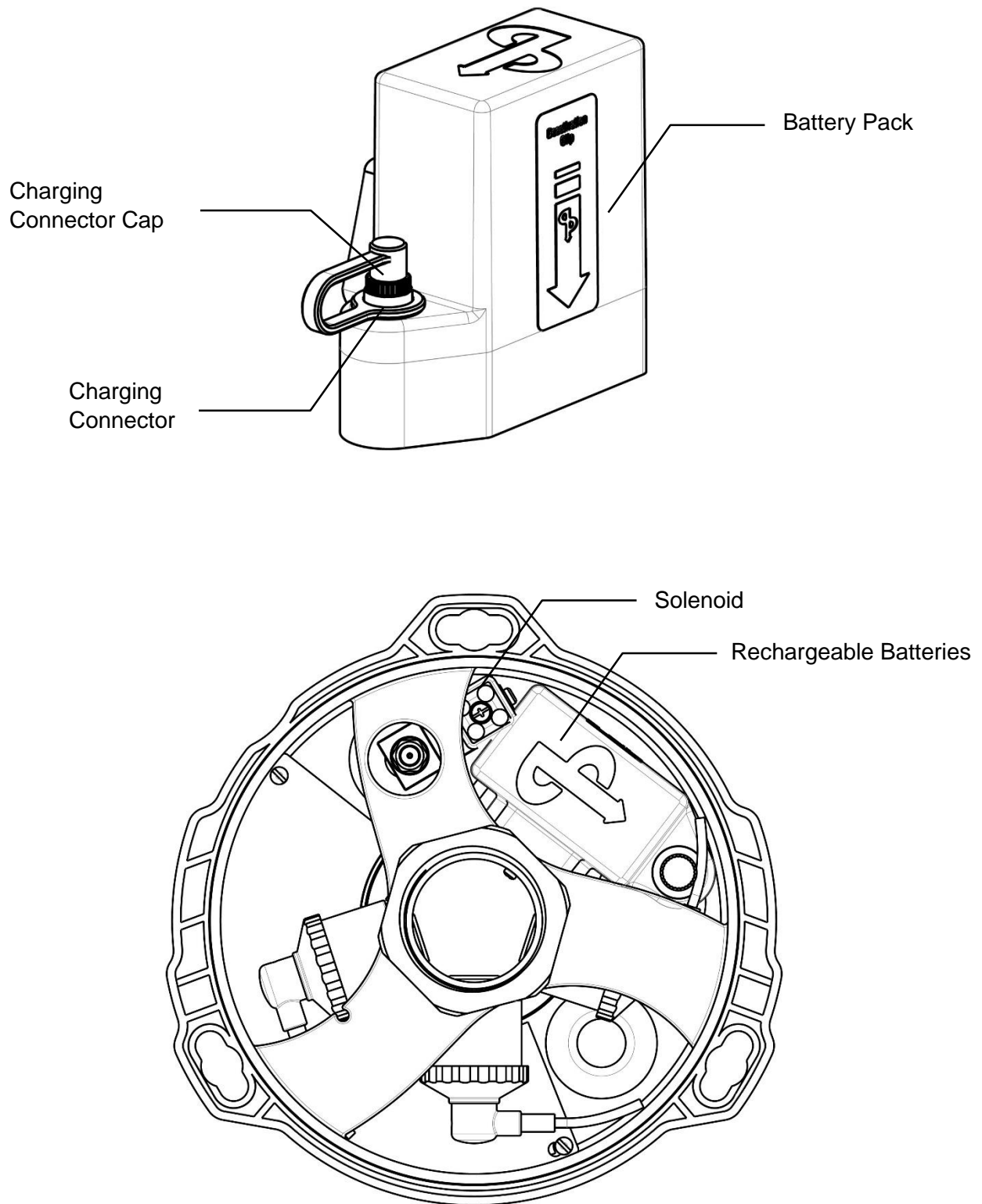
The AP Diving Rechargeable Dual Battery Pack (RB140) has been specially developed for Vision equipped AP Diving rebreathers. The battery pack which incorporates two separate, large capacity, power supplies – B1 & B2, is intended as an upgrade for existing customers as well as a standard item with new AP Diving rebreathers.

- The rechargeable RB140 battery pack is compatible with Vision electronics with V06.00.00 + firmware:
  - The V6+ firmware has a factory setting for the type of battery, non-rechargeable or rechargeable, and once set the firmware applies the appropriate warning and switch over levels as the batteries are depleted.
  - Batteries are checked for operation during start up
  - Graphical display of battery levels on rebreather handset (and HUS if fitted)
  - Low battery warnings communicated on the rebreather handset, HUD, buzzer (and HUS if fitted)
  - Intelligent dual battery system using AP's well-established technique of using B1 first, keeping B2 in reserve until B1's voltage diminishes enough to force the switch over to B2 and later switch over to both batteries when the B2 voltage drops.
- Rechargeable from mains supply (100-240V) or 12 volt supply:
  - Supplied with interchangeable mains power adaptors (types A,C,G & I) for US, EU, UK and Australian sockets – ensuring compatibility for all mains power outlets Worldwide.
  - For specific Country compatibility refer to:  
<http://www.worldstandards.eu/electricity/plug-voltage-by-country/>
  - 12v adaptor also supplied to allow charging from 12v sockets in cars and boats.
  - Intelligent battery charger applies appropriate charge to both batteries, taking approx. 4hours from completely empty to maximum charge, resorting to a trickle charge when completed.
  - Intelligent protection circuitry during use and charging
  - Threaded waterproof, cap for charging port
- Advantages:
  - 1.8 x the capacity of the CRP2 and CR123 batteries previously used in the Vision electronics, so re-charging is required less often than new battery insertion on previous battery boxes, typically keeping B2 in reserve & requiring a recharge every 15-27 hours of diving depending on type of solenoid fitted, work rate, temperature and use of backlight.
  - Battery lifetime of approximately 500 charging cycles (typical of lithium-ion polymer batteries)
  - More convenient in remote locations
  - Hardwired to the rebreather controllers ensuring uninterrupted power supply
- Factory fitted and encapsulated to isolate from the breathing gas
- Located in the warmest part of the loop ensuring best possible performance in extreme cold.
- B1 & B2 individually isolated, physically and electrically.
- Supplied with deactivation clip and new mixing chamber that allows deactivation for travelling and transportation. The use of the deactivation clip also prevents accidental auto activation when the handset is kept in damp conditions
- Type Tested for CE approval according to the EN14143:2013 Rebreather standard (Notified Body: SGS United Kingdom Ltd)

## Parts Supplied



## Rechargeable Dual Battery Configuration



Note: The Rechargeable batteries are hardwired into the rebreather controller and as such are not user removable, but can be deactivated using the deactivation clip.

