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## Rockman Rockmodules

How to install a built-in  
transformer  
How to convert a module from  
110V to 230V or from 230V to  
110V

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## FOREWORD

❑ This document has two objectives:

- Explain to the non-technician musicians what a power-supply is for a technician.
- Provide all necessary information to someone who needs to adapt the power supply of his Rockmodules to his local requirements

❑ If you have enough technical skills, just skip the first part and jump to the “how-to” section.

❑ In case you don't feel comfortable with electronics, please read carefully every line and make your best to understand what you do. It is not only a matter of result. It is also a matter of security:

- For your Rockmodule, but you can always buy another one
- For your own life, since electricity can seriously kill

**Always have in mind that as soon as you deal with power transformers, your life is endangered. It takes only a few milliseconds to touch the wrong wire and die from a heart attack.**

**A good way to reduce the risks is to keep you left hand in your pocket if you have to intervene live on a Rockmodule: this will prevent the electrical flow to meet your heart in case of electric shock.**

## ABOUT POWER SUPPLIES

### **Power Supplies**

❑ An analog audio device needs some power in order to process the signal it receives. This power is supplied by... a power supply!

❑ What do we call power here? Mega-Watts, kilo-Watts, or Watts? Unless you play in the Shea-Stadium every week or so, you will need only Watts, maybe a few hundred Watts.

❑ We're talking here about the Rockman Rockmodules. If you look at their rear panel, you will find a tag saying "3 Watts".

A Watt, in electricity, is the combination of both a Voltage and an Amperage:

$$P = U \times I$$

In other terms, if your Rockmodule is a 110V US model, the current draw it requires is approximately 3/110, i.e. 30mA. That's almost nothing: a complete Rockman rack with 12 modules will draw only 36 Watts: less than a common light bulb.

❑ The first thing to do, before connecting the fragile electronic components to a source of current, is to diminish the Voltage drastically. Imagine an OpAmp chip connected directly to 110VAC: it won't last long. The component used to step down the voltage is called a transformer. The Transformer converts the high-voltage from the mains into a low-voltage (a few Volts) alternative current.

❑ The second operation is to convert the Alternative Current (AC) coming from the mains supply into one or several Direct Current (DC) voltages: if you don't do it, your audio circuit will produce one sound only: a 60Hz (or 50Hz in Europe) giant hum.

That's not what we want, so we have to rectify the low-voltage AC coming from the transformer into something that looks like DC.

The components used to rectify the current are a few diodes (note that in the old times, and in some "modern" guitar amps, this operation is done with special vacuum tubes called "rectifiers").

❑ The third thing to do is to stabilize this DC voltage. As a matter of fact, a basic power-supply without filtering and regulation is not suitable for professional audio gear: the more current you draw, the lower the voltage is, resulting in poor results.

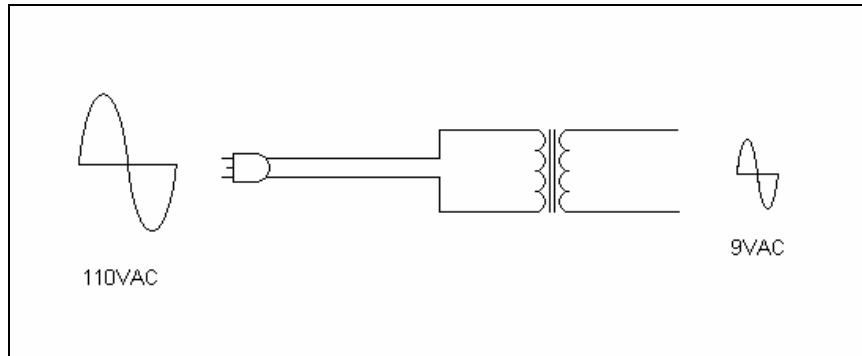
This filtering and regulating operation is done via a circuit made of capacitors and regulators (a sort of specific chip designed for this operation).

### **Transformers**

❑ A transformer is a simple component that converts a primary Alternative Current (AC) into a secondary AC. The two currents flow in two separate coils, called primary and secondary. There is no contact between the two coils.

