

TWCE ADVANCED ELECTRONIC REGULATOR

You need your batteries charged quickly, completely, safely and efficiently – so you need to fit a TWC ADVANCED ELECTRONIC REGULATOR.

Boat batteries have a hard life. We expect a lot from them – sometimes in an emergency – so it pays to keep them in good working order.

Problems arise from deep discharge over a period – caused by lighting, VHF, refrigerator and all other kinds of equipment draining the battery while the engine is not running.

So if you only use batteries for engine starting – and *always* re-charge them straight away – don't read on. You won't need a TWC REGULATOR.

You may be surprised to learn that a half-discharged battery can never be fully re-charged by a standard alternator and fixed-output charging regulator. At best you may get 70% of the rated capacity restored. The battery actually resists further charging.

Left in that state, the extra 30% will be permanently lost, through sulphate deposits on the plates. Repeat this process and you will lose even more capacity, until your batteries are ruined.

BATTERY THEORY – COUNTER VOLTAGE AND SULPHATION

To charge a battery you need to overcome the battery's counter voltage. This creates a resistance which increases as the charging proceeds – so the current drops to a minimal level long before the battery is fully charged. This is caused by poor diffusion of electrically-charged ions within the battery cells.

The sulphuric-acid electrolyte can become fully restored in the vicinity of the lead plates, but this benefit is not rapidly spread to the bulk of electrolyte in the cells.

Discharging a battery reduces the specific gravity (S.G.) or weight of the acid electrolyte. Re-charging has the opposite effect, increasing the S.G.

With a rapid discharge – such as with engine starting – the electrolyte is only affected in the immediate area to the plates. The slow diffusion effect prevents the entire charge of electrolyte from becoming affected – in the short term. Normal charging can restore the battery quite easily.

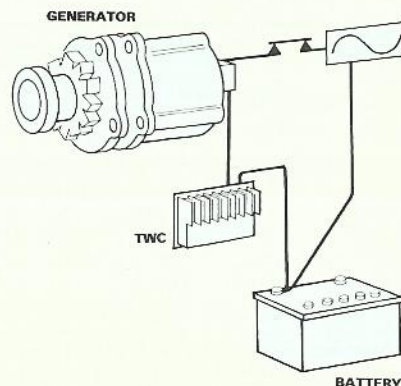
With a slow discharge, the entire volume of electrolyte is affected. When you come to re-charge, the slow-diffusion effect is working against you. The acid near the plates is easily restored (specific gravity increased) but the benefit is localised. The battery gives the "impression" that it is fully charged, when it is not.

Simple regulators are baffled by this phenomenon. As they maintain a fixed voltage, the charging current reduces to a trickle when faced with increased resistance.

SULPHATION is caused by inadequate charging, at too low a voltage.

An incomplete chemical reaction in the battery cells causes harmful deposits of lead sulphate ($PbSO_4$) to form on the active surface of the plates.

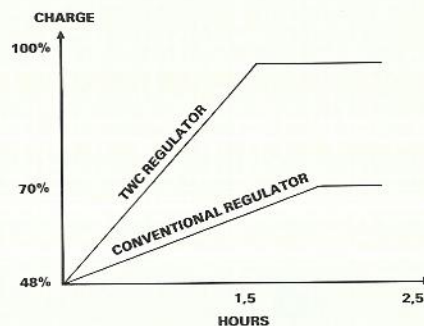
These deposits reduce charging capacity, by inhibiting current flow and increasing the "diffusion resistance" – creating a vicious circle of damage which is usually permanent.



TWC – THE FUNDAMENTAL DIFFERENCE

The TWC regulator overcomes the counter-voltage by using micro-chip technology.

- ▶ It measures the true battery status – voltage and temperature – at the battery terminals. Using this information and a sophisticated charging program, it controls the charging voltage.
- ▶ Alternating periods of high and low voltage are used to "pump-up" the battery.
- ▶ The low-voltage rest periods allow counter-voltage to level out.
- ▶ There is no risk of gassing. Sulphation is prevented.
- ▶ By measuring directly at the battery, TWC is not misled by circuit losses. It compensates for these and applies the correct voltage required at all times.



