

# 17 battery chargers



Emrhys Barrell examines chargers ranging from the most sophisticated units to a

£30 eBay cheapie!

## ABOUT THE AUTHOR



Emrhys Barrell has worked in boatyards including Macwester, Groves & Guttridge and Palmer

Johnson, and built *Great Britain II* for Chay Blyth. He was technical editor of *Motor Boat & Yachting*, then set up *Motor Boats Monthly*, followed by *Luxury Yacht* and *Canal Boat & Inland Waterways*. He lives beside the Thames in Goring, south Oxfordshire, and is an expert in electric propulsion.

**F**or many boat owners, our portable battery charger spends most of its life at the bottom of a damp locker, or at the back of a dusty shelf in the garage. It's only dragged out when the batteries go flat, to put in enough charge to get the engine started.

But now, in its modern multi-stage form, it can play a vital role in extending the life of all your

onboard batteries.

## Battery theory

To understand why, we need to remind ourselves once again of the principles of the lead-acid battery. In its simplest form, this consists of two plates – one made of lead, Pb, and the other of lead oxide, PbO<sub>2</sub>. These are immersed in sulphuric acid, H<sub>2</sub>SO<sub>4</sub>. When the tops of the plates are connected, a voltage of 2.1V is generated and a current flows. At the same time, the lead and lead oxide convert to lead sulphate, PbSO<sub>4</sub>, and the acid to water, H<sub>2</sub>O. When this conversion is complete, the current stops.

To recharge the battery, a higher voltage is applied in the opposite direction, the plates convert back to lead and lead oxide, and the water back to acid.

If six pairs of plates are connected in series, we get our familiar 12V battery. This has a voltage of 12.6-12.7V fully charged, which reduces to 11.6V fully discharged. To recharge this, we need to apply a reverse charge of at least 1V more, so the charger will need to start with a voltage of around 12.6V, which increases to 13.6V as the end of

charge approaches.

However, this will only put 75-80% of the charge back into the plates. To get the last 25% in, the voltage has to rise to at least 14.4-14.5V, but this is getting close to the voltage at which gassing takes place.

When a battery gasses, the sulphuric acid breaks down into its component hydrogen and oxygen, which rise to the top of the liquid and form an explosive mixture above the plates or in the engine compartment.

Many older chargers simply ignored this problem, with their voltages rising uncontrolled to 15V or 16V and your boat or garage filling with the familiar sharp smell of hydrogen, just waiting for a spark to ignite it.

Or, if you forgot to switch it off, you came back in a week to a dry battery ready to explode.

With the advent of safety regulations, many chargers took the easy option by controlling the output to 13.6V, thus avoiding gassing, but never completely charging the battery. In a battery that is regularly never more than 80% charged, 20% of the plates will gradually sulphate, ie turn into a crystalline form of lead sulphate that will never convert back to

lead. As this process continues, your battery quickly loses all of its capacity until it becomes useless and you have to buy a new one.

And don't think the alternator on your engine will solve this problem. Again, to avoid the risk of gassing it will never deliver more than 14.2V, and this is at its terminals. By the time the electricity has travelled down thin wires, poor connections and splitting diodes,

the voltage reaching the battery will rarely be above 13.6V or so, and so the sulphation process will continue in secret.

### Multi-stage chargers

However, help is now at hand in the form of the modern multi-stage charger. Using electronics, these will charge the battery in carefully controlled phases, each one with preset current and voltage levels.

The number of stages and their functions will vary with the unit's sophistication and cost, but they should all reach 14.4-14.5V, at which point they will bring the battery close to 100% full and prevent sulphation taking place.

If you regularly hook them up to your batteries through the season, they will extend battery life by anything up to three or four years. Not only that, they will also ensure that you have the full 100% capacity for much of their lifetime instead of a rapidly deteriorating figure.

Most of the chargers we tested can also be left permanently connected to your batteries to keep them in top condition, but it is very important to note that they must always be plugged into the mains when connected. If you switch the mains off, the batteries will gradually discharge through the charger. This may only be milliamps, but over a period of weeks it will drain the batteries and cause sulphation.

Sophisticated chargers may have up to seven or eight charge stages in all, but most will have a basic three: in the first stage the current is held constant, usually at the charger's rated maximum. The battery's voltage gradually rises until it reaches 14.4-14.5V. This is called the bulk phase, and by the end of this the battery should have attained at least 80% of its nominal capacity.

