# A sense of algorithm

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Take 10 current diving computers equipped between them with seven different formulas to stop their owners getting bent. How cautious or devil-may-care would they prove to be on ascents from around the 50m mark

Take 10 current diving computers equipped between them with seven different formulas to stop their owners getting bent. How cautious or devil-may-care would they prove to be on ascents from around the 50m mark

John Bantin heads for the Red Sea to find out

**A NUMBER OF YEARS AGO** there was one British-built roadster over which I drooled. It was one of the fastest cars on the road.

They later introduced an even more beautiful V12 version, and I was gagging to take it for a spin. When I did, I was disappointed to find that not only did it accelerate like a space-rocket, but it also cornered like one, and was as difficult to stop.

They say most people have made up their minds about the car they want to buy long before they enter the showroom. Were seduced by what it looks like rather than what it does.

In diving, this is only too true when we purchase a diving computer.

The software-writing wizards of the computer world and the hardware-designing geeks can put more computing power on your wrist today than was used to take that one giant leap for mankind to the Moon.

There are computers that not only double as a watch and calendar, but provide a digital game or two. Some have layer upon layer of menus, while others cry out buy me! with an appealing look. The peripheral functions, the added value, become more important at the point of sale than the core function.

**SO WHAT IS THE CORE FUNCTION OF A DIVING COMPUTER** No manufacturer would put his product liability on the line to state this, but its the intention of every computer designer to bring you back up from a dive without sustaining decompression illness.
Whether via a simple controlled rate of ascent with an added stage of decompression, euphemistically called a safety stop, or by means of both this and staged pauses at points during an ascent (deco-stops), what counts is the mathematical calculation, or algorithm. This takes into account how deep youve been and for how long, and how fast you ascended.
But its not just a simple mathematical calculation. Each algorithm writer has to try to take into account whats happening inside his model divers model body before formulating a model dive algorithm. This is where different versions of decompression theory come into play.
Micro-bubbles are sub-clinical bubbles that might cluster together to give the symptoms of DCI. Does gas perfuse the body tissues, does it simply dissolve, or both Should the gradient allowed when plotting reducing pressure against time be fixed or variable
Is ascending relatively quickly to traditional Haldanian shallow stops before pausing for a long time bend and mend Do pauses at depth to allow slower tissues to off-gas aid decompression, or give the slower tissues opportunity to on-gas more
Its all theory. We dont really know.
And who is this computer algorithm written for anyway Is it the cyclist who just finished the Tour de France, or the middle-aged truck-driver who spends his life exercising his upper body, but wraps the rest of himself around fast food and unhealthy drinks
Is it the Olympic champion teenage nun, or the grandmother who lost her youthful figure years ago Luke Skywalker or Obi-Wan Kenobi
The manufacturers arent saying, and yet, like the high-speed handling of a dream-car, the algorithm of a diving computer is the one part you cant see in the shop.
Hearing the sales assistant tell you hes had no trouble with the model hes trying to sell doesnt help either.
We at DIVER can compare computers side by side, on dives that are as serious as most leisure divers breathing air or nitrox will ever do. Well tell you the information the instruments imparted at different stages of a typical dive and leave it to you to decide which one has got it right.
A review in another magazine recently reported two computers as having identical read-outs. This was not surprising, as they came from the same factory in Japan and used identical software. There arent that many different algorithms available.
We counted seven different algorithms among the 10 computers we strapped side by side and took diving, and two of these were in the same computer as an option.
You do of course have options to add in safety levels or decrease gradient factors and, in one case, even increase the aggressiveness and therefore the element of risk.
The ease with which you can interpret the information provided can be crucially important too. It amazes me how many people on their
first liveaboard, and hence repetitive-diving, trip think their computers have gone wrong when they display SOS and refuse to work on the next dive.

Read and digest the manual. If you dont know what your computers trying to tell you, why wear one

**WE USED AN EXAMPLE OF EACH COMPUTER** at the manufacturers presets, which is probably how most people use their computers. Where we had computers of a similar make but different model, we added in a certain amount of caution to one, just to see the differences.
We went on a series of dives and photographed the computers together at various crucial moments.
The most cautious is not necessarily the best. Sometimes there are factors that make you want to get out of the water rather than stay in. Running out of breathing gas or getting swept along in a current to somewhere the boat cant follow are obvious examples.
On the other hand, if Im comfortable, I would rather eke out my gas in the shallows to give my tissues the easier ride.
I was once chided by a dive-guide for making a 20-minute deco stop while she waited impatiently. Five minutes is quite enough, she baldly stated.
When I asked her what her computer had required in the way of stops, she told me she didnt have one. Thats another option!
Diving-computer designers, like car designers, add all sorts of exciting extra functions to seduce you into wanting their products. Here we concentrate on the bit you have to take on trust, the algorithm.
We made a series of dives with the Technical Diving Department of Camel Divers in Sharm el Sheikh, and feature a typical days diving. Nigel Wade, a watch officer in the Fire Brigade in normal life, was my doughty bodyguard. Cathy Bates, a TDI Instructor from Camel, came with us to make sure we behaved ourselves.