## Important Information



Each oxygen controller has its own battery and circuitry. It is imperative to ensure that both, B1 & B2, are charged sufficiently prior to diving.



The 7.4V lithium-ion polymer batteries **MUST** only be charged with the AP Diving dual battery charger from mains power or 12v sockets.



The AP rechargeable battery pack must only be used with Firmware version 06.00.00 onwards as it allows factory configuration to ensure the appropriate warning and switch over levels are applied. If previous versions of firmware are used with the rechargeable batteries, the rebreather **WILL** shut down during use, without warning, resulting in no oxygen addition and no audible warning.

V06+ will also ensure that only B1 is used during calibration and for powering the solenoid & handset. Should B1 drop below the pre-determined voltage the power drain will automatically be changed to B2. Should B2 also reach the pre-determined voltage then power will be drawn automatically from both batteries. Should the ppO<sub>2</sub> fall below 0.4 bar the power is drawn from both batteries.

The battery life varies due to the frequency of use of the backlight and the brightness setting. To ensure that the reserve power is as good as it can be and you get the best use from the batteries always recharge when the low battery level on B1 is reached.



The electronics do not automatically power down when not in use, therefore it is very important to ensure that it is switched off after use to preserve battery life.

**DO:** Read the rebreather instruction manual fully before using the rebreather

**DO:** Carry out all pre-dive checks prior to each dive

**DO:** Replace the charging connection cap after charging and prior to diving again

**DO:** Post-dive maintenance, particularly recharging the batteries after a low battery warning

**DO:** Keep a record of battery usage

**DO:** Use the de-activation clip for shipping or flying.

**DO:** Switch off the rebreather when not in use, to preserve battery life, as the electronics do not automatically power down after use

**DO NOT:** Ignore a low battery warning

**DO NOT:** Dive without recharging batteries after a low battery warning

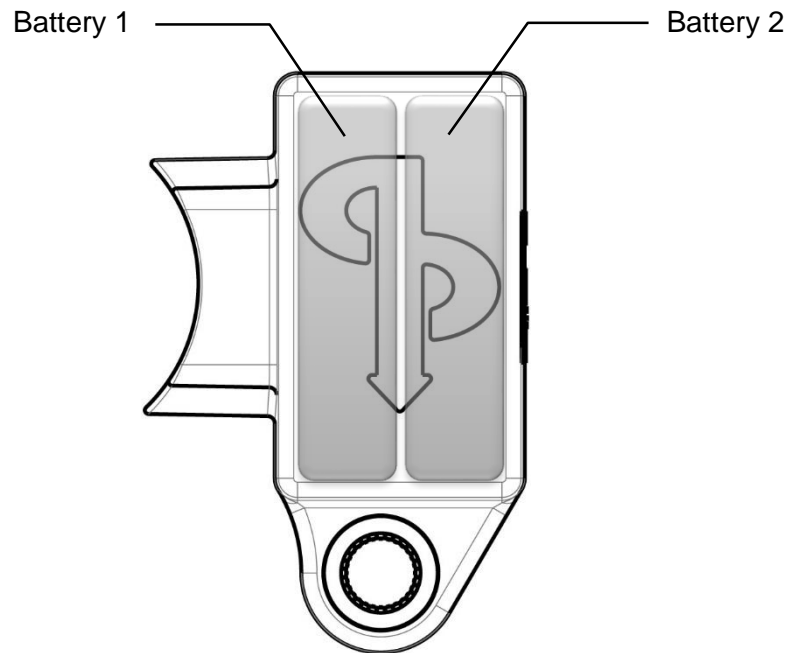
**DO NOT:** Dive without the charging connection cap on

**DO NOT:** Recharge the batteries in a wet environment

**DO NOT:** Attempt to open the rechargeable battery pack as it is built as a sealed unit and contains no user-serviceable components.

## Intelligent Dual Battery System

There are two batteries within the rechargeable battery pack, B1 and B2. B1 is the battery for oxygen controller C1; B2 is the battery for C2. Additionally, both controllers when active have the ability to use the other controller's battery when necessary.



If B1 is discharged, there will be no C1 controller, the same applies for B2 & C2 – no battery, no controller. If there is sufficient charge in B1 for all operations it will automatically be used as the Master battery. If B1 only has sufficient power to start the C1 processor, C1 will still be the Master oxygen controller but B2 will be promoted to the Master battery status and will be used for powering the solenoid, wrist display and HUS if fitted.

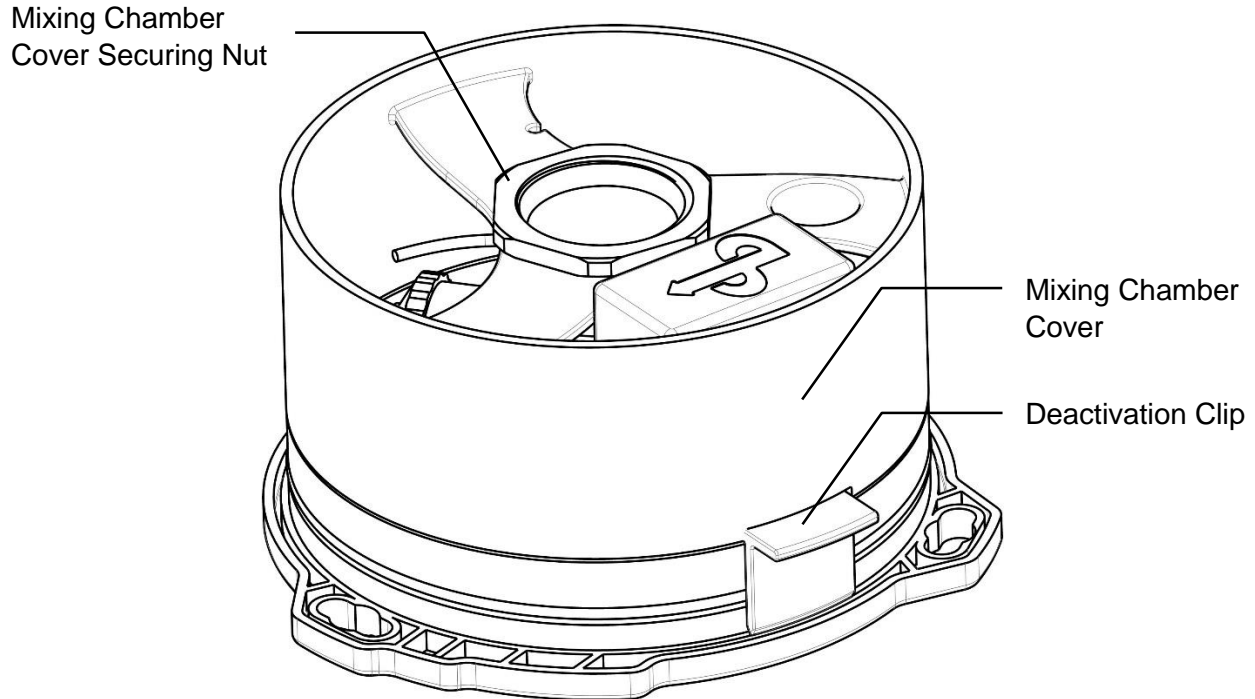
During use, the same thing happens, B2 will be promoted to Master should B1 reach the low battery warning level. Once B2 also reaches the low battery warning the power will be drawn from both B1 and B2. Each change will be notified to the diver via the HUD and wrist display and HUS, if fitted, as well as the buzzer.

In the event that one of the batteries is below the low battery warning level, the power will always be drawn from the battery with sufficient voltage.

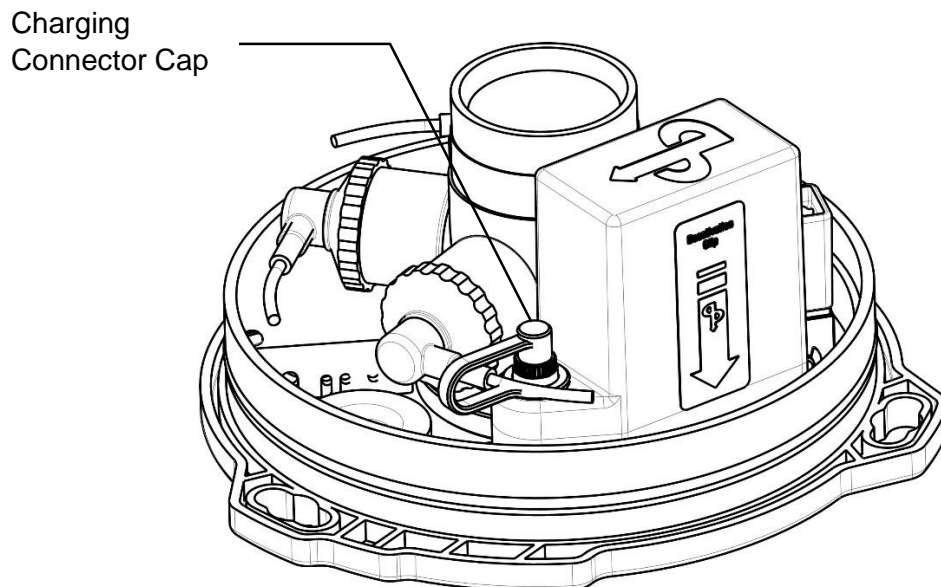
## Rechargeable Battery Charging

The battery pack will be supplied with some charge, but we recommend that the battery is charged before it's first use and recharged when required using the following procedure:

1. Remove the mixing chamber cover securing nut, the mixing chamber cover itself and the deactivation clip (if fitted) from the rebreather lid.

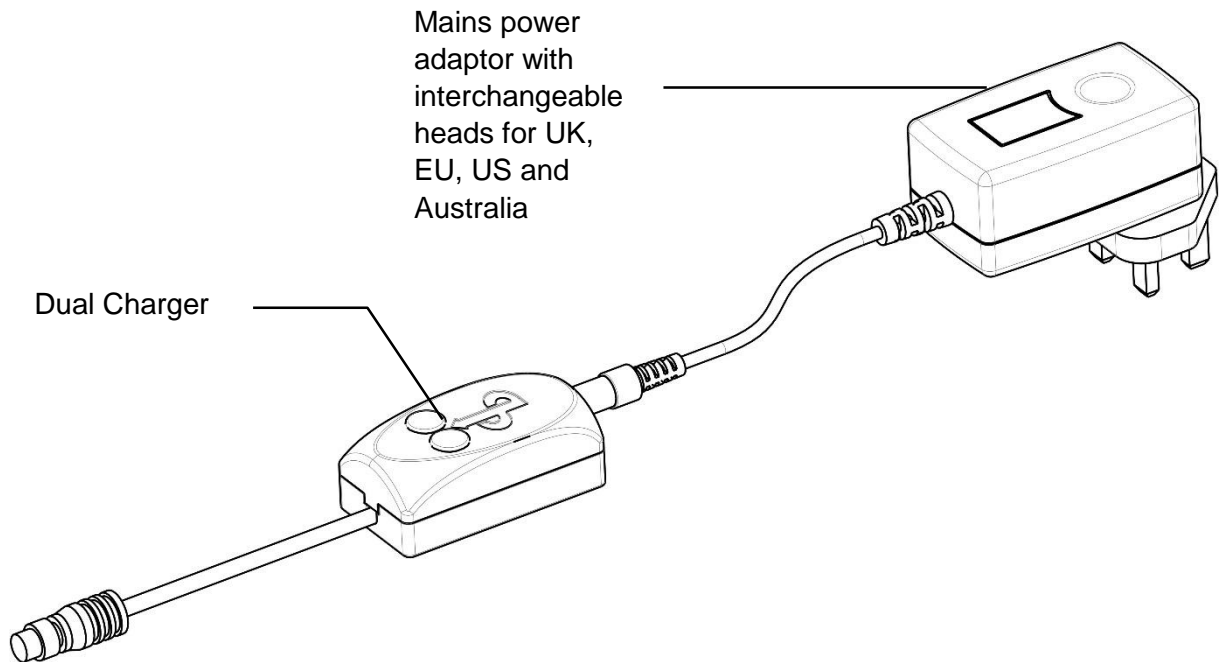


2. Unscrew the charging connector cap from the side of the battery pack. The rubber lanyard should keep the cap with the lid.

