



Multimode AAD

BY



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"Your Guardian Angel"

From the beginning, AAD makers have tried to humanize their product by choosing appropriate slogans. This started with clever phrases like: "Here is your third hand" for the FXC 12000 and it became a trend to get rid of the leading "the" in front of a proper name as in "Cypres", opposed to "the Cypres". More recently we've seen the arrival of Vigil, "your guardian angel".

The AAD movement has been praiseworthy: entrusting your life to a machine. Even with today's electronic AADs, this is not an easy task psychologically. This is certainly why manufacturers have tried to humanize their equipment. With that in mind, let's begin this presentation of Vigil...

"The Vigil had a painful birth followed by a difficult childhood, subjected to strict bans which slowed down its development. Due to a diagnostic error by its personal Doctor, it had to miss the exam of the 2003 Mondial where it could have been launched. Supported through these difficult moments by its godfathers from the 4-way FS team "Equipe de France", today it seems to have reached the age of reason."

Here then is an imaginative, step-by-step biography of the Vigil, as reported in previous issues of ParaMag, starting with its first appearance in June 2003.

The obligation to take over the marketing service that had been subcontracted for the first months of sales, the unexpected misfiring of a prototype (not yet commercialized) on a test jump of the French team (which was also a training jump), the ban for a short period of time by the French federation, printed circuits that had to be modified in order to eliminate a static electricity problem and the free recall of all devices in the field, then the Swedish and German federations forbidding the use of the Vigil: these are some of the numerous obstacles that had to be surmounted before even hoping a real start of the project.



On the market since September 2003, Vigil is progressively integrating itself into the international skydiving web. Since its elaboration began in 2001 in partnership with the French 4-way FS team, attentive observers have known about the Vigil's existence for several years already. As well, the flashy Vigil logos sewn on the French 4-way team jumpsuits at the 2003 Mondial got noticed. More and more renowned skydivers are now gaining confidence in

Vigil and are accumulating a lot of jumps using the device: members of the Deland Majik team (4-way FS world champions in 2004), French 8-way FS, 4-way FS and 4-way FS female teams, Belgian military team (world military champions), Willy Boeykens, the photographer. As of the beginning of this year 2005, Vigil makers have successfully passed further mandatory testing during professional meetings such as the symposium of the Parachute

Industry Association (P.I.A.) and the French Technical Directors colloquium of the "Fédération Française de Parachutisme" (F.F.P.) (see article in the March 2005 issue of ParaMag). On every occasion Jo Smolders, (head of B&B Controls, the Belgian makers of the Vigil) answered without hesitation the sharp questioning of the well-informed professionals who were utterly satisfied by the answers. We are happy to share these clarifications with you.

The manufacturer



Vigil custom build pressure and test chamber.

Vigil is made by B&B Controls S.A. and marketed by A.A.D. S.A. (Advanced Aerospace Designs), a well chosen name since it shares its initials with "Automatic Activation Device". The two companies are headquartered in Brussels while the electronic components are assembled, calibrated and tested in a factory located at a few 30 minutes drive from the Belgian capital. A.A.D. is a subsidiary of B&B Controls group specialized since 1970 in research, development and production of sub-assembly of automatic systems such as the electronic motion controls of electromagnetic devices (solenoids, clutches,...). B&B Controls' first contact with skydiving was made in 1996 when they were asked to bid on the development and manufacture of the E.P.O.S. controller. The project, dealing with an activation device based on acceleration, never came through. Following this first experience, B&B Controls kept their eye on the AAD market and started to study the possibility of designing and patenting a new concept based on the continuous calculation of the remaining free fall time: the Vigil project was born.

