**Oakley Sound Systems**

# Rack Power Supply Unit (RPSU)

## Issue 2

# Builder's Guide

## V2.3

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# Introduction

This is the Project Builder's Guide for issue 2 of the Rack Power Supply Unit, or RPSU, circuit board from Oakley Sound. This document hopefully contains everything you need to know to build and install the Oakley RPSU into your project.

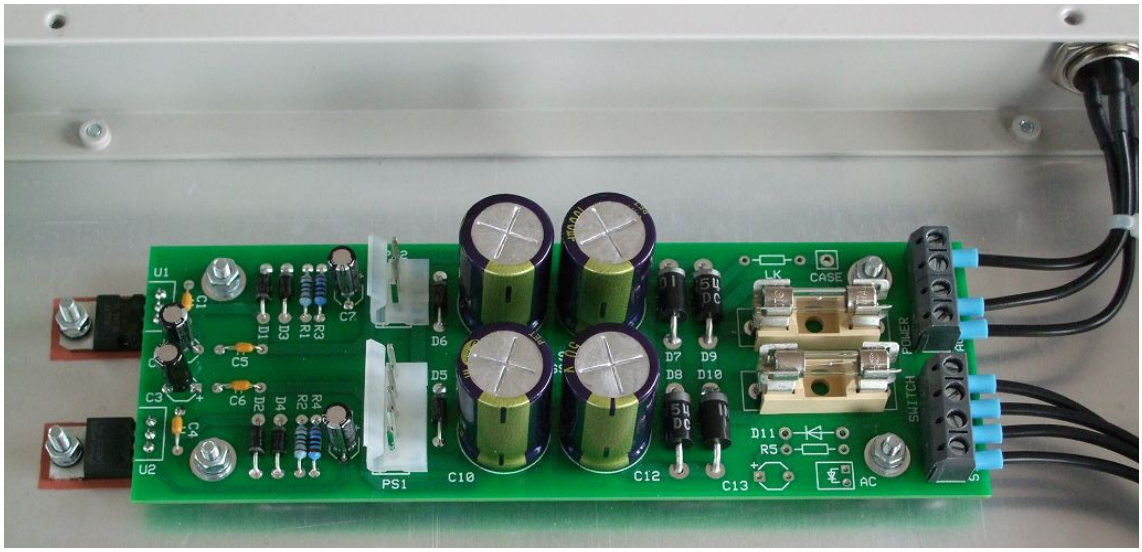
The Oakley RPSU allows for various options in the installation. You can use the unit either in full wave rectification mode for connection to tapped linelumps or twin transformer secondaries, or in half wave rectification for single phase AC output wallwarts and linelumps. If all this sounds very confusing at the moment, do not worry, in this manual I will try to make it clearer so that you make the right decision about what power source you will need.

It is designed to be mounted onto the metalwork of the project case. The metal panel is then used as a heatsink for the two power devices used on the board. Mounting your power devices to a metal panel on the outside of your case helps keep your project run cool. Metal cases are always recommended for audio projects since they reduce the chance of external interference from other electrical items.

Although very stable and low noise the output is approximately +/-15.3V. Please note that there are no trimmers used in this project so it is not possible to set the output voltages to exactly +/-15V. In the majority of cases this is not required since most projects do not require the supply rails to be an exact specific value. Other voltage outputs can be simply achieved by changing a couple of resistor values.

For general information regarding where to get parts and suggested part numbers please see our useful Parts Guide at http://www.oakleysound.com/parts.pdf.

For general information on how to build our modules, including circuit board population, mounting front panel components and making up board interconnects please see our Construction Guide at http://www.oakleysound.com/construct.pdf.




*A completed RPSU2 board built in full wave rectification mode powering an Oakley SRE330 ensemble housed in a 1U high 19" rack enclosure. This one has been fitted with both the five way header for +/-15V, 0V and case ground, and a three way header for +15V and 0V.*

# Safety Warning

The RPSU has been designed to work with isolated low voltage AC inputs. Connection to any other supply, such as an internally mounted mains transformer, is done at your own risk. Low voltage is classified as being less than 25V with respect to the ground potential. Voltages above this level can be, and often are, lethal to living creatures.

Oakley Sound Systems will not advise on building or modifying this board to allow for direct connection to the mains, or other high voltage sources, further to what is provided in this document. Please do not ask me for any additional information pertaining to direct mains connections or using internally mounted transformers as I will not give it.

**For safety and legal reasons I cannot recommend powering this board from any other supply other than low voltage AC output mains adapters.**

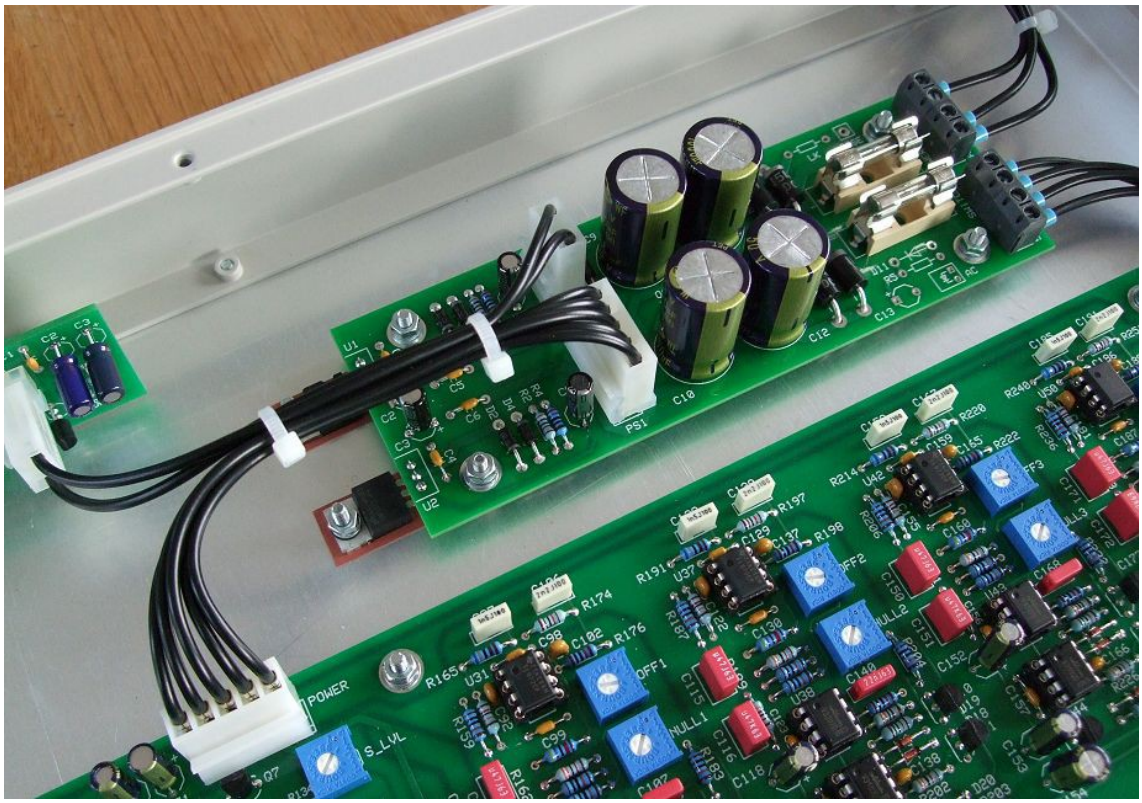
Oakley Sound Systems are not liable for any damages caused by the misuse of this product. It is your responsibility to use this product safely. If you have any doubt about installing a safe power supply, then please do not attempt to do so.

*The three way power socket that will fit the Yamaha PA20 or PA30 power supply.*

# The Oakley RPSU module

This power supply board will allow the conversion of a suitable low voltage alternating current (AC) to be rectified, smoothed and regulated. The module is designed to be fitted to a suitably large metal panel which functions as a heatsink for the two regulator devices attached to the RPSU circuit board. The metal panel should have adequate airflow around it and it is expected that it will be part of the metal enclosure your rack project is built into.

It is possible, if the RPSU is only powering a small amount of electronics, that the unit can be used with either no heatsinks or just small clip-on types. However, it is up to the builder to determine whether or not this is possible. If in operation the two power devices get too warm to touch for more than ten seconds you will need additional heatsinking.




*The RPSU fitted to a SRE330 project. The power enters the case at the rear, seen here at the top right. The parts pertaining to the power LED have not been fitted as the SRE330 main board already has an LED.*

The voltage output of the power supply module is a split rail 15V supply. This means it generates both +15V and -15V. That is, two power rails, one of a positive voltage, the other a negative one. These voltages are measured with respect to a common ground which is normally connected, via your house's wiring, to the earth that you stand on. The voltage across both rails is 30V, with the common ground sitting exactly in the middle of this at 0V.

The output current capability is the maximum current you can draw out of the power supply. The current taken from the supply is determined by the amount and type of modules you are connecting to the power supply.

The Oakley RPSU features current limiting but only what is built into the two power devices. Although this will probably stop your project from bursting into flames it is not to be relied on if the fault continues for a long period of time. The RPSU is fitted with fuses and the correct choice of fuse will probably save your project in the event of a major breakdown.

If you are using a single phase 500mA (or 0.5A) AC wallwart* then the most current you can take from this power supply module is around 125mA from each rail. This is enough a couple of 5U modules. You may think that a 500mA power pack should be able to drive up to 250mA for each rail. But simple arithmetic does not work when you are dealing with conversion from AC to DC. The various parts of the power supply require energy to work and this reduces the useful power we can actually draw from the supply. The rule of thumb for a single phase supply driving a half-wave rectified supply is that the AC current drawn is roughly 3.6 times that of the DC current drawn from each rail. This means for a 500mA wallwart we can take only 139mA for each rail. To allow for some safety margin we drop this down to 125mA per rail which allows for a 10% overhead. This is plenty enough for two or three 5U modules but not much else.

Single phase wallwarts are the most common AC output power adapters but increasingly they are getting harder to find particularly at higher output currents. Most wallwart supplies produce DC (direct current) voltages which means they are not suitable for use with the RPSU. Ensure that when you buy a wallwart type adapter it does actually output an AC (alternating current) voltage. Some DC output adapters are confusingly called AC adapters simply because they plug into your AC mains supply.

Various companies make wallwarts and linelumps** with a greater capacity than 500mA. If you can get a 1A output one than this will be able to drive up to 250mA per rail. With any single phase supply you will be using your RPSU in half wave rectification mode. Single phase mains adapters are the most common and have only two wires coming from them. They are normally connected to the rack with a barrel type plug.

Some linelumps, like the Yamaha PA-20 and PA-30, use a split AC output or a centre tapped AC output. This means it has three wires coming from it and will use a different plug from the usual round barrel one you see on the single phase AC wallwarts. With a split AC output the Oakley RPSU should be wired to work in full wave rectification mode.

The Yamaha PA-20 supply is rated to give an output voltage of 35Vac (with a centre tap) at a load of 0.94A. Once rectified and smoothed this means that a maximum current of 0.52A per rail can be drawn from the RPSU. This is plenty enough to power a single SRE330 main board for example.

