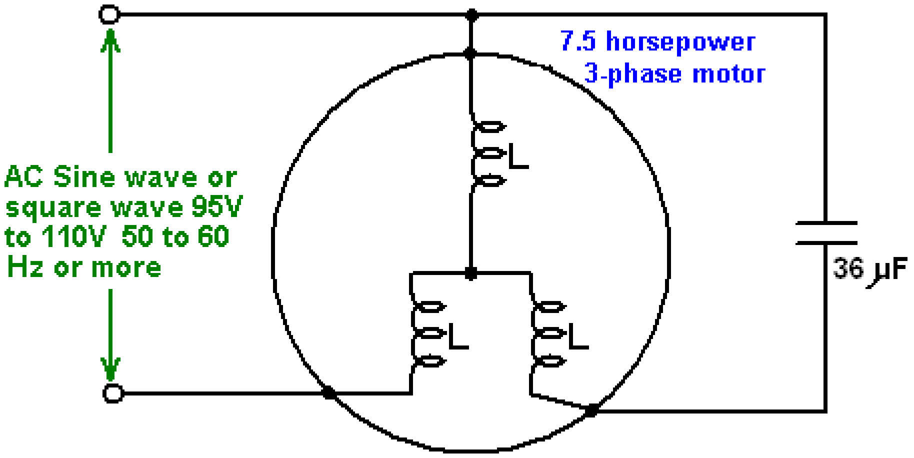
A very effective additional circuit has been developed by David Kousoulides. This circuit allows extra current to be drawn off a RotoVerter while it is running, without increasing the input power needed to drive the RotoVerter. David's circuit can be used with a wide range of systems, but here it is being shown as an addition to the RotoVerter system, raising it's efficiency even higher than before.

As is common with many effective circuits, it is basically very simple looking, and it's apparent operation is easily explained. The objective is to draw additional current from the RotoVerter and use that current to charge one or more batteries, without loading the RotoVerter at all. The current take off is in the form of a rapid series of current pulses which can be heard as a series of faint clicks when fed into the battery.

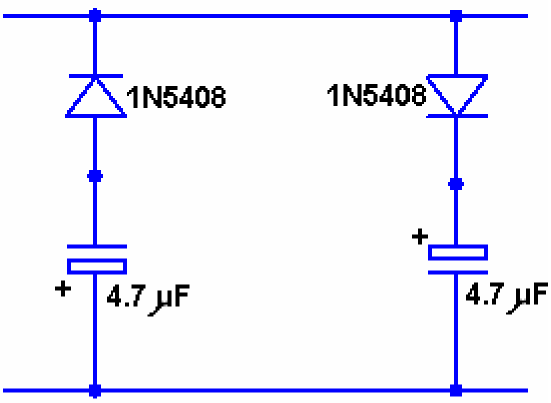
Let us examine the circuit section by section:

First, we start with a standard "off the shelf" 3-phase motor. In this example, the motor is a 7.5 horsepower motor, which when wired in RotoVerter mode, using just a single-phase supply as shown here, only draws a very low amount of power when running, especially if the single-phase supply is about 25% of the voltage rating of the motor:



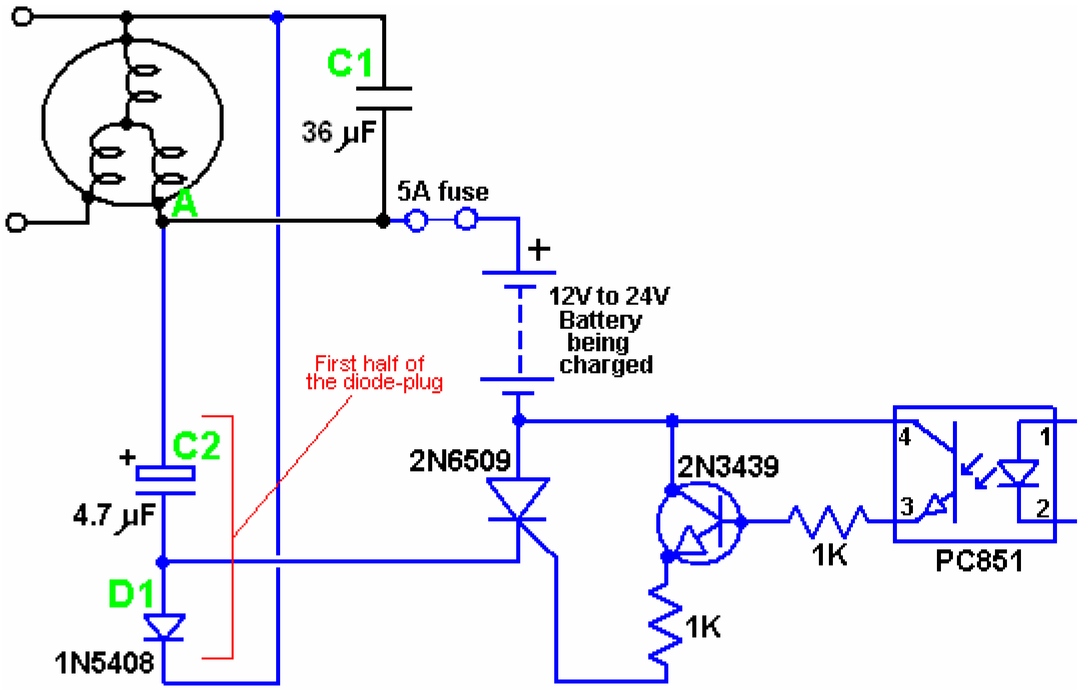
Because the running power draw is so low, it is possible to run this motor from a standard battery-powered inverter, but the current draw at start-up is some 17 amps, so the mains is used to get the motor started and then the motor is switched from the mains to the inverter. The inverter also allows easy measurement of the power input and so makes for easier calculation of the overall power efficiency of the system.

There is a power extraction device called a "diode-plug", which in spite of it's seeming simplicity, is actually much more subtle in it's operation than would appear from a quick glance at the circuit:



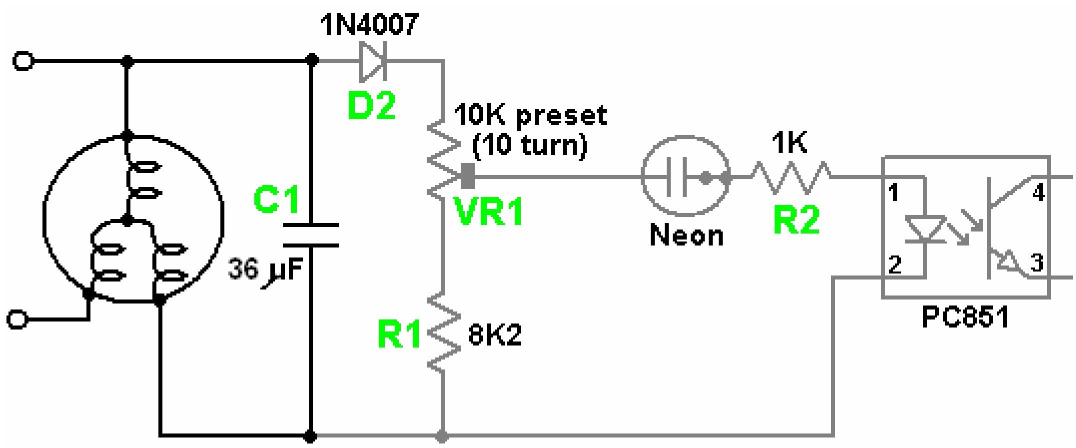
This circuit has been presented as a public-domain non-copyrightable circuit by Hector Perez Torres and it is capable of extracting power from a range of different systems, without affecting those systems or increasing their power draw. In the circuit presented below, just the first half of the diode plug is utilised, though it should perhaps be stressed that it would be perfectly feasible to raise the efficiency of the circuit even further by adding extra components to duplicate the power feed from the battery, drawing on both parts of the diode-plug circuit. For clarity, this is not shown here, but it should be understood that it is a possible, and indeed desirable, extension to the circuitry described here.

When the motor is running, high voltages are developed across the windings of the motor. As only the first half of the diode-plug is being shown here, we will be capturing and using the negative-going voltages. These negative-going pulses are picked up, stored in a capacitor and used to charge a battery using the following circuit:



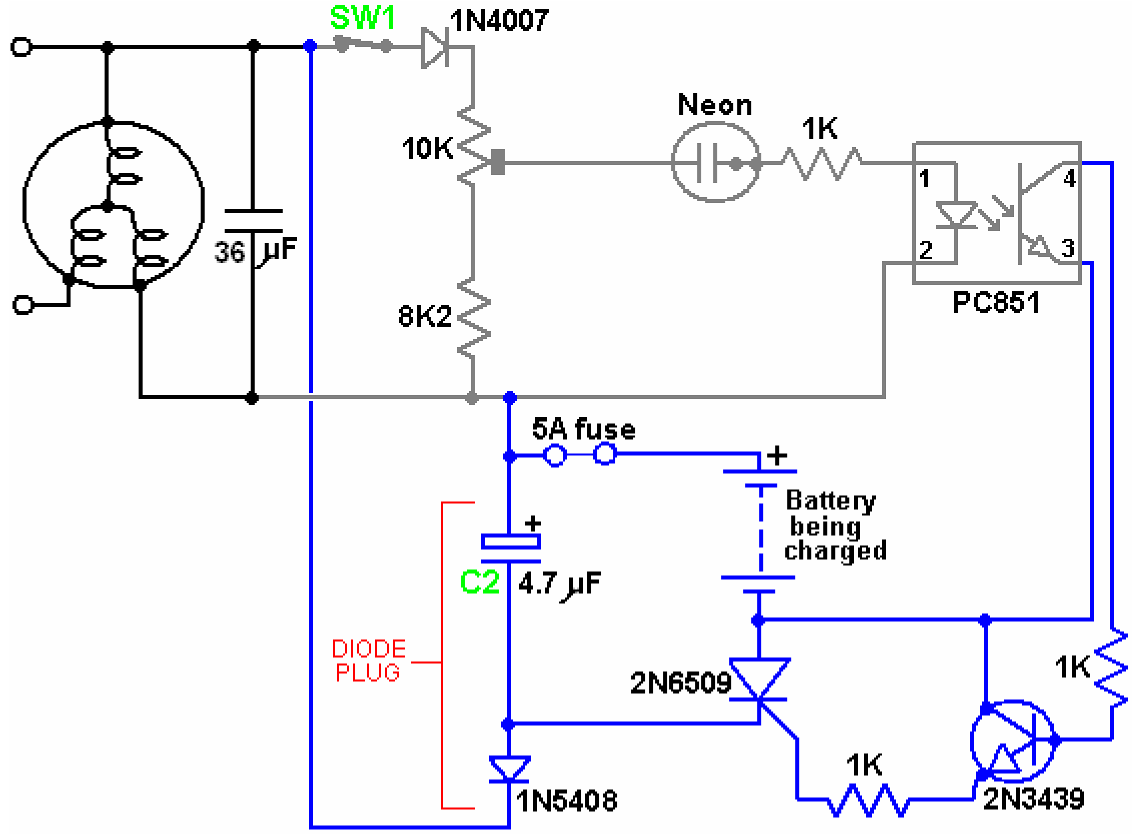
Here we have the same RotoVerter circuit as before, with high voltage being developed across capacitor **C1**. The battery-charging section is a free-floating circuit connected to point **A** of the motor. The high-voltage diode **D1** is used to feed negative-going pulses to capacitor **C2** which causes a large charge to build up in that capacitor. At the appropriate moment, the PC851 opto-isolator is triggered. This feeds a current into the base of the 2N3439 transistor, switching it on and firing the 2N6509 thyristor. This effectively switches capacitor **C2** across the battery, which discharges the capacitor into the battery. This feeds a substantial charging power pulse into the battery. As the capacitor voltage drops, the thyristor is starved of current and it turns off automatically. The charging sequence for the capacitor starts again with the next pulse from the windings of the motor.

The only other thing to be arranged is the triggering of the opto-isolator. This should be done at the peak of a positive voltage on the motor windings and has been built like this:



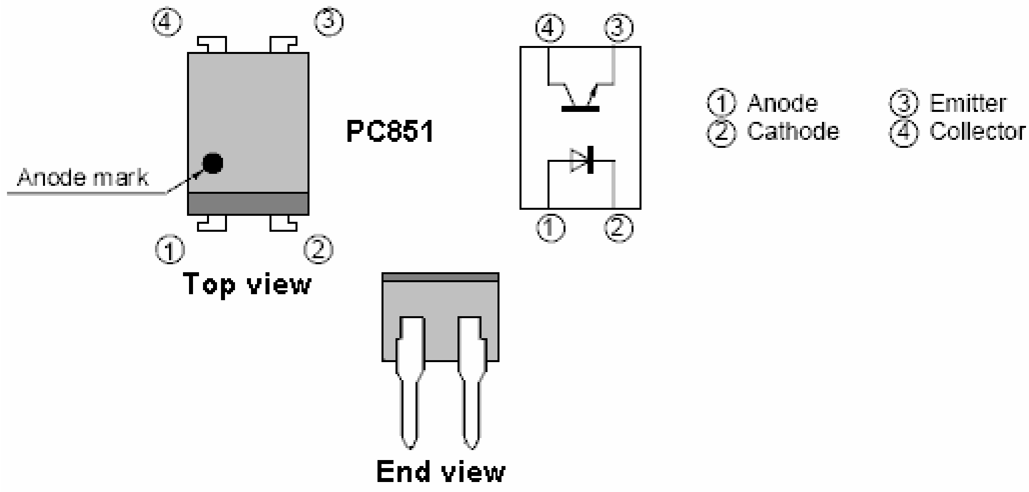
Here, we have the RotoVerter motor as before, with the voltage developed on **C1** being used to trigger the opto-isolator at the appropriate moment. The voltage on **C1** is sensed by the diode **D2**, the pre-set resistor **VR1** and the resistor **R1**. These place a load of some 18.2K ohms on capacitor **C1** as the neon has a very high resistance when not conducting. The ten-turn preset resistor is adjusted to make the neon fire at the peak of the voltage wave coming from the motor. Although the adjustment screw of most preset resistors is fully isolated from the resistor, it is recommended that adjustment of the screw be done using an insulated main-tester type of screwdriver, or a solid plastic trimmer-core adjustment tool.

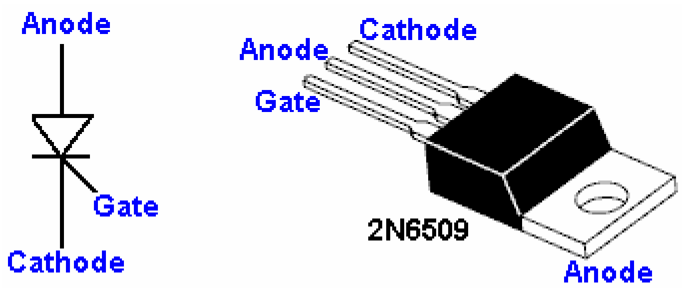
The whole circuit is then:



The switch **SW1** is included so that the charging section can be switched off at any time and this switch should not be closed until the motor gets up to speed. All wire connections should be made before power is applied to the circuit. Capacitor **C1** which is shown as 36 microfarads, has a value which is optimised for the particular motor being used and will normally be in the range 17 to 24 microfarads for a well-prepared motor. The motor used for this development was retrieved from a scrapyard and was not prepared in any way.

The value of capacitor **C2** can be increased by experimenting to find at what value the resonance gets killed and the charging section starts drawing extra current from the supply. It should be noted that many new thyristors (Silicon Controlled Rectifiers or “SCR”s) are faulty when supplied (sometimes as many as half of those supplied can be faulty). It is therefore important to test the thyristor to be used in this circuit before installing it. The circuit shown below can be used for the testing, but it should be stressed that even if the component passes the test, that does not guarantee that it will work reliably in the circuit. For example, while 2N6509 thyristors are generally satisfactory, it has been found that C126D types are not. A thyristor passing the test may still operate unpredictably with false triggers.





Please note that the 2N6509 package has the Anode connected inside the housing to the metal mounting tab.

Components List:

Component	Quantity	Description
1K ohm resistor 0.25 watt	3	Bands: Brown, Black, Red
8.2K ohm resistor 0.25 watt	1	Bands: Gray, Red, Red
10K ohm preset resistor	1	Ten turn version
4.7 mF 440V (or higher) capacitor	1	Polypropylene
36 mF 440V (or higher) capacitor	1	Non-polarised polypropylene
1N5408 diode	1	
1N4007 diode	1	
2N3439 NPN transistor	1	
2N6509 thyristor	1	Several may be needed to get a good one
PC851 opto-isolator	1	
Neon, 6 mm wire-ended, 0.5 mA	1	Radiospares 586-015
5A fuse and fuseholder	1	Any convenient type
30A switch 1-pole 1-throw	1	Toggle type, 120-volt rated
Veroboard or similar	1	Your preferred construction board
4-pin DIL IC socket	1	Black plastic opto-isolator holder (optional)
Wire terminals	4	Ideally two red and two black
Plastic box	1	Injection moulded with screw-down lid
Mounting nuts, bolts and pillars	8	Hardware for 8 insulated pillar mounts
Rubber or plastic feet	4	Any small adhesive feet
Sundry connecting wire	4 m	Various sizes

When using and testing this circuit, it is important that all wires are connected securely in place before the motor is started. This is because high voltages are generated and creating sparks when making connections does not do any of the components any particular good. If the circuit is to be turned off while the motor is still running, then switch **SW1** is there for just that purpose.