A TWC chooses the correct charging voltages – both high and low – according to the battery temperature. Colder batteries require higher voltages to overcome increased resistance. Standard regulators cannot do this (see diag A).

B After a five-minute period of normal charging (lower voltage) the voltages are applied in eight alternating phases of high (12 minutes) and low (2 minutes) (see diag B).

- A** 5 minutes at lower voltage.
- B** 12 minutes charge at higher voltage.
- C** 2 minutes charge at lower voltage – to relax the battery.
- D** One-hour rest period at lower voltage to prevent gassing and over-charging.

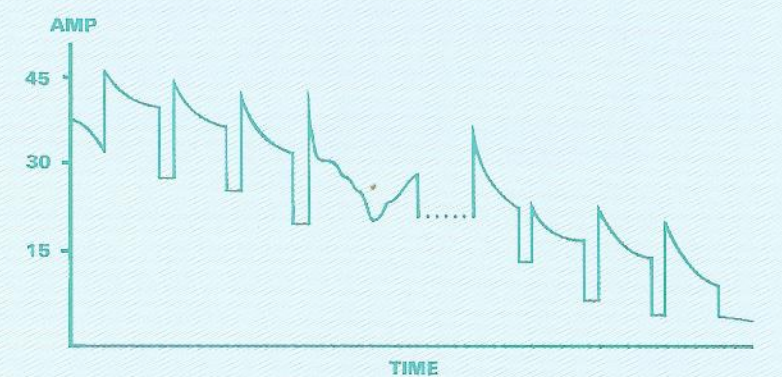
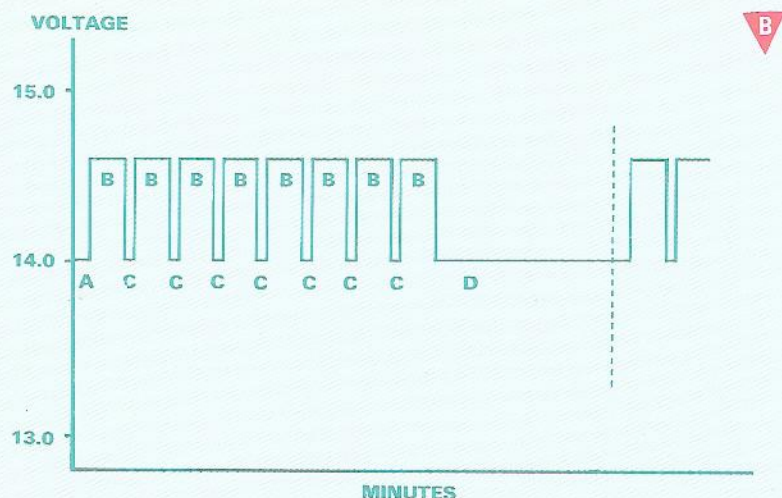
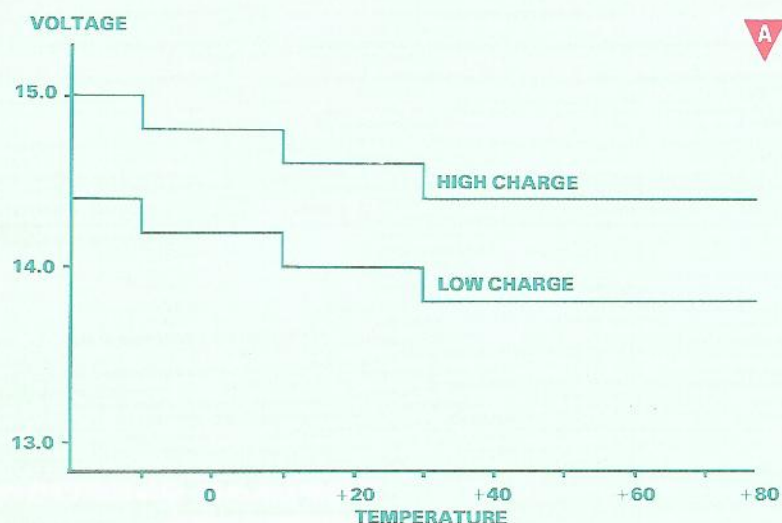
The cycle is then repeated if needed; otherwise charging continues at lower voltage.