The device

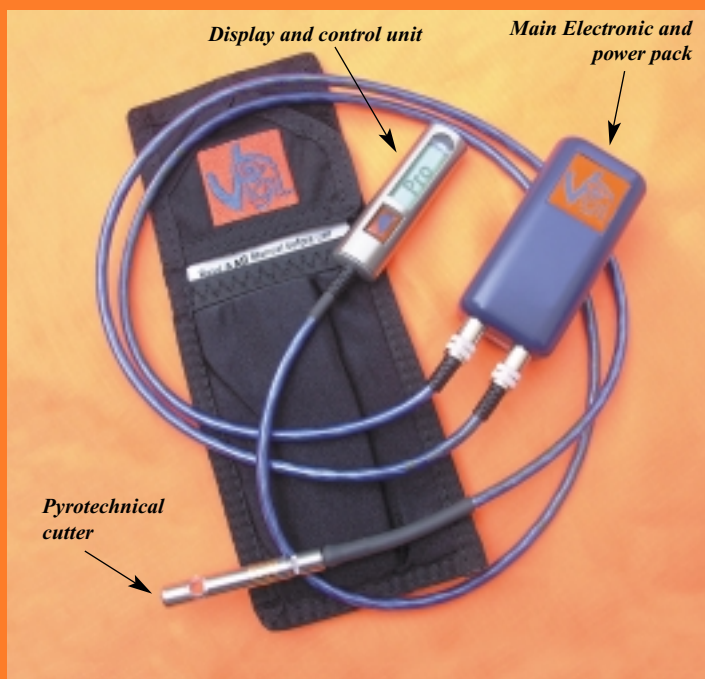
The Vigil has 3 modes: PRO, STUDENT or TANDEM, selectable by the user during the start-up procedure.

In "PRO" mode, the Vigil fires at 840 ft or 256 m if the fall speed rate is equal to or higher than 115 ft/sec or 35 m/sec.

In "STUDENT" mode, the Vigil fires at 1040 ft or 317 m if the fall speed rate is equal to or higher than 66 ft/sec or 20 m/sec.

In "TANDEM" mode, the Vigil fires at 2040 ft or 622 m if the fall speed rate is equal to or higher than 115 ft/sec or 35 m/sec.

As soon as the predetermined altitude and speed for the selected mode is reached, the Vigil fires instantly. The device is guaranteed for one year against all manufacturer defects, its lifetime is not limited but estimated to 20 years starting from the date of manufacturing. Moreover, the manufacturer doesn't require mandatory maintenance. The suggested sales price is 899 euros or US \$1199.



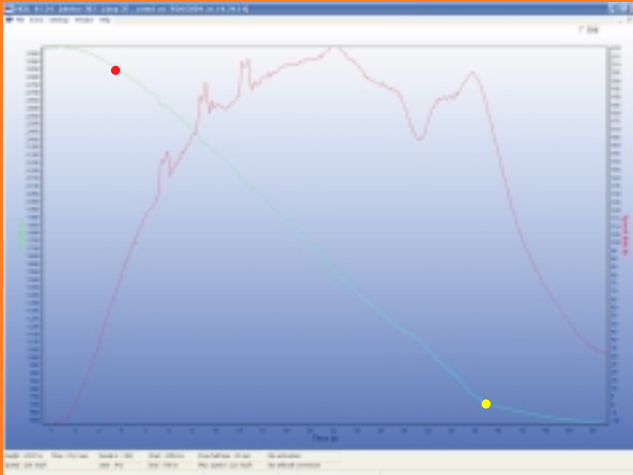
The concept

The functional principle is protected by two patents: a European one (filed in September 1999) and an American one (filed in September 2000).

It is based on a permanent calculation of the remaining time before reaching the activation altitude. The device continuously calculates the remaining time at the rate of 64 measurements per second. It uses an average speed so that peaks caused by fast and brief position changes in free fall will have little or no effect on calculations.

Thanks to the patented "time calculation" method, the Vigil has a never reached opening accuracy of ± 20 m or ± 66 ft in all modes.

Graph A



Graph A shows the completion of a normal jump where Vigil is in the "PRO" mode. It corresponds to what the user can see after downloading the data to his computer. The recording starts 7 seconds before reaching the vertical speed of 35 m/sec or 115 ft/sec and stops 12 seconds after the freefall ends.

The red dot indicates when the speed of 35 m/sec or 115 ft/sec is exceeded in freefall.

The green curve shows the altitude decrease with respect to time.