**THE DIVES**
We wanted to see how these computers compared on two extreme leisure dives. On the day of the test we made two dives, the first to around 49m deep and the second, after a surface interval, to around 46m.
Each computer recorded a fractionally different maximum depth. The second dive would reveal how the micro-bubble setting really kicked in.
I used the Suunto Vyper (RGBM100) as my yardstick, and watched how the others compared. I stayed at the maximum depth long enough to get them all well into deco mode, but I emphasise that this exercise replicated an extreme leisure dive rather than a deep technical dive.
We made all the deep stops required or suggested by all of the computers during the ascent, which was conveniently up a reef slope for the major part. We used the slowest ascent rate allowed at any given moment or slower.
For the last part I used a downline from our boat or a DSMB to control my depth precisely and avoid those slight discrepancies in buoyancy control that can occur in blue water.
We had to alter our plans on site and substitute on the rig VR Technologys VRX for the NHeO we had wanted to test, because the display of the NHeO was not bright enough to photograph in tropical ambient light. The VRX was set to emulate the simpler NHeO.

**DIVE 1**

During the first dive, most of the computers gave results that were close to each other, except for the Oceanic with the Pelagic DSAT algorithm. Intended for warmwater no-stop diving, this really punished us for going deeper than 30m by clocking up deco stops almost immediately.

By contrast, the Oceanic with the Pelagic Z+ algorithm was very much in line at this time with the Mares Nemo Excel, set without any additional caution level.

**8min/42m**

At this point in Dive 1, the DSAT Oceanic was into 6m stops while the Z+ Oceanic was showing a 1min stop at 3m. Meanwhile, both the Suunto RGBM 100 and the Suunto RGM50 algorithms gave 3m stops. All the others indicated similar 3m stops with ascent times of 7 or 8min.

**12min/30m**

Making our way up the reef slope at a typical speed, the computers gradually began to separate out. At 30m after 12 minutes, both Suuntos still had around 5min at 3m, plus a deep stop at 26m. The two Galileos were giving 7min and 10min of ascent time; the standard Mares showed a 2min stop, and the Mares with caution had added a further minute.

The VRX showed 1min/6m, the Z+ Oceanic gave 4min/3m, the Apeks/Seiko required 3min/3m and the DSAT Oceanic rattled away, adding masses of deco time, starting at 9m.

You can see that, with one exception, none of the computers was outrageously different at this time, although the Suuntos recommended deep stops at 26m and the Galileos at 12m and 14m respectively.

One minute later, the Suuntos had changed their deep-stop recommendation to 16m with 5min total ascent time, while the Galileos asked for 14m and the VRX suggested a 1min/9m stop with 9min ascent time.

The two Mares computers, the Z+ Oceanic and the Apeks/Seiko asked for 2, 3 and 4 minutes at 3m, and the DSAT Oceanic was still into its 9m stop.

**19min/15.5m**

The Suuntos and Galileos had all counted down the 2min of deep stops that we had made. The Suunto RGBM50 asked for 1min less than the 5min of total ascent time mandated by its RGBM100 sibling.

The Apeks/Seiko, standard Mares and Oceanic Z+ required 3 or 4min/3m, while the Mares with caution wanted 6min, the Galileo MB1 required 5min/3m and the MB2 2min/6m. The Oceanic DSAT was back to 6m stops, and the VRX, becoming increasingly difficult to read in the brighter light near the surface, required 6min/3m.

**28min/7.5m**

Both Suuntos required 2min/3m, as did the standard Mares and the Apeks/Seiko. The more cautious Mares required an extra 4min at 3m. The Z+ Oceanic required a 1min/3m stop, while its DSAT brother was still showing a 6m stop.

The two Galileos were mandating 3min/3m and 3min/6m, while the VRX was in between with 5min of total ascent time.