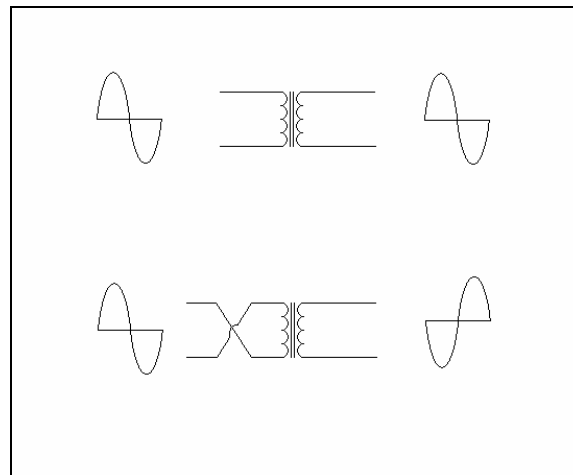
The ratio between the two voltages is determined by the material and geometry of the transformer. For a given frequency (eg 60Hz, 100Hz, 100 kHz, etc...), this ratio has a constant value. The frequency is not altered by the conversion.

In this example, a transformer is used to convert 110V, 60Hz AC voltage into 9VAC, 60Hz:



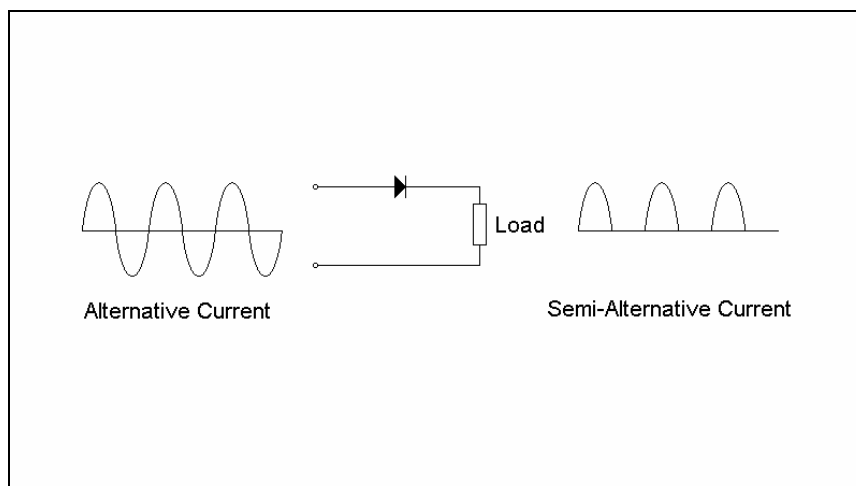
The conversion ratio is  $110/9 = 12.2$ . Hence, the same transformer will convert 230VAC, 50Hz into  $230/12.2 = 18.8\text{VAC}$ , 50Hz.

□ Transformers have an interesting property: if the phase of the input signal is inverted or shifted, the output signal's phase will be proportionally inverted or shifted. In other words, if the two input wires are inverted, the output signal will be inverted (mirrored):



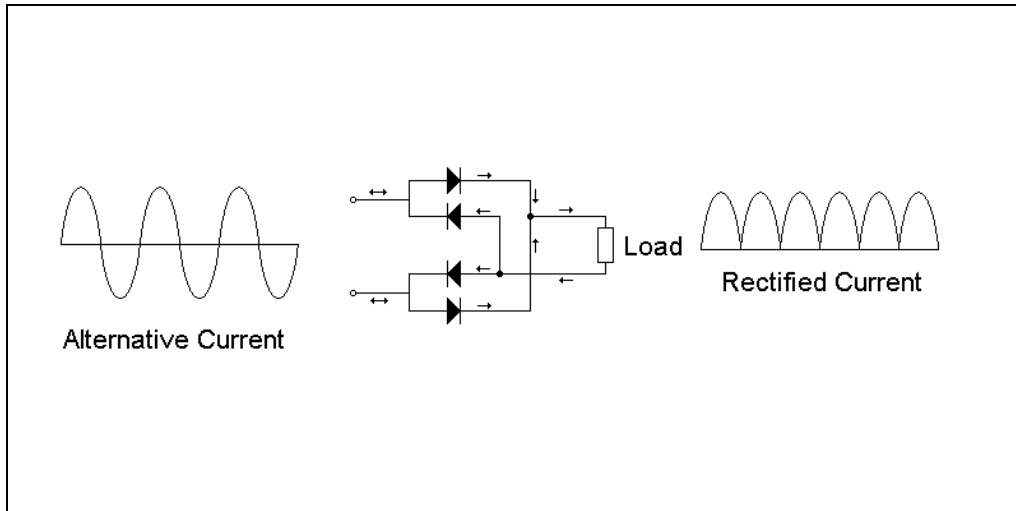
### Rectifier circuits

□ The basis of a rectifier circuit is the diode. This component acts like a valve that lets the current flow in one way, and blocks it in the other way:

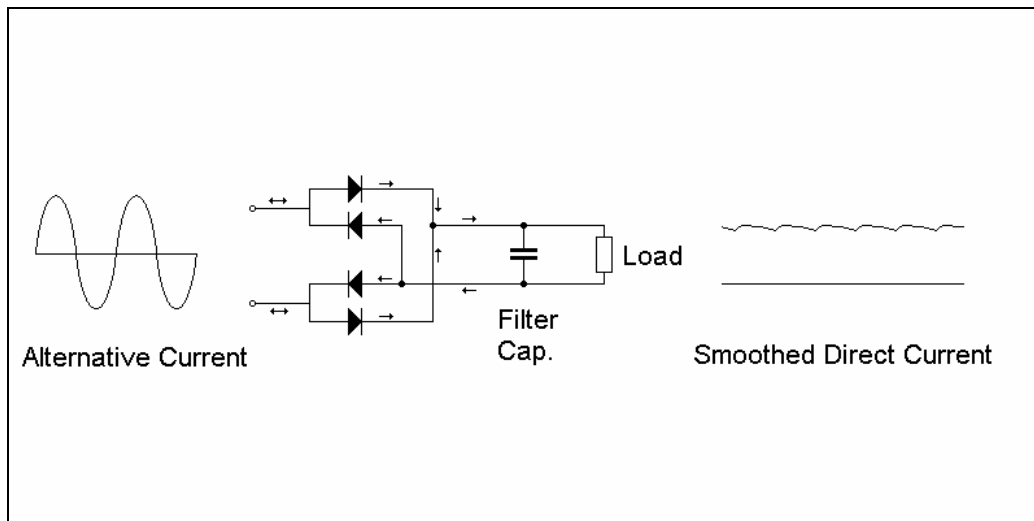


❑ One diode only is not enough to get a real Direct Current. First, only one half of the power is used: the other half is lost (in fact, it is converted in heat in the diode).

The classical rectifying circuit is made of four diodes (also called Graetz's bridge). Each half of the original AC is dispatched to the proper branch of the bridge, and depending on its orientation, is dispatched to the proper output pole:

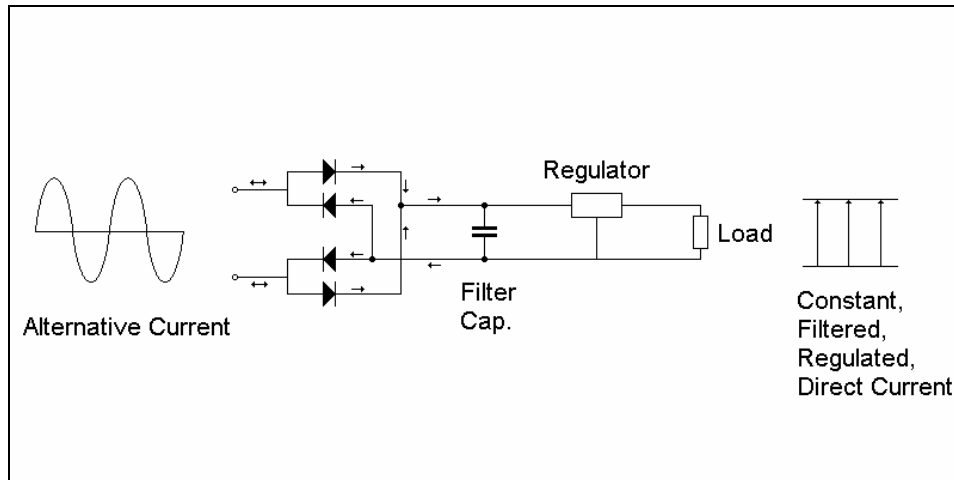


❑ In order to get a continuous, stable Direct Current, one needs to filter the rectified current (the 60Hz original sine is now a 120Hz complex signal). We will use a large capacitor to do that: a capacitor is a sort of "current tank" that charges and discharges slowly, so slowly that it hasn't time to discharge from one current peak to another. The result is not perfect yet, but it's enough if the device doesn't need a perfect DC to operate:



❑ This basic rectifying and filtering circuit is not capable of providing the pure DC that we expect, and that would be represented by a horizontal, straight line. Moreover, the voltage of this smoothed DC (the height above the horizontal axis) would fluctuate and change, depending on the current demand of the device. For example, the more gain you ask to your amp, the lower the voltage would be, cause the required amperage would increase. It is interesting in some specific cases: the old-school tube amps had this kind of behaviour, and this "default" helped them to get a thicker saturation. This "default" was reproduced by a famous Californian amps manufacturer in a series named, let's see... Diodes? No. Filter? No. Rectifier!!!! Yes, that was the Rectifier amp!