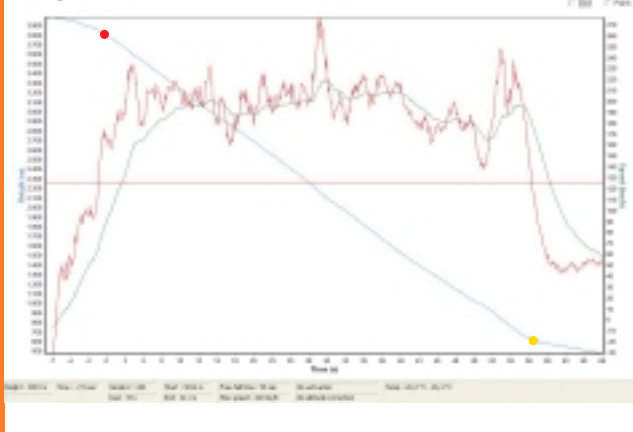
The red curve shows the average fall speed calculated by the Vigil.

The yellow dot indicates when freefall ends.

The real time functionality of the remaining time calculation concept is outlined by A.A.D. engineers who have superimposed the 2 curves on the corresponding jump video. This animated demo is available on the manufacturer's web site: www.vigil.aero, under DOWNLOADS, select video item "Gap Nico".



Graph B



Graphs B et C show an actual save by a Vigil in "PRO" mode on September 11, 2004 at Moorsele in Belgium. This corresponds to what A.A.D.'s technical staff recovers and uses as data in such a case. In this particular instance, a late cutaway generated a second graph because of the second acceleration.

Graph B shows the main part of the jump and displays an almost normal curve: opening at 700 m or 2300 ft and then deceleration. After a malfunction followed, by a late cutaway the Vigil triggered the cutter.

The second acceleration shows up as the curve shown on graph C where the speed increase is well seen (as if it were another jump) followed by the activation. The

recording starts at 425 m or 1394 ft at a vertical speed of 65 km/hr or 40 mph. The cutaway is made at 290 m or 951 ft and one second later, when the 35 m/s or 115 ft/sec speed is reached, the Vigil cutter severs the reserve closing loop at 212 m or 696 ft from the ground.

The red dot shows when the speed of 35 m/sec or 115 ft/sec is reached.

The blue curve shows the height change with respect to time.

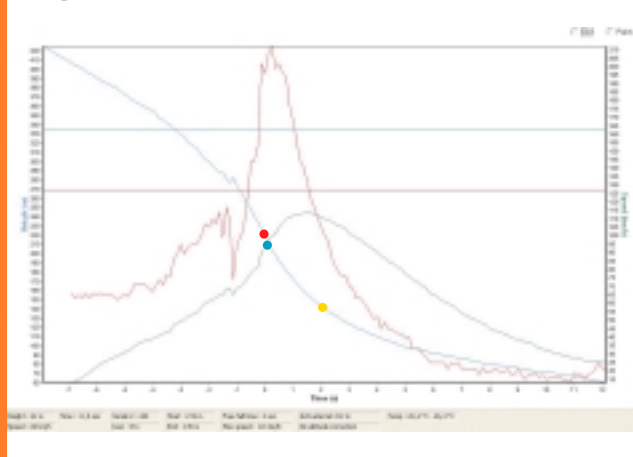
The red curve indicates the calculated speed used by the Vigil.

The green curve is the average speed calculated by the Vigil.

The blue dot shows the cutter firing.

The yellow dot indicates when freefall ends.

Graph C



Components



Main Unit

Vigil is composed of a strong metallic main unit box in which you will find the power pack as the electronic unit. The 2 Kevlar “ reinforced flexible cables are the links between the main unit, the control display unit and the pyrotechnical cutter, using a two-wire technology (specially designed for Vigil). You can handle these reinforced cables without worrying disconnections.

The manufacturer makes it clear that the shielding guarantees the proper functioning even when exposed to electromagnetic interferences from airport and airplanes (up to 100 volt/m) to protect the Vigil against electromagnetic waves produced by radio, cellular phones, transponders or radars.