Two sets of screw terminal blocks are provided for connecting the low voltage AC power source to the board and the optional power switch. If you are using a single phase wallwart to power the RPSU module than you need only to use two terminals per terminal block.

The board has four mounting holes for stable placement onto your modular case. Care should be taken so that the board's various board mounted components do not come into contact with any part of the enclosure. One of the mounting holes, the top right hand one, is connected to the CASE solder pad and pin 5 of the PS1 header which can provide a handy way of reinforcing any earth connection. The optional wire link, LK, can connect the case metalwork to the RPSU's 0V.

The power supply has two integral fuse holders in case of a problem with the power supply circuitry itself. Two fuses are needed if you are using full wave rectification, but only one, F2, is required for half wave rectification. The fuse type should be a slow blow or anti-surge type. The size is 20mm. It should be rated at between one and two times the maximum current of your wallwart. Thus a 500mA AC output mains adapter should have a fuse that is rated between 500mA and 1A, ideally 750mA. A 1A linelump should have a fuse that is between 1A and 2A, ideally 1.5A.

There is an LED indicator for the AC  input. This can be built onto the board, fitted to the front

panel or omitted altogether. The RPSU's LED will light as soon as AC power is applied to the RPSU and not just when the unit is switched on.

As we have seen the standard circuit provides two outputs, one at +15V and one at -15V. Unlike some power supplies the -15V rail will not track the +15V. The RPSU contains two separate, but complementary, power supplies.

The output voltages are available from a single four or five way 3.96mm Molex KK or MTA header, PS1. A second three way header, PS2, provides only the positive voltage.

* A wallwart is the vernacular term for a low voltage mains adapter that plugs directly into the wall. These take the form of a black plastic block that is shaped like an oversized mains plug. It is called a wart simply because its appearance is somewhat uglier than a normal slimline plug.

** A linelump does the same job as a wallwart but it generally can handle greater currents. Because of its increased size it cannot be made so that it will safely fit into a plug socket directly. Thus the adapter sits in a black plastic box and connects to the wall via a cable and traditional mains plug. It is therefore a black plastic lump connected to a line. The Yamaha PA-20 and PA-30 are such linelumps.

# The Power Supply to the Power Supply Unit

The standard method of powering the RPSU is from a low voltage tapped AC source. The safest available option is to use a ready made 'wallwart' or ‘line lump’ supply.

You can use a variety of 15V or 18V AC output wallwarts or linelumps. The current capability of the mains adapter, sometimes incorrectly called the 'ampage', will primarily determine the maximum current draw of your PSU.

Quite often you will find power supplies not rated in amps but instead given an overall maximum power rating, or wattage. The maximum amount of current that can be taken is worked out by dividing the power rating in watts by the voltage output. The problem is that you don't often know the exact voltage the device is producing since it does vary a lot from what it says on the device. For example, a 15V supply may well be producing 18V even when at full load.

Ultimately, the proof of whether it works is twofold. It must firstly produce the correct voltage so the RPSU can actually create a stable +/-15V when driving your project. And secondly, the adapter must not get overly warm in use. If you've bought what should be a good adapter but it gets hot or hums loudly when powering your project then it is not suitable. Another solution must then be sought.

Below are just two examples of power supply that you can use and will give you a rough idea of what sort of thing to look for.

**Ideal Power 77DB-10-15M – Use for currents up to 180mA**

This is for use in the UK only and is a 670mA single phase AC output wallwart. It is available from Farnell as their part number 2368009. I do not recommend you take more than 180mA per rail from the RPSU using this supply.

Because this is a single phase unit the Oakley RPSU is wired in half-wave rectification mode. You notice that only two wires come out of the wallwart and that you can select from a variety of output socket types. Simply chose the one you would like to use on your system and buy the appropriate

socket for it to go into. I tend to recommend the 2.5mm DC power plug one since this is the most common type of power socket.

You should fit fuse F2 only and it should be an anti-surge type and rated between 1A and 1.25A.

**Yamaha PA-20 – Use for currents up to 520mA.**


*The European version of the PA-20. Other country's units are similar but will have the local mains connector fitted.*

This is a linelump supply and features a fixed 17.5-0-17.5 volt AC output at 0.94A maximum. This means it gives us two AC outputs with a centre tap or mid point reference voltage. So unlike the single phase AC adapter output with two leads, this one has three. This means you need to use the Oakley RPSU in full wave rectification mode.

The PA-20 is made for Yamaha products and they are available from Yamaha spares departments as well as many music shops, eg. Thomann. These are CE approved and connect to the mains via your local mains connector. They will be different types depending on the country you need them for. It comes with a handy three way plug at the low voltage end that you can use with an appropriate socket. If you wish you can ditch their connector and use your own. Oakley Sound sell a suitable three way connector to fit the Yamaha one perfectly.

In the UK the line lump's part number is V9812300 and the total cost is around £30 including VAT and postage. We do have permission from Yamaha-Kemble in the UK to use this particular part for the Oakley system, but in other countries this may be not so clear cut. The liability issue once again rears its ugly head and they may not want to sell power items for third party use. If you are buying these direct from Yamaha and, for some reason, are asked why, the best thing is to say it is for your own MG12/4 mixer.

Once rectified, smoothed and regulated the Yamaha PA-20 can deliver up to 0.52A continuously into both 15V rails.

You should fit both fuses and both should be anti-surge types and rated at either 1A or 1.25A.

**Yamaha PA-30 – Use for currents up to 780mA**

This is essentially a bigger version of the PA-20 as detailed above which supplies 18V-0-18V at 1.4A maximum. Once rectified, smoothed and regulated it can supply up to 0.78A continuously. You should again fit both fuses and both should be 2A anti-surge types.

