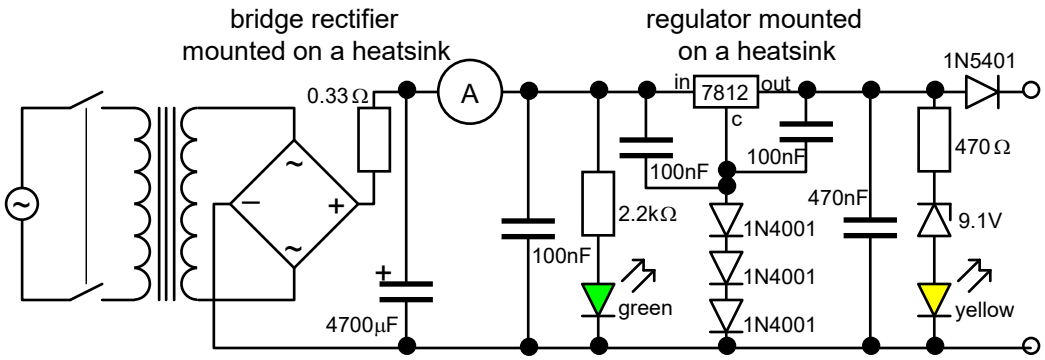
12V Battery Charger.

Specification

Charges 12V lead acid batteries.
End terminal voltage is 13.6V
Maximum charging current 1.5 - 2.5A (depends on type of 7812 used)
Short circuit protected (1.5A)
11V LED indicator (yellow).

Circuit diagram



The transformer is rated at 15V, 4A and was liberated from a very old battery charger. The bridge rectifier is a 10A device, mounted on a heat sink. The green LED serves as a power on indicator. The ammeter was also liberated from the old battery charger.

How it works

The mains is supplied via a fused 3A plug. The switch serves as an On/Off switch.
The transformer provides a 0 - 15V alternating supply which is changed into a direct current by the bridge rectifier. To limit the surge current to the 4700μF smoothing capacitor when switched on, the positive line passes through a 0.33Ω resistor and than onto the ammeter, which indicates the current supplied to the battery being charged. The green LED and associated resistor show when the unit is switched on and the direct voltage is avaliable for the 7812 regulator.
There are several different versions of the 7812 regulator, and either the 7812 or 78S12 should be used as these will supply a larger current than the 78M12 version.
A 12V lead acid battery should be charged with a constant voltage supply of between 13.6V and 14.4V.To ensure that the 7812 can supply this higher voltage, three 1N4001 diodes are put into the common lead circuit of the regulator to increase the voltage by about $3 \times 0.75V = 2.25V$, giving a voltage of approximately 14.35V. The 1N5401 diode in the positive supply line isolates the battery from the circuit when the charger is switched off. It also lowers the voltage to the battery by approximately 0.75V giving 13.5V. (The measured output voltage was 13.6V).
The yellow LED is lit when the output voltage to the battery is greater than approximately 11V. This is achieved by the LED needing approximately 2V to light and is in series with the 9.1V zener diode. This indicator is useful as it indicates when the regulator is current limiting and the output voltage is below 11V.

If the battery is very discharged, then it will attempt to draw a significant current. The 7812 regulator is rated at a current of 1A, but the prototype was able to supply a maximum current of approximately 2.2A at a reduced voltage. Any attempt by the battery to draw more current makes the regulator current limit and start to reduce the current supplied - the short circuit current being measured at 1.5A.
As the battery charges, the current will decrease and the regulator returns to providing a constant voltage of approximately 13.6V. This voltage is suitable for keeping fully charged batteries topped up - float charging.
The 7812 needs to be mounted on a large heat sink to ensure that it can dissipate the heat produced especially when operating in current limiting mode (potentially in excess of 30W).

The prototype was largely wired point to point, with an old tag board used to secure some of the connections. It was built into the old battery charger case.

Battery care

A 12V lead acid battery can be considered to be fully discharged at a terminal voltage of 11V.

A 12V lead acid battery can be considered to be fully charged at a terminal voltage of 12.9V
A battery should be allowed around 20 minutes for its terminal voltage to settle following being charged or discharged.

Aim to keep 12V lead acid batteries at a terminal voltage of >12.3V.

To float charge a battery, a supply of 13.5 - 13.8V should be used.

Charging with a terminal voltage of 14 - 14.5V, will charge the battery much faster but runs the risk of doing permanent damage to the battery if it is allowed to overcharge.

Lead acid batteries should always be stored fully charged.

Heat is detrimental to the life of batteries - store in a cool location.

ALL lead acid batteries (including sealed ones) need to be checked for electrolyte level and topped up with distilled water when necessary. The top of the plates should just be covered.