The charger then enters the next phase, keeping the voltage constant while the final 20% is put in, with the charge current gradually falling. This is called the absorption phase.

When the current reaches a preset figure, the charger either switches off or moves into the final stage and the voltage drops to around 13.6V: the float phase.

After a preset time in this phase, the charger may switch off or it may continue indefinitely at the float voltage. If a load is applied to the battery in this phase, the voltage should rise to match this.



The diagram above shows the full set of stages a battery charger may provide. They are:

1. **Desulphation.** This applies pulses of current to break down sulphation on the plates. The effectiveness of this is doubtful.
2. **Soft start.** The charger gradually ramps up the current from zero to maximum to avoid sudden shocks to the plates, which will damage them.
3. **Bulk charge.** Constant current, increasing the voltage to around 14.4V and achieving 80% charge.
4. **Absorption.** Constant voltage, decreasing the current towards zero to charge the final 20%.
5. **Battery test.** The charger checks that the battery is holding charge.
6. **Reconditioning or equalisation.** The charger applies a higher voltage (up to 16V) but a low current, around 1% of the battery capacity. This stirs the electrolyte in a wet battery and equalises a gel battery, but should only be used occasionally, and in a well-ventilated space.
7. **Float.** The charger maintains voltage at 13.6V.
8. **Maintenance.** A pulsed current phase to extend battery life.

### Battery types

There are five main types of battery you may encounter.

■ **Open-cell wet lead acid, with liquid electrolyte.** Gas will be given off above the battery, and it may need topping up periodically. More tolerant of over-voltage, but it will gas.

■ **Sealed or closed-cell lead acid.** These have a liquid electrolyte, but sealed cells. The plates will have calcium added to reduce gassing, and cannot be topped up.

■ **Gel lead-acid.** Sealed, with the acid in a gel. They are more sensitive to over-voltage and can be permanently damaged by this. Maximum voltage should normally be 14.4V, but can rise above this if the current is kept low. Any gas

bubbles produced at the plates are recombined as they pass through the gel.

■ **AGM (absorbed glass mat) lead-acid.** The electrolyte is held against the plates in layers of mat. They are also sealed, need 14.7V to fully charge, and can be damaged if the voltage rises too high.

## Safe charging

**Even with modern regulated chargers you should observe the normal safety precautions when working with batteries.**

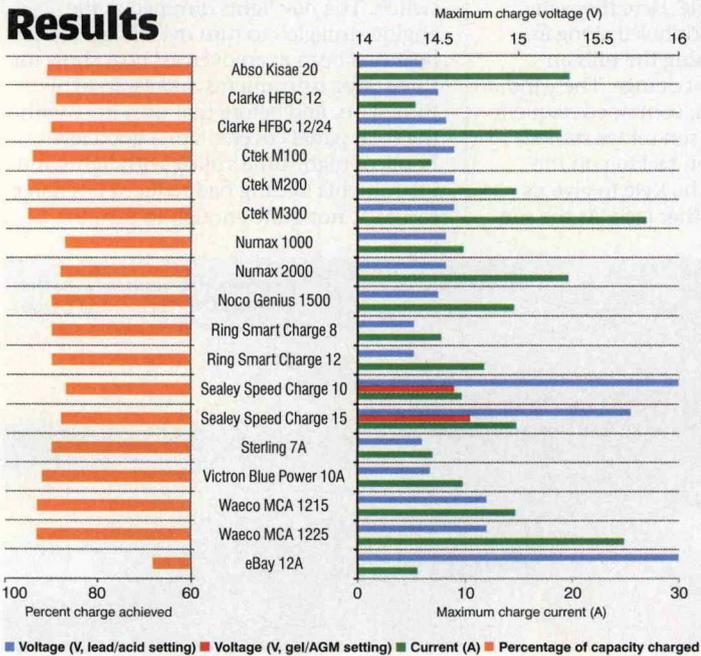
- Wear goggles and gloves, avoid sparks or naked flames, and always charge in a well-ventilated space.
- Connect the charger leads to the battery terminals first, before connecting to the mains or switching on, to prevent sparks – and always switch off before disconnecting the leads.
- Some chargers have a no-spark feature that stops current from flowing until the leads are connected – but don't rely on this.