If you have successfully used the Oakley RPSU with any other types of power pack please do let people know via the Oakley Sound forum at www.muffwiggler.com

# RPSU issue 2 Parts List

For general information regarding where to get parts and suggested part numbers please see our useful Parts Guide at the project webpage or http://www.oakleysound.com/parts.pdf.

The components are grouped into values, the order of the component names is of no particular consequence.

A quick note on European part descriptions:

For resistors: R is shorthand for ohm. K is shorthand for kilo-ohm. M is shorthand for mega-ohm

For capacitors: 1uF = 1,000nF = 1,000,000pF. Sometimes the F is not included on the circuit diagram to indicate a capacitor's value, ie. 100n = 100nF.

To prevent loss of the small '.'as the decimal point, a convention of inserting the unit in its place is used. eg. 4R7 is a 4.7 ohm, 4K7 is a 4700 ohm resistor, 4n7 is a 4.7 nF capacitor.

**Resistors**

All resistors 1% 0.25W metal film resistors.

| | |
|---|---|
| 270R | R3, R4 |
| 3K | R1, R2 |
| 10K | R5 |

Wire link, LK, can be fitted if you wish your metal case to connected to 0V at the power supply. See the section 'Grounding your case' for more details.

For +/-12V make R1 & R2 both 2K4

**Capacitors**

| | |
|---|---|
| 100nF axial multilayer ceramic | C1, C4, C5, C6 |
| 10uF, 35V or 50V electrolytic | C2, C3, C7, C8 |
| 22uF, 35V or 50V electrolytic | C13 |
| 1000uF, 35V or 50V electrolytic | C9, C10, C11, C12 |

C9 to C12 are radial types and have standard wire ended leads. Lead spacing is 7.5mm. Do not get 'push-fit' types as their pins would be too large to fit into the PCB. Ensure they have a ripple rating of at least 750mA and that their height doesn't exceed your chosen case once they are fitted into the board.

**Discrete Semiconductors**

| | |
|---|---|
| 1N4002 or 1N4004 | D1, D2, D3, D4, D5, D6, D11 |
| 1N5401 | D7, D8, D9*, D10* |
| 5mm red or green LED | Optional 'power on' LED. |

* D9 and D10 do not need to be fitted if you are using a single phase wall wart or line lump, although they won't cause any problems if they are. For full wave rectification, that is, if you are using a split output line lump or an internal transformer with twin secondaries, then D9 and D10 are required.

**Integrated Circuits**

| | |
|---|---|
| LM317T 1A variable regulator | U1 |
| LM337T 1A variable regulator | U2 |

Ensure that both devices are TO-220 types and not any surface mounting or TO-3 packages. I much prefer the devices that have a thicker mounting (dual gauge) tab.

Do not fit solder U1 and U2 into the board just yet. They are only to be soldered once the board is fitted to the base panel of your case. See the section on mounting the RPSU board later in this document.

**Miscellaneous**

| | |
|---|---|
| Antisurge 20mm fuse* | F1, F2 |
| 20mm fuseholder PC mount* | F1, F2 |
| 4-way screw terminal 5mm | POWER, SWITCH |

* If you are using a single phase wall wart supply, then fuseholder F1 and its associating fuse does not need to be fitted. F2's fuse rating should then be a 1A antisurge or time lag type. If you are using an internal transformer or split output line lump supply then both fuseholders are fitted and the fuses are both 800mA antisurge or time lag types.

Suitable headers and connectors for the outputs. You may wish to have a look at the pin out diagrams later in this document to see which headers you need to purchase. However, for use with the SRE330 and ADR30 projects the following are needed:

| | |
|---|---|
| 0.156” Molex KK 5-way header | PS1 |
| 0.156” Molex KK 3-way header | PS2 |

| | |
|---|---|
| 2 off TO-220 insulator | For mounting of U1 and U2 to panel |
| 2 off TO-220 insulating bush | For mounting of U1 and U2 to panel |
| Heatsink paste | For mounting of U1 and U2 to panel if using mica plates |

Suitable power switch
Suitable power socket

A suitable length of 24/0.2 insulated cable for all power connections.

Mounting hardware for the four mounting holes:

M3 hex threaded 6mm spacers (4 off)
M3 16mm screws (4 off)
M3 hex nut (4 off)
M3 shakeproof washers (8 off)
M3 flat washers (4 off)

The shakeproof washers go between the bottom panel and the hex spacer, and between the flat washer and the top nut. The flat washer goes up against the top surface of the PCB.

For mounting the power devices, U1 and U2, you will also need the following parts.

M3 10mm screws (2 off)
M3 hex nut (2 off)
M3 shakeproof washers (2 off)

Please see later in this document for more details on how to mount the power devices.

# Grounding Your Case

If you are powering your project with an internal mains transformer then you will need to earth your case directly. This is covered in more detail in the section “Using a Mains Transformer” later in this document. If, however, you are powering your case from a wallwart or linelump power supply, the 0V reference point in your project will be floating with respect to the mains earth. The 0V will then only be 'tied' to mains earth or ground when you connect your audio cables to your studio system.

It is a good idea to connect the metal casing of your project to 0V. This helps keep unwanted signal interference to a minimum. There are variety of ways that the case can be connected to 0V and I have found the best way is to use the sleeve connections of the audio input and output sockets. Since these are securely fixed to the case this should mean that the case is also now connected to 0V. To ensure a good connection I use toothed shakeproof washers between the sockets and the inside surface of the rear panel. This, however, only works if you have used metal bushed sockets such as the ubiquitous Switchcraft 12A or 112A. It is worth checking that your case does have continuity between all of its constituent parts. Simply grounding the rear chassis with your sockets may not ground the rest of the case if the case's paintwork prevents good electrical conductivity. In this scenario you may have scrape off some areas of paint around the securing screws, or perhaps add an additional grounding terminal on the isolated parts of the case as discussed below.

