

6 Inverter/battery chargers on test

Inverters combine the convenience of 'mains' power with the freedom of batteries. But, as we know, there's no such thing as a free lunch, so anything you take out of a battery has to be repaid – with interest. Could combined inverter-chargers be the answer? Tim Bartlett finds out.

For about twenty quid, you can buy an inverter the size of a coke can or a couple of paperback books, which can convert ordinary battery power into something that is almost as good as mains electricity and is well up to recharging a mobile phone or running a small telly. Step up a size and an inverter can power a computer or a sanding

machine. Step up a bit further and you could power an electric kettle, a toaster or a microwave.

In fact, there's no real reason why a boat shouldn't have an all-electric galley: plenty already do. A typical electric hob only uses about a kilowatt per ring at full chat – about the same as a microwave or a toaster.

Kettles are relatively greedy, drawing anything up to three

kilowatts, but you could still turn out a full English breakfast without drawing more than about 10A of 240v mains power – so long as you're prepared to shop around for a suitable kettle and make the coffee before you start on the toast.

The snag is that there is no such thing as a free lunch – or a free breakfast! To get 10A of 'mains' power out of an inverter,

you have to put more than 200A of battery power into it. At that rate, you'll flatten a typical 'leisure' battery before your sausages are cooked.

So, if you plan to use an inverter as a realistic alternative to a gas bottle or a generator, you need to budget for some pretty serious battery capacity and some pretty serious charging facilities to go with it.

OUT OF THE BOX

STUDER XTENDER XTH3000/12 £1,958.73

The biggest and heaviest of the group is the Studer Xtender. It's beautifully engineered and boasts an array of up-market features, such as a facility that allows up to nine units to be interconnected to handle bigger loads or to provide three-phase power. These, and the fact that it is made in Switzerland, contribute to its position at the top of our price table – a position made unassailable by the fact that the 'optional' remote control adds another £156.28 to the price.



MASTERVOLT MASS COMBI 12/2000/100 £1,874.12

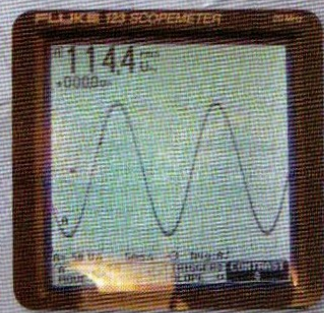
At just 11kg, the Mastervolt Mass Combi is by far the lightest of the group – less than a third of the weight of the Studer – so it came as no great surprise to find that in inverter mode its nominal output is also the lowest: there simply isn't the weight of copper wire in its transformer to cope with the sort of DC input current that is required to produce a big AC output. But it's well presented and its charger output is well up with the competition.



VICTRON MULTIPLUS 12/3000/120 £1,519.28

Victron, like Mastervolt, is a Dutch company and probably one of the best-known names in the business of on-board electrical power systems. Like the Studer, the Victron Multiplus is a sophisticated device that allows multiple units to be connected in parallel to handle large loads, or to produce three-phase power for things like diving compressors, or to use inverted power to supplement a low-rated shore power supply.





LEAGUE TABLE - FIRST IMPRESSIONS

	Rating
Mastervolt Mass Combi 12/2000/100	★★★★★
Victron Multiplus 12/3000/120	★★★★★
Sterling Pro Combi S 2500	★★★★★
Sterling Pro Combi Q 2500	★★★★★
Studer Xtender XTH3000/12	★★★★★
Powermaster SL Combi 3000SL	★★★☆☆

And that, of course, is where the inverter-chargers of this month's group test come in.

The idea is simple. When the boat is sitting at a marina pontoon – as most boats spend

most of their lives doing – the inverter-charger operates in charging mode, stashing away power in a substantial bank of batteries. When you unplug from the shore power supply, the

inverter-charger instantly switches into inverter mode, supplying

surrogate mains power to the boat's AC sockets.