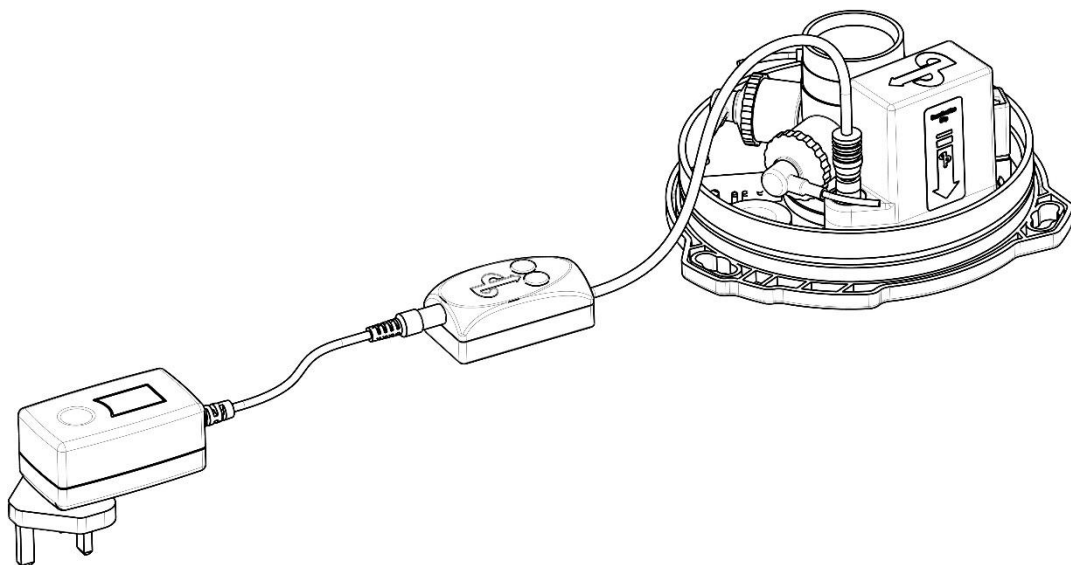




3. Select either the mains power adaptor or 12v power adaptor and plug into the Dual Charger. The mains power adaptor is supplied with 4 different heads for use with different international power outlets. The appropriate one is simply clipped onto the power adaptor body.

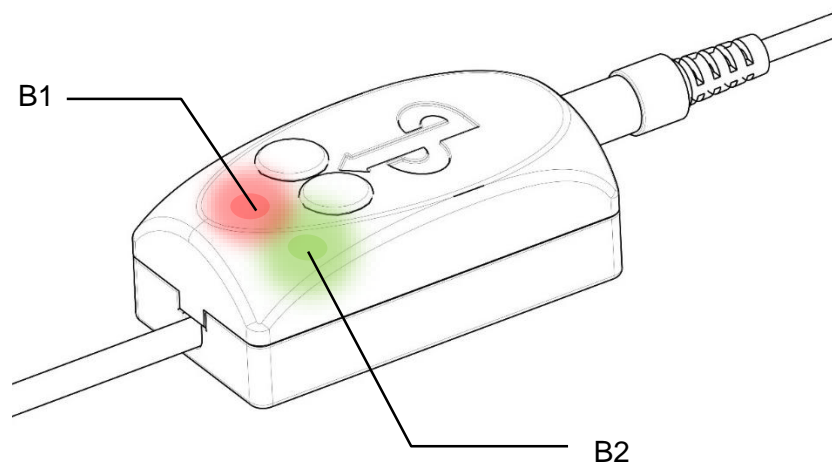


4. Before using the charger make sure that the connector is free from moisture, dirt or corrosion as this can affect the charging process.
5. Screw the dual charger connector onto the battery pack (finger tight). Put the power adaptor into the socket and turn on the socket to apply power to the charger.



6. The dual charger will light up showing the charge status of each battery within the battery pack.

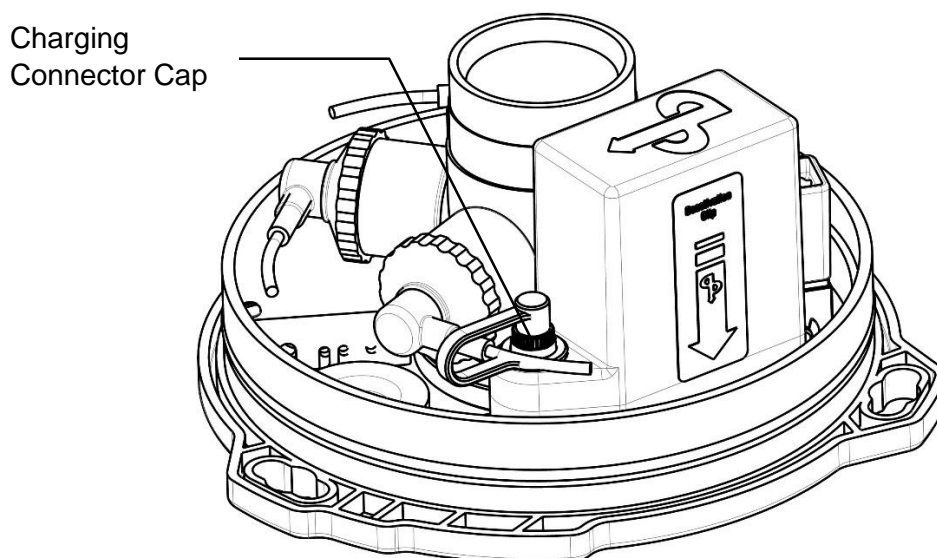
Green	=	Fully Charged
Red	=	Charging
Flashing Red	=	Charging Error – Contact AP Diving
No Lights	=	Power is not applied to the charger or the charger is not Connected to the lid correctly



The image here shows B1 charging and B2 fully charged. When both B1 and B2 show green the batteries are fully charged and ready for use.

It is not recommended to leave the battery on charge for long periods after the battery pack has reached full charge (green light shown on both B1 and B2).

7. Turn the power off, remove the charger and adaptor and **replace the charging connector cap**. This cap protects the connector and batteries from moisture damage when in use. The mixing chamber cover and securing nut can now be replaced and the lid can be assembled onto the scrubber.



## Initial Switch-On Tests

As with all AP rebreathers produced, an electronic check of connected devices is done on first switch-on and this includes an initial battery check.

### Scenario 1: Initial switch-on finds two batteries with readable voltage levels

Handset proceeds to display connection status for Oxygen cells, solenoid, buzzer, temperature stick and CO<sub>2</sub> monitor (if fitted), followed by “loaded” battery test.

