Lead Acid Battery Desulfation Pulse Generator

Some help and information for builders

***NEW:* Parts kits available, now with peak reading option**

(Last update Sept 20 '02)

This ever growing page is intended to provide builders of the battery desulfator circuit, as shown in Home Power Magazine, issue number 77, with additional information. (Here is the original article, PDF format.)

Please note that due to time constraints, I am not able to answer desulfator related questions any longer. I would ask all those needing further assistance to please submit your questions to the desulfator BBS. Thanks for your understanding.

The volume of email has made it clear that a few more details are needed. This circuit has been duplicated by many around the world. (Africa, India, Indonesia.....) Anyone with soldering skills can build the unit. There are many reports of successful battery reclaimation after more than a year of testing, so it can be safely said that this technique is valid. While there are a number of commercial units available now, this circuit represents the lowest cost way to rejuvenate tired batteries. I have included complete technical details so that anyone with typical electronics skills can adapt or modify the circuit to their specific needs.

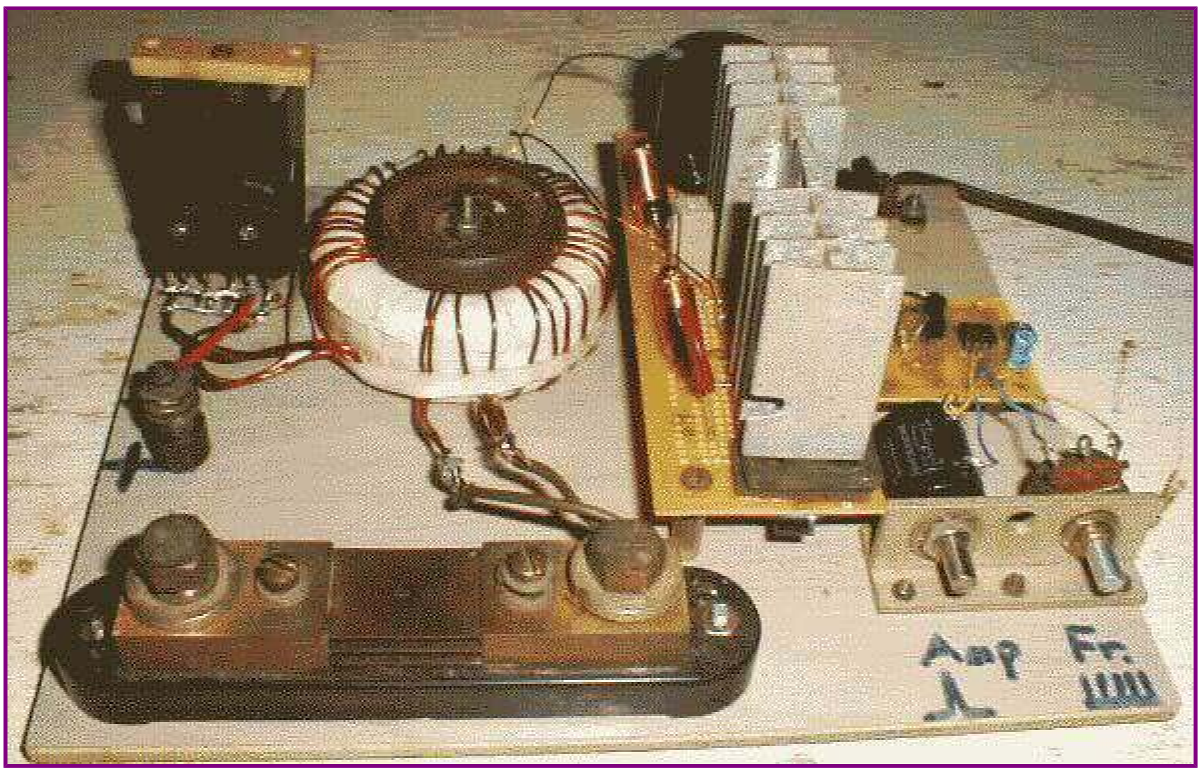
The main concern I have in presenting this information is to keep as many recoverable batteries in service as possible. Most batteries are discarded prematurely, due to sulfation rather than having reached their cycle limit. This represents a huge waste, and a potential resource. It is hoped that many tons of batteries can be kept out of the world's dumps by this simple technique.

- To start with, take a look at this short note on lead acid battery chemistry and the sulfation process.
- Don Denhardt has assembled a gallery of dissected batteries, showing their internal anatomy.
- **Here is a patent worth reviewing:** Patent #3,963,976 (www.uspto.gov) shows that high peak current is essential to overcome electrolyte stratification.
- Here are a few hints, suggestions, and procedures for reclaiming old batteries.

There are now several versions available, tailored to specific needs:

The original, low power version, suitable for most solar systems, vehicle starter maintenance, and gradual battery reclamation. There are several flavors of this circuit.

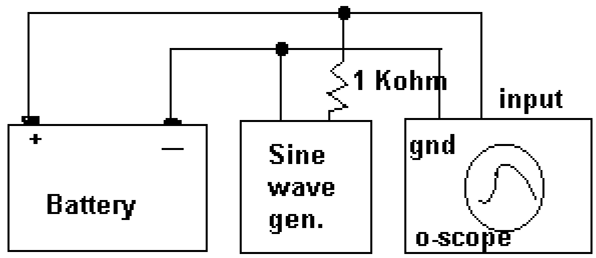
The high power version, for large battery reclamation, electric vehicle maintenance, high voltage systems, and low level charging. Under development.