❑ In a solid-state studio quality device, we don't want hum, we want a stable current and voltage. We shall use a special chip called regulator that will finish the job and transform the semi-stable smoothed direct current into a regular, constant Direct Current with a precise voltage.



### **Symmetrical power-supply**

❑ The signal we handle in an audio device is symmetrical: it is a complex combination of cosines and sinus, with negative and positive halves.

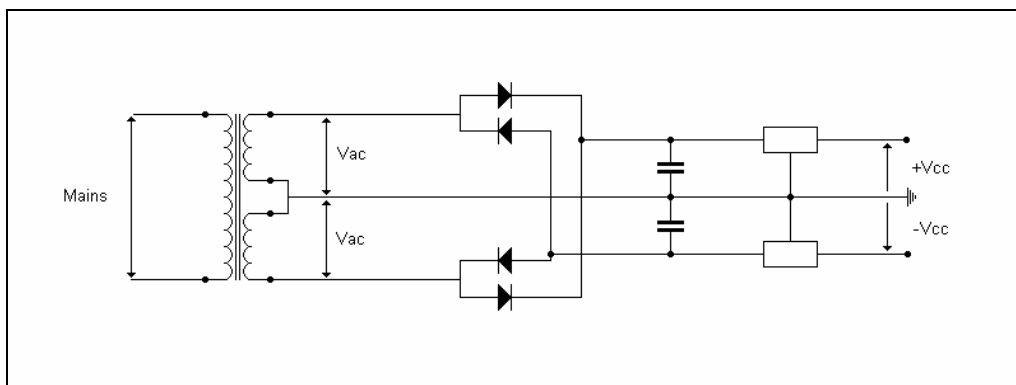
It is possible to shift the signal towards the positive voltages, so that the device can be powered with one positive voltage only: that's how stompboxes, usually cheap devices, are designed.

In professional audio, where OpAmps are widely used, the gear is powered by two opposite voltages: +Vcc and -Vcc (referred to the ground which corresponds to 0V). It has several advantages:

- Twice more voltage means twice more headroom
- More headroom usually implies a better signal-to-noise ratio
- The symmetrical – or balanced – power supply principle can act sometimes like the two coils of a humbucker, and provide some noise-cancellation
- The audio circuit is easier to design (it is more “natural”)

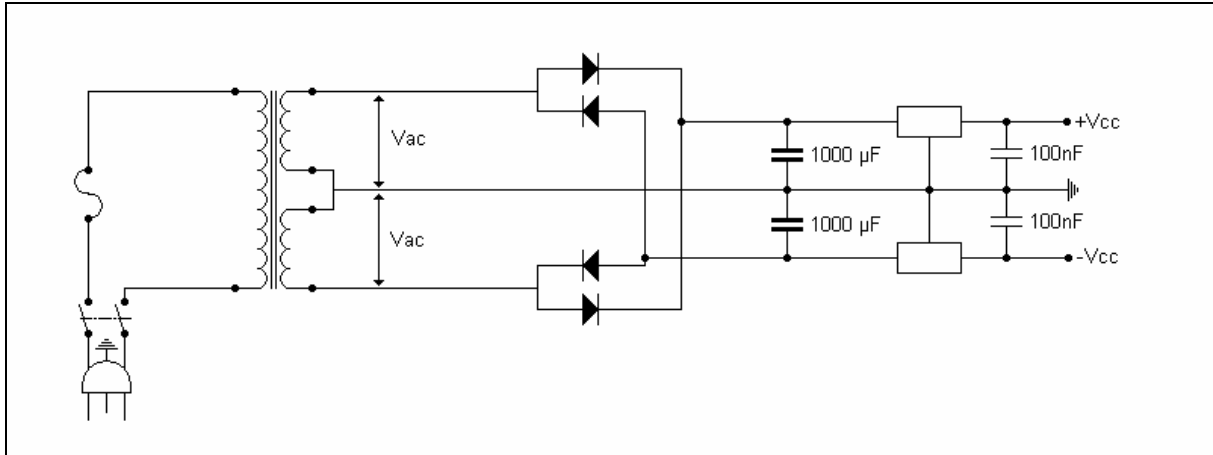
❑ Balanced power supply requires a double regulation circuit (that's why you won't find that in cheap gear). You could of course envisage having two separate transformers and two rectifiers bridges, but it is not necessary.

A balanced power-supply is usually built on the basis of a transformer with two independent secondary coils sharing the same primary coil (mains side). The power-supply looks like this:



Note that the two secondary coils are connected by one end, and that this connection is itself connected to the ground: as a matter of fact, this common point defines the 0V reference voltage of the complete device.

□ A few additional components, and we have the exact schematics of a Rockmodule power-supply section:



### Dual-Voltage Transformers

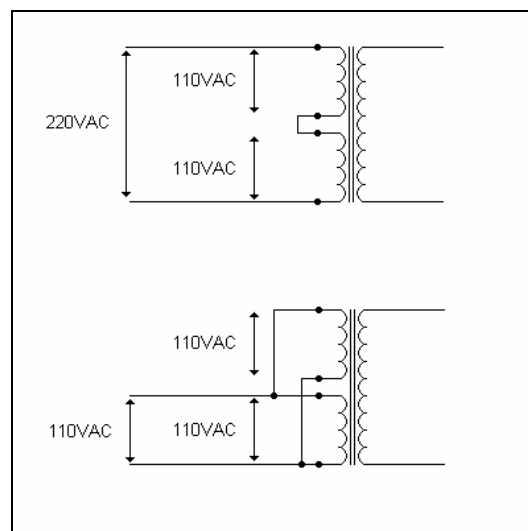
□ The Rockmodules are equipped with 110VAC transformers: they fit the US market, but cannot be used, for example, in Europe where the mains voltage is 220 or 230VAC. Dual voltage devices are equipped with dual-voltage transformers. A few words about them now.

□ Dual-Voltage transformers are usually built on the split-coil principle. In other terms, the primary coil is cut in two half coils.

Each half is designed to handle 110V: when they are connected in series, the total primary voltage they can handle is 220V.

If one half-coil only is used, the primary voltage can be 110V, the output voltage is unchanged, and the output power is divided by two. If the two half-coils are connected in parallel, the output voltage and the output power are unchanged.

□ The following diagram depicts the two possible configurations for a dual-voltage transformer:





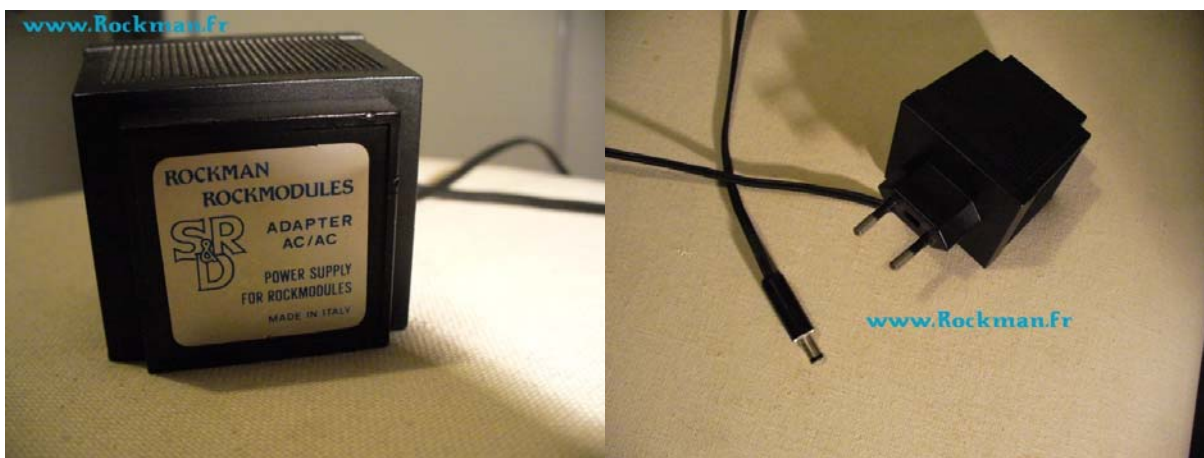
### *The Rockmodules export models*

❑ A limited amount of Rockman gear was truly designed for the export market:

- The Smart Gate and the Guitar Compressor had 230VAC versions
- The XP100 is a real dual-voltage device, and maybe some XPR's
- The PGE2 can be easily converted to 230VAC

That's it. For most of the Rockmodules, the customer had two choices:

- 110VAC US models with a US power-cord
- Export models with an external wall-wart provided by the local importator



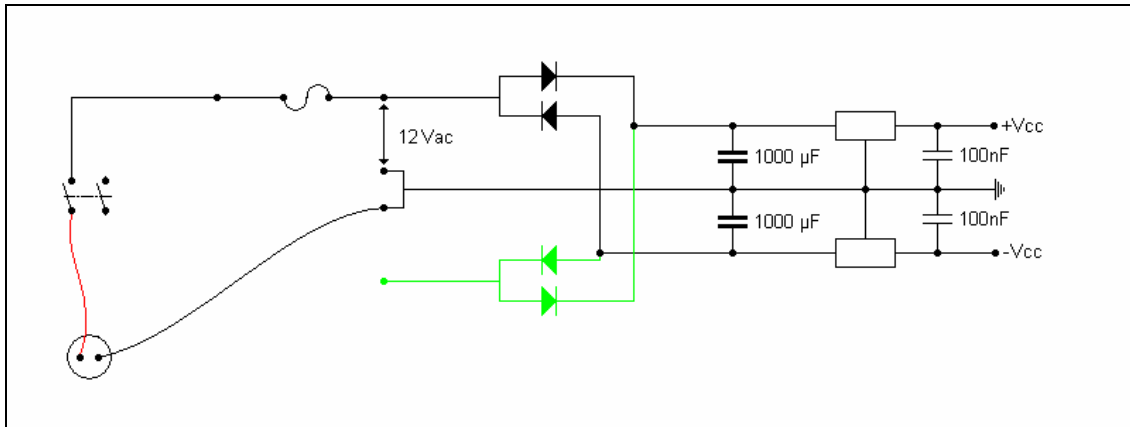
❑ The choice of the wall-wart, rather than built-in 230VAC transformers, was justified by the power-cord issue: each country or so has its own specific mains plug shape and size, though some normalization has occurred since the eighties.

❑ The issue with a wall-wart is that a balanced power-supply requires three connections: +Vcc, -Vcc and Ground. That's what we have on the Rockman headphone amps that have either a TRS mini-jack, either a Rockadaptor.

❑ SR&D managed to create a "standard": 12VAC with a classic barrel plug on the rear panel. As a matter of fact, the rectifying, filtering and regulation circuit was left as is, only the built-in dual-coil transformer was replaced by a single coil 12VAC transformer in a wall-wart format.



❑ Here's the way SR&D managed to modify the power-supply circuit for these wall-warts models:



The red wire couples the barrel plug to the power switch (only one half used).

The fuse is simply tilted from its standard position, and connects directly the 12VAC to one half of the diodes' bridge.

The other pole of the barrel plug is coupled to the ground of the circuit via a black wire.

Note that the second half of the diodes bridge becomes useless (green part of the schematics).

Weird and cumbersome, but cost-effective from a manufacturing standpoint!



❑ From a practical standpoint, these export modules are a pain in the back: the wall-warts are big, their cord is fragile and the barrel plug is a point of weakness.

It is therefore highly recommended to retrofit the 12VAC Rockmodules to the local mains voltage with a built-in transformer, either 110VAC if you live in the US/Canada zone, either 230VAC if you live in Europe.

That's what the next pages will show you.

## Retrofit an export Rockmodule

### Clear the 12VAC wiring

- ❑ Open your Rockmodule, and first of all, get rid of the two wires (black and red).



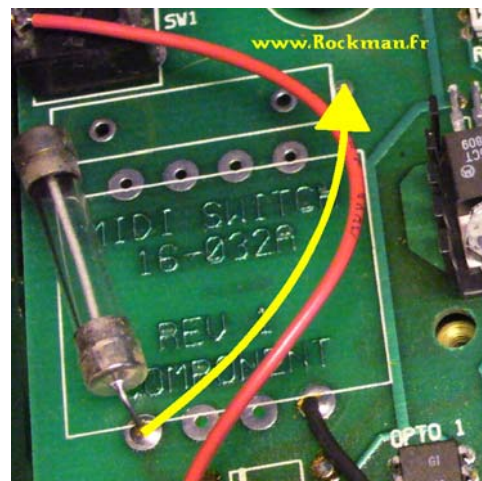
- ❑ Then you can unscrew the barrel plug nut, and remove it from its mounting hole.