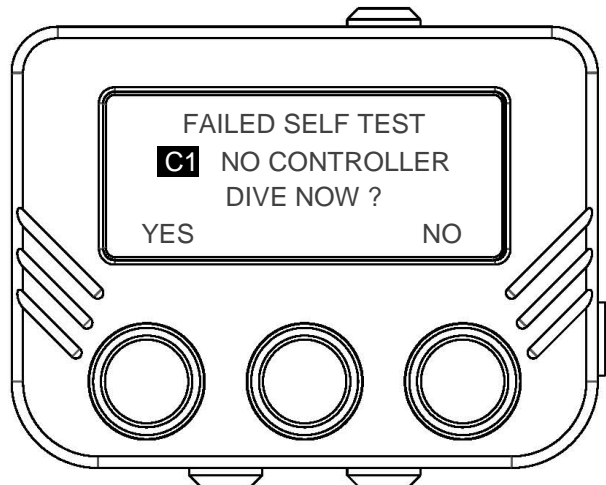
### Scenario 2: Initial switch-on finds two dead batteries



If both batteries are too low the unit will not switch on and in this extremely low battery state the Self-activation features (if fitted) will not function;

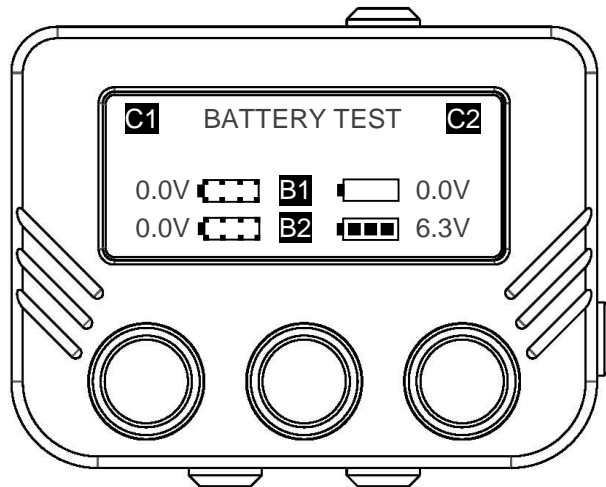
### Scenario 3: Initial switch-on finds one dead or low battery and one good one.

If only one battery has sufficient voltage to power it's oxygen controller the following screen is displayed, indicating which controller is missing, in this case – C1 and the option to Dive Now? Yes or No is given.



**WARNING** – Selecting to continue the dive with only one healthy battery is a feature that should only be used in an emergency, such as returning from a cave dive with no other means of escape. Depleted batteries should always be recharged, if at all possible.

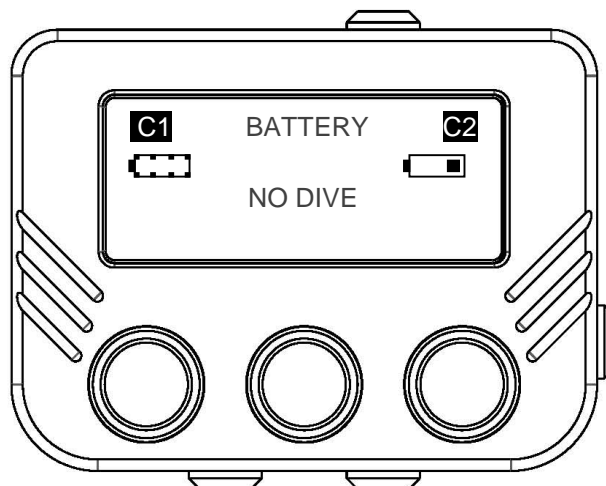
If Yes is selected then the unit will display the connection results for oxygen cells, solenoid, buzzer, temperature stick and CO<sub>2</sub> sensor (if fitted) and then move onto the normal battery test:



In this scenario, B1 has insufficient voltage and, as there is no B1- there is no C1 (Controller 1). C1 cannot measure anything, as it's not switched on, so 0.0v is displayed for both B1 and B2 in the C1 column. C2 is working properly and reports 6.3v for it's own battery (B2) and 0.0v for B1.

#### Scenario 4: Initial switch-on finds two low batteries.

If both the battery readings are low a “Failed Self-Test” screen will appear, followed by “NO DIVE”.







## Normal Pre-Dive Operation

Once the initial connectivity tests are completed, to help reduce the possibility of starting a dive with weak batteries, the solenoid “load” is placed on each battery in turn, while the battery voltages are measured by both oxygen controllers, C1 and C2.

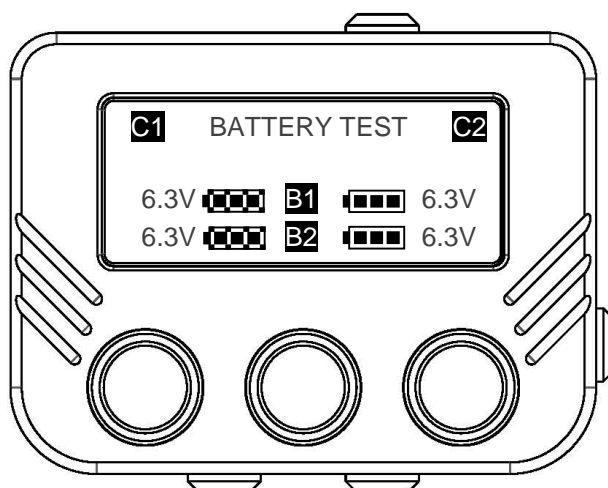
Note: Although the fully charged Lithium Polymer batteries are nominally 7.4 volts each, in order to make the rechargeable battery pack compatible with the A/D convertor range of legacy systems, the display during the battery tests will not show voltages higher than 6.3 volts, so 3 squares indicates 6.3volts +.

Nominal battery voltage levels:

	=	3 squares = Good level (6.3 volts +)
	=	2 squares = 6.25 volts, recharge before a decompression dive
	=	1 square = 6.0 volts. If occurring pre-dive on both batteries you will see “LOW BATTERY, NO DIVE”. If the other battery has 2 squares or more you will see the prompt “LOW BATTERY DIVE NOW, Y OR N?”
	=	0 squares = 5.8 volt. If occurring during the dive you will see and hear the low battery warning and it will switch to B2.