The effect on current flowing to the battery is shown in diag C.

C After each low-voltage phase, a brief high current flows. This creates a stirring action in the electrolyte, which prevents sulphation. In some cases, this can actually break up existing sulphate deposits.

An in-built timer performs two useful functions:

- ▶ If the ignition is switched off, TWC remembers where it was in the charging cycle. It will continue where it left off, if you re-start the engine within one hour. After this time it will switch itself off (having only consumed 15 milli-Amps).
- ▶ If the generator output voltage falls below an adequate level (e.g. the engine is idling) TWC will stop timing its charging phases. Timing will resume when sufficient voltage is available.



ALARM FUNCTION — THE ADDED BONUS

The TWC indicator light gives two useful alarms.

Normal "ignition warning" lights only show up generator failure or fan belt breakage/slippage.

TWC's own lamp blinks, at two speeds:

SLOW BLINK

one per second — means the battery is discharging. The boat is drawing more current than the generator can supply. This can be due to —

- ▶ Low generator r.p.m.
- ▶ Too many electrical accessories in use.
- ▶ Faulty generator.
- ▶ TWC voltage sensor detached from battery.
- ▶ Over-voltage alarm function, indicating earth leakage or failed regulator.

In most cases, increasing engine revs or switching off some equipment will extinguish the lamp.

FAST BLINK

three per second — shows excessive circuit losses. This normally means —

- ▶ Inadequate battery cable size.
- ▶ Corrosion at terminals or connections.
- ▶ Worn contact breakers.

These can then be instantly investigated.

FIT A TWC REGULATOR IF:

- ▶ You have ever flattened a "domestic circuit" boat battery.
- ▶ You find you are replacing batteries frequently.
- ▶ A boatyard has suggested more batteries, larger batteries, high capacity "traction batteries", more powerful alternators.
- ▶ You want trouble-free, worry-free boating.

FIT YOURSELF OR ASK YOUR DEALER

TWC Regulators are available from our nationwide dealer network.

You can install yourself — with the easy instructions provided. All wiring is colour-coded in a neat loom. One wire inside the alternator has to be cut.

If you are at all unsure about electrics — don't worry. Our dealers are fully trained to install quickly and competently. They will also give you excellent advice on all electrical matters.

POPULAR QUESTIONS ANSWERED

WHAT IS THE T.W.C.?

The TWC Advanced Electronic Regulator is a charging regulator for alternators. It controls the alternator's output voltage. It does not take the charging current. It will keep your batteries in good condition, but will not recover damaged batteries.

HOW MANY BATTERIES WILL IT CHARGE?

The TWC Regulator controls output from the alternator, therefore the number of batteries is not important. The only thing to remember is that the red wire must be connected to the positive battery terminal.

HOW DOES THE TWC FIT INTO THE CHARGING SYSTEM?

The TWC has its own plug-in wiring harness which plugs into the TWC black box.

The black box should be mounted in an area which is dry.

The harness has colour coded wires.

TWC HARNESS WIRES	ALTERNATOR CONNECTIONS
BROWN	Low current output L WL 1 61 D+ IND
BLUE	High current output B+ A A1 +B Batt. 30
BLACK	Negative B- D- Neg. E.G. Grd. M- 31
GREEN	Field Winding Field Brush. DF. EXC. F. Field M.67
RED with temperature sensor.	Battery + connect to common positive terminal on battery selector switch or when blocking diodes or split charge relays are used connect to domestic battery positive terminal. Red wire must always be connected to positive battery terminal.
YELLOW	TWC alarm function- optional kit available

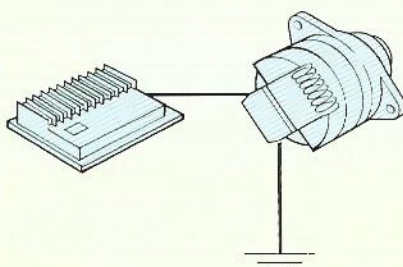
IF THE RED SENSE WIRE IS CONNECTED TO THE DOMESTIC BATTERY WON'T MY ENGINE BATTERY BECOME OVERCHARGED?

