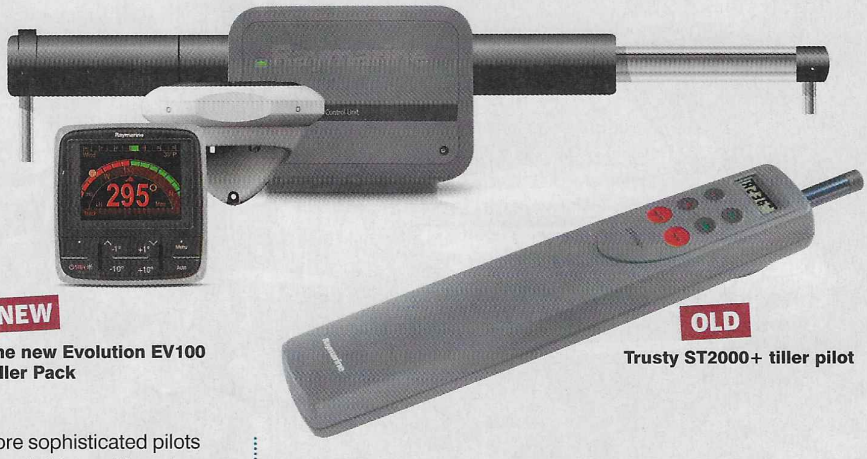
Autopilot comparison: old vs new tech

Does the latest autopilot technology knock old systems into a cocked hat? PBO's Ben Meakins finds out…

Autopilot technology has come a long way in the past few years. Fluxgate compasses and separate gyro sensors have been consigned to history: now we have the latest generation of nine-axis sensors and sophisticated electronics – and with them, we're told, a different level of performance.

The standard autopilot for tiller-steered boats has long been the tiller pilot, an all-in-one pilot that just needs power to work.

Introduced by Autohelm in 1973, they have had a few upgrades since but the Raymarine ST1000 and 2000 pilots, along with their competitors from Simrad – the TP10, TP20 and TP32 – are still the main option for tiller steered boats, especially those with transom-hung rudders.



The new Evolution EV100 Tiller Pack

Trusty ST2000+ tiller pilot

More sophisticated pilots are available, and have been for some time, but they cost a lot more. Until recently these still relied on the humble fluxgate compass, but some had solid-state gyroscopes included to add pitch, yaw and roll information to the mix and result in better steering, in particular reacting to and learning wave patterns.

We set up both autopilot systems and took them to sea

PBO tested the two most common tillerpilots back in 2012, pitting the Simrad TP10 against Raymarine's ST1000. Raymarine have since added the Evolution EV100 Tiller Pack to their range, which uses a cockpit-mounted tiller arm controlled by their latest Evolution sensor core, Actuator and P70S control head – and keen to see how it all worked we set sail to see what improvements are on offer to those wanting better performance than a traditional tiller pilot can provide.

How we tested them

We took a Raymarine ST2000+ tiller pilot and the new EV100 Tiller Pack system for a series of test sails, temporarily installing them on my Impala *Polly*.

The Evolution system comprises a nine-axis sensor core (that's a three-axis gyroscope, three-axis accelerometer and three-axis magnetometer), an Actuator Control Unit (ACU), a Tiller Drive ram and a P70S colour control head. We mounted the control head and actuator on a temporary washboard in the companionway. The 'sensor core' nine-axis sensor was mounted in the heads as close to the centreline as possible and well away from the engine and other sources of deviation. We wired the components into the boat's NMEA2000 network. While it uses the Seatalk^{ng} system, converter cables are available to link it in with standard Devicenet connectors.

The tiller drive fits into the same pin and sockets as used by the ST2000+, so switching between the two was a very simple matter.

Setup was a simple process. Upon initial powering up, the system started detecting the maximum compass deviation (4° in our case), and you can then begin the setup process, which comprises setting the

Setup was simple: choose the boat type – in this case Sail...

... choose the drive type, in this case 'Tiller'...

type of vessel (sail for us), drive type (tiller), plus three rudder drive checks.

The ST2000+ can run as a standalone pilot, but it is also able to accept Seatalk[1] and NMEA0183 inputs, allowing it to steer to a wind angle and track to a waypoint. We wired this into the boat's instrument network via a Seatalk[1] to Seatalk[ng] converter.

Everything duly wired up and working, we headed out.

For our first day of tests, we sailed down the West Solent with the wind on the beam.

A gusty northwesterly was blowing, which gave us a good opportunity to really push the pilots hard. We hoisted a spinnaker and headed up onto a tight reach to see how each would respond and react.

Sailing like this means that if the pilot doesn't react immediately, the spinnaker will collapse. On our way back up the Solent the wind died to around 8 knots, which gave us an excellent opportunity to see how each pilot would steer on wind mode, close-hauled in a light and shifty breeze.

...and let the system perform some calibration movements

In search of waves

And finally, we headed out a week later in a breezy 18+ knots of northeasterly. We reached out to the Nab Tower before heading downwind, south of the Isle of Wight. Here, with wind against tide, there were some sizeable waves, and running dead downwind with the genoa goosewinged gave the pilots a good test.