POWERMASTER COMBI 3000SL £1,399.00

Powermaster is the new kid on the block: it's a Taiwanese company that was set up just eight years ago, but whose product range already covers a wide spectrum, from cheap and cheerful 150W quasi sine wave inverters to 320kVA uninterruptible power supplies. Tipping the scales at 28kg, the 3000SL is almost as heavy as the Studer and has the highest nominal AC output of the group, but its price is immediately appealing – particularly as it includes a remote control unit.



STERLING PRO COMBI S 2500 £950.00

Designed in Worcester, but assembled in Taiwan, the Pro Combi Q is a very recent addition to Sterling's range – so new, in fact, that at the time of our test ours was the only 12v version in the country. Apart from the Sterling Pro Combi Q, it's the smallest of the group by quite a healthy margin and it undercuts the price of its nearest competitor by more than 30 per cent. Its charging output of 50A is modest, but its AC output of 2,500W is well up to scratch.

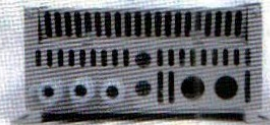


STERLING PRO COMBI Q 2500 £540.00

The cheapest of the group, by a massive margin, is Sterling's controversial Pro Combi Q. Externally, it looks almost indistinguishable from the Pro Combi S: what makes it controversial is the letter 'Q' and what it stands for. Conventional wisdom holds that quasi sine wave output isn't as good as sine wave. Sterling's response is that there is nothing wrong with sine wave except that there's nothing wrong with quasi sine wave!



INSTALLATION AND SET UP



There's nothing inherently complicated about installing an inverter charger – assuming, of course, that you've got a suitable space for it that is reasonably close to the batteries and that the boat's AC wiring is already in place. There are three essential connections to be made: the AC input, the AC output and the DC. Most inverter-chargers also have an 'optional' remote control panel – though it is more optional in some cases than in others. In any case, connecting it is dead easy: it's merely a matter of plugging a telephone or ethernet type cable into a socket on the inverter.

The AC in and out connections involve three wires each and are no more difficult than wiring a new socket into a domestic system at home.

The DC connection, in principle, is even easier: it's just two terminals, marked plus and minus, which have to be connected to the corresponding terminals of the domestic battery bank. The problem is the sheer size of the cables involved. As a rule of thumb, the cross section of the cable (in square millimetres) can be found by multiplying the wattage of the inverter by the length of the cable connecting it to the battery and dividing it by 120. So, for a 3kW inverter with

a 3m cable run, you're talking about $(3000 \times 3)/120 = 75\text{mm}^2$ cables. With a bit of insulation round them, the chances are that each cable will be as thick as your thumb.

It's also worth knowing that as you connect the DC cables, there is likely to be a startling blue spark, even if the inverter is switched off. You're less likely to jump if you're expecting it, but it's worth bearing in mind that from that moment on, there is at least the possibility of mains voltage AC being present inside the inverter. It pays to be careful!

The only product in the group that stood out as being significantly different, in this respect, was the Powermaster, which shared the DC current between two pairs of slightly thinner cables, rather than through one pair of thick ones. But it let itself down, rather, by using push fit connections rated at 120A each. Even in pairs, they aren't man enough for the three hundred-odd amps that we measured in the DC cable when it is running flat out.

For a straightforward installation, using a single inverter, the main part of the set up process is concerned with adapting the DC output of the charger to match the characteristics of the battery.

It's not the kind of thing you're likely to do very often, but it still came as rather a surprise to find just how complicated some manufacturers had chosen to make it. Despite its neat-looking remote control panel, the Studer was particularly bad in this respect, due mainly to its almost impenetrable and poorly translated manual.

The Victron too, was disappointing, depending on tiny dip switches to select the parameter to be adjusted, push buttons to make the adjustment and a complicated code of fixed and flashing LCDs to show the value that had been set.

Mastervolt also uses dip switches, but we found their system rather easier to use.

Powermaster's approach is better, using up, down and enter keys, of the type that most of us are completely familiar with,

and a simple digital display. But it could be better still. Is it really too much, in this day and age, to expect a product with a four-figure price tag to have an alphanumeric display, rather than having to refer to the manual to see that 'P13', for instance, means 'absorption voltage' or 'P15' means 'float voltage'?

Best of the bunch, by a country mile, were the two cheapies from Sterling. Whilst not boasting quite as many options as the others, they were both so easy to use that the manual – just four A4 sheets – was almost unnecessary. A rotary switch – recessed so that it could only be operated with a screwdriver – selects different battery types according to a numbered list. And if you lose the instructions, it doesn't really matter, because the list is printed on the machine as well as in the manual.

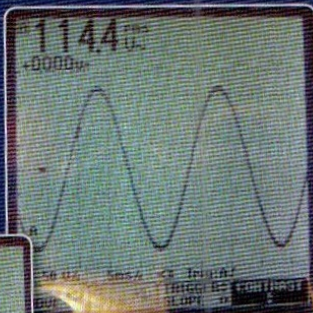
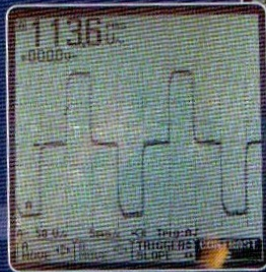
LEAGUE TABLE – INSTALLATION AND SET UP

	Rating
Sterling Pro Combi S 2500	★★★★★
Sterling Pro Combi Q 2500	★★★★★
Mastervolt Mass Combi 12/2000/100	★★★★★
Studer Xtender XTH3000/12	★★★☆☆
Victron Multiplus 12/3000/120	★★★★★
Powermaster SL Combi 3000SL	★★★★★

SINE WAVE OR QUASI SINE WAVE

There is a widespread and understandable belief that quasi sine wave, in which the voltage changes in a series of abrupt steps, is 'not as good' as 'pure' sine wave, in which the voltage changes smoothly and continuously. And it's quite true that some equipment intended for mains power will simply not work if it is connected to a quasi sine wave inverter, but the problem is less common than it is often made out to be and seems to be getting rarer.

We tried the only quasi sine wave inverter in the group on a variety of everyday appliances, including a microwave oven, with no problems and no measurable loss of performance.



Oscilloscope traces highlight the difference between quasi sine wave (left) and pure sine wave (above).

BELLS AND WHISTLES

The basic requirements of an inverter-charger combi are that it should invert DC power to AC and that it should convert AC mains power to DC to charge a battery. But once those boxes have been ticked, there are various other possibilities. The terminology varies between manufacturers, but these are some of the common ones.

Power Boost

It may say '16A' on the plug, but that doesn't mean your marina shore power socket is actually capable of supplying 16A. If the shore power supply is limited, 'power boosting' allows the inverter to make up the shortfall. So, if your shore power can only deliver 6A, but your electric kettle

needs 11A, the inverter will chip in to provide the extra five.

Power Share

This is almost the opposite of power boost. If the shore power is capable of delivering more than your appliances need, power sharing allows the combi to divert the extra power to the battery charger – charging at a reduced rate, if necessary, to avoid overloading the shore supply. So, if your shore power delivers 6A, but your toaster only needs 4A, the charger will operate at a reduced output to make use of the other two.

Paralleling

If you need more power than a single inverter can provide, the

obvious answer may be to use two or three. The snag is that alternating current, by its very nature 'alternates'. So, if you connect two independent AC supplies you need to make sure that they are in phase with each other – that their currents are flowing the same way at the same time. Some inverters can do this, but not all.

Charging from flat

All combis require some power to operate their own control systems and, because the whole point of an inverter is that it can provide mains power without being connected to the mains, it makes sense for it to draw its own operating power from the battery supply, rather than relying

on the mains. But what happens when the battery is completely flat and you plug into the shore supply to recharge it? You'd have thought the solution was obvious: allow the charger to draw its operating power from the mains. Unfortunately it can't be as obvious as all that, because some combis can't do it.