Because a battery will only accept the charge from the alternator when it needs it, the dedicated engine start battery will simply take what charge it requires to replace energy used when starting the engine, then the charge will only be accepted by the domestic battery as they are linked together whilst charging. The TWC red sense lead is also able to sense the engine start battery and will not over-charge it. The difference between the two batteries will be .5 volt.

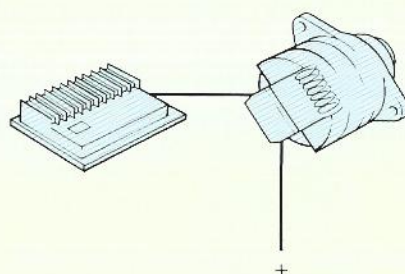
WHICH VERSION DO I NEED?

When selecting a TWC Regulator, you must first know what voltage your system operates on: 12 or 24 Volt. Secondly, which polarity you need: positive or negative. The positive or negative has nothing to do with the way the batteries are connected to earth, but the way the alternator's field is connected.

A positive regulator puts positive voltage via a brush to the field from the regulator. This means the other end of the field winding has to be connected to negative to complete the circuit. In this case a positive regulator is required.



A negative regulator switches one end of the field to negative via the brush. This means the other end of the field winding has to be connected to positive to complete the circuit. In this case a negative regulator is required.



T.W.C. REGULATOR APPLICATION CHART

ALTERNATOR TYPE	TWC 37788 12V NEG.	TWC 37789 12V POS.	TWC 37786 24V NEG.	TWC 37787 24V POS.	ACCESSORIES
LUCAS A 127	•		•		07795 Brush Holder
LUCAS ACR 17-25	•		•		
PARIS RHONE	•		•		Brush Holder
A.C. DELCO	•		•		
MITSUBISHI	•				
HITACHI	•				Plug & Socket Set
LUCAS A.C. 5	•		•		
LUCAS 11AC		•			
SEV MARCHAL		•			
BOSCH K1-N1		•			07779 Brush Holder
BUTEC				•	
MOTOROLA 9AR		•			
Valeo: These alternators are Paris Rhone or Motorola. Please contact your TWC dealer for help on identification.					

Please note: T.W.C. is unsuitable for installation on outboard motors and dynamos. Also, some alternators on old engines give low outputs. This is due to

their design i.e. SEV Marchal on old Volvo's 28 amp. In this case it may be better for the owner to fit a large output alternator.

If your alternator is not on this list, ask your dealer or our Service Department for advice.

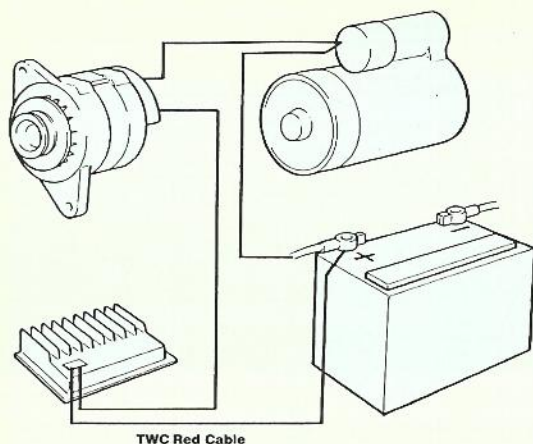
WILL IT WORK WITH MY SYSTEM?