If you have used sockets with a plastic bush like those made by Cliff and others then you will need find another way of grounding your case. One way is to use a grounding terminal which is simply a M3 or M4 metal screw secured through an appropriate part of the metal case to which a solder tag has been attached. The grounding terminal should have a toothed washer to bite through the metal surface of the case to ensure a good electrical contact.

The solder tag can then be wired to the CASE solder pad near the top right mounting hole. A wire link, perhaps made from a resistor lead clipping, should then be soldered into the LK position on the RPSU board. LK joins the CASE pad to 0V.

Another way is to use the RPSU's top right mounting hole. All four holes have a wide solder pad around them but the top right one is connected to a solder pad labelled CASE. If using metal hardware to secure the RPSU then the top right hand mounting hole will make an electrical connection to the case without any need for an additional ground terminal. Again the LK link should be fitted.

Finally, pin 5 of the PS1 header on the RPSU is also connected to the CASE solder pad. Pin 5 may then be used to augment any grounding arrangement.

One has to a little careful when using the word 'ground'. I sometimes talk about local ground and 0V as being the same thing. This is technically incorrect but it is used a lot. I worked at Marconi in the 80s and Soundcraft in the early 90s, and ground and 0V were used interchangeably even by seasoned engineers. We'd talk about chassis ground, dirty ground, signal ground and clean ground. They'd all be connected to 0V somewhere in the system but the term ground was in common usage.

Ground, when used in this way, is then a local common reference connection tied to the 0V of the unit's power supply. It is not the same as mains earth. Indeed, it may not even be tied to mains earth in the unit in question.

Strictly speaking, electrical ground is mains earth and historically it was solely referred to as that, but usage, incorrect or not, has meant a shift in the meaning. Ideally, we should call our common reference connection within our unit as 0V and not use the term ground.

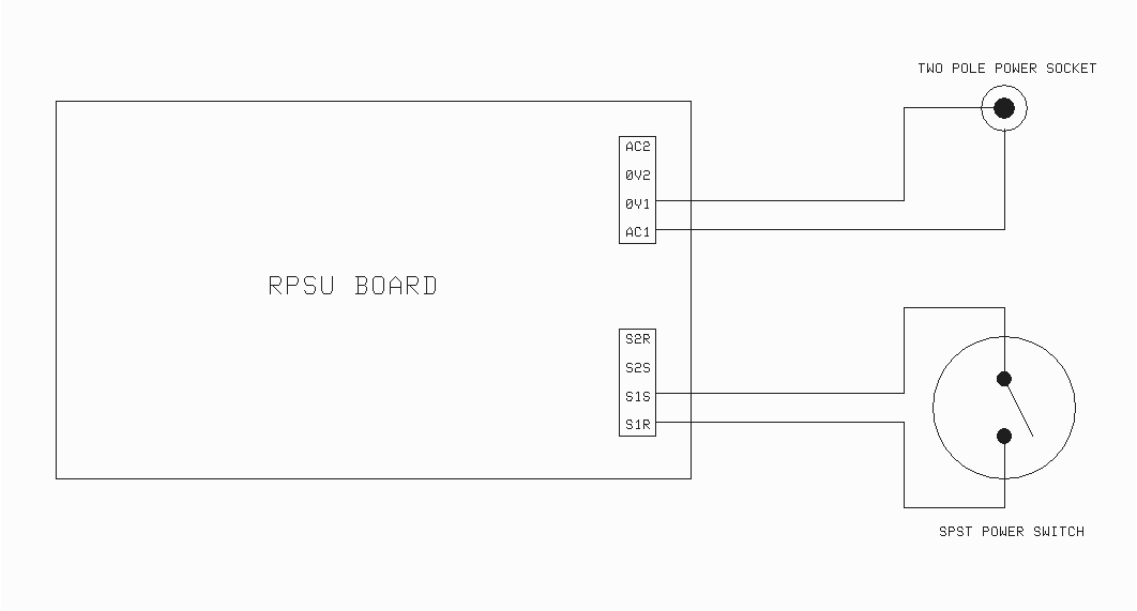
# Linelumps and Wallwarts: Wiring Diagrams

The input power wiring will depend on the type of wallwart or linelump you will be using.

**Standard AC output wallwart**

Single phase, two wire, wallwarts or linelumps need to use half wave rectification so the Oakley PSU can generate both positive and negative supplies simultaneously. They only need the terminal's AC1 and 0V1 wired to the power socket. AC2 and 0V2 are left unused.

D9, D10 and F1 are not needed to be fitted to the RPSU although it will do no harm if they are fitted.