Control panels

One of the delights of a combi is that in normal use it is completely automatic. But the constant drain of a big inverter is quite significant, so, if nothing else, you are quite likely to want to switch it off. This makes remote control panels almost essential and yet they aren't always provided as standard.

PRODUCT	POWER BOOST	POWER SHARE	PARALLEL	FLAT CHARGE	REMOTE CONTROL
Studer Xtender XTH3000/12	Yes	Yes	Yes	No	Extra
Mastervolt Mass Combi 12/2000/100	Yes	Yes	Yes	Yes	Included
Victron Multiplus 12/3000/120	Yes	Yes	Yes	Yes	Extra
Powermaster SL Combi 3000SL	No	Yes	No	No	Included
Sterling Pro Combi S 2500	No	No	No	Yes	Included
Sterling Pro Combi Q2500	No	No	No	Yes	Included

CONCLUSION

Mastervolt Mass Combi 12/2000/100



Sterling Pro Combi Q 2500



As is so often the case, there were no 'bad' products in this group. There were, however, some that excelled in certain respects and others that were less impressive.

The pricey Studer, for instance, is nicely put together and delivered beautifully clean sine wave AC power, without even becoming warm.

But it let itself down by its sheer size and weight, by its impenetrable instruction manual

and disappointing charging performance.

The Powermaster, by contrast, was visibly built down to a price, but was easier to operate and turned in a respectable all round performance, particularly as a battery charger.

At the very bottom of the price range, the Sterling Pro Combi Q is a very recent introduction to the market, distinguished from the others in the group mainly

by its very low price. Compact, lightweight and easy to use, it let itself down only by its relatively disappointing performance as a battery charger.

Whether you agree with our choice of it as the best buy depends almost entirely on whether you are prepared to accept a quasi sine wave inverter. If not, the Pro Combi S is a sine wave version of the same thing.

The two big names in marine

power systems are probably Victron and Mastervolt.

On paper, there was no contest between them: the Victron offers more inverter output and more charger output, for less money. But the Mastervolt is so much lighter and easier to set up, and so much more efficient, that it's very difficult to split them.

Overall, the Mastervolt gets our vote – but only by the narrowest of margins.

LEAGUE TABLE – OVERALL PERFORMANCE	Rating
Mastervolt Mass Combi 12/2000/100	★★★★★
Sterling Pro Combi S 2500	★★★★★
Sterling Pro Combi Q 2500	★★★★★
Victron Multiplus 12/3000/120	★★★★★
Studer Xtender XTH3000/12	★★★★★
Powermaster SL Combi 3000SL	★★★★★

LEAGUE TABLE – BEST BUY	Rating
Sterling Pro Combi Q 2500	★★★★★
Sterling Pro Combi S 2500	★★★★★
Mastervolt Mass Combi 12/2000/100	★★★★★
Victron Multiplus 12/3000/120	★★★★★
Powermaster SL Combi 3000SL	★★★★★
Studer Xtender XTH3000/12	★★★★★

SPECIFICATIONS			Price		Size		Weight	Inverter	Waveform	Charger
Make	Model	Rating	£	h (mm)	w (mm)	d (mm)	kg	Nom output (kW)	Type	Nom output (A)
Studer	Xtender	XTH3000/12	1,958.73	230	399	500	34	note 1	sine	160
Mastervolt	MASS COMBI	12/2000/100	1,874.12	496	318	156	11	note 2	sine	100
Victron	MULTIPLUS	12/3000/120	1,519.28	362	258	218	18	2,500	sine	120
Powermaster	SL COMBI	3000SL	1,399.00	190	280	550	28	3,000	sine	100
Sterling	PRO COMBI S	2500	950.00	180	185	430	20	2,500	sine	50
Sterling	PRO COMBI Q	2500	540.00	180	185	430	20	2,500	quasi-sine	60
note 1	Specifications quote nominal power as 2,500VA (approx 2,250W)									
note 2	Specifications quote nominal power as 2,000VA (approx 1,800W)									

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