### Scenario 1:

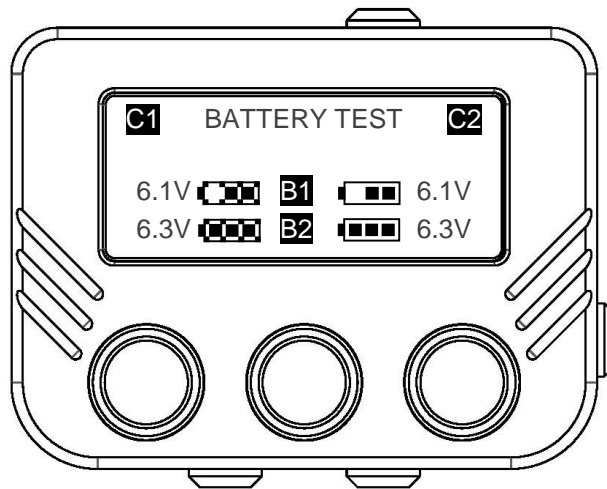
Two good batteries



Handset proceeds to “Open Oxygen Valve”

### Scenario 2:

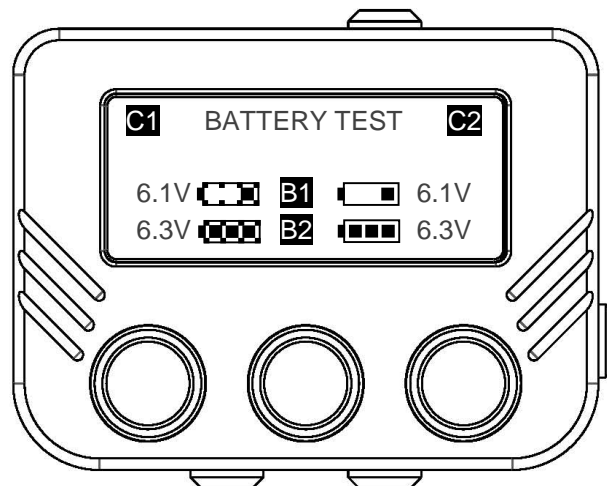
One part used battery, one good battery



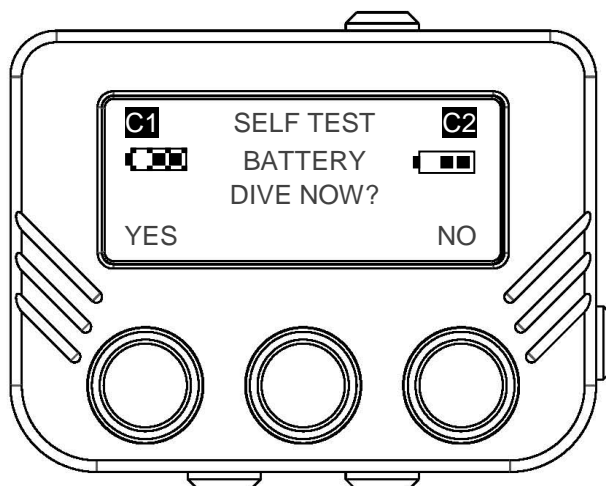
Handset proceeds to “Open Oxygen Valve”

### Scenario 3:

One low battery, one good battery



If one battery reading is low, one or zero squares, and the other battery has two or more squares the “SELF-TEST, BATTERY, DIVE NOW YES OR NO?” screen will appear.



Careful consideration is required at this time:

- Is the planned dive a long duration or decompression dive?
- Does the reserve battery C2 have three squares or two?
- Will I be diving in cold water?

It is your personal decision as to whether you can proceed or delay the dive until you have recharged the batteries but clearly if the answer to either of the above questions is yes, then it would be foolhardy to proceed without charging.



During the battery test there is no “battery parachute”, the system which allows the 2<sup>nd</sup> battery to take over from the first in the event of a “voltage collapse”.



If both battery compartment voltages are so low that the voltage drops below the “brown out” value then the system will simply shut down and the battery pack will need to be recharged prior to use.



In this extremely low battery state the Self-activation features (if fitted) will not function.



Selecting to continue the dive with only one healthy battery is a feature that should only be used in an emergency, such as returning from a cave dive with no other means of escape. Spent or missing batteries should always be recharged if at all possible.

## Dive Mode Operation

### Master / Slave Batteries

The battery management is very simple, largely done for you automatically, keeping B2 in reserve as much as possible.

If C1's battery, B1, has sufficient power to qualify as the Master battery, then the electronics will always start up with B1 as the Master battery. The Master battery is used to power the wrist mounted display, the solenoid and the HUS (if fitted).

The Master battery is highlighted, shown here on the left:







If B1 has insufficient voltage to be the Master battery then C2's battery (B2) will be designated as the Master battery. In use, it will be possible to see C1 as the Master controller but B2 being used as the Master battery. In the same way it would be possible to see C2 as the Master controller but using B1 as the Master battery.



In the event that both B1 and B2 are below the low battery levels then the power to drive the wrist display and the solenoid is drawn from both batteries simultaneously.

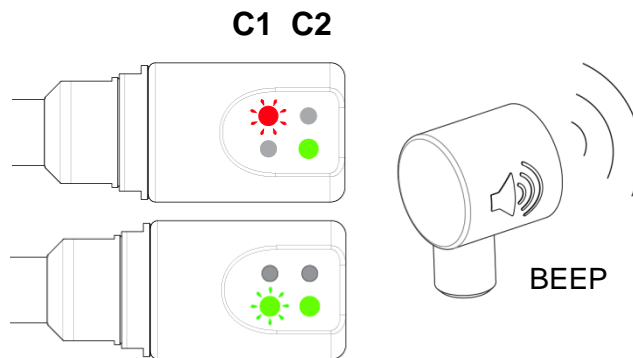
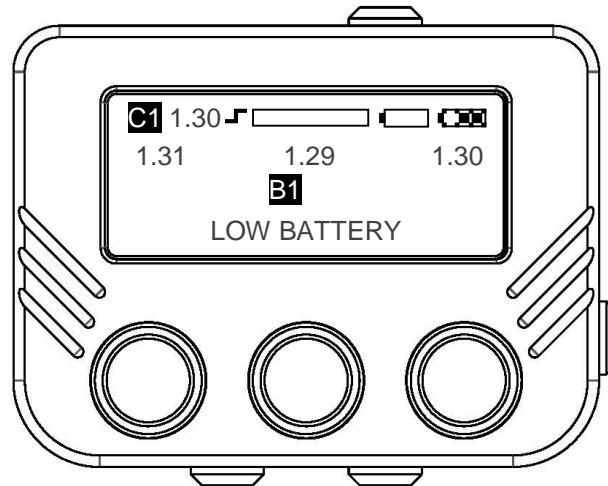


Nominal battery voltage levels:

	=	3 squares = Good level (6.3 volts +)
	=	2 squares = 6.25 volts, recharge before a decompression dive
	=	1 square = 6.0 volts. If occurring pre-dive on both batteries you will see "LOW BATTERY, NO DIVE". If the other battery has 2 squares or more you will see the prompt "LOW BATTERY DIVE NOW, Y OR N?"
	=	0 squares = <5.8 volt. If occurring during the dive you will see and hear the low battery warning and it will switch to B2



## Low Battery Warning



A low battery warning is indicated by alternating red/green/red/green etc flashing lights in C1 or C2 or both if both batteries are low.