Power consumption

How hard your pilot is working will determine how much power it draws from your ship's batteries. The EV100 had three modes – Performance, Cruising and Leisure. On the ST2000+ you can set it to various levels of response, or enable 'Auto Seastate'. We used the boat's NASA battery monitor to track the power consumption of the pilot in each mode – and these are the maximum figures seen while the boat was heading downwind in waves. You can see that the ST2000+ was pulling more amps as, despite having fewer components, the drive was working much harder.

EV100 in Performance mode	0.9A
EV100 in Cruising mode	0.6A
EV100 in Leisure mode	0.4A
ST2000+ in High Response mode	2A
ST2000+ in Auto Seastate mode	1A
ST2000+ in Wind mode	0.6A

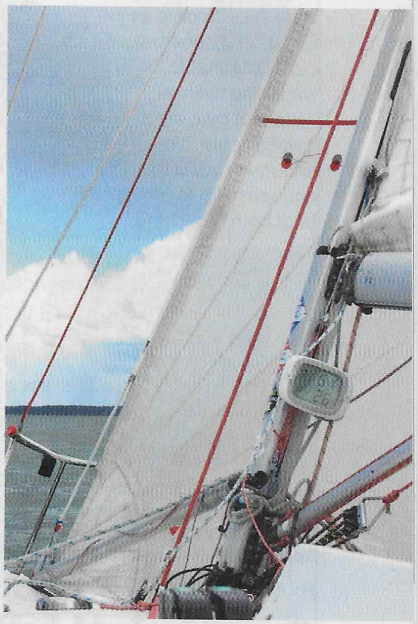
Head to head

Upwind in light airs (8-10 knots)

ST2000+

In Wind mode with wind data input, the ST2000+ showed some improvement on its Compass mode performance. With the same wind data as the EV100 it tracked the wind well, beeping whenever a shift was detected.

However, lacking the early warning of heel that the more advanced sensors in the EV100 provided, it worked much harder, and the course was much more erratic, wavering around 10° or so each side of close-hauled, with the telltales lifting frequently.



We headed upwind, checking the telltales to see how each pilot coped with windshifts

EV100

In Wind mode you can ask the pilot to steer to either true or apparent wind angle. Upwind, apparent is best in anything but very light winds as it allows the pilot to steer much more accurately to shifts, whereas downwind true wind is more stable.

In Performance mode the telltales were constantly streaming aft, with the boat tracking the windshifts and helming perfectly to a set wind angle. The ram was constantly making small adjustments, and as the boat heeled it would apply negative helm in order to stop the boat rounding up, just as a human helmsman would. In Cruising mode it was still reasonably effective, with the ram moving much less. With the sails perfectly balanced this kept the boat on the wind, with some course deviation and a bit more lag in the gusts and shifts.

In Leisure mode the EV100 had similar performance to the ST2000+ in Wind mode – there was not as much wandering around but a much slower response time.

Here the EV100 pilot is set to Apparent Wind mode

The tiller pilot was much improved when fed wind data

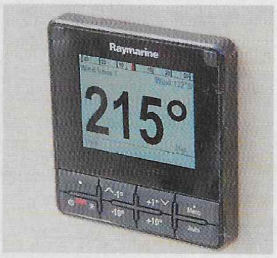
Tight Spinnaker Reach in 12-16 knots

This was a tough test for the pilots, and perhaps a little unfair, as most cruisers will be unlikely to hold a spinnaker at anything approaching a tight reach – but we wanted to push them and see how they coped with staying on a critical angle with the rudder prone to loading up in an instant.

ST2000+

Lacking heel data, the ST2000+ in Wind mode wasn't as effective as the EV100, but nonetheless it still did a reasonable job in flat water and the lulls.

Without gyro input, however, it wasn't able to react early enough in gusts to apply enough helm to prevent the boat from broaching.



Set to sail to Apparent Wind Angle the EV100 kept the spinnaker full

In Compass mode it lacked the wind data to keep the boat at the same angle, so relied instead on the heading changing before it applied any rudder. This reactive approach wasn't enough to keep the boat on course, and she wandered around with large helm movements.

EV100

In Performance mode and in Wind mode, the EV100 kept the boat bang on the correct apparent wind angle of around 80-90°. The helm made constant small adjustments but the spinnaker stayed filling – and the pilot dealt well with gusts, detecting the slightest change in heel and applying enough helm to pre-empt any rounding up.

The spinnaker collapses as the heading wavers around

In Compass mode, it obviously lacked the ability to sail to the luff of the spinnaker, but held the compass course very effectively.

In Leisure mode it couldn't react fast enough to keep the spinnaker from collapsing, but Cruising mode was a decent compromise and minimised the tiller movements while keeping the wind angle well set at 80-90° AWA, with fewer spinnaker collapses.

Downwind in big waves, 12-18 knots

From Bembridge Ledge the waves were on the boat's quarter, creating a corkscrewing motion with the waves first heading the boat up and then bearing her away as they rolled under her.

ST2000+

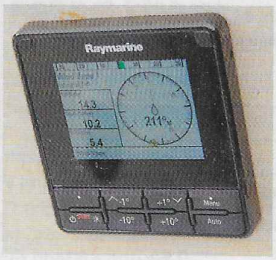
The pilot was working hard in this situation. We enabled the Auto Seastate mode, which helped a little, but the problem was that the pilot could only react to the waves once they had changed the boat's compass heading. Therefore it would apply a large amount of helm once the bow had started swinging one way, which then had to be negated once the boat reached the trough of the wave. The result was large tiller movements and not particularly effective course-keeping.

On Wind mode things were a little better. This allowed the pilot, steering to apparent wind, to react earlier – as the boat slowed in the trough, the apparent wind would come aft, the boat would head up, speed up down the wave, whereupon the wind came forward and the boat bore away. In this way her progress was much more comfortable and the pilot needed much less tiller action to keep to the same wind angle.

We headed downwind in waves south of the Isle of Wight

EV100

This was where the improved sensors of the EV100 really showed. Steering to compass, the EV100 was impressive. In Performance mode, it could sense the wave pattern and the pitch, roll and yaw of the boat and adjusted the steering accordingly. Thus the headsail stayed goosewinged and the boat picked herself up and steered down the waves as well as if steered by a racing helmsman.



This useful screen displays wind angle on a compass rose

Wind mode

In Wind mode, set to True Wind, it was even more effective, heading up and bearing away as necessary and keeping the sails full and the boat thundering down the waves. This did use a fair amount of tiller movement, but these were much smaller than those of the ST2000+ and were more twitches to keep the boat on course.

On its lower response settings, the tiller moved less and the boat's nose wandered a few degrees either side of her course, but the movement (and noise) from the tiller drive was much reduced – as was the current draw. Leisure mode was a little too sleepy for these demanding conditions, with a fair amount of yawing, but Cruising mode seemed a good compromise.

Two-sail reaching in 12-18 knots

Finally, on our second test day we tried a full-sail reach in gusty conditions. No spinnaker this time, to make the test fairer, but we set the pilots to Compass mode instead to see how they responded to gusts.

Loaded up on a reach, we tried the pilots on compass mode

ST2000+

The tiller pilot coped well in flat water and a steady breeze, but waves and gusts made it work harder. That's not surprising given the simple compass inside – and it wandered around in the gusts, reacting to the information it received from its fluxgate compass once the heading started to change.

EV100 pilot kept the boat admirably on course

EV100

The EV100 coped much better, being better able to predict the boat's intentions as she heeled ahead of a gust and tried to round up. Performance mode saw the heading wavering no more than 2° either side. Cruising mode saw changes of around 5°, while Leisure mode wandered around 10° each side in the gusts.

A gusty 12-18 knots loaded up the helm

Other options

■ Other manufacturers offer autopilot brains, drives and controllers, but none are suitable for a tiller-steered boat with transom-hung rudder, as the rams aren't designed for mounting outside, and they often require a rudder reference sensor, which again can't be mounted outside. It's possible to cobble together bits and pieces – a B&G ACU computer, controller and heading sensor and a rudder reference sensor should work with a Raymarine tiller drive arm if you want to build a system as such.

Of course, if you've got a rudder with a through-deck stock, you can get an arm welded on and a ram to drive it below-decks – but for a simple installation with minimal fuss (and indeed the only option for transom-hung boats) the EV100 tiller pack is the only packaged option from the major manufacturers.

■ Another relatively new option is the Pelagic Autopilot (below), developed by a group of offshore sailors in the USA. It currently costs $780 for an equivalent system to the EV100. We were unable to get hold of one at this time, but hope to do so later this year and put it to the test.

PBO Verdict

There's a big price difference in these units – online prices are around £500 for the ST2000+, compared to around £1,245 for the EV100 Tiller pack – so you'd expect a similar difference in performance.

The ST2000+ performed well for a simple tiller pilot – and feeding wind data to it proved a revelation. This transformed its use under sail on the twitchy Impala, meaning it would steer a reasonable course to the wind. Playing around with response and 'Auto Seastate' also improved performance.

However, even with these adjustments to the ST2000+ the EV100 was in another league altogether. It steered us solidly for two days, coping well with everything we could throw at it.

On Performance mode it was just as good as many helmsmen. Leisure mode gave a reduced level of response, broadly similar to the performance of the ST2000+ and suitable for motoring in calms and sailing in flat water, while Cruising mode was a handy compromise between the two.

Where the Evolution EV100 pilot scored was its nine-axis sensor, which could sense as soon as the boat began to heel, yaw or pitch and apply just enough helm to nip any course change in the bud before the heading changed, after which much more helm is required and the pilot – and thus your batteries – must work much harder.

It would be a relatively expensive upgrade, but if you're doing any shorthanded sailing in conditions that require a steady hand on the helm it would be worth every penny.

If that's out of budget, and your tillerpilot will accept data, it's worth feeding it wind data if you can – it will give you a much improved level of performance.