Model	Rated Max Current (A)	Voltage (V)	Max test Volts Normal (V)	Max test Current (A)	Max battery Capacity %	Price (RRP)
Abso Kisae 20A	20	12	14.40	19.8	91	£240
Clarke 6A HFBC 12	6	12	14.50	5.4	89	£48
Clarke 20A HFBC 12/24	20	12/24	14.55	19.0	90	£84
Ctek M100	7	12	14.60	6.9	94	£130
Ctek M200	15	12	14.60	14.8	95	£175
Ctek M300	25	12	14.60	27.0	95	£280
Numax 10A 1000	10	12	14.55	9.9	87	£80
Numax 20A 2000	20	12	14.55	19.7	88	£120
Noco Genius G15000	15	12/24	14.50	14.6*	90	£185
Ring Smart Charge 8	8	12	14.35	7.8	90	£100
Ring Smart Charge 12	12	12	14.35	11.8	90	£110
Sealey Speed Charge 10A	10	6/12	16.0**	9.7	87	£80
Sealey Speed Charge 15A	15	6/12	15.7***	14.8	88	£95
Sterling 7A	7	6/12	14.40	7.0	90	£50
Victron Blue Power 10A	10	12	14.45	9.8	92	£105
Waco MCA 1215	15	12	14.80	14.7	93	£209
Waco MCA 1225	25	12	14.80	24.9	93	£259
eBay 12A	12	6/12	16.0+	5.6	68	£30

\* See the product notes \*\* This figure was on the Normal setting. Set to Gel/AGM it was 14.6V

\*\*\* This figure was on the Normal setting. Set to Gel/AGM it was 14.7V

## Results



## PBO verdict

**T**he portable charger market is in a state of flux at present as new EU regulations come into place. All chargers will eventually have to comply, which means some makers are taking longer to introduce new models so there are fewer about. Still, we found enough to give a good spread of performance and price.

If your batteries are around 100Ah, then you will need at least a 10A charger, in which case the Ring Smart Charge 12 at £110 came out best for performance, features and price, and this is a very new model, so fully compliant. If you have a larger bank, then

the Ctek M200 at £175 provides well-tryed quality, features and performance, while the Clarke 20A at £84 gives you maximum bang for your bucks in a simple no-frills charger.

But if you only have a 60-70A battery, then Sterling's 7A at £50 cannot be beaten.

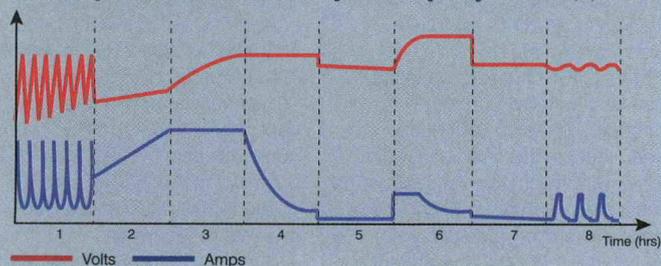
Both the Ctek 100 and Victron 10A are waterproof to IP65, useful if yours is a damp boat, and both will start a battery from zero volts.