The TWC Regulator will function with:

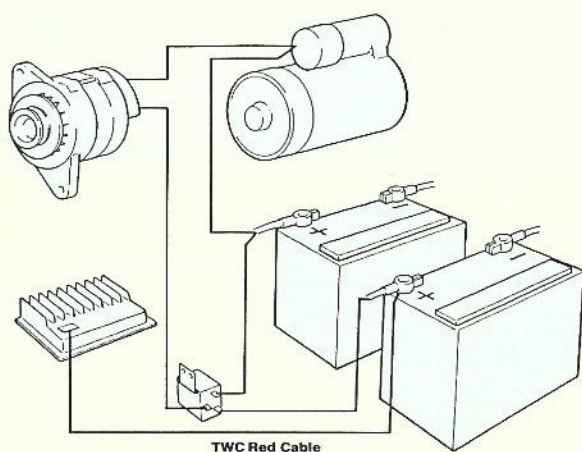
- ▶ 1, 2, 3 or 4 battery banks.
- ▶ 1 or 2 engines/alternators
- ▶ Blocking diodes, split charge relays or selector switches. These devices allow multiple batteries to be charged by one alternator but will not allow one battery to discharge one into another.

DIFFERENT CHARGING SYSTEMS IN BOATS

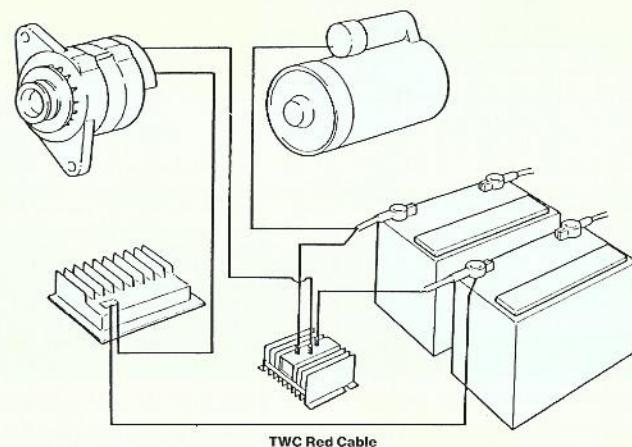
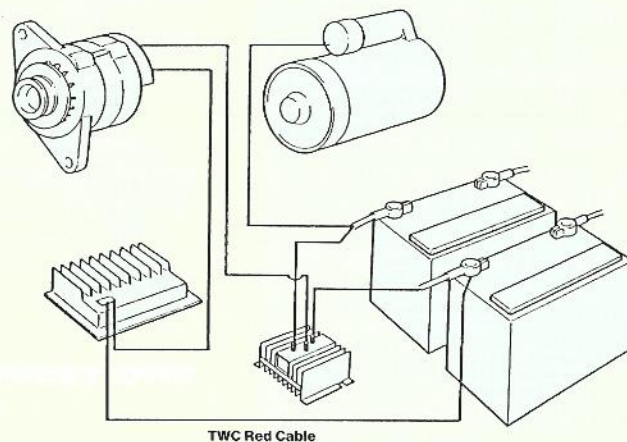
1 Battery-system, 1 alternator, 1 TWC regulator. TWC Red Cable to battery+



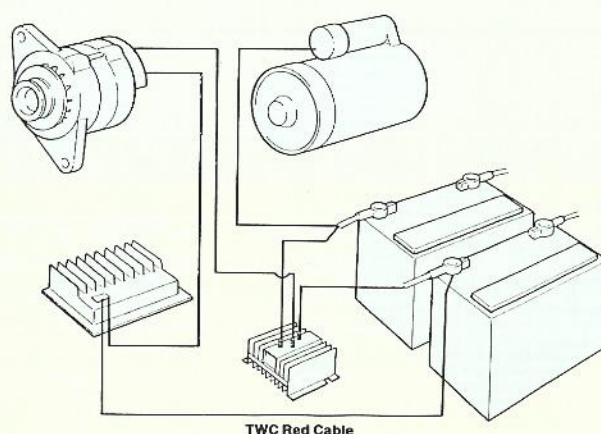
2 Battery-system, 1 alternator with split relay, 1 TWC regulator. TWC Red Cable to domestic battery+