In the example above C1's HUD is indicating a low battery and this is confirmed in the display, by showing red then green, red then green etc. When the B1 battery hits its LOW Battery threshold B2 is automatically promoted to Master status and B2 is then used to supply power to the wrist mounted display and solenoid. B2 can be seen above to be highlighted indicating it is already at Master status.

## Battery Warning Suppression

If you decide to stay on the rebreather the LOW BATTERY warning

- may be temporarily suppressed by pressing and holding the right switch for 2 secs plus. The HUD, HUS (if fitted) and buzzer warnings will then be suppressed, leaving the wrist display showing the Battery Warning.
- promoting C2 to master, by switching off C1 then turning it back on again ensures there is little load now placed on B1 and low voltage alarms will be less frequent.



Do not ignore low battery warnings. If the battery power to the unit depletes completely, the whole rebreather life support will stop functioning and there will no longer be any warnings. This can lead to serious injury or death.



For protection, each battery has a low voltage protection circuit incorporated, so when the voltage drops to these critically low levels, the power will stop abruptly.



Atmospheric temperature can have an effect on the battery life. In lower temperatures the battery life will decrease.

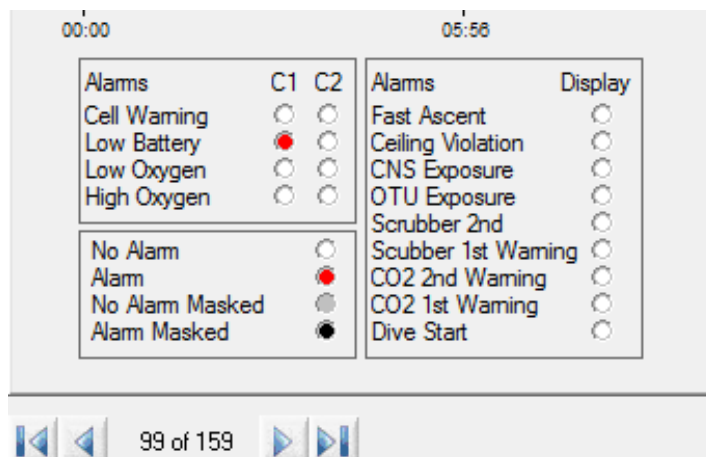
## Post Dive

Actions to take after a LOW BATTERY warning is displayed

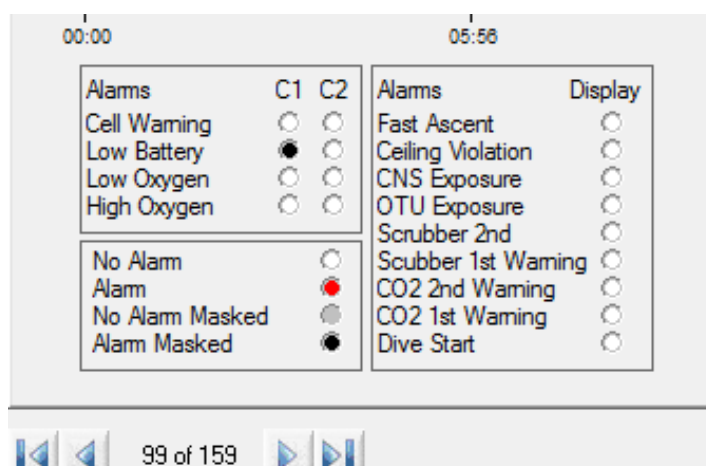
The best battery management technique is to simply recharge straight after a dive that had a B1 Low Battery Warning. This way, you always have a well charged battery in B2 effectively in reserve.

## Dive Log / Log Viewer

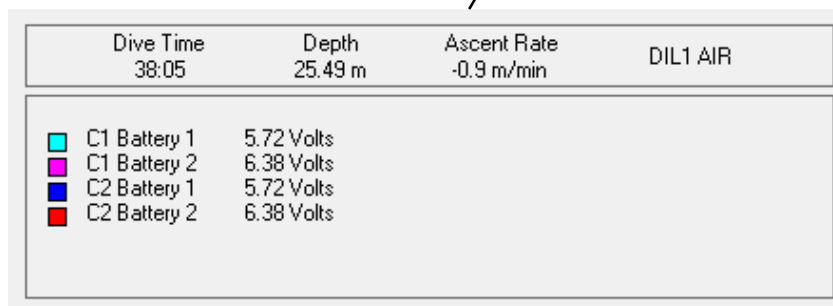
When viewing your dive downloads in the AP LogViewer, any low battery warnings given during the dive are shown in the bottom left.



When moving the cursor across the dive, low battery warnings are shown in red when alarming and black when suppressed.

