Desulphater for Car Batteries

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Even if you take great care of your car or motorbike battery, you're bound to have noticed that its life is considerably shorter than the high purchase price and sales pitch probably led you to expect. Of course there are several reasons for this, and high on the list is the phenomenon of slow but inevitable sulphating of the plates. To understand properly what this involves, we need to look at a bit of chemistry.

A lead/acid battery exploits a chemical reaction which is written as follows, when discharging:

Pb + 2H2SO4 + PbO2 —> PbSO4 + 2H2O + PbSO4

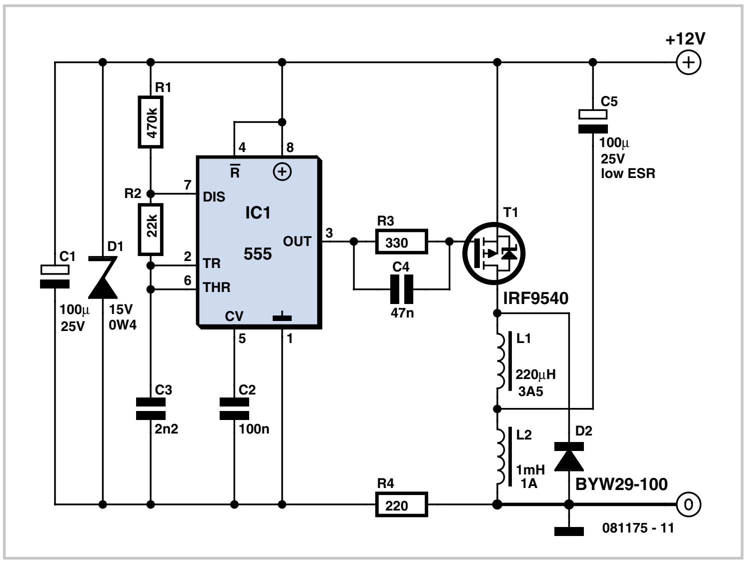
This indicates that, in contact with sulphuric acid, the porous lead of one plate and the porous lead dioxide of the other are both converted into lead sulphate and water. During charging, the following reverse chemical reaction occurs:

$PbSO_4 + 2H_2O + PbSO_4 \longrightarrow Pb + 2H_2SO_4 + PbO_2$

This time, the electric current being passed converts the lead sulphate and water into lead, lead dioxide, and sulphuric acid. In theory, the reaction is totally reversible, which is why a battery can be charged and discharged a great many times.

Unfortunately, with the passing of time and successive charge/discharge cycles, the second reaction, i.e. the one that converts the lead sulphate back into lead, becomes incomplete, and leaves some lead sulphate on the surface of the battery plates. As this is a poor conductor, it tends to get thicker in places where it has started to collect, and unfortunately this phenomenon of sulphating, for that's what it's called, is cumulative and gets worse and worse as time goes by.

Once a battery has got badly sulphated beyond a certain point, no standard charging process is able to recover it. What happens is that, because the lead sulphate Is a poor conductor, the battery's Internal resistance Increases, which In turn reduces the charging current, and thereby the effectiveness of the charging chemical reaction; this in turn leaves even more lead sulphate on the plates… and so it goes on, in a vicious circle. There is a chemical process that makes it possible to eliminate the lead sulphate from a battery before it's too late, but it's a tricky operation and uses highly corrosive chemicals that are dangerous to handle. What's more, many of the batteries sold these days are sealed and so it's impossible to gain access to their electrolyte without damaging them.



The project we're suggesting here lets you desulphate your battery electronically — and the sooner you start doing it, the more effective the process will be. It is based on research carried out in the United States, which showed conclusively that if you apply short, high-amplitude pulses to the battery, the resulting ionic agitation produced at the battery electrodes gradually breaks up the lead sulphate crystals. Even if you're a bit sceptical about the effectiveness of this process, you can try it out for yourself without any great financial risk, as the circuit required is simple and cheap. Nothing ventured, nothing gained!