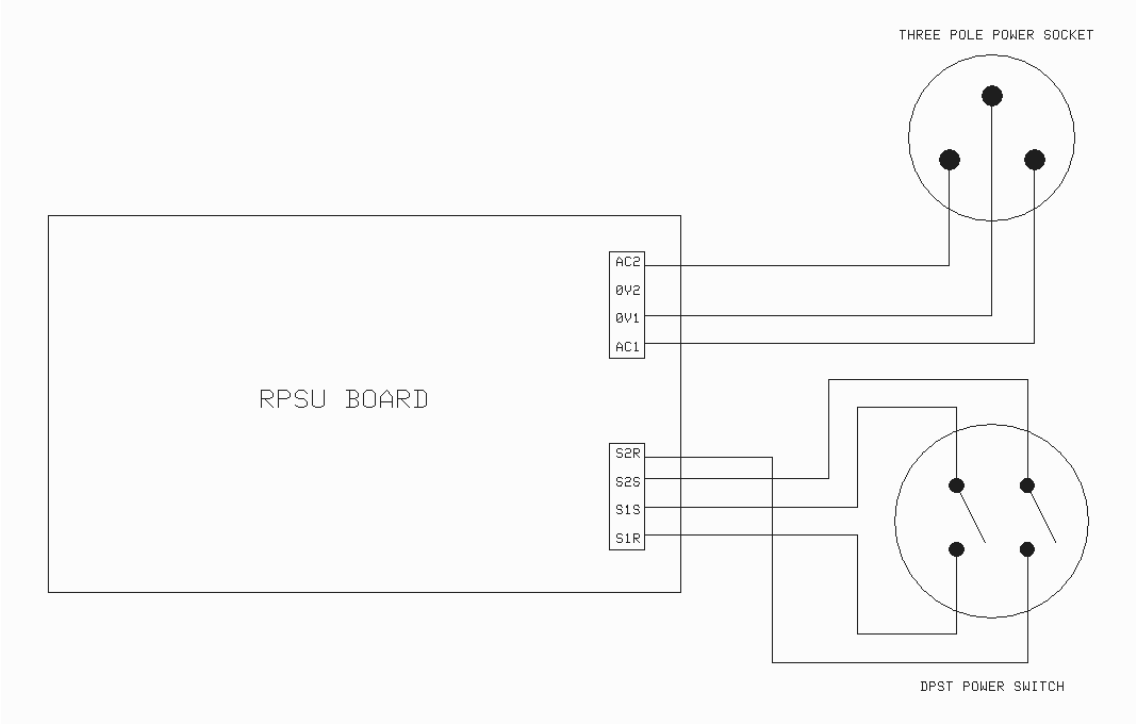

*Connecting to a wallwart with single phase AC output.*

The front panel switch is a single pole single throw (SPST) switch which simply connects S1R and S1S together when switched on.

Only F2 needs to be fitted and it should be rated at 1AT, ie. a one amp anti-surge or time lag fuse.

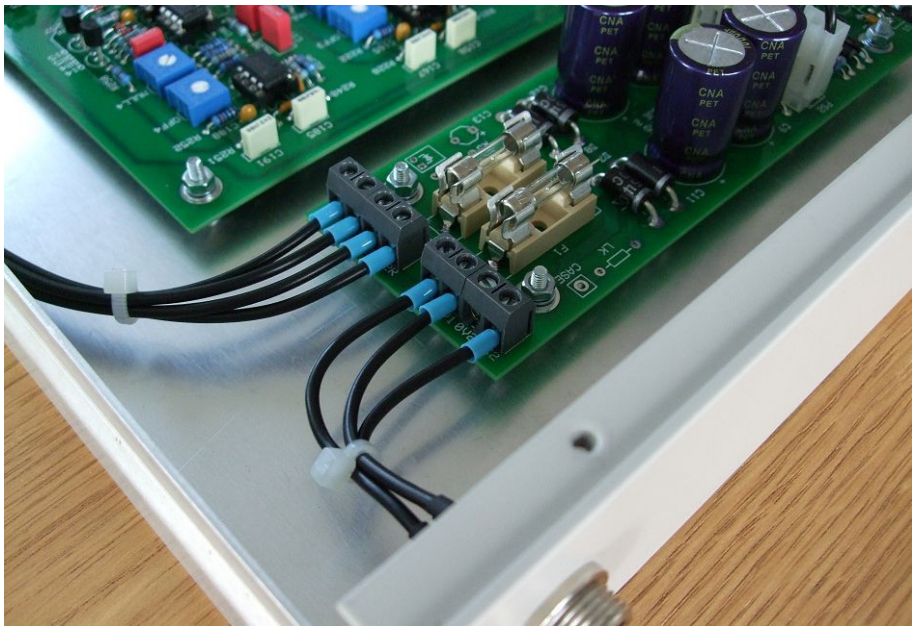
**Centre tapped wallwarts and linelumps**

Centre tapped linelumps like the Yamaha PA-20 will have three wires coming from their connector. It will have two AC outputs and one 0V. Take one of the AC outputs to terminal AC1 and the other AC output to terminal AC2. It should not matter which AC output goes to AC1 or AC2. The 0V should go to the 0V1 terminal. The 0V2 terminal is left unused.




*Connecting to a linelump wiring with centre tapped output, eg. Yamaha PA-20*

The front panel switch is a double pole single throw (DPST) switch which connects S2R and S2S together, and S1R and S1S together, when switched on. Both fuses are fitted and they are both 800mAT anti-surge or time lag types.



*All power wiring uses 24/0.2 insulated wire. I have also boot lace ferrules on the wire ends that go into the terminal blocks for neatness.*

# Using an Internal Mains transformer

Be afraid, be very afraid...

Some of you old hands will laugh about the level of hysteria that surrounds direct mains connection to DIY projects. However, this fear is more to do with our litigious society than the real danger to the builder. Even so, I have had more than my fair share of high voltage shocks over the years and it is not something I would want any builder to have to experience. It has been purely luck that has saved me in several of those cases.

So I will say again – do not attempt to build a mains transformer into your project without realising that to do so carries a risk of death to either you, or to the person who may inadvertently put their fingers into your half built construction. Furthermore, it is up to you as the builder of such an item to make sure, that once built, the item is safe to use and meets all current safety legislation.

**This is not a complete set of instructions on how to fit a transformer into a piece of electronic equipment. This information is offered only as a guide and should not be considered as your only source of information. No further information, other than that included here, will be provided by myself regarding the construction of mains powered items.**

For powering a typical small project requiring up 400mA then the mains transformer's secondaries should be rated:

Voltage: 18-0, 18-0 (dual secondary) or 18-0-18 (single tapped secondary)

Power: At least 25VA

This will give you a power supply that should be theoretically capable of providing just over 400mA to each rail assuming your heatsinking and smoothing capacitors are up to the job.

The transformer secondary voltage is suggested to be 18V. It may be possible to use a 20VA transformer rated at 15V. Most transformers produce more than their stated voltage when drawing less than their maximum current and I have found that 15V toroids always work well here in the UK. The benefit of using a lower secondary voltage is cooler power devices. However, the disadvantage is that you may be running your power supply very close to its lowest operating voltage – particularly if your country's line voltage is less than the expected 230V (or 110V).

Slightly higher transformer secondary voltages can also be tolerated although you need to consider three things:

1. You may need a physically larger transformer for the same output current.

2. The power supply's components, including the smoothing capacitors, should be rated at a high enough working voltage to handle the increased voltage across them.

3. The heatsink, ie. the case, will need to dissipate even more energy because of the greater voltage drop across the regulators.

In the wiring diagram shown I have included a suggested wiring method for connecting up a mains transformer. Not all mains transformers are the same, some have additional windings, others have tapped windings. I have simply used a single primary, double secondary type for example only.

For the mains side fuse you should use a 500mA anti-surge type. All wiring at mains potential should be adequately insulated, secured well and protected from straying fingers.

There is no need to fit an AC standby switch since you will be fitting a proper mains switch in series with the transformer primary coil. So you should link S1S to S1R, and S2S to S2R, on the RPSU PCB.

Toroidal transformers are in theory much easier to mount than ordinary EI transformers, they simply need one large bolt to secure the various parts provided. However, there is one particularly important consideration involved when mounting a toroidal in a metal case. You must ensure that the transformer and the mounting bolt must fit inside the case without the metal mounting bolt or top mounting plate touching the metal case. The mounting bolt must only be in contact with the lower panel. If it touches the top this will short circuit the transformer and it will probably catch fire.

**Earthing**

Remember it is up to you, the builder of the equipment, to make sure that your item is safe and is built to the required safety standard in your country. These notes are only a guidance and it is up to the reader to establish the exact obligations required in their own country.

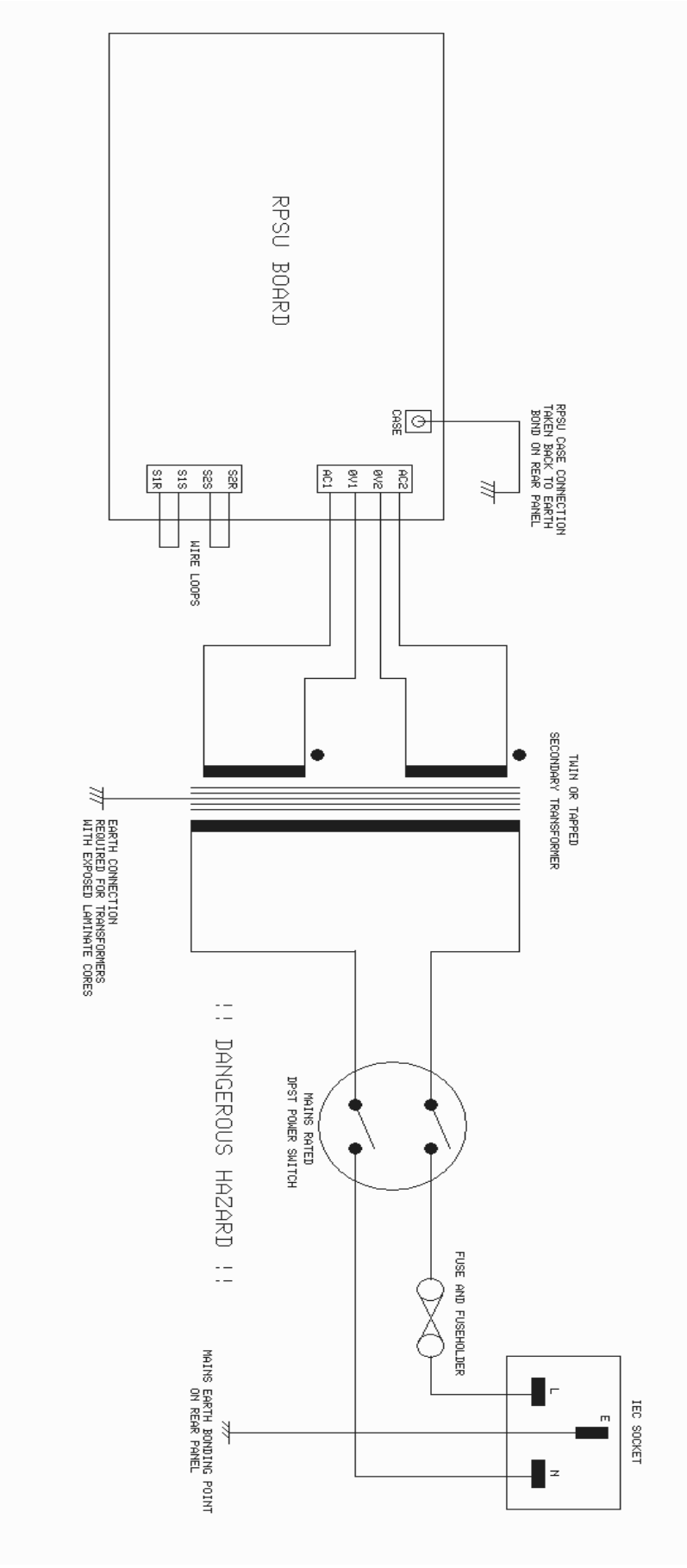
It is essential that everything you build, that has both live mains inside and a metal case or panels, has a safety earth fitted. UK legislation requires that any metal panelling should be adequately insulated, ie. double insulated, or connected to earth. Since making a double insulated case is not practical you should ensure that any exposed external metal parts be properly earthed.

