The budget rival to satellite phone connectivity

Radio amateurs can maintain contact worldwide for the cost of a radio and an antenna, explains Tony Preedy

ABOVE **You don't need the latest, expensive satellite phone for worldwide connectivity if you join the amateur radio community**

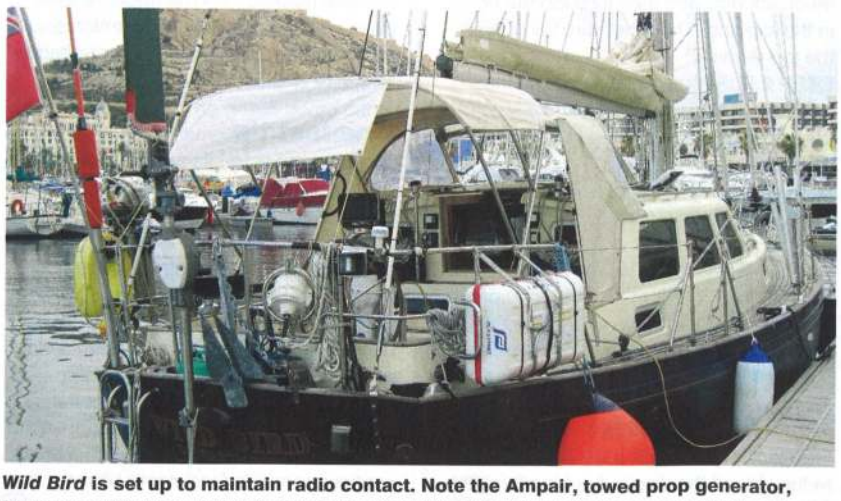
These days it's relatively easy to maintain phone contact almost anywhere in the world – but to do so from a boat utilising a satellite phone is expensive. Radio amateurs, meanwhile, can maintain contact between themselves anywhere on the planet for only the cost of their radio and an antenna.

My daughter Liz and I recently completed a one year cruise of the islands of the Atlantic and Caribbean. By using amateur radio, for which I've been licensed for 66 years, we were able to keep in touch with radio friends throughout the world during our journey.

Casual radio contacts invariably wanted to know about the boat's radio equipment. From what I have seen of other cruising boats of similar size to ours, we shared similar facilities for living on board and for navigation with maximum independence. But our radio set-up is less conventional.

Wild Bird, our 23-year-old glassfibre Vancouver 38p, had been taken by previous owners around the world and across the Atlantic several times so we have great confidence in her. She has a single aluminium mast, a mainsail and two foresails which make her cutter rigged. All the working lines are extended to the cockpit from where she may be sailed single-handed.

While on the lookout for other vessels and icebergs Liz, who is a competent sailor, and I operated a four-hour watch system. This leaves plenty of time for radio.



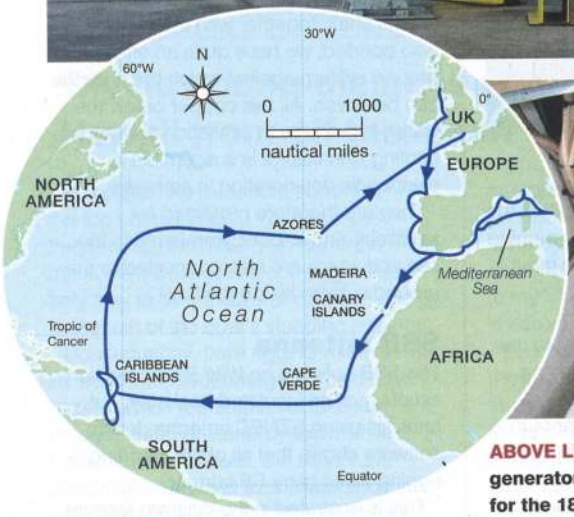
***Wild Bird* is set up to maintain radio contact. Note the Ampair, towed prop generator, Hydrovane wind-powered steering device and the backstay high frequency (HF) antenna**

Our equipment

Wild Bird is equipped with a Navtex receiver for shipping and weather reports, an AIS receiver that provides information about nearby vessels, a general coverage SSB/MF/HF/ VHF radio receiver, a marine VHF transceiver, a VHF emergency rescue transmitter, A UHF satellite location beacon, RADAR, a domestic broadcast receiver/CD player and an ICOM 706 Mk11G ham radio transceiver.