The following provides some supplemental info and links for those interested in theoretical aspects and additional help:

A few words about the "several megahertz resonance" that is mentioned in the original article. One of the most frequent questions is about the fact that the drive frequency is at 1 khz, but the resulting vibrations in the battery are at several MHz. Go back over the part in the article about the "plucked string". This is a very common situation in all systems with a resonant frequency. A disturbance of any sort will tend to create vibrations at the resonance. The megahertz range vibrations are over very quickly, ie they are a damped oscillation. The pulser circuit does not drive these frequencies, any more than a finger nail drives a guitar string at its pitch.

One can see them readily using an oscilliscope, but some care is required to get the triggering just right. A better way to see the fact that batteries have a high frequency resonance is to use a sweep generator, as in the diagram:



Vary the sine wave source over a range of one to ten megahertz, and look for the peak in the response, showing electrolyte resonance.

In the original article, I put forth an idea of what might be happening in the battery to cause this resonant frequency, and guessed that it was occuring in the electrolyte itself. An email from battery expert Heinz Wenzl, in Germany, said this:

> *The next question in my quest to understand this is the following: Given the same battery type there are small deviations of resonant frequency which are no measurement artefact. Now under normal conditions (i.e. the battery not being deep-deep discharged with an acid density close to one), there are always a lot of hydrogen and sulfate ions around which can create a plasma type charge distribution. A change of the frequency could be linked to the electrolyte density which is related to the state-of-charge (I have found no real correlation here), the viscosity (this I would imagine would be linked to the IR spectrum of molecular vibrations), the current exchange density (linked to state-of-charge and surface area and catalytic properties, etc.) and to .... some others. But gut feeling would tell me, that all these effects should be small compared to the plasma properties themselves. In which case, all lead acid batteries with flooded electrolyte should have the same resonance and NiCd a different one.*
>
> *What makes you think that the plasma condition is associated with the electrolyte and not with the solid material? Some lead minerals, e.g. PZT are piezoelectric and the few Mhz are really in that range of effects!*

So my original guess about what may be going on was not very close to the mark. Nevertheless, the resonance is very much there, and it helps to create conditions of high peak voltage (ringing) that are favorable to the process of desulfation.

Does this really work ?

The results are coming in. Here are some typical comments:

- *Hello Alastair, I would like to thank you for such a neat product. I have reclaimed several batteries now that were junk. I have gathered up as many more as I can find and have them connected to an Air 403 for charging and running of the desulfator. Free batteries and free power, doesn't get much better than this. I have built several other desulfators for other people to use ..... thanks again for such a fantastic project. Ed Goddard Castle Dale, Utah.*
- *I am pleased with the performance. Yours works faster than the $90 Pulse Tech unit I've had 3 years. George Ficklen Newport News, Va.*
- *I can actually see etching into the sulfate crystals on top of the cells. Eric Wiggins. Thames, N.Z.*
- *It looks as though this little device saved me $60.00. The white deposits have all but disappeared on the plates. Scott Sisson. Portland, Or.*

A number of comments on the message board have been about battery testing. Here is a response from Geoge Aumann:

> *Using a resisitive load to measure battery condition is a standard method. For each battery type a standard load is defined, and if the voltage under load drops below a certain level, the battery is bad or in need of recharging. For small batteries this load can be typical, like a 5 Ohm load for a AA Alkaline drops the voltage at end-of-life to 1.0 Volts. Using a load across the battery (for a few milliseconds) is used by laptop computers to assess the charge status of the battery.*
>
> *For big batteries the "standard" load resistor may get to be very small. However, given the availbility of good and fairly cheap(under $40) 3 1/2 digit digital volt meters, it is not necessary (or safe) to draw a big current spike out of the battery to measure its internal impedance. For my Dynasty UPS12-310 High output battery I use a 1 Ohm 1% 20 watt resistor shunted with a bar directly to the battery terminals. The resulting drop across the 1 Ohm resistor is eazy to measure with the voltmeter set to the 200 mV scale.*
>
> *A fully charged 12.6 volt lead-acid battery will have an internal resistance of about 0.01 ohms. My Dynasty UPS12-310 high output battery is spec'd at 0.0033 Ohm. Determine the internal resistance of the battery by measuring the terminal voltage with open circuit, V, and then the voltage drop across an accurately known resistive load R, voltage DV. The internal impedance of the battery, Ri, is then given by Ri= DV * R / V.*
>
> *Example: V=12.60 volts and DV= 81 mV Volt using a 1 Ohm 1% 20 watt Ohmite resistor. Ri= 0.081* 1.0 / 12.6 = 0.0064 Ohm.*
>
> *The power dissipated in the resisitor is V*V / R = 12.52 * 12.52 = 158 watt. The resistor will get warm very quicky. If this experiment is not finished quickly, the temperature increase will change the resistance. This will make the measurement inaccurate and will burn your fingers).*
>
> *Somebody on the email suggested pulling 200A, presumably using a 0.062 Ohm resistor. Pulling that much power (200 * 12.6 = 2.5KW!) has to be done fast indeed. Batteries of this size can be very dangerous.*

If you would like to communicate with others in this project, or to ask questions not answered by the above material, please try the
desulfator bulletin board.

Some relevant links:

Commercial Desulfators from Solar-Electric.com
Technical details on why pulse charging is good.

This shows that Ni Cads are similarly benefitted
Here is an email exchange on battery testing techniques.
A Battery Tester by Megger
http://www.btechinc.com/ Another battery tester.
http://www.powerdesigners.com/InfoWeb/design_center/Appnotes_Archive/A2615.shtm Further Battery testing info.
http://www.batterybes.com/ Commercial desulfator.
http://www.innovativeenergy.com/index.htm Another commercial desulfator.
http://www.van-haandel-1.myweb.nl/Download.html An article in Dutch about a desulfator with some interesting features. See page 2 for the schematic. Here is a translation to English of the most important details.http://users.pandora.be/vandenberghe.jef/battery/

Back to Aquarian Homepage
Visitors since April 2, 2002: