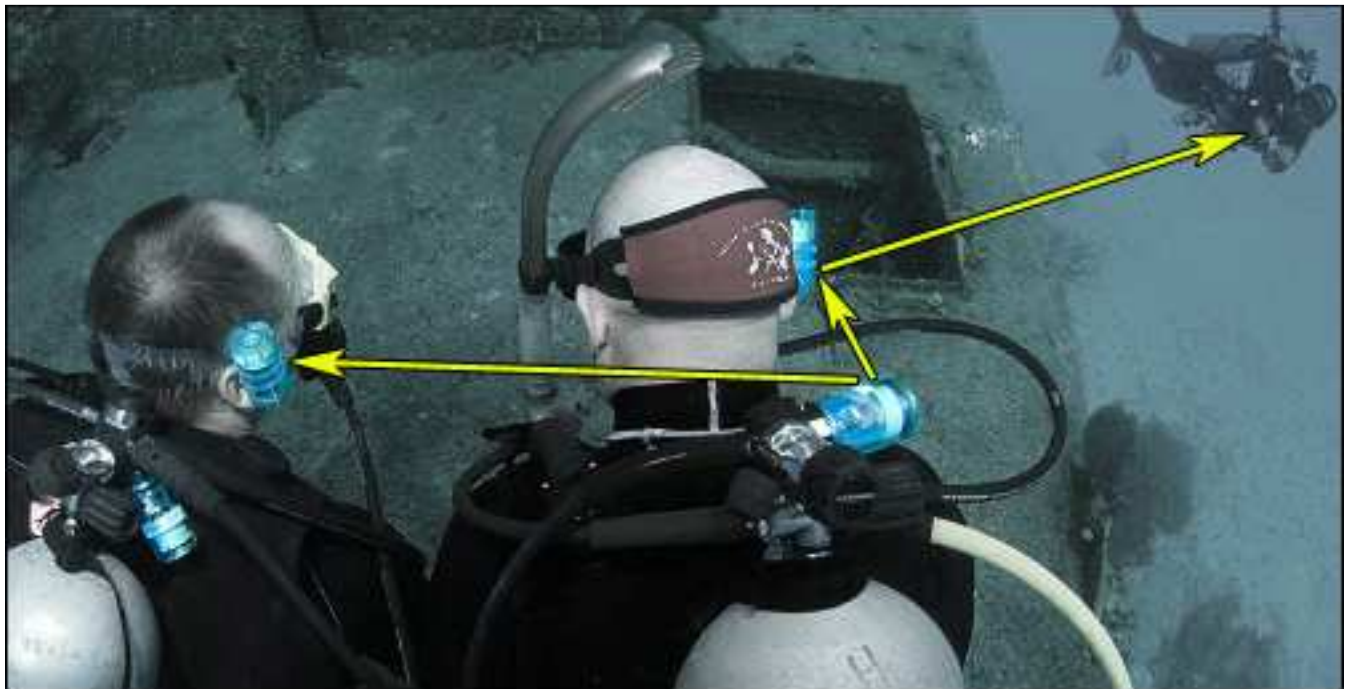




# APA™ Diver Low Air Pressure Alert

## DSO and Technical Reference Manual

Rev 1.30 20FEB13



Desert Star Systems, LLC  
3261 Imjin Road  
Marina, CA 93933

Phone: (831) 384-8000

[www.desertstar.com](http://www.desertstar.com)

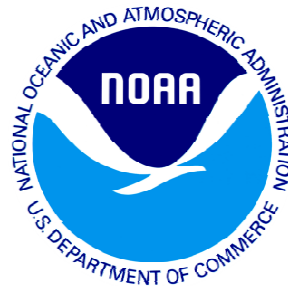
## WARNING!

APA™ is only authorized for use by certified divers following appropriate training or instruction through a qualified institution or certification agency. As any electronic device, APA™ can fail unexpectedly. APA is an air management device. For your own safety and that of your dive team members, always use APA to augment air pressure gauge checks, never to replace them. Safety in air management is obtained through a multi-layer approach, and you must never rely solely on APA to assure your safety

**Your safety is your responsibility; use common sense and good judgment!**

## LIABILITY DISCLAIMER

By purchasing or using APA™, it is agreed and understood that in no event will Desert Star Systems or any of its representatives be held liable for any personal injuries or death or damages to property resulting from its operation, or for any other damages whether direct, indirect, or consequential even if Desert Star Systems has been advised of such actual or potential damages. Desert Star Systems dive products are authorized for use only by properly trained divers. The user must understand that the products are liable to sudden failure. Diving is an inherently dangerous activity, and proper safety procedures demand that the diver never rely solely on just the APA™ or any other single instrument, method or mechanism for his/her safety or the safety of property.