The latter I had converted to cover both amateur and marine frequencies. With an SCS 7400 Pactor4 modem, we were also equipped for high frequency (HF) internet and for receiving weatherfax charts in conjunction with a laptop computer.

Wild Bird, a 23-year-old glassfibre Vancouver 38p, ashore at Lanzarote



ABOVE LEFT The tubular housings for the watermaker membranes behind the generator's acoustic enclosure. **ABOVE RIGHT** Our twin boomed headsails which we set for the 18-day easterly trade wind crossing from Sao Vicente in Cape Verde to St Lucia

Weather charts for the eastern half of the North Atlantic were received from DDH in Hamburg and those for the western side and Caribbean from NMG in New Orleans. The radio shack is also my sleeping cabin.

Small boat considerations

Problems that arise when you try to install and use HF radio equipment on a small boat are:

- Battery capacity for transmitting.
- Fitting an efficient antenna without compromising sailing ability.
- Electromagnetic compatibility (EMC) or interference between the radio and the boat's electronic or electrical equipment. There are, for example, a surprising total of 22 electric motors that can be connected to the 12V system on *Wild Bird*.

Supplying the power

To feed these and the electronic systems, we have five 110Ah AGM batteries. One is dedicated to starting engines. They can be charged either via splitting diodes from an 80A main engine alternator, a 4kVA diesel generator, a 100A shore powered battery charger, a wind turbine or a 100W towed generator that's driven by a propeller on the end of a trailing rope. We were not, therefore, short of primary power for the radio.

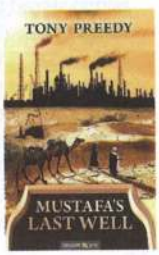
Many cruising boats rely on solar panels to keep their batteries topped up but, on a boat, they can only produce a few per cent of their potential because they have to be mounted horizontally, or frequently adjusted towards the sun, can sometimes be shaded by sails and can only be irradiated for about half a day.

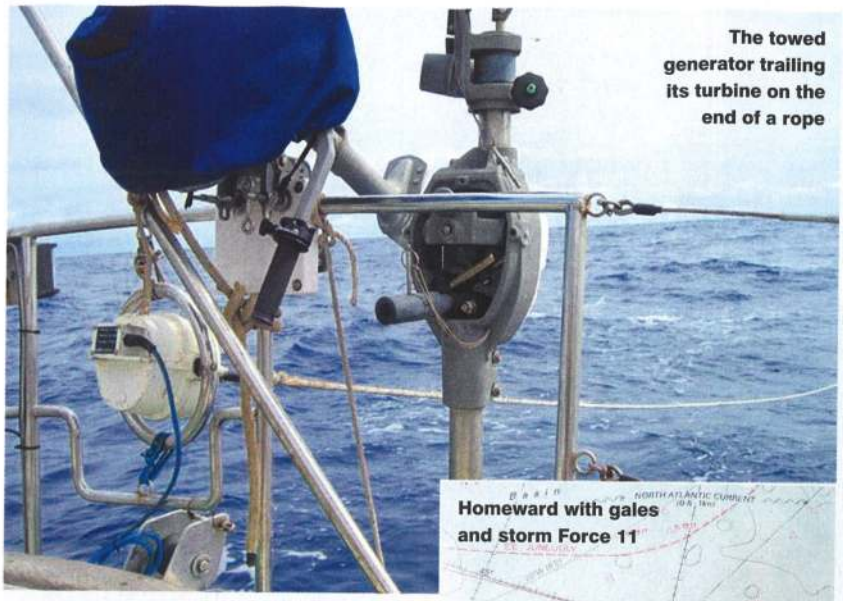
I considered adding a linear amplifier to boost my radio signal because this could have been powered by the auxiliary generator rather than batteries but it transpired that 100W output power was enough to get me through to most of the world. Besides, the generator may then have needed electrical suppression.

The Ampair towed generator could just about make up the average 5A load imposed on the batteries by the refrigeration compressor, providing we were making more than 6 knots. With the boat steered by an electric autopilot, it

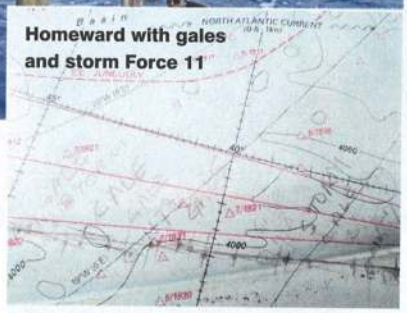
ABOUT THE AUTHOR

Tony Preedy's autism shaped his young life, leading him to enter Technical College. He studied to be a Chartered Engineer while a REME apprentice, at Bristol Polytechnic, then the BBC. He was elected a Fellow of the Institution of Engineering and Technology. He has worked as an engineer in broadcasting, spending time in Arabia– inspiration for his book *Mustafa's Last Well* – and in law in the USA. Widower Tony married Jean while living on Ascension Island and had two daughters. They moved to Shropshire after retirement. He enjoys sailing, restoring classic boats and vehicles, walking, and amateur radio.

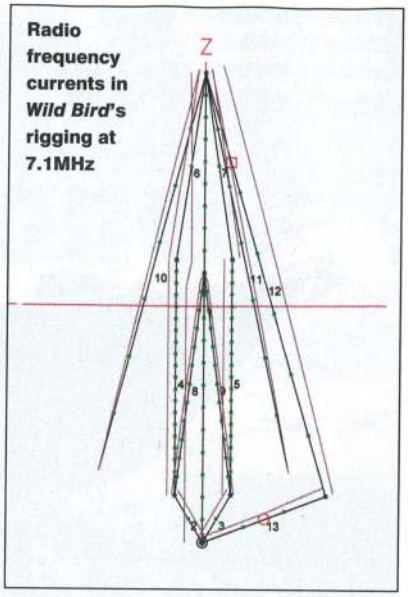




The towed generator trailing its turbine on the end of a rope



Homeward with gales and storm Force 11



Radio frequency currents in *Wild Bird*'s rigging at 7.1MHz

was often necessary to run the diesel auxiliary for a few hours each day. To keep a reasonable load on the diesel generator and maximise its efficiency we would also during this time connect it to the hot water immersion heater and the reverse osmosis water-maker.

We set twin boomed headsails for the 18-day easterly trade wind crossing from Sao Vicente in Cape Verde to St Lucia. During this time, when we were sometimes making more than 150 miles per day, the Ampair supplied all of our power, day and night. This was despite a sabotage attempt by porpoises who were almost successful in biting through the rotating rope.

Lightning protection

On *Wild Bird*, the aluminium mast is about 16m tall and, for lightning protection, it is electrically bonded with the stainless steel shrouds or side stays to a copper plate below the water. The lightning protection system is isolated from the boat's main grounding system. The mast and its side stay wires, therefore, from a radio viewpoint look like a cage monopole.

The other stays, of which there are seven, are joined to the mast at two levels but are not joined to the ground system where they reach the deck. The main ground system relies on a 5cm wide copper tape running fore and aft within the bottom of the hull. It has branches running crosswise for connections. It is the main negative return from the onboard electronic and electrical equipment.

At radio frequencies, it is coupled to the sea through the hull via its capacitance. The wide tape conductor ensures minimum potential between the various bits of equipment when lightning current is induced into the rigging. I know this arrangement works because we survived a direct strike in Corsica, with no harm done to the boat, her electronic equipment (switched off at the time) or ourselves. There are also two copper plates on the outside of the hull below the water which provides a sea/ground connection, primarily for the radio.

The refrigerator and freezer also have submerged copper plates through which refrigerant is pumped to transfer heat to the sea. These are also bonded to the other ground elements. If we add the propeller and its shaft, together with the lead keel, also bonded, we have quite an efficient ground system against which the antenna can be driven. All this copper below the water, together with sanitation and engine cooling skin fittings is susceptible to electrolytic deterioration in seawater.

They are therefore protected by sacrificial zinc anodes, immersed in the sea and which are also connected to the ground system inside the hull.

SSB antenna

The SSB antenna on *Wild Bird* looks very simple, just an insulated backstay, but analysis using EZNEC antenna design software shows that all of the standing rigging wires carry RF current.

This is illustrated in the diagram (above) where the dotted lines represent the rigging and the plain lines are currents. Line 12 represents the backstay antenna, 11 is the second backstay and 10 is the forestay. On frequencies below those where the wires are a quarter of a wavelength, the radiation appears to be of an omnidirectional pattern. This is the situation below about 4MHz. Antenna Insulators for the standing rigging of boats are required to maintain mechanical integrity if the dielectric breaks under excessive load. To achieve this the two parts of the stay are joined to loops within each other, but not touching, before being encapsulated in insulating material. Unfortunately, this results in relatively high capacitance of typically 15pF. This can limit the upper frequency at which the antenna can be effective. Egg insulators are sometimes used here because they have much lower capacitance but the copper ferrules clamping the ends of the wire are, I am told, not considered reliable by riggers.

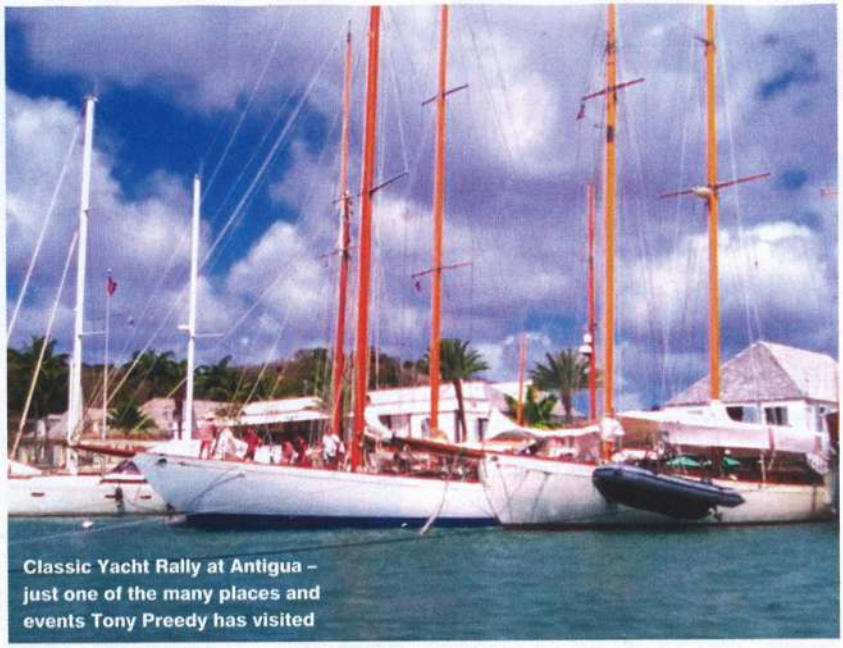
The insulated backstay on the face of it looks as though it is the radiator that is driven against the sea. It does not carry the most RF current on some frequencies. On 14.3MHz, where a lot of marine ham radio

About the radio licence

The amateur radio licence is free but there are fees for exams.

Courses are organised by local or online clubs and exams are administered by the Radio Society of Great Britain (RSGB), rather like the RYA and sailing qualifications. Three licence levels permit progressively higher transmitter power and access to more frequency allocations. Many schoolchildren have achieved a ham licence. The radio Tony Preedy has on board was bought second-hand for £300 but typically a new set for a beginner would be about £500 up to the most sophisticated at £7,000. A whip type antenna that could be used at home or on a boat can be bought from about £200, but usually on a sail boat a stay is used after fitting a pair of insulators. The main cost then being that of modifying the stay. The cheapest form of antenna for use at home would be a length of wire between a tree or pole in the garden and a chimney.

■ Visit **www.rsgb.org/foundation**



Classic Yacht Rally at Antigua – just one of the many places and events Tony Preedy has visited

Sources of onboard interference to HF radio reception

(Descending order of contribution)

- The regulator which the wind and or towed propeller shared.
- LED cabin lights.
- The charge boosting regulator for the alternator of the main engine.
- Autopilot motor's contactor.
- The fuel pump of the diesel-powered space heater.
- Seatalk and NMEA data buses that link the navigation and sailing instruments to a plotter and navigation computer.
- The forward-looking sonar.
- Automatic bilge pump.
- Pressurising pump for the domestic H and C water system.
- The fuel pump of the generator.
- Galley grey water pump.
- Deck-wash pump.
- Ventilation fan motors.
- Windscreen wipers

'My best long-distance contact was probably Hawaii from off the coast of Western Sahara'

takes place, the maximum current is near the top of the forestay. On some other frequencies, the maximum current is in the mast. I therefore consider the insulated backstay to be a means of coupling energy to the rest of the boat's standing rigging.

Consequently, bare rigging wires are an RF burn and Electromagnetic field (EMF) hazard which requires us to take care not to touch them or stand by them while transmitting. However, the stays have plastic tubes around their lower ends to minimise chaff on the sheets and these also protect the crew from RF burns.

BBC shipping forecast

We have an ICOM AT140 automatic tuner for the backstay. To convert it for my use it was only necessary to change the connector at the radio because it used the same control system as the ICOM SSB marine radio that had previously been on board. The AT140 can tune from at least 30MHz to well into the MF broadcast band although the rigging is too long for optimum performance above 10MHz.

My main interest was the amateur bands 1.8-7.2MHz but most of my activity was around 3.79MHz.The coax feeder from the tuner passes via a switch which can divert the antenna to the Locata marine SSB/ broadcast receiver.

On this radio, the BBC shipping weather forecast on 198KHz was receivable at night up to 1,200 miles and by day up to 800 miles from Droitwich, but only with everything else switched off. Fortunately, the antenna is self-resonant at 3.7MHz but it has a relatively broadband characteristic and may be used between 3.5MHz and 3.8MHz without the AT140.

The tuner is therefore only necessary for rare operation on other amateur bands and marine channels. I have a marine radio operator's license that includes SSB and the boat has her call-sign in addition to my ham call-sign to which the suffix MM is added.

On one occasion the ICOM radio received a soaking of salt water that stopped it working. Deciding I had nothing to lose, I immersed it in freshwater before drying it in the sun. After this, it worked as before except that it takes about 15 minutes to warm up. Presumably, there's still a bit of salt inside.

With everything else on board switched off, no electrical storm in the vicinity and clear of land the signal strength, or S meter, showed noise of only S1 or S2 on 3.7MHz with the preamp in the circuit. This compares with the S7 to S9 suffered at home and the S9+ we get on board when some of the other equipment is running.

Under these quiet conditions, I could surprise UK operators who were struggling to hear me because of their local noise by giving Q5 reports. To operate in this quiet state while sailing we had to forego most of the comforts on board. Maintaining our course then relied on the Hydrovane wind-powered steering system while navigation was by magnetic compass rather than the flux gate type or the satellite signals required by the navigation computer and electrical autopilot.

In the reciprocal direction, the radio caused many problems until I made quite a small change to the way the tuner was connected to the backstay.

Initially, this was made by an insulated wire that was taped to that part of the stay below the insulator. In this condition if I spoke on the radio the autopilot would go to standby, the chartplotter would switch itself off and the bow thruster, a 5KW motor driving a propeller that moves the boat sideways, would come on (how the latter could happen is a mystery). The change was to space the wire a few inches from the stay. After this simple modification, all the boat systems were instantly immune to HF radio transmissions except for the plotter which switched itself off.

Time zone considerations

Operating time while crossing the Atlantic Ocean was usually when the sun had just risen in the UK and had set in New Zealand. Signals generally peaked at this time and it suited my body clock which tended to keep UK time.

From the Caribbean, results were surprisingly good and reports received were generally better than those given to operators on the islands. Simultaneous contacts could be made with New Zealand, West and East USA, and the UK although the other operators could often not hear each other. My best long-distance contact was probably Hawaii from off the coast of Western Sahara.

There was never a day on which I operated the radio when contact with the UK on 3.7MHz was not possible. We visited most of the Caribbean islands, The Canaries, Cape Verde, Azores and sailed in the waters of Morocco, Western Sahara, Mauritania, Senegal and Venezuela.

Most of these had no reciprocal or CEPT licensing concessions so it was not politic to amend my call-sign with their International Telecommunications Union (ITU) prefixes. My legal amateur transmission was, therefore, confined to non-territorial waters. PBO