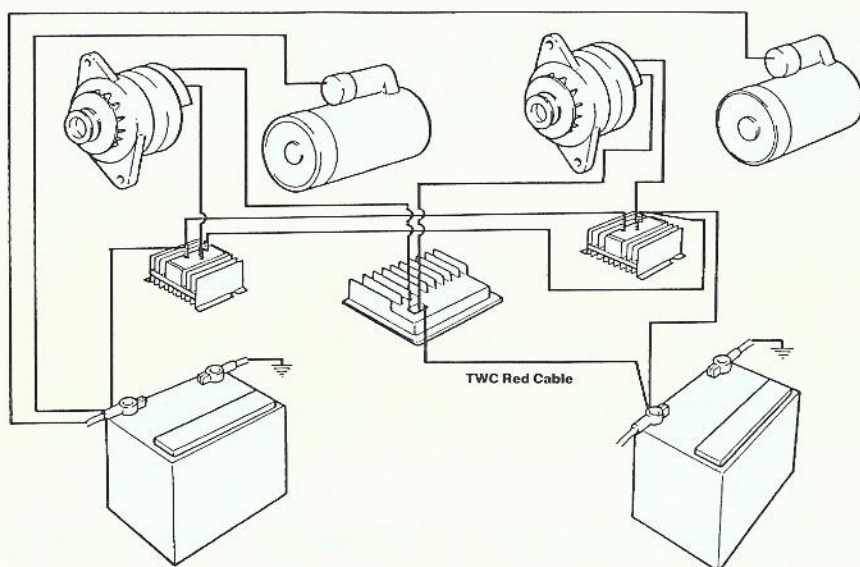
4 Battery-system, 2 alternators with blocking diodes in each system, 2 TWC regulators. TWC Red Cable domestic battery+



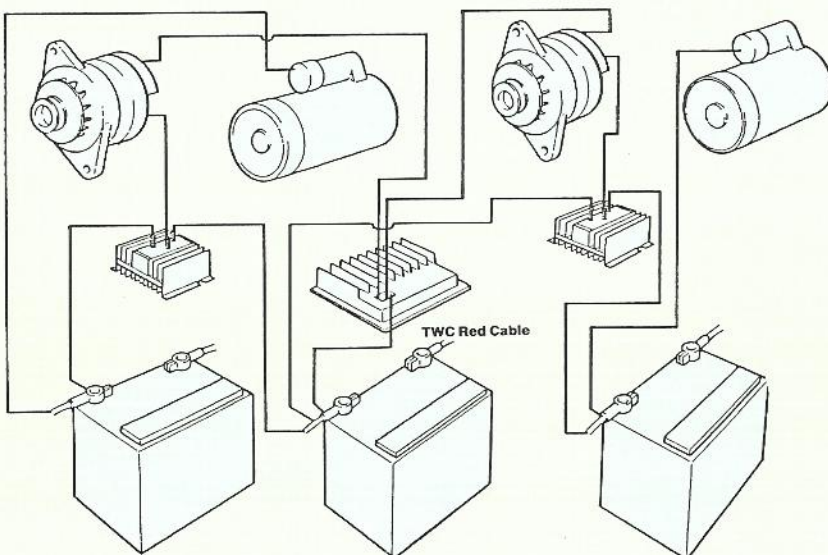
2 Battery-system, 1 alternator with blocking diode, 1 TWC regulator. TWC Red Cable to domestic battery+



2 Battery-system, 2 alternators with blocking diodes, 1 TWC regulator.
TWC Red Cable to domestic battery +



3 Battery-system, 2 alternators with blocking diodes, 1 TWC regulator.
TWC Red Cable to domestic battery +



2 Battery-system, 1 alternator with battery switch, 1 TWC regulator.
TWC Red Cable to common + terminal on switch