### A NOAA Small Business Innovative Research (SBIR) Product

This material is based upon work supported by the Department of Commerce under contract number WC133R09CN0109 (SBIR Phase-1 and Phase-2). Any opinions, findings, conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the Department of Commerce.

**Contents**

<b>1. Information for Dive Safety Officers</b>	<b>4</b>
<b>2. Method of Operation and Fail Safe Mechanisms</b>	<b>7</b>
<b>3. Mounting Options</b>	<b>9</b>
<b>4. Diver Training and Dive Operations with APA</b>	<b>11</b>
<b>5. Maintenance Instructions</b>	<b>12</b>
<b>6. Technical Specifications</b>	<b>15</b>
<b>7. Warranty</b>	<b>16</b>

## 1. Information for Dive Safety Officers

APA represents a new capability and a new product category in SCUBA diving. The following information for dive safety officers is provided by the system's architect and chief designer, Marco Flagg.

### Why use the APA system in your diving program?



Marco Flagg dive testing APA

DAN and other statistics show that low and out of air emergencies occur at a persistent rate. A look at the circumstances shows that they are varied, affecting recently certified and experienced divers alike. Factors might include stress, high task loading, peer pressure, poor dive conditions, or simple preoccupation / inattention. Instructive among recent documents are the DAN Recreational Diving Fatalities Workshop Proceedings (2010), which identify 'gas supply problems' as 41% of the triggers of diving fatalities and further specify that these problems resulted 'mainly from inappropriate gas management'.

While developing APA under a SBIR contract for NOAA, I asked myself skeptically if a new product to address the issue of air reserve management was indeed needed, or if the real issue is quality of training and experience.

But over time, as we refined and simplified the system and dive tested it, I came to the conclusion that, in an institutional dive setting at least, the capability provided by APA is in fact essential.

The situation might be compared to aviation. SCUBA diving is a similarly technology-supported activity; and the consequences of accidents can be severe. In aviation, a persistent rate of emergencies on account of low fuel situations, stalls and the like would be unacceptable. And so, that industry long ago developed a combination of interlocking procedures and warning technologies that virtually eliminate risk factors once identified and have over the years resulted in dramatic safety gains in aviation.

By comparison, air reserve management continues to depend almost entirely on manual air gauge check by a diver who may be operating under difficult conditions, preoccupied with work, is subject to peer pressure, is stressed or is simply distracted. And, communication of air status to other team members is even more problematic as it first requires getting the buddy's attention; not an easy task in many cases. Thus, the air reserve management now generally practiced by divers provides only a **sporadic awareness** of air status – at those moments when the diver checks his/her gauge or actively communicates with a buddy. Viewed in this context, it is no surprise that low air emergencies do continue to occur as a diver fails to perform these manual checks or presses the limits for any number of reasons. And, with so many human factors involved, it is unlikely that training alone will be the solution.

The principal advantage of APA is that it provides the diver with **continuous awareness** of air status. The device not only alerts you when you are low on air, but also informs you actively when air status is still OK, or reminds you to check the gauge when no telemetry is temporarily available or indeed if the device failed entirely. By operating in a complete head's up fashion, the diver can remain concentrated on the task. And, by relaying low air information to other team members through multiple redundant mechanisms, dive operations can be concluded in a safe and methodical fashion.

## **APA Compared to Air Integrated Dive Computers**

An obvious question is the performance of APA as compared to air integrated dive computers when it comes to air reserve management. The technologies are similar in the sense that they generally consist of a regulator first stage mounted pressure transmitter and a display device. The difference is that APA is a task-optimized safety device, yielding overall a much greater effectiveness than dive computers. This effectiveness is the result of three fundamental aspects of the APA technology:

- 1. Effectiveness of alert signaling:** APA uses a combination of high-intensity LED and bone conducting sound to alert the diver even under adverse circumstances. The method of signaling with its combination of informing OK as well as LOW or no data creates a continuous awareness of air status. Yet, the alerting system is entirely head's up, allowing the diver to remain concentrated on the task.
- 2. Enhanced reliability of air status transmission:** APA uses long-distance capable ultrasonic acoustic signaling to reach the diver and other team members then uses a repeater function by which a diver's mask mounted alert unit repeats air status messaging to overcome diver body and other blocking of signals. Further, high-intensity LED on the alert and transmitter unit augment the telemetry and make the low air status of a diver obvious when in visual range. The mechanisms combine to propagate air status awareness throughout a dive team in an unobtrusive way. This promotes safe, air reserve guided conduct and conclusion of diving activities.
- 3. Simplicity of use:** APA minimizes training requirements and use of the device is easily taught in minutes. Alerts mirror the rope-pull signals used by divers and are intuitively clear even without instructions.

## **Equipment Load and Diver Acceptance**

Some initial resistance from divers to the use of APA should be expected, on grounds of additional equipment load or practiced air management techniques sufficing. But our experience has shown that divers quickly appreciate the equipment due to the head's up awareness of their own and buddy's air status. The alert unit positioning on the mask strap may cause some concerns, but again, divers interviewed after a dive uniformly say that the equipment is not an issue.

APA is also designed to give divers flexibility, in particular in terms of mounting options for the alert unit. Mask strap based mounting is most effective in terms of the bone conducting audible alert signals, good visibility of the high intensity LED to other divers and as a good (low obstruction) vantage point for the repeater function of the alert unit; i.e. relaying a diver's low air status to other team members.

Yet, there are options. If a diver wears an opaque skirted mask or prefers visual over audible signals, a very simple fiber optic light stalk with suction cup attachment to the mask is available. A diver may also not need the visual signals, and mount the alert unit just for comfortable audio level. When not wearing a hood, the audible alerts are very loud. Here, a diver may choose to B/C mount the alert unit on the shoulder, perhaps also reducing snagging potential in overhead or cluttered environments.

Overall, APA provides sufficient flexibility and signaling redundancy to support diver's customization for their individual needs.

## **Optimizing APA for your dive program**

APA is intended for use by dive organizations as an institutional safety capability. Ultimately, advances in safety are gained through thorough evaluation by your organization, programming of APA to reflect your institutional standards and requirements, development of training material and a supervised phase-in of the new capability.

Desert Star Systems will support you in that effort. This includes the initial review of your needs, provision of source material for your training syllabus, assist in evaluation, maintenance and train-the-trainer classes.

The APA devices themselves are factory programmable and we will configure units with a profile specific to your organization prior to shipping. The configured parameters are:

1. The pressure thresholds for the CAUTION range (standard 750 PSI) and LOW air range (standard 600 PSI).
2. The tones and blink patterns for the air status, messaging and fault signals (standard approximating NOAA rope pull signals, with red LED reserved for LOW air only, all other blink patterns yellow).
3. The alert message transmission interval (standard 16 seconds for OK and 8 seconds for LOW, CAUTION).
4. The duration of the LOW air continuous alert phase 'alert lock'. (Standard five minutes).
5. The programming of unit ID codes. (ID codes 1-16 support up to 16 divers at one site).

APA can also be custom programmed to perform other functions. For example, a 'buddy search' capability could be implemented to indicate closing or rising distance to a buddy, similar to the audible object proximity alerts now available in some cars. An 'over the side' surface unit with a connection to a display device could provide air status of divers to the designated person in charge (DPIC). Such more specialized optimizations will require a development and test program and associated development charges, but are an available option for our APA customers.

APA as any other piece of instrumentation has its limitations and is clearly subject to failure. But, within the context of a thought-out fielding and training program, and by providing an additional layer of defense, my estimation is that APA will help your organization significantly reduce the incidence of low air incidents and out-of-air emergencies.

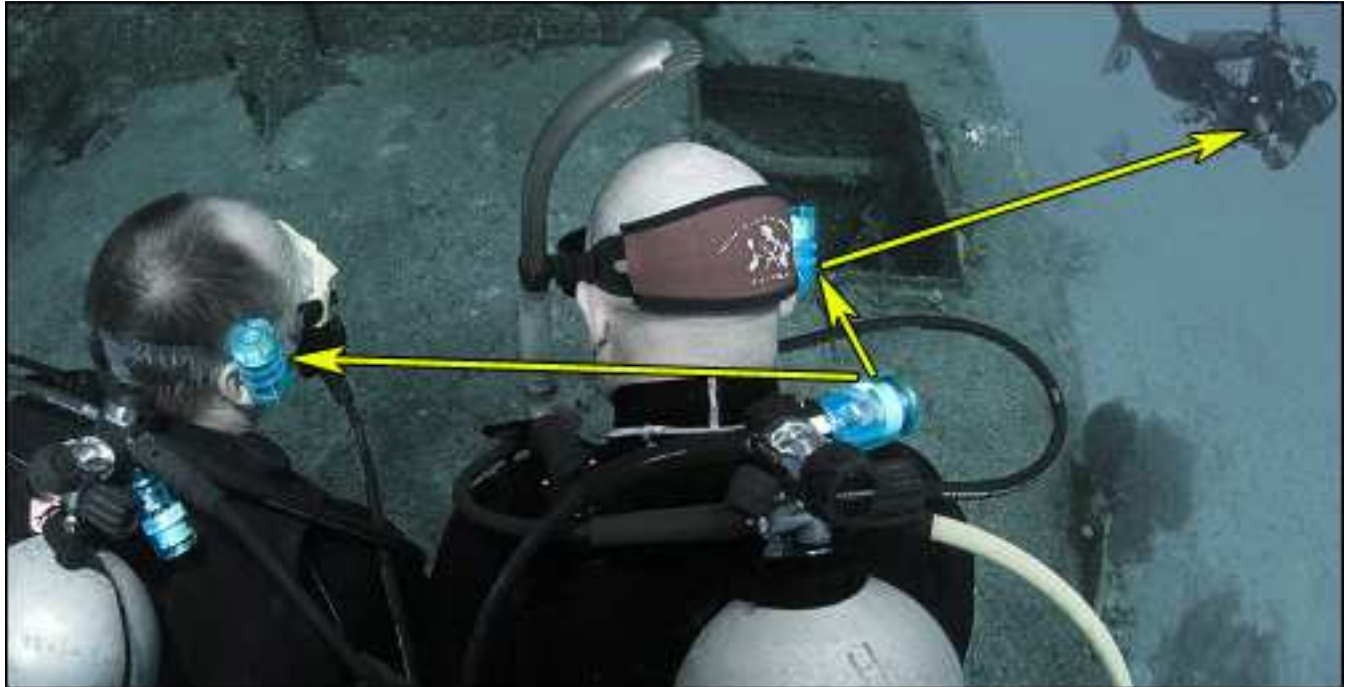
The remainder of this manual provides you with information of the method of operation, use and maintenance of APA. Beyond that, we are looking forward to assisting and supporting you with the evaluation and integration of APA in your diving program.

Best Regards,



Marco Flagg  
CEO, Desert Star Systems LLC

## 2. Method of Operation and Fail Safe Mechanisms



**Figure 1: Components and Signal Exchange Paths of the APA System**

APA consists of a pair of devices carried by each diver:

- The pressure transmitter (APA-TX) is mounted to a high-pressure port of the regulator first stage. This pressure activated device senses the air pressure, categorizes it as OK, CAUTION or LOW range and sends that information as acoustic telemetry directly to the diver's mask mounted alert unit, as well as to other team member's alert units if the acoustic path permits. APA-TX also includes an indicator LED which indicates CAUTION or LOW pressure through rapid blinking, providing a visual means to spot a buddy's air status.
- The alert unit (APA-RX) is generally mounted on the diver's mask using a snorkel keeper. It receives the diver's air status telemetry from the pressure transmitter, and other team member's air status directly from their pressure transmitter. The alert unit, which is mounted in a relative good unobstructed location for transmissions, also repeats the air status received by its pressure transmitter. This repeater function further improves the reliability of sending each diver's air CAUTION or LOW air status to other divers. The alert unit signals the diver through both high-intensity yellow and red LED that is also clearly visible to other team members in visual range. A bone conducting sound signal is perceived by the diver as very loud without a hood, and generally comfortable when wearing a hood. The alert unit is button activated. When the button is pressed after activation, the unit sends a message or 'hail' to other APA equipped divers. This can be used to get a diver's attention, or as a signal to conclude a dive.

The APA devices are factory programmed with an ID code of 1 to 16. A diver must use pressure transmitters and alert units with matching ID code. Similar, each diver in a team must use a different ID code. Thus, APA supports up to 16 divers at a site. The ID code is used by the alert unit to distinguish signals received from the diver's pressure transmitter, or from another team member. Each APA alert unit will signal the diver's own OK, CAUTION or LOW air status, but only CAUTION and LOW for other divers. The audible alerts using rising tone



sweeps to indicate a signal relates to the diver, or falling tone sweeps to indicate a signal relates to another team member.

**Fail Safe Mechanisms**

Availability of any mobile wireless signaling can never be 100% guaranteed because it is subject to the physics of wave propagation and interfering factors. APA uses ultrasonic acoustics for telemetry. The signals reach far compared to the inductive signaling used in many air-integrated computers: about 30m/100ft for the APA-TX signals and about 10m/33ft for the APA-RX signals through unobstructed water. But, underwater ultrasonic signals are also blocked by air interfaces such as a diver’s body and equipment or by blocking terrain features. Further, strong ultrasonic noise sources may interfere.

For this reason, APA is equipped with multiple fail-safe mechanisms. The fail-safe system is built around the concept of continuous air status awareness, and the use of APA to augment submersible pressure gauges (SPG) rather than replace them. The primary element is that APA informs the diver not only when air is getting low, but also when air status is in the OK range, when no telemetry is temporarily available and when the device is not functional at all. The signals are timed and composed to be informative or awareness building, but not obnoxious when air status is not low yet. They gradually become apparent once the CAUTION range is reached, and become continuous once air status is low. Divers generally get used to the signals quickly and appreciate the periodic signal indicating air OK in a heads up fashion. During LOW air status with its continuous signaling, divers generally feel an urgency to ascend now and have been reported by other divers as ‘lighting up like a Christmas tree’ due to the ongoing high-intensity red blinking.

The following table summarizes the fail-safe aspects of the APA signaling system.

<b>Condition</b>	<b>Signal</b>	<b>Repeat Rate</b>	<b>Diver Action</b>
Air OK (more than 750 PSI standard)	Single tone sweep & yellow blink	16 seconds	Continue work, check SPG occasionally to verify
Air CAUTION (600-750 PSI standard)	Triple tone sweep & yellow blink	8 seconds	Conclude work; check SPG
Air LOW (less than 600 PSI standard)	Quadruple tones sweep & red blink	Continuous alerting	Ascend to surface; check SPG
No telemetry available	Single buzzing sound & yellow blink	After 32 sec of no telemetry; repeat every 16 sec.	Rely on SPG checks if persistent.
Completely failed APA	No signals	n/a	Rely on SPG checks

**Table 1: APA signals and associated diver actions**

Other elements of the fail-safe system:

- APA checks for a defective depth sensor. If fault is detected, no telemetry is sent and alert unit will produce ‘no telemetry available’ buzz.
- Diver gear-check: Pressure transmitter (APA-TX) and alert unit (APA-RX) self-check functionality including low battery when pressure is applied. Error code is 8-second continuous blink. Unit then shuts down again.
- Visual inspection: Clear housing support visual inspection, including for flooding.
- Over pressurization safety: Similar to a SPG, APA-TX is subject to housing pressurization in case of a pressure sensor mechanical failure. The stainless steel pressure port end-cap is secured to the APA-TX housing with four nylon bolts. These bolts shear at about 400PSI housing pressure, providing a relative safe housing separation from the end cap and venting in case of failure.

**Fail-safe defeat scenarios:**

Despite the multiple fail-safe mechanisms, APA failure in such a way that fail-safe mechanisms would not activate is still possible. One scenario might be a gradual drift of the air pressure sensor, resulting in inaccurate pressure readings but not to the extent that the ‘out of range’ fail safe is triggered. To guard against such conditions, APA must always be used in conjunction with a SPG, and good maintenance must be practiced.



### 3. Mounting Options

Diver equipment mounting is very individual, driven by dive conditions and diver preferences. APA supports individualized mounting in particular of the alert unit and divers are encouraged to experiment for best performance. This section provides starting points.

#### Pressure Transmitter Mounting (APA-TX)

APA-TX is mounted on a high pressure port of the first stage of a SCUBA regulator. APA should only be used with a regulator that has at least two high pressure ports, so that a SPG can be attached to the second port. Check the O-ring on the APA fitting to make sure it is clean, thread on by hand and then tighten using a 3/4" crescent wrench.

**CAUTION:** Never tighten APA-TX by applying torque to the housing itself. Doing so may shear the four nylon bolts that secure the end cap to the housing. These four bolts provide a controlled jettisoning of the housing at 400PSI internal pressure, in case housing pressurization occurs due to a mechanical failure of the pressure sensor assembly.



**Figure 2: Pressure transmitter (APA-TX) mounted on one of two high-pressure ports on a SCUBA regulator first stage. A SPG must be mounted on the second port. Tighten with 3/4" wrench (never tighten by turning the housing), and point in safe direction during pressurization in case of pressure sensor fail leading to housing pressurization.**

Transmitter obstruction by the B/C should be minimized as reasonably possible for best signal transmission. In the example case, there will probably be some obstruction due to the transmitter pointing downward at a 45 degree angle. For the Oceanic FDX-10 regulator there is no other realistic option, so you would proceed as shown. For other regulators, a sideways orientation as in Figure 1 is preferred.

### **Alert Unit Mounting (APA-RX)**

The primary goal for mounting the alert unit should be to provide a clear head-up indication of air status to the diver. The recommended position is on the mask strap, secured by a snorkel keeper (supplied with the APA).

This position has several advantages:

- Close proximity to the diver's skull for optimum bone conduction of the audible alert signals.
- Heads-up viewing of the LED signals either as reflections in a clear skirted dive mask, or by using the optional fiber optic light stalk.
- Line of sight to the pressure transmitter for reliable air status telemetry.
- A good line-of-sight position for repeating the diver's air status to other team members ahead.

This mounting should be tested as a starting position and then modified as desired. For example, warm water divers not using a hood may find the audible alerts too loud and mount the unit on the shoulder of the B/C. In very cold water diving where more than one layer of hooding mutes the sound, a mounting that emphasizes visibility of the LED signals may be sought.

The alert unit should also be mounted so that the diver can easily reach the button; both to activate the device if that was forgotten at the surface, and to use the messaging/hailing function if necessary.