The operating technique is as follows:

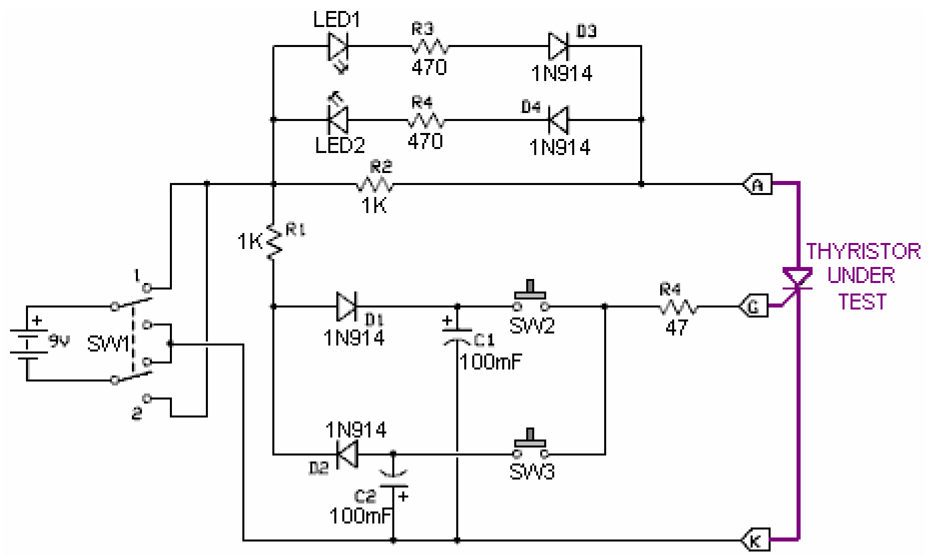
Before starting the motor, adjust the slider of the preset resistor **VR1** to the fixed resistor end of it's track. This ensures that the charging circuit will not operate as the neon will not fire. Power up the circuit and start adjusting the preset resistor very slowly until the neon starts to flash occasionally. There should be no increased load on the motor and so no extra current drawn from the input supply.

If there is an increase in the load, you will be able to tell by the speed of the motor and the sound it makes. If there is an increase in the load, then back off **VR1** and check the circuit construction. If there is no increased load, then continue turning VR1 slowly until a position is reached where the neon remains lit all the time. You should see the voltage across the battery being charged increase without any loading effects on the motor.

If you use an oscilloscope on this circuit, please remember that there is no "ground" reference voltage and that the circuit is not isolated.

Thyristor testing:

The components needed to construct the thyristor testing circuit shown below can be bought as Kit number 1083 from www.QuasarElectronics.com



The circuit is operated by operating **SW1** several times so as to get capacitors **C1** and **C2** fully charged. **LED1** and **LED2** should both be off. If either of them light, then the thyristor is faulty.

Next, with **SW1** at it's position **1**, press switch **SW2** briefly. **LED1** should light and stay on after **SW2** is released. If either of these two things does not happen, then the thyristor is faulty.

With **LED1** lit, press **SW3** and **LED1** should go out. If that does not happen, then the thyristor is faulty.

As mentioned before, even if the thyristor passes these tests it does not guarantee that it will work correctly in any circuit as it may operate intermittently and it may trigger spuriously when it shouldn't.

Component list:

Component	Quantity	Description
47 ohm resistor 0.25 watt	1	Bands: Purple, Yellow, Black
470 ohm resistor 0.25 watt	2	Bands: Purple, Yellow, Brown
1K ohm resistor	2	Bands: Brown, Black, Red
100 mF 15V capacitor	2	Electrolytic
1N914 diode	4	
Light Emitting Diode	2	Any type, any size
Toggle switch 2-pole 2-throw	1	
Press-button Push-to-Make	2	Non-latching press-on, release off type
9V battery	1	Any type
Battery connector	1	To match chosen battery
Socket	1	Plug-in socket for thyristors
Veroboard or similar	1	Your preferred construction board
Plastic box	1	Injection moulded with screw-down lid
Mounting nuts, bolts and pillars	8	Hardware for 8 insulated pillar mounts
Rubber or plastic feet	4	Any small adhesive feet
Sundry connecting wire	4 m	Various sizes