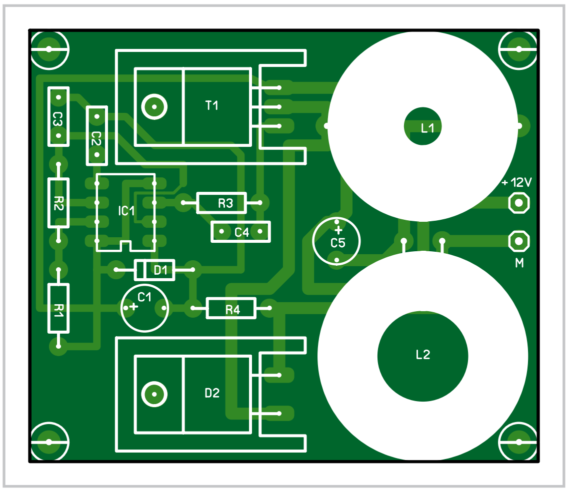
The circuit used is very similar to the one currently to be found in the United States, where this type of desulphating process is popular as well as widespread. Apart from a few details, it's pretty much like a 'boost' type switch-mode power supply unit (SMPSU) — i.e. one that steps up the input voltage. IC1 is wired as an astable multivibrator running at a frequency of the order of a kilohertz and generates very short mark/space (on/off) ratio pulses at its output.

When T1 is turned off by the level of these pulses, capacitor C5 is able to charge up to the battery voltage through inductor L2. When T1 turns back on again, which happens for only a very short time, given the mark/space ratio of the pulses, capacitor C5 discharges abruptly via T1 and L1. When T1 then turns off again, the inductor L1 means that the discharge current can't stop instantly. So it is obliged to pass through the battery via diode D2.

With a high-quality capacitor for C5 (meaning a device with a low ESR) and a short connection in heavy-gauge wire from the circuit, we can push a peak current of some 5 to 10 A through the battery. Despite this, the power consumption of the circuit is still fairly low, of the order of 40 mA, because of the very low mark/space ratio of the signals produced.

Construction shouldn't be any problem, especially if you use the printed circuit board design suggested [1], but for optimum performance, you do need to pay careful attention in choosing the components.

The inductors used must not be changed. They are available, for example, from Radiospares (RS Components) as part numbers 228-422 (L1) and 334-9207 (L2). Diode D2 is a readily-available type and should only be replaced if this is unavoidable, and then only by an ultra-fast device. Capacitor C5 must be a low series resistance type, such as those intended for switch-mode power supplies. As can be seen from the component overlay of the PCB designed by Elektor Labs, T1 and D2 are fitted with small U-shaped heatsinks designed to take TO-220 packages.



It is advisable to install the circuit into an earthed metal case, as it generates quite severe electromagnetic interference that it's best not to allow to radiate out as it is likely to upset the operation of other equipment. EMC regulations and recommendations apply here.

The battery connection must be made using short wires, of at least 2.5-3.0 mm^2 gauge (AWG # 12-13), securely connected to the battery terminals, since for the process to be effective, it's important to minimise any series resistance between the circuit and the battery. If necessary, it can be left permanently connected.

Some writers and pundits advise connecting a charger (even a low output one) to the battery at the same time, to avoid the circuit's discharging the battery in the long term. But we would not recommend doing so, since the charger's relatively low output impedance distorts the pulses produced by the circuit and hence diminishes its effectiveness.

COMPONENT LIST

Resistors

R1 = 470kΩ
R2 = 22kΩ
R3 = 330Ω
R4 = 220Ω

Capacitors

C1 = 100µF 25 V
C2 = 100nF
C3 = 2nF2
C4 = 47nF
C5 = 100µF 25 V, low ESR

Semiconductors

D1 = 15 V 0.4 W zener diode
D2 = BYW29-100
IC1 = NE555
T1 = IRF9540

Inductors

L1 = 220µF 3.5A
L1 = 1mH 1A

Cautionary advice. If you use this desulphater directly on your vehicle battery, remember to disconnect at least one of the connections to the battery, as the parallel impedance of the many devices that stay permanently powered in modern cars once again diminish the effectiveness of the system.

(081175-I)

Internet Link

[1] www.elektor.com/081175

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081175-1: PCB layout (.pdf), from [1]