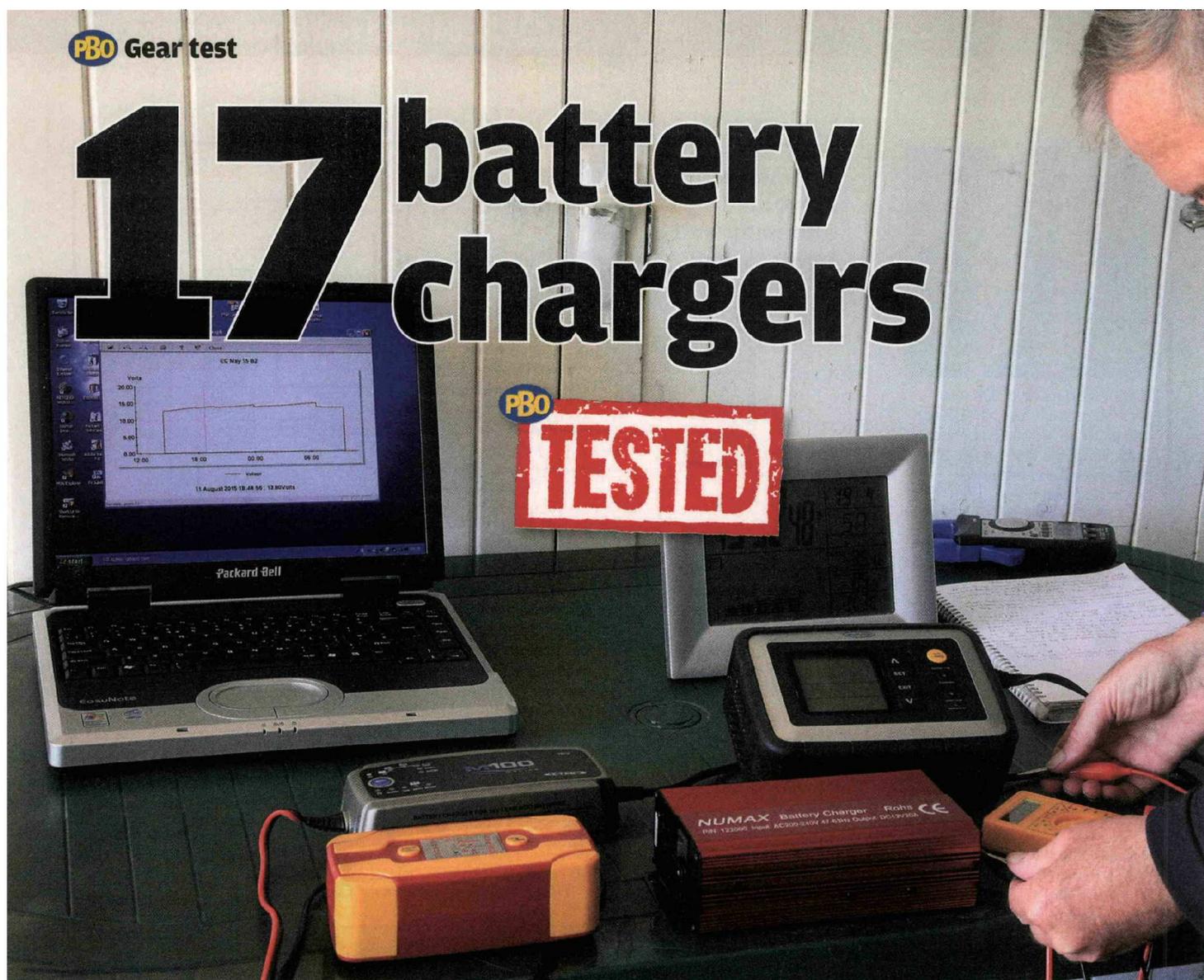
As usual prices vary if you shop around, but remember you may not always get the same after-sales back-up.

And if you think you'll save money going to eBay, then tread very carefully.

## Multi-stage charging

Different chargers will have some or all of these stages. Three-stage chargers will have 3, 4, and 7





## How we tested them

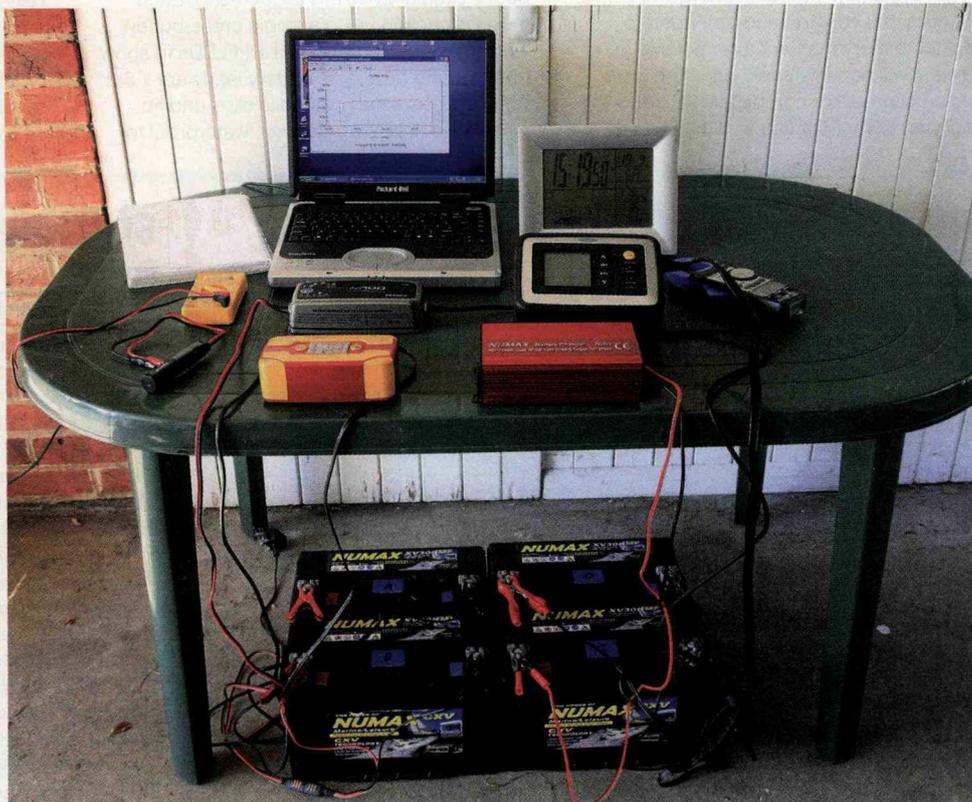
For our test we used four identical 105Ah leisure batteries. We discharged each of them down to 30% each time using a fixed current discharge tester, then connected up each battery in turn. We measured the resulting charging profile using data loggers on each unit, measuring current and