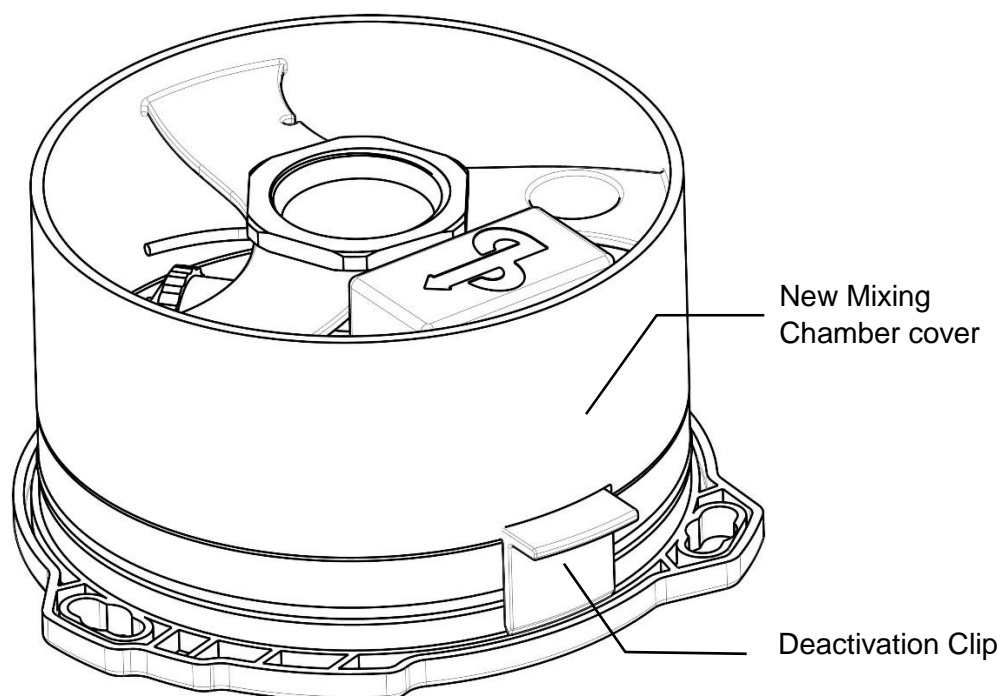
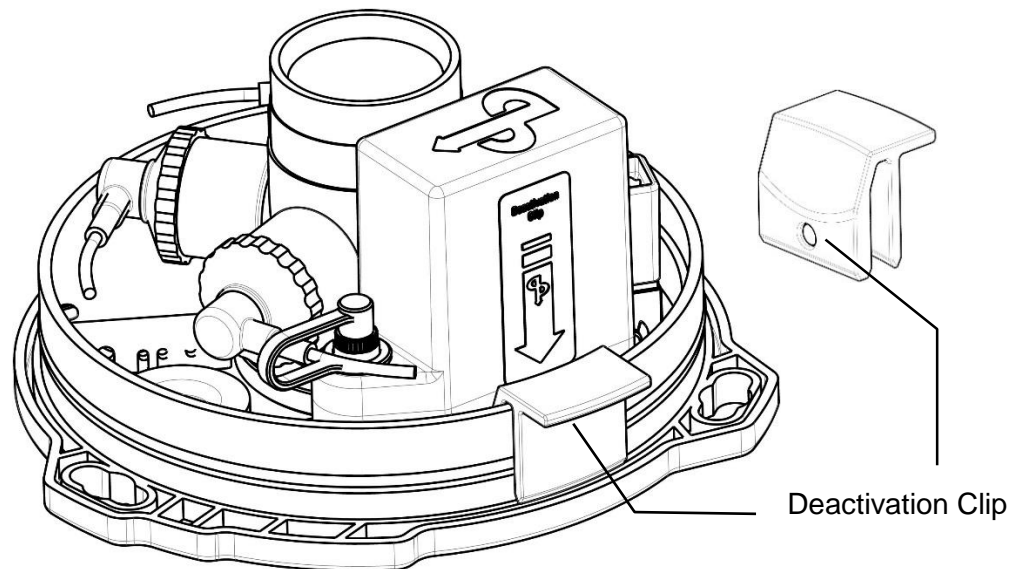


## Battery Voltages



## Deactivation Clip

The deactivation clip disables power to the complete rebreather lid. Therefore, whilst in place, the rebreather cannot be turned on in any form. It is not possible to achieve a PC link to upload firmware or download dives and it will not automatically activate when the handset makes contact with water or sustain life. For this reason the clip is designed to prevent the lid from being assembled into the scrubber whilst in place.



This clip allows the diver to isolate the power supply when flying with the rebreather lid and also avoid the worry of the auto activation turning the unit on unnecessarily when in a damp environment.

## **Maintenance**

Post dive, always store the rebreather lid in a clean dry environment and take care not to leave the lid and battery pack exposed to high or freezing temperatures. Do not expose the batteries to cleaning and disinfecting regimes.

If the rebreather is not to be used for long periods, AP Diving recommend that the battery is still recharged on a monthly basis to prolong the life of the battery. Long periods without the battery being cycled can seriously shorten the life of the battery pack. The battery has a lifetime of approximately 500 charging cycles (typical of lithium-ion polymer batteries). If the battery is not holding charge contact AP Diving to replace it.

Before using the charger you should make sure that the connector is free from moisture, dirt or corrosion as this can affect the charging process.

AP Diving recommend that the batteries are recharged after every low battery warning or sooner. This expected duration can vary due to the particular diving conditions and use of backlight and brightness on the handset.

Always replace the connector cap after charging. This cap seals the connector and protects it from moisture.

## **EC TYPE Approval**

EC Type approved by SGS United Kingdom Ltd, Unit 202b, Worle Parkway, Western-Super-Mare, Somerset, BA22 6WA. Notified Body number 0120.

The “Inspiration”, “Evolution” and “Evolution+” are CE approved to 40m using an air diluent and 100m using a Heliox or Trimix (with a max. END of 30m at 70m, reducing to an END of 24m at 100m). The EC Type Approval was granted on the APD Manufacturer’s Technical Specification and satisfactory user trials. The Technical Specification was based on the “Respiratory equipment-Self-contained re-breathing diving apparatus” standard EN14143:2013.

## **EC PPE Article 11B Approval**

The on-going certification to allow CE marking under Article 11B Directive 89/686/EEC is granted by Lloyd’s Register Quality Assurance Ltd. CE0088.

## Technical Data

### Battery Pack - Part Number: RB06/01/60


Each battery contains two battery systems. Each battery system contains: 2 x 7.4v 2400mAh (17.8Wh) Lithium ion Polymer Batteries


Internal protection circuitry

- Overvoltage protection
- Excess discharge trip
- Over current protection
- Short circuit protection time
- Operating current protection



### Dual Charger - Part Number: RB06/01/70


Input: DC 12V  2A

Output: DC 8.8V  2A



### Mains Power Adaptor - Part Number: RB06/01/80

Input: 100-240V 50-60Hz 1A

Output: 12V  3A

### 12v Power Adaptor - Part Number: RB06/01/90



**WARNING** – Only use the Power Adaptors, Dual Charger and the AP Diving Rechargeable Battery Pack together.

**DO NOT** attempt to use them with other devices.

**DO NOT** attempt to disassemble or short circuit the battery pack.

**DO NOT** expose to high or freezing temperatures and use indoors only.

**DO NOT** attempt to dispose of the batteries at the end of their life but please contact AP Diving and they will advise on disposal.

## Manufacturer

Designed and Manufactured in the UK by:



Ambient Pressure Diving Ltd  
Unit 2C, Water-ma-Trout Industrial Estate,  
Helston, Cornwall. TR13 0LW.  
Telephone: +44 (0)1326 563834  
FAX: +44 (0)1326 573605  
[www.apdiving.com](http://www.apdiving.com)

For spares and accessories visit:  
[www.apdiving.com](http://www.apdiving.com)