The main unit is equipped with two filters that safeguard against dust while allowing the transfer of air pressure from outside. A single screw allows access into the main unit in order to replace the power pack or the pyrotechnical cutter, but it is recommended to let a rigger or an official manufacturer representative do that work.



Power Pack



The power pack is equipped with a “Lithium Battery” and a “Pulses Plus” component which ensures there is enough capacitance available to fire the pyrotechnical cutter instantaneously. The battery, specially designed for Vigil by Sonnenschein-Tadiran, is molded in epoxy to avoid any leakage. It is guaranteed to have no memory effect and has a lifetime (estimated at 4 years or 700 jumps). The battery only needs replacing when the digital display indicates: “BAT-LOW” or “BATRPL”. The power pack’s working range allows for temperature between -25 and $+70$ degrees Celsius or -13 and $+158$ degrees Fahrenheit.

The electronic unit

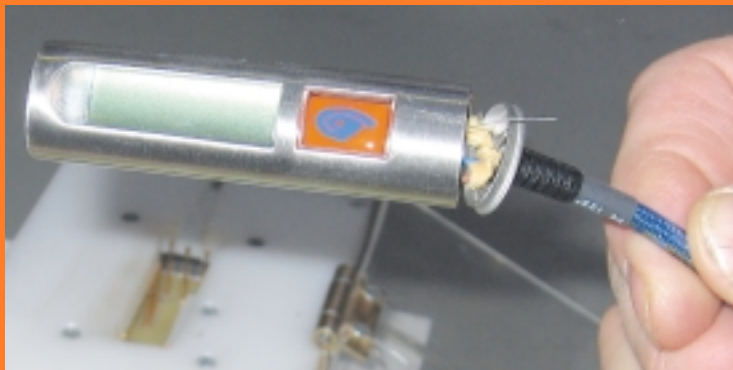
Its electronic components benefit from automated assembly and are using S.M.D. (Surface Mounted Devices) technology. Combined with optical and electronic quality control, they meet the highest industrial standards and military specifications. The unit works as a data recording device as well. It automatically keeps in its memory the reference parameters of Vigil (version, serial number ...) temperature, barometric pressure as the last 16 minutes of freefall data (max. 16 jumps). The unit also shows the total number of jumps made with the Vigil, total freefall time, last freefall maximum speed as the number of firings. Most of this data can be seen on the digital LCD display and the memory can be downloaded on a computer via an infrared interface.



Optical and electronic control during production

Pyrotechnical cutter unit

Specially designed for the Vigil, the pyrotechnical cutter has a functional warranty of 20 years. It is made in the U.S.A. by a company working for NASA according to a patent held since 1965 for Apollo Capsules parachute recovery. The cutter is composed of a circular blade which ensures a double mechanical cut of the closing loop. In case of a life-saving activation, a new cutter will be provided free of charge by the manufacturer upon acceptance of a user-submitted official report based on the document available for downloading on the Vigil web site www.vigil.aero. It is recommended to have the cutter replaced by a certified rigger, this procedure being mandatory in some countries.



Control unit/display console assembly with its "2 wires technology" connection cable. The Kevlar reinforcement feature can be seen as well

Control Unit & display console I.R. download console

The control unit includes a LCD screen (26 x 96 pixels), a red LED pacing the switch on/off procedures, a green LED which confirms the end of the startup process and an orange push button located on the right hand side of the display window. The red LED also doubles as an infrared transmitter when plugged into the I.R. communication interface.



Communication Interface

The Vigil's infrared communication port allows data download to a computer. The interface and associated software are available as an option. The complete data of the last 16 minutes of freefall (16 jumps maximum) and the total number of jumps made with the Vigil are memorized along with other data described elsewhere in this article. Riggers can also download test reports made in pressure chamber.



Startup and shutdown procedures

The Vigil will switch on by 4 short pushes on the push button located on the right hand side of the display console. Each push needs to be done shortly after the red LED flashes.

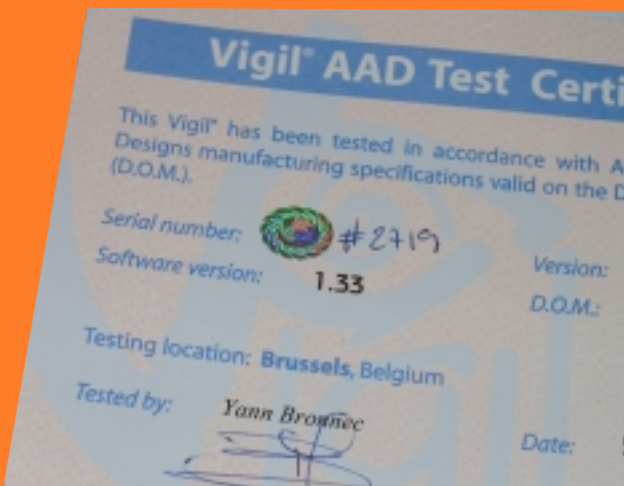
The shutdown procedure of the Vigil is similar to the startup procedure: 4 short pushes on the push button each time the red LED flashes. Those safety procedures eliminate the risk of unexpected startup/shutdown. The Vigil cannot be switched on or off by an accidental pressure on the push button. Each time the device is turned on it calibrates itself according to the present altitude.

During the startup sequence, the Vigil validates the correct operation of all its components. It verifies and displays the correct operation of the power pack, the cutter unit and electronic circuits as follows: "Bat OK", "Cut OK" and "Ctrl OK". If an anomaly is detected an error message will be displayed and the device will switch itself off automatically.

As soon as the Vigil is correctly operating, it switches to standby status and calibrates itself automatically every 32 seconds.

Upon reaching activation altitude in a climbing airplane (150 ft or 46 m), the Vigil will switch to the active state within 32 seconds. It will then calculate its position 64 times per second and confirms its activation with 3 flashes of the green LED.

The Vigil stays on for 14 hours, or it can be switched off manually during that period of time.



Additional features and goodies

- The Vigil is shipped in a small aluminum case which, after the installation of the device in the parachute pack becomes very handy to carry small skydiving accessories such as goggles, altimeter, audible altimeter, camera etc...
- Very clever also are the user-selectable measurement units, the up or down orientation on the LCD display, along with adjustable contrast.

Restrictions

- Whatever mode is selected, the airplane must not fly longer than 100 seconds in a range of 150 ft (46 m) above or below the take off altitude (with or without altitude correction). Should this happen, the Vigil would return to its standby state.
- The Vigil multimode is not waterproof.

Altitude correction

- The altitude correction function allows the user to enter a positive difference (max +2000 m or + 6000 ft) or a negative difference (max - 2000 m or - 6000 ft) between the take off altitude and the expected landing site altitude. Vigil takes that correction in account in order to recalculate the activation altitude.

Installation and compatibility

- The Vigil is compatible with international market standards such as Relative Workshop, Sun Path, Parachutes de France, Performance Variable, Parafun.
- A special Vigil pocket is provided which can be installed in the reserve container by a rigger or the manufacturer.
- The reserve closing loops available on the market (Spectra type) are usable but tests have shown the cutter is able to cut through any type of loops. The pyrotechnical cutter of Vigil has to be installed in accordance to the specifications of the container/ harness manufacturer.

Disturbing questions, Reassuring answers...

As the previous title suggests, A.A.D. representatives have had to answer questions from instructors and riggers when attending professional meetings (P.I.A. Symposium, Colloque des D.T. (Colloquium of Technical Directors) in France, A.G.M. day in England). We are making available to you a selection among the most interesting exchanges rewritten in interview form.

ParaMag : As soon as it showed up on the market, the Vigil was hit by 3 bans: one in France in June 2003 (lifted a few weeks after), one in Germany in October 2004 (lifted few days after) and one in Sweden. How do you explain that?

A.A.D. : Vigil is a new product; it's therefore logical that concerned people raise questions... We have always tried to answer these questions by explaining the functioning characteristics of our device and then generally the misunderstanding dissipates and the bans are removed

It seems anyway that some bans were due to unexpected firings... In France, there has been a firing on a prototype used by a member of the French team in June 2003. It was related to experimental software (not in public distribution and even before sales standards) that our engineers had configured with modified parameters which evidently proved to be inappropriate. This was part of testing, which we then corrected and explained to Federation who immediately lifted the ban. A few months later we experienced firings on the ground during packing in an environment loaded with static electricity. I want to point out that before Vigil was marketed in September 2003, more than 5000 test jumps were made over a five year period, the project having started in 1998. Regarding the static electricity issue: we designed our first devices with a protection of 12 Kvolts which had seemed to be sufficient. However it was demonstrated that some packing environments or the use of



In front of the Vigil's electronic components assembly factory, located at about 30 miles from Brussels, part of the A.A.D. team accompanied by Willy Boeykens, a renowned skydiver sponsored by the manufacturer.

a static line can generate static charges over 17 Kvolts thereby triggering unexpected cutter firings. Even though that risk was only present on the ground, after March 2004, we have raised that protection to 25 Kvolts and we have upgraded and replaced, free of charge, every unit in the field.

Is it reasonable not to impose a lifetime limit neither a periodic maintenance for such an electronic device?

Compare this to the car industry: manufacturers do not impose a lifetime limit or periodic maintenance for airbags. Only when required, as indicated by a red warning light you need to consult for maintenance. Nowadays this is an accepted, normal practice, common in the electronic world: the devices are able to self-diagnose and can warn the user when they require a maintenance or intervention. This means that the Vigil's functions are controlled every time it is switched on.

On the other hand, a program of mandatory maintenance does not protect you from a breakdown which can happen at any time.

Some system failures have been observed when the barometric pressure is above 1035 millibars or 30.56 inches of mercury...

This happened once in 2004 at Texel Island, Holland and once more in Ampuriabrava in Spain. Indeed at the beginning we had set up the lower usage limit to sea level or for a maximum atmospheric pressure of 1034 millibars or 30.53 inches of mercury, assuming no jumps would be made below that level. This was a mistake firstly because some jumps can be performed below sea level (for example: the Dead Sea in Israel lies at minus 398 m or 1306 ft). Secondly, when the ambient barometric pressure is very high and over 1035 millibars or 30.56 inches of mercury at sea level (which is extremely rare), the Vigil considers that pressure as beyond the acceptable level and will switch itself into "invalid" status.

To overcome that problem, one can proceed to an altitude correction of 50 m (164 ft) to allow the Vigil to become serviceable again.

In the PRO mode, that means it will fire at 306 m or 1004 ft instead of 256 m or 840 ft. On every device made after October 2004 we have modified the software in order to allow a maximum pressure of 1090 millibars or 32.19 inches of mercury. Devices made before October 2004 can be updated free of charge in our factory if the owner so chooses, but this

is optional.

Is it true that the pocket of a competitor is not compatible with the Vigil? That specific pocket can currently be found in most reserve containers.

We have our own pocket which can be installed by the manufacturers on new rigs or by riggers on used equipment. We want to make it clear that our pocket is similar to the existing ones. Additionally, we can certify that the Vigil is compatible with existing rigs and their AAD configuration, whatever their brand

Since the Vigil is not waterproof do we have to worry about mould or moisture related problems? Especially when used in very humid climates for instance...

Absolutely not, all electronic components are protected by a "tropicalization" process using a special varnish

"Three modes in one" is presented as being very useful for parachute fleet management or when used equipment is resold. But that could also represent a danger if the user chooses the wrong mode or invert it unwillingly...

On the Vigil, the mode is displayed continuously when the device is operational; this is the same as the color code featured on some devices... And unfortunately it has not avoided some mistakes in the past as in the case of the Pilatus crash in Germany in 2000 when an instructor had possibly used a student AAD without noticing it. Ask the skydiving schools about using multimode and you will see what they think about it: schools such as: Texel Holland (70 Vigil units), Pack Plus at Gap France (80 Vigil units), Belgian army (45 Vigil units). We currently count more than 2500 devices in service around the world. We remain at the skydiver's service. We are convinced that today and in the future that the Vigil will be the answer to the demands of the skydiving industry, as it's doing what it does best: being reliable and saving lives!