voltage for each phase over a full 24-hour cycle.

For practical reasons we were unable to test any claimed sulphation phases or long-term maintenance phases.

We recorded the time it took each unit to complete the bulk charge phase, how the bulk charge current related to the

unit's claimed output, and the maximum voltage they delivered during the absorption phase. We took chargers from all of the major manufacturers, and also went onto eBay and bought what purported to be an automatic charger, to see just what the bargain basement had to offer.



We tested the chargers using four identical Numax 105Ah leisure batteries discharged down to 30%

## Battery chargers on test

### Noco Genius G15000

**PRICE: £185**

Contact: [www.manbat.co.uk](http://www.manbat.co.uk)

From the Manbat stable is the Noco Genius G15000, a very sophisticated unit with a whole host of features. It will charge 12V or 24V lead acid batteries, including normal, gel and AGM, plus advanced AGM (as used in cars with stop-start systems). It will also charge 12V lithium cells, but you are recommended to contact the battery manufacturer before doing so. It will administer a 5-minute higher jump-start charge to a completely flat battery, and will start from 2V or below. It also has a

13.6V 5A supply mode, which can be used to run equipment or save memories in electronics. It is an 8-stage unit, with an initial analysis phase that checks the battery, plus soft start and the usual bulk, absorption and float phases.

Repair mode delivers 16.5V and 1.5A to desulphate and de-stratify, although you are advised to disconnect the battery from the boat's circuits while this is operating. Each mode is chosen using a single press-button with an illuminated icon trail and LEDs to show the charging progress. Battery leads are 1.8m, with large insulated crocodile clips and an in-line fuse. It is a rugged unit, waterproof to

IP44.

On our test it only delivered a maximum 9.6A into one 105Ah battery, but when we queried this with the makers they said its electronics govern the current to what it considers the battery is best able to accept, and so adjust automatically to the size of the battery. We therefore hooked two of them together in parallel, making 210Ah, and the current went up to 14.6A. Clever. Maximum voltage was 14.5V, and battery charge 90%.



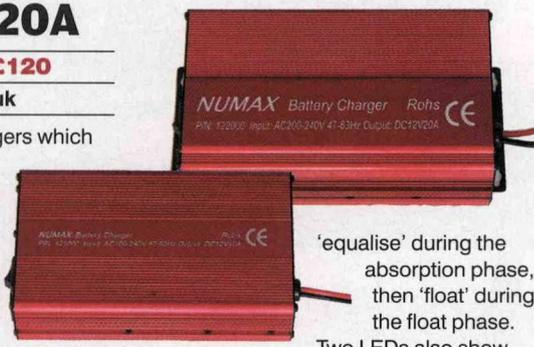
### Numax 10A, 20A

**PRICE: 10A £80, 20A £120**

Contact: [www.manbat.co.uk](http://www.manbat.co.uk)

Here's a similar pair of chargers which have been on the market for some years now under different brand names, and which have proved to be simple but reliable units.

They are basic 3-stage chargers, though the 20A model does have a slow start in the form of an initial 30-second phase at 50% current. It also starts with what is termed in the instruction leaflet a Pulse mode, which we presume is a desulphation phase. The 10A unit has a small LCD display that shows the state of charge of the battery in four steps from 25-100%. It also has a flashing 'charging' text, plus a fixed text that confusingly says



'equalise' during the absorption phase, then 'float' during the float phase.

Two LEDs also show the three stages.

The 20A model has an LED display which just shows the battery voltage, plus the same two LEDs. Both units reached a maximum 14.55V during absorption, then dropped to a 13.55V float. Their maximum currents were 9.9A and 19.7A respectively, with battery charges 87% and 88%. Both have 1.1m leads and partly-shielded clips.

## Sterling 7A

**PRICE: £50**

**Contact: [www.sterling-power.com](http://www.sterling-power.com)**

Sterling concentrate mainly on fixed chargers but they always have a small unit in their range, offering good performance at a competitive price. Presently it is the 6A, but we tested their new 7A, with many more features, which is about to come on the market.



The new unit will charge 6V or 12V batteries, with six battery types: flooded, gel, AGM, advanced AGM, calcium and lithium. It has three basic stages – bulk, absorption and float – but if it detects the initial voltage is between 7.5V and 10.5V, it goes into pulse mode to rescue a dead battery. You can also choose a 15.5V desulphation mode at any time. The maximum current can be set to 3A, 5A or 7A.

In our test it delivered a maximum 14.4V, 7.0A and 13.8V float, charging the battery to 90%. Its cables are 1.7m with fully shielded clips.

## Battery chargers on test

### Clarke 6A & 20A

**PRICE: 6A £48, 20A £84**

**Contact: [www.machinemart.co.uk](http://www.machinemart.co.uk)**

Another pair of chargers with different outputs, from a well-known maker in the automotive market. These are no-frills multi-stage units, but with some neat features, at competitive prices. They both have a diagnostic stage, plus soft start, bulk, absorption and float, but no conditioning or equalisation. They have just one charge cycle, covering wet, gel and AGM, and three settable currents – 2A, 4A and 6A for the smaller unit and 2A, 10A and 20A for the larger model. A compartment in the base allows you to stow the mains leads and 1.75m battery leads out of the way, avoiding



them dangling loose as you carry them. Press buttons make setting them up quick and easy. On test they delivered a maximum 14.50V, and 5.6A and 19.0A respectively, and charged the batteries to 89% and 90%.

### Abso Kisae 20A

**PRICE: £240**

**Contact: [www.merlinequipment.com](http://www.merlinequipment.com)**



Merlin did not have a portable unit available at the time of test, so they sent us their smallest fixed unit, the Kisae 20A. This is another sophisticated charger, with a corresponding price tag. It has three outputs, one for the main service bank and two more for engine start and generator start batteries. In use, the main bank gets the priority charging until it has reached float stage, when charging moves to the other two.

It can be set for four different battery types and end voltages: flooded lead acid (14.4V), gel (14.2V), AGM (14.3V) and lithium. The current can be set to 5A, 10A, 15A and 20A to suit the size of battery, and it will start as low as 2.5V. It has four basic stages – bulk, absorption, float, and maintenance every seven days, plus you can set equalise and recovery modes. There is also a silent setting that cuts the fan down overnight, and a power supply mode. A digital screen shows all the operating parameters, volts, amps, battery type and mode, for each bank. The unit is waterproof to IP32, and you have to make up your own leads.

On test it delivered 14.4V maximum and 19.8A, charging the battery up to 91%.

## Ring Smart Charge 8A, 12A

**PRICE: 8A £100, 12A £110**

Contact: [www.ringautomotive.co.uk](http://www.ringautomotive.co.uk)

These are two identical-looking models, but with different outputs, and are very sophisticated 7-stage chargers with a host of features. They can be set for standard lead-acid batteries, with a maximum 14.4V output charge, or AGM (as used in cars with stop-start systems) with a maximum 14.6V. They also have a winter mode, which increases

these voltages to 14.6V and 14.8V respectively. The input current can be set to levels from 2A upwards to cater for smaller batteries. They have a battery test feature which will measure the actual cranking amps of the battery compared to its rated figure, and also have an



alternator test mode. The recondition mode puts a low current into a deeply discharged battery, and the memory saver function allows you to change the battery without losing all the settings of the radio, etc.

The screen shows current, volts, percentage capacity reached and all the functions

activated. Setting up all these features was the most complicated process of the test, but we got there eventually.