Take off the plastic washers: you will see that this hole was designed for a mains power cord with its strain relief.

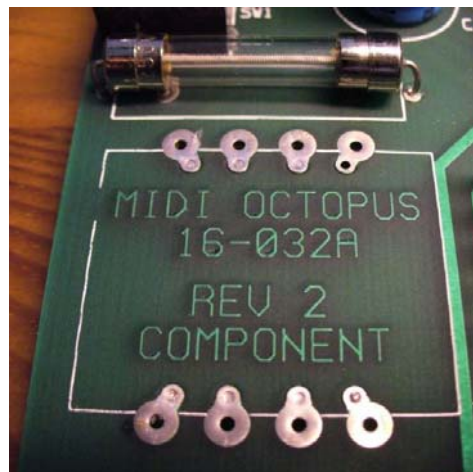
- ❑ You must now put the fuse back to its original location.

Unsolder the bottom end and tilt the fuse where it belongs.

*Nota: if you need to change this fuse, just buy a new one, and solder two pieces of plain copper wire on its ends.*



- ❑ Your Rockmodule is now ready to receive its built-in transformer:





### Special cases

❑ The Sustainer PCB misses the link between the two primary coils of a dual-voltage transformer. If you install such a 230VAC, the unit won't power-up.

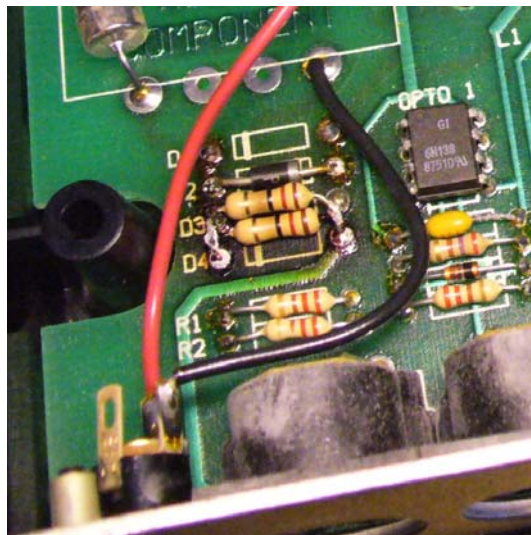
Just solder a strap between the two points (terminals 2 & 3 of the transformer) to correct this (refer to the paragraph Dual Voltage Transformers).

❑ The export Midi-Octopus 12VAC modification was truly infamous.

Before installing a built-in transformer, you will need to clear these resistors placed at D1 to D4 locations

❑ Remove the diode that was here too. Buy four new ones (1N4001 are the most common) and place them where they belong (D1 to D4).

Your Octopus will be clean again and ready to receive its transformer.



### Choose the right transformer

❑ The Rockmodules usually operate under +/-8V, with three exceptions:

- The Chorus/Delay is a +/-6V device (follow-up of the Rockman headphone amps)
- The Instrument Equalizer is a +/-12V device
- The Midi-Octopus is not an audio item, and operates with one voltage only: 5V

❑ The following table provides the transformers cross-references for all these modules.

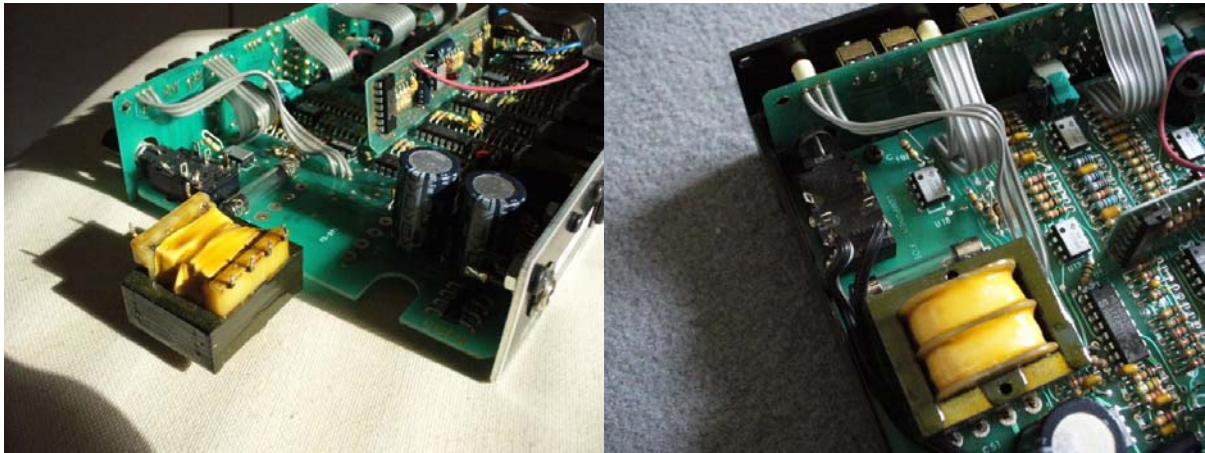
SR&D used Hobart Electronics transformers, but Hammond Manufacturing makes identical transformers (Made in Canada) and TRIAD Magnetics too (Made in China).

Hammond and Triad transformers are available from Mouser.com.

Module		230V Transformers		
Name	Voltage	Hobart 230VAC	Hammond 230VAC	Triad 230VAC
Midi Octopus	+5V	PSD-310	162E10	FS10-250
Chorus/Delay	+/-6V	PSD-310	162E10	FS10-200
Instr. EQ	+/-12V	PSD-332	162E24	FS24-100
Other modules	+/-8V	PSD-320	162E20	FS16-150

### ***Install a built-in transformer***

❑ Once you got rid of the ugly 12VAC wiring, you just need to solder the proper transformer in its location on the PCB.



### ***Install the power-cord***

❑ You also need to solder a power-cord and install its strain relief.

That's the last step. The strain relief may be a little difficult to insert if you don't have the very specific tool to do it, but a common ply and some patience should be sufficient to do that.

❑ The US power-cords are 3 wires cords: two for the mains voltage plus one for the ground. They are flat cords that easily fit the hole of a Rockmodule, and are flexible enough for this usage.

In Europe, the grounded cords are too big for the Rockmodules, and I strongly recommend using non-grounded cords. It is not a problem, because:

- If your rig is clean and mounted in a correct rack, security issues are extremely limited.
- Each module is grounded via the audio cords, from one module to another then from the modules to the power amp: this power amp is usually grounded and thus provides the security grounding to the whole set-up.
- Too many ground connections can result in ground loops, i.e. hum in the sound.

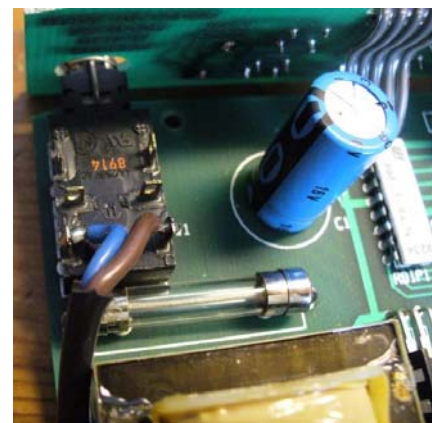
Moreover, the plugs of these bipolar cords are smaller, allowing handy and compact power strips instead of those ugly oversized grounded power strips: keep them for your computer and other power devices!

The two wires of the power cord must be soldered on the power switch. The polarity has no influence: you can invert the blue and brown wires at will.

You're now ready to press the "On" button. If you were careful during the installation, everything will work fine.

**REMEMBER THAT YOUR MODULE HAS NOW DEADLY VOLTAGE INSIDE.**

**Do not make tests without being sure that the 230VAC is correctly protected and that no shortage can happen!**



### Conversion from 110VAC to 230VAC

❑ This situation is fairly simple. All one needs to do is to change the power cord and the transformer, in conformance with the procedures described in the previous pages.

### Conversion from 12VAC to 110VAC

❑ The procedure is similar. Choose the proper transformer in the following table:

Module		110V US Transformers		
Name	Voltage	Hobart 110VAC	Hammond 110VAC	Triad 110VAC
Midi Octopus	+5V	PSS310	164E10	F10-250
Chorus/Delay	+/-6V	PSS310	164E10	F10-200
Instr. EQ	+/-12V	PSS332	164E24	F24-100
Others	+/-8V	PSS320	164E20	F16-150

❑ While it is more suitable to install non-grounded power cords in Europe, one will of course install a grounded power-cord as SR&D used to do it.