**Figure 3: Alert unit in vertical and horizontal mounting configuration. Horizontal has reduced snag potential and provides maximum LED visibility when facing a buddy. Vertical provides a better sonar beam pattern for buddy communication and LED visibility from behind.**

The mask based mounting may raise some concern about interference with diver activities, but divers uniformly report that they do not even notice the unit underwater. When operating in overhead or cluttered environments, snagging potential should be considered however.

The light stalk attaches to the alert unit by friction fit, and to the mask by suction cup. Once submerged, hydrostatic force will keep the suction cup very strongly secured, but it may pop off at the surface. It can be pressed against the map again both at the surface and underwater. Fiber optics is also rather rigid and may break. See the maintenance section of this manual for repair instructions.



## 4. Diver Training and Dive Operations with APA

The information needed by divers to use APA is provided on a two-sided postcard included with each set. Divers should receive brief training instructions before first use. The instructions should cover these topics:

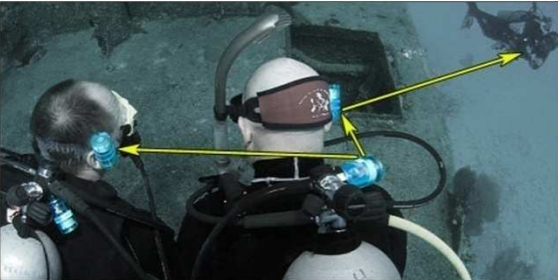
1. Check that the ID of a diver's pressure transmitter and alert unit match, and that the ID is unique among the team.
2. APA pressure transmitter activation by opening the tank valve. Watch for indicator signal. Short blinks means functional, an 8-sec blink followed by a pause and repeat or no blinking at all means fail. Replace battery to see if low battery is the cause of a self-test fail.
3. APA alert unit activation by pressing the button for two seconds or more, then releasing. Watch for indicator blink and sound. Melody with yellow blinking means OK, an 8-sec red blink and shut-down or no blinking means fail. Replace battery to see if low battery is cause of self-test fail.
4. Review air status signals, no telemetry buzz and no signal at all. Remind divers that these generally mirror rope-pull signals; for ease of remembering. Point out required diver action; generally being a check of the SPG. Inform divers that a rising tone sweep pitch means signal relates to them, and falling pitch relates to another diver.
5. Review diver message or hailing function – press the button on the alert unit for two seconds until transmission starts.

# APA - Diver Low Air Pressure Alert

## Operating Instructions


A NOAA SBIR Product



APA pressure transmitter unit signals to both your and your team member's alert unit. Mask mounted alert unit relays to buddies. Minimize obstructions for good signal path.

**Transmitter Mounting**

Do not twist housing. Tighten with wrench here.




Green status LED.

Point in a **safe** direction when pressurizing.

**Alert Unit Mounting**


Optional fiber optic light stalk. Minimize flexing to prevent fiber breakage.



Use snorkel keeper. Mount alert unit close to ear for best audio signaling.

Your transmitter and your alert unit must have the **same ID**.

Other team members' units must have different IDs.



Activate Alert Unit: Press button until LED lights  
 Activate Transmitter: Apply more than 100psi  
 \*If the LED stays solid for 8 seconds, do not use!\*

Figure 4A: Operating Instruction Card, Front

**Use Recommendations**

1. APA raises your air status awareness. Use to augment gauge checks, **not** replace them!
2. If it blinks or beeps fast sweeps, check your gauge. If you aren't low, another team member is.
3. Minimize obstructions of transmitter and alert unit for best signaling reliability. Neoprene, air bladders, tank & diver's body block telemetry signals.

**Air Status and Other Signals**

Air status signals (tone sweeps & blinks) are roughly equivalent to the standard diver rope pull signals.

Your Air Status	You will see & hear	Other team members will see & hear	Equivalent Rope Pull Signal
<b>OK (more than 750 PSI)</b>	One rising pitch 'slow sweep' & <b>yellow</b> blink. 16 sec interval.	Not reported	1 pull – "I'm OK"
<b>CAUTION (600-750 PSI)</b>	Three rising pitch 'fast sweeps' & <b>yellow</b> blinks. 8 sec interval.	Three falling pitch 'fast sweeps' & <b>yellow</b> blinks.	3 pulls – "Pull me In"
<b>LOW (less than 600 PSI)</b>	Four rising pitch 'fast sweeps' & <b>red</b> blinks. Continuous for five minutes.	Four falling pitch 'fast sweeps' & <b>red</b> blinks.	4 pulls – "Haul me up"
Hailing signal (press button until start)	Confirming <b>yellow</b> blink & beep. Four repeats.	Two falling pitch 'slow sweeps' & <b>yellow</b> blinks.	2 pulls – "Give me slack"
No air status received for 30 seconds	Single 'buzz' & <b>yellow</b> blink. Check your gauge.		

Transmitter LED signals: Rapid blinking – CAUTION or LOW air. One blink, 16 sec repeat – OK air.

Desert Star Systems LLC 3261 Imjin Rd, Marina, CA 93933 www.desertstar.com 831-384-8000

**Figure 4B: Operating Instruction Card, Back**

## 5. Maintenance Instructions

Because APA is a safety device, maintenance should be thorough. Here are our recommendations:

1. Incoming inspection when first receiving the devices (instructions below).
2. Rinse after use to prevent salt build up and corrosion of metal components.
3. Visual inspection of the clear housing before use to identify mechanical damage or flooding.
4. Periodic inspection, same as incoming inspection, in monthly intervals (instructions below).
5. Battery replacement annually, or when low battery (fault code or does not activate) is indicated (instructions below).
6. Return to Desert Star Systems for service every three years. We will inspect and replace housing and internal parts as needed, and re-calibrate the air pressure sensor.

**Incoming and Periodic Inspection**

Desert Star Systems will insert batteries in the receiver and transmitter immediately before shipping, and conduct a final test. Upon receipt perform this incoming inspection:

1. Visually inspect the devices, looking for any flaws, material breakage and the like.
2. Connect the APA-TX pressure transmitter to a SCUBA regulator and pressurize. As you are doing so, watch for the indicator LED through the side of the clear housing not covered by the ID label. APA-TX will check pressure once every 16 seconds, wake up and perform a self test. You should see a single brief blink once every 16-second (>750 PSI) or rapid blinking repeated once every 8 seconds (<750 PSI). An 8-second continuous blink indicates low battery or device fault. Neither condition should happen at this time. Follow the return instructions in the warranty section if an 8 second continuous blink occurs.
3. Using an accurate SPG, set pressure accurately to the center point of the CAUTION air range, about 675 PSI. You should now see periodic rapid blinking of the indicator LED. We will use this setting later to verify the pressure thresholds.



4. Activate the APA-RX alert unit by holding the button at least two seconds, until the device activates. APA-RX will wake up and perform a self test. You should hear a melody and see yellow LED blinking, indicating the self test passed. If you see an 8-second red blink and the unit shuts down again, there is a low battery or device fault. Neither condition should happen at this time. Follow the return instructions in the warranty section.
5. Hold the APA-RX firmly against the APA-TX; bottom end cap against bottom end cap. Note that the APA acoustics are designed for underwater use. The telemetry won't transmit far in air, thus the need to hold the two devices firm. APA-TX is transmitting the telemetry signal just before each start of the LED blink pattern. You should see APA-RX respond. The CAUTION air range response (750-600 PSI) is three yellow blinks and a triple rising tone pitch alert sweep. The alerts will also not sound as loud in air as underwater because of the bone conduction mechanism. If you find that the pressure thresholds are not correct, follow the return instructions in the warranty section. *Note: If you test at <600 PSI you will see the LOW air alert, four blinks and sweeps in red. After APA-RX receives the second LOW air alert in a row from a transmitter of the same ID, it will go into alert lock where alerts are continuous. Alerts will persist for five minutes. Just wait until the alerting stops.*

### **Battery Replacement**

Replace the battery when the fault code is indicated (8-second blink on start up for either device), when the device does not activate at all, regularly once a year, or when dive behavior such as alert unit cutting out and then starting up again with self test indicates that the battery is low.

1. Use the supplied 3/32" Allen wrench to remove the four screws; keep them in a safe place.
2. Pull off the battery end-cap. Carefully inserting a blade in the gap between the end cap and the housing helps.
3. The battery may fall put, or you may have to shake/tap it out.
4. Inspect the O-ring. If contaminated, remove with a plastic O-ring remover (a corner of a credit card may suffice for this). Clean the O-ring, O-ring groove, and the O-ring seating area on the housing carefully removing all contaminants. Apply a thin layer of silicone grease (shiny finish, no globs) to the O-ring and re-install.
5. Insert a new battery. Positive terminal goes into the housing first.
6. Carefully re-seat the battery end-cap on the housing, aligning the holes on the end cap with those in the housing. Re-insert the screws with the Allen wrench. Tighten to a finger-snug finish. DO NOT over tighten, to avoid unnecessary material stresses that may cause cracks.



**Figure 5: Battery alignment for insertion. Positive terminal goes in first.**

**Cleaning the APA-RX button**

When subjecting the alert unit to mud or sand, there is some chance that the button may become jammed. In many cases, rinsing the device thoroughly will clear the problem. If this does not work, remove the four screws on the button plate with the supplied 3/64" Allen wrench. Remove the plate and button, and clean. Install the button and secure the screws, tightening them only snug tight to avoid unnecessary stress on the material.

The button action is magnetic and there is no feed-through to the inside of the housing. So, flooding is not a risk.

**Repairing a broken light stalk**

The fiber optic material of the light stalk is fairly rigid and brittle. It may snap after some use. If the snap happens at or not far from the stalk insertion point on the APA-RX end cap, you can fix the stalk. Remove any remnant of the light stalk from the housing. The button plate may have to be removed to pop out a stub, see instructions above. Cut the stalk with snips, and then polish the end straight with fine-grid sandpaper. You may also have to sandpaper the diameter slightly, to achieve a good friction fit of the light stalk in the access hold of the end cap.

If the stalk is getting too short, order replacements at Desert Star systems, part # APARX-LS.

## 6. Technical Specifications

### APA-TX

Size: 40.9mm D x 67.6mm L (1.61"D x 2.66"L)  
(length measured between end cap surfaces, 86.6mm when including pressure fitting)

Weight: 222g in air including battery. Approx. 130g (0.27 lb) negative buoyant in water.

Battery Life: Approx. 1.5 years in sleep mode. Approx. 700 hours of diving.

Sonar System: Transmitter only, 47.619kHz, approx. 171 dB re. 1µPa, 2ms pulse length

### APA-RX

Size: 40.9mm D x 67.3mm L (1.61D x 2.65"L)  
(length measured between end cap surfaces, 78.2mm when including button)

Weight: 158g in air including battery. Approx. 67g (0.14 lb) negative buoyant in water.

Battery Life: Approx. 1.5 years in sleep mode. Approx. 60 hours of diving.

Sonar System: Receiver & Relay Transmitter, 47.619kHz.  
Relay transmitter approx. 163dB re. 1µPa, 2ms pulse length  
Receiver, 47.619kHz, detection threshold programmable with 125dB re. 1µPa standard

### Acoustic Telemetry Transmission Range

- Approx. 30m (100ft) from pressure transmitter (APA-TX) to alert unit (APA-RX)
- Approx. 10m (33ft) for signal repeat or diver message/hail between alert units (APA-RX)
- Distances are through unobstructed water. Obstructions will reduce range.
- APA-RX uses a high detection threshold that makes it immune to much regulator noise, but also reduces range.

### Spare Parts & Wrenches

Battery: Tadiran TL-5902 or TLL-5902 3.6V ½ AA Lithium  
(Desert Star Part # BAT00370, Radio Shack Part #23-937)

Battery Compartment O-Ring: Size 2-114, Viton material. Desert Star Part # ORI00107

Spare light stalk for APA-RX: Desert Star Part # APARX-LS

Wrenches: ¾" Crescent wrench to secure APA-TX to first stage of SCUBA regulator  
3/32" Allen wrench to remove battery compartment screws  
3/64" Allen wrench to remove button plate screws of APA-RX



## 7. Warranty

Your APA™ is a high-quality product which has been designed and manufactured in the United States of America. Like all Desert Star Systems products, it is backed up by a one year limited warranty. To make a warranty claim or return for service or repair, follow the return instructions below.

**The greatest danger to your APA™ is flooding. You can avoid flooding entirely by carefully inspecting and cleaning the O-ring before you close the housing. However, because the risk of flooding depends on your degree of care, we cannot be held responsible for damage due to flooding except when it is due to a housing defect. Flooding without a housing defect that is not caused by abuse is thus specifically excluded from our warranty.**

The precise legal wording of our warranty is as follows.

Desert Star Systems ("Seller") warrants APA™ to be free from defects in design, workmanship and material under normal and proper use and service for a period of one year following delivery to Buyer. Seller agrees to repair or replace at the place of manufacture, without charge except shipping charges, all parts of said products which are returned, for Seller's inspection, to its factory within the warranty period, provided such inspection discloses that the defects are as above described and provided also that the equipment has not been altered or repaired other than with Seller's authorization and by its approved procedures, subjected to misuse, improper maintenance, flooding, negligence, or accident.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THOSE OF MERCHANTABILITY, PERFORMANCE OR FITNESS FOR PURPOSE.

### **Return to Manufacturer Instructions**

Return APA to Desert Star Systems if the incoming inspection fails, if the device fails or needs service at any other time, and in three years intervals, for regular maintenance.

Call 831-384-8000 x117 or e-mail [service@desertstar.com](mailto:service@desertstar.com) to request a RMA number (Return to Manufacturer Authorization). If e-mailing, please specify the devices and their serial numbers, and the problem or reason for return. You will then receive a RMA number. Please mark that RMA number clearly visible on the outside of the box and any internal paperwork.

Return to:

Desert Star Systems LLC  
Service Department  
3261 Imjin Road  
Marina, CA 93933  
USA