The case is rubberised for protection, and the substantial cables are 1.5m long with large, fully-insulated crocodile clips. On test, their maximum wet voltage was 14.35V, with 13.60V float, and maximum currents of 7.8A and 11.8A. Battery charge was 90% for both. The 12A version costs only £10 more than the 8A, so it's well worth paying the extra.

## Ctek M100, M200, M300

**PRICE: M100 £130, M200 £175, M300 £280**

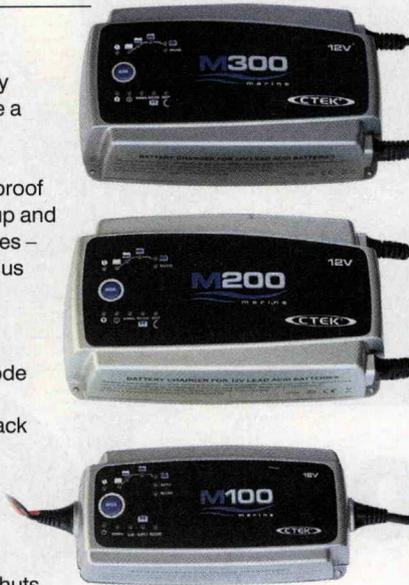
Contact: [www.ctek.com](http://www.ctek.com)

Ctek have led the field in microprocessor-controlled, multi-stage chargers for many years, and they have become a byword for quality, albeit at a premium price.

The units are robust, waterproof and incredibly simple to set up and use. There are two Ctek ranges – standard automotive units, plus marine versions. The latter have a few extra features – at a higher price – including longer cables and a night mode for the 15A and 25A models, which cuts the charge rate back and stops the cooling fan disturbing your sleep.

The 7A M100 is an 8-stage charger, with an analysis phase after the absorption phase. This first shuts off the current: then, if the battery voltage drops below 12V within three minutes, it signals a fault with the battery, usually when one cell has failed. A simple press-button sets the modes, which can be normal, for wet batteries; AGM, which also doubles as an increased voltage winter setting; or recondition, which stirs up the acid. Finally you can set supply mode, in which the charger just delivers a constant 13.6V, regardless of whether a battery is connected. The charger will start a battery that has fallen as low as 2V, or in fact below this if you use the supply mode. Cables are 2.3m long, with optional ring terminal ends or fully-shielded crocodile clips.

The M200 (15A) and M300 (25A) have the same features as the M100 but with longer 3.5m cables with ring ends, and a temperature probe as standard. They each produced a maximum 14.60V absorption phase, and 13.60V float. Maximum currents were 6.9A, 14.8A, and 27.0A respectively, and battery charges were 94%, 95% and 95% – the highest of the test.



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## Victron Blue Power 10A

**PRICE: £105**

**Contact: [www.victronenergy.com](http://www.victronenergy.com)**

The latest Blue Power model from Victron is a very interesting unit. It is waterproof to IP65, with 1.9m leads, and optional clips or rings. It can be set for three battery types: Normal, 14.4V, which it recommends for flooded batteries, flat plate gel, and AGM. High, 14.7V, is for flooded Calcium batteries, Optima high-performance spiral-cell AGM, and Lithium.

It is a 7-stage unit, with an initial test phase, plus two float phases, 13.8V for two days, which then drops to 13.2V, to prolong battery life. It also has an optional recondition phase. This delivers up to 16.5V, but at a maximum 0.8A. This will equalise wet or gel batteries, and de-sulphate the plates, though it admits this will only have limited effect. It can be set for low current, for small batteries, and has temperature compensation built in to the unit. It actually looks very similar to the Ctek 100 in size, features, mode of setting up, and performance, and like the Ctek it will start a battery from zero voltage, or operate as a 12V power supply.

On test it delivered 14.45V maximum, and 9.8A, charging the battery to 92%.



## eBay 12A charger

**PRICE: £30**

The advert for this said 'Automatic 12A charger', so for just £30 it seemed we couldn't go wrong.

Sadly, when it arrived the reality did not match the claims. In the instruction leaflet, the 12A was termed an RMS rating, which stands for root mean square, and really only applies to alternating currents. It never delivered more than 5.6A and, as for being automatic, on test it never turned off. When the voltage went past 16V and was still rising, we switched it off for safety reasons. Verdict – don't bother.