**32min/5m**
Most of the computers were into no deco/safety stop time by now. However, the more cautious Mares and the Galileo MB2 both had 4min left to do at 3m, while the DSAT Oceanic still required 22min at 3m. I stuck it out so that it would be good for the next dive. The second dive would be telling, because the micro-bubble calculations would come into play.

| **Dive 1 (max depth 49m)** | **8min/42m** | **12min/30m** | **19min/15.5m** | **28min/7.5m** | **32min/5m** |
|---|---|---|---|---|---|
| Suunto Vyper Air (RGBM 100) | 4min/3m (26m DS) | 5min/3m (26m DS) | 5min/3m | 2min/3m | - |
| Suunto D6 (RGBM 50) | 4min/3m (26m DS) | 4min/3m (26m DS) | 4min/3m | 2min/3m | - |
| Scubapro Galileo Sol (MB1) | 1min/3m | 4min/3m (12m DS) | 5min/3m | 3min/3m | - |
| Scubapro Galileo Luna (MB2) | 3min/3m | 3min/6m (14m DS) | 2min/6m | 3min/6m | 4min/3m |
| Mares Nemo Wide (RGBM PF1) | 1min/3m | 3min/3m | 6min/3m | 6min/3m | 4min/3m |
| Mares Nemo Excel (RGBM PF0) | 1min/3m | 2min/3m | 4min/3m | 2min/3m | 1min/3m |
| VR Technology VRX* (Buhlmann ZH-L16) | 1min/6m | 1min/6m | 6min/3m | 4min/3m | - |
| Oceanic OC1 (Pelagic DSAT) | 4min/6m | 1min/9m | 5min/6m | 1min/6m | 22min/3m |
| Oceanic OC1 (Pelagic Z+) | 1min/3m | 3min/3m | 4min/3m | 1min/3m | - |
| Apeks Quantum (Mod. Buhlmann ZH-L16) | 1min/3m | 3min/3m | 3min/3m | 2min/3m | - |

Tables (above & below) show required deco times and depths at five typical sample points on each of the two dives.

*Substituted on site for the VR Technology NHeO (see text)

**DIVE 2**
Two and three-quarters of an hour later, we went in for a second dive. This was slightly shallower, with a maximum depth of 46m.

**7min/44m deep**
We expected the DSAT Oceanic to mandate masses of deco, and we were not wrong.
At 7min/44m the least cautious computers on our rig, the Z+ Oceanic and the Galileo MB1, and what was meant to be the more cautious Mares, were finally into stops. The DSAT Oceanic had rattled through all its 3m stops and was into its first 6m stop.
The two Suuntos still agreed and the VRX was in step with the Galileo MB2, the standard Mares and the Apeks/Seiko.

**20min/20m deep**
The VRX, the Galileo MB1 and the Apeks/Seiko were building stops at 6m. The Galileo MB2 was adding to this, while the standard Mares was slightly less cautious than the Z+ Oceanic and Suunto RGBM100 with its 3m stops, and the Suunto RGBM50 less cautious still with only 6min of total ascent time.
In contrast, the PF1 Mares was piling on the stops, with 15min/3m required, and we knew the DSAT Oceanic was going to be a casualty of a dive it was not designed to do.

**25min/13m deep**
The more cautious of the Mares computers was indicating a 23min stop and the DSAT Oceanic was going for more. Back in the realms of reality, the Z+ Oceanic required a 10 min/3m stop, and the Suunto RGBM 100 indicated a 3m stop including a 2min deep stop at 11m and a total ascent time of 9min.
The Suunto RGBM50 needed no deep stop. The VRX, Galileo MBL1, standard Mares and Apeks/Seiko were in step, with a 7min/3m stop, while the Galileo MB2 mandated 1min/6m and a total ascent time of 11min.

**29min/9m deep**
By now the DSAT Oceanic had racked up 2 min/6m, which meant there was going to be a lot of time required at 3m too. But the Oceanic Z+ was still more or less in step with the standard Mares and Suunto RGBM100, with only 10 min/3m indicated.
However the Mares Nemo Wide with PF1 now needed 24min/3m. The Suunto RGBM50, Apeks/Seiko and VRX all required 7min/3m whereas the Scubapro Galileo MB1 and MB2 stood either side of that with 6min/3m and 9min/3m respectively.

**6min/4m deep**
At this point the VRX and Galileo MB1 sprinted past the others to allow us one minute to surface. We still had four or five minutes to do on the others, apart from the Mares with the caution-setting and the wayward DSAT Oceanic, which we knew were going to get intentionally bent.

| Dive 2 (max depth 46m) | 7min/44m | 20min/20m | 25min/13m | 29min/9m | 36min/4m |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Suunto Vyper Air (RGBM 100) | 4min/3m (24m DS) | 8min/3m (13m DS) | 9min/3m (11m DS) | 10min/3m | 4min/3m |
| Suunto D6 (RGBM 50) | 4min/3m (24m DS) | 6min/3m (14m DS) | 7min/3m | 7min/3m | 2min/3m |
| Scubapro Galileo Sol (MB1) | zero no stop time | 1min/6m (16m DS) | 7min/3m | 6min/3m | 1min/3m |
| Scubapro Galileo Luna (MB2) | 1min/3m (8m DS) | 3min/6m (16m DS) | 1min/6m | 9min/3m | 5min/3m |
| Mares Nemo Wide (RGBM PF1) | zero no stop time | 15min/3m | 23min/3m | 24min/3m | 21min/3m |
| Mares Nemo Excel (RGBM PF0) | 1min/no stop time | 5min/3m | 7min/3m | 9min/3m | 5min/3m |
| VR Technology VRX* (Buhlmann ZH-L16) | 1min/3m | 9min/6m | 7min/3m | 7min/3m | 1min/3m |
| Oceanic OC1 (Pelagic DSAT) | 1min/6m | 1min/6m | 5min/6m | 2min/6m | 25min/3m |
| Oceanic OC1 (Pelagic Z+) | zero no stop time | 8min/3m | 10min/3m | 10min/3m | 4min/3m |
| Apeks Quantum (Mod. Buhlmann ZH-L16) | 1min/no stop time | 1min/6m | 7min/3m | 7min/3m | 3min/3m |

**CONCLUSION**

Most of these computers give a sufficiently similar result for us to have confidence in them. If you use an Oceanic OC1 with the dual algorithm, be sure to set it for the Pelagic Z+ option unless you are doing only shallow dives.

Set caution levels on the Mares with care! If you intend to do a series of deeper dives, gas supplies with single cylinders could be an issue.

The Seiko series of computers as represented here by the Apeks seems sensible in the deco it mandates, as does the Mares in standard mode.

We found the illuminated display of the VRX very hard to read in bright ambient light, and the type in the LCD might be too small for older divers to make out easily.

It is pointless setting MB0 on a Galileo, because it effectively deactivates any micro-bubble calculation. Setting MB2 might be overdoing it, but its your choice. Even higher MB settings might get you into trouble with insufficient gas supplies to finish a dive; but if you miss the level stops, the Galileo defaults
to the next lower MB setting.

We see little advantage in choosing for repeat diving the slightly more lenient RGBM50 over

the conventional RGBM100 algorithm of the Suuntos, in which we have complete confidence.
Its complex! If you dive with a buddy who uses a different computer, or one with a different setting for caution, always come up together, using the more conservative deco requirements.

**THE COMPUTERS**

**1 SUUNTO VYPER AIR**
**Suunto-Wienke RGBM100 with Deep Stop option**
Suuntos popular gas-integrated computer uses the algorithm that is equivalent to all the algorithms used by Suunto nitrox computers. It takes into account residual micro-bubbles that might remain from previous dives.

**KEY FEATURES:** Two-gas switching; wireless gas-integration; digital compass; dot-matrix display; deep stop option; user-replaceable battery; PC-uploadable.
Price: £399 with transmitter.
www.suunto.com

2 SUUNTO D6
**Suunto-Wienke RGBM50 with Deep Stop option**
We set this computer-watch to an optional more-aggressive version of the RGBM algorithm for comparison, but included the deep-stop setting option.

**KEY FEATURES:** Stainless-steel computer-watch; two-gas nitrox-switching; digital compass; deep-stop option; watch/stopwatch functions; metal or rubber bracelet; PC uploadable.
Price: £575.www.suunto.com

**3 SCUBAPRO GALILEO SOL**
**ZH-L8 ADT MB PMG PDIS MB1**
This was set to the least-cautious micro-bubble setting, MB1, of its predictive multi-gas algorithm. Users can cancel this altogether and use the original Buhlman ZH-L8 ADT algorithm at MB0, but we thought this pointless. We set the screen to Classic configuration with PDIS option (Profile Dependent Intermediate Stops). The Sol can be wirelessly integrated both with the breathing mix and the heart-rate of the user via a strap-on monitor. We passed on the second option.

**KEY FEATURES:** Predictive multi-gas algorithm; wireless air-integration for three nitrox mixes; wireless heart-rate integration; digital compass; dot-matrix display with clear text alarms; three screen display options; PDIS; user-changeable battery; upgradeable; PC-uploadable; oil-filled apart from battery chamber.
Price: £939 with heart-rate monitor and one transmitter.www.scubapro.com

**4 SCUBAPRO GALILEO LUNA**
**ZH-L8 ADT MB PDIS MB2**
A simpler version of its dearer sibling, this can be wirelessly integrated with only one gas

mix (unless upgraded later). It was set to a more cautious micro-bubble MB2 setting and the screen was in Light configuration. We again selected the PDIS option.
A third Full screen configuration is also available.

**KEY FEATURES:** Wireless air-integration; digital compass; dot-matrix display with clear text alarms; three different screen display options; PDIS; user-changeable battery; upgradeable to PMG; PC-uploadable; oil-filled apart from battery chamber.
Price: £689 without transmitter. www.scubapro.com

**5 MARES NEMO WIDE**
**Mares-Wienke RGBM PF1**
With the new gas-switching possibility downloaded from the Internet, we set this wide-screen computer to the first degree of personal caution level.

**KEY FEATURES:** Mares RGBM; wide screen and simple to use; upgradeable software; two-nitrox-mix gas-switching; PC-uploadable.
Price: £335. www.mares.com

**6 MARES NEMO EXCEL**
**Mares-Wienke RGBM PF0**
We used this straight out of the box. Its a very simple computer, but with diving this can be good, because its almost impossible to set it incorrectly with its four buttons.

**KEY FEATURES:** Stainless-steel computer-watch; watch/stopwatch functions; Mares RGBM, PC-uploadable.
Price: £370. www.mares.com

**7 VR TECHNOLOGY NHEO**
**Buhlmann ZH-L16 derivative**
An entry-level computer from this technical-diving company is bound to be more than basic. Its ready for open-circuit air and nitrox diving but it can be upgraded to trimix and a colour screen after purchase if required.

**KEY FEATURES:** OC-compatible; nitrox with trimix upgrade, programs for up to four nitrox mixes per dive; user-replaceable battery: PC upload option.
Price: £550. www.vr3.co.uk

**8 OCEANIC OC1**
Pelagic DSAT with Deep Stop
The blue OC1 on our rig was set to use the well-known Pelagic DSAT algorithm that has seen such success with countless US leisure divers. However, we know that it is really designed for no-stop diving no deeper than 30m, so it was not really appropriate to use it for the dives we were doing. However, Oceanic has badge-engineered computers for other brands including Seemann, Aeris and Beuchat, so we thought it was relevant. We set it for the optional Deep Stop.

**KEY FEATURES:** Dual-algorithm; wireless nitrox-integrated technology with up to three independent transmitters; titanium body; digital compass; deep-stop option; buddy pressure-check; watch/stopwatch functions; PC-uploadable.

Price: £855 (transmitter £230 extra). www.oceanicworldwide.com

**9 OCEANIC OC1**
**Pelagic Z+ with Deep Stop**
The OC1 is an important development in Oceanic computers because it has a unique dual-algorithm setting. The Pelagic Z+ algorithm setting promises to do more of what we European divers expect, so we set this algorithm on the orange OCI on the rig together with a Deep Stop option. Expect all future Oceanic computers to offer dual algorithms. These top-of-the-range computer-watches can be wirelessly integrated with up to three different tanks, depending on the number of transmitters used.

**KEY FEATURES:** (as blue OC1)

**10 APEKS QUANTUM**
**Modified Buhlmann ZH-L16**
This is one of the many incarnations of the Seiko computer that can also be bought wearing the brand of other companies, notably the Apeks Quantum, Cressi with its Edi, the DiveRite range
and the Scubapro Xtender. This one can be used to switch between two nitrox mixes during a dive.
We used it set at Safety Factor 0.

**KEY FEATURES:** Competitively priced; simple to set up; personal safety factors and manual altitude correction; two-gas nitrox switching; user-changeable battery; PC uploadable.
Price: £220. www.apeks.co.uk

What the computers were telling us after 20 minutes on Dive 2.

**THE SPONSORS**

**CAMEL DIVE CLUB & HOTEL**
Established in 1986, Camel Dive Club & Hotel is one of the few dive centres in Sharm el Sheikh that still operates from its original location, in the centre of Naama Bay. Its PADI 5* dive centre is also an Instructor Development Centre and TDI technical diving facility. The 4* Camel Hotel offers high-quality accommodation, two restaurants, a café and two bars, and has a famously friendly atmosphere. www.cameldive.com, www.scuba.co.uk

**MONARCH**
Monarch offers regular flights to Sharm el Sheikh from London Gatwick and Manchester Airports. In addition to flights, Monarch says it also now offers a huge range of great-value holidays and accommodation options, which can all be booked via a one-stop online shop. For further information, or to book Monarch flights, Monarch holidays or Monarch hotels, visit monarch.co.uk