The case should be bonded to earth using an M4 screw, toothed washer, washer, solder tag and a securing nut (or two) bolted through the case and then via a thick piece of wire back to the earth tang of the IEC power inlet. It is useful to mount this earth bonding point on the rear panel of the unit. Remember that all other parts of the case must be earthed too. Painted metal parts of the case must be dealt with so that they too are earthed. This may involve using secondary bonding points or scraping back the paint at the appropriate point.

The RPSU board should be securely mounted (using all four mounting holes) onto the earthed casing using appropriate screws and toothed washers. You should also solder a thick wire from the solder pad marked 'CASE' on the RPSU to the earth bonding point on the rear panel.

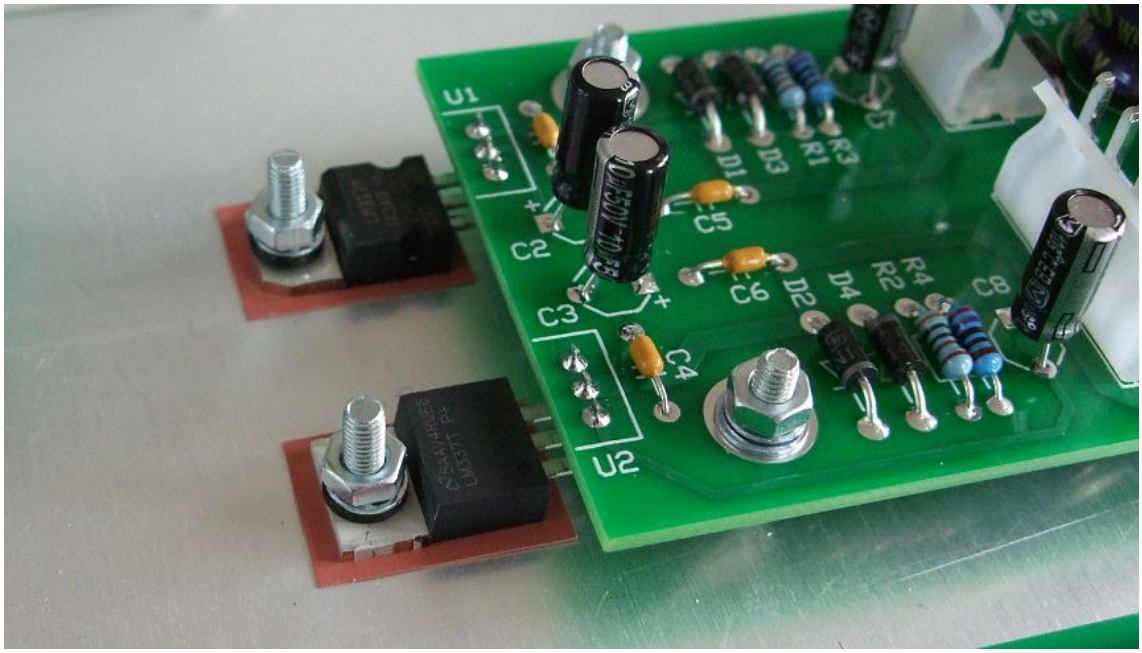
You will also need to provide earthing to any exposed transformer core. This does not apply to toroidal types but EI types should have their metal frame earthed.

It is possible that by earthing the case and local ground you may introduce earth loops when you connect your mixer to the sockets of your project. The outcome of this is audible humming at 50/60Hz and its harmonics. It is produced by currents travelling down the screen of the connecting cable(s). This can be avoided by careful studio wiring and/or by using balanced audio lines to pipe signals to and from the unit and mixing desk. Most mixing desks and sound cards will have balanced outputs and inputs.




*Mains wiring diagram. For experienced builders only!*

# Attaching the Power Devices




*In this build the two regulators are insulated from the panel with soft red insulating pads.*

The RPSU PCB needs to be fitted to your case metalwork. Use the PCB as a template for the four holes needed for the mounting pillars. The board should be spaced high enough off the panel so as to not short out any of the components' leads should the board be flexed downward. However, they should also not be too long so that the leads from the two regulators can't reach through the board to be soldered. I find an 5 or 6mm spacer works very well.

Now you need to prepare the leads of the two power devices. The three legs need to be bent upwards so that the PCB can be fitted over them. Note that the top surface of the device is marked with the name of the component and it is the flat side on the bottom of the device that will be in contact with the panel. You should be able to see that the leads have a thicker section close to the body of the device. Make a 90 degree bend upwards at the point where the lead thickness changes. Do this for all three legs of the device.

Remove the board from the panel and fit the power devices to the board by poking their legs up through the bottom of the board. Do not solder them but fit the board back into place. Use the hole in each regulator to mark out where you need to drill the mounting hole for the two devices. Now remove the board and regulators. Carefully drill a 3.8 or 4mm hole in the panel for each of the regulators. Clear off any swarf and, twisting with your hand only, use an 8mm drill bit to lightly deburr the edges of the holes. There should be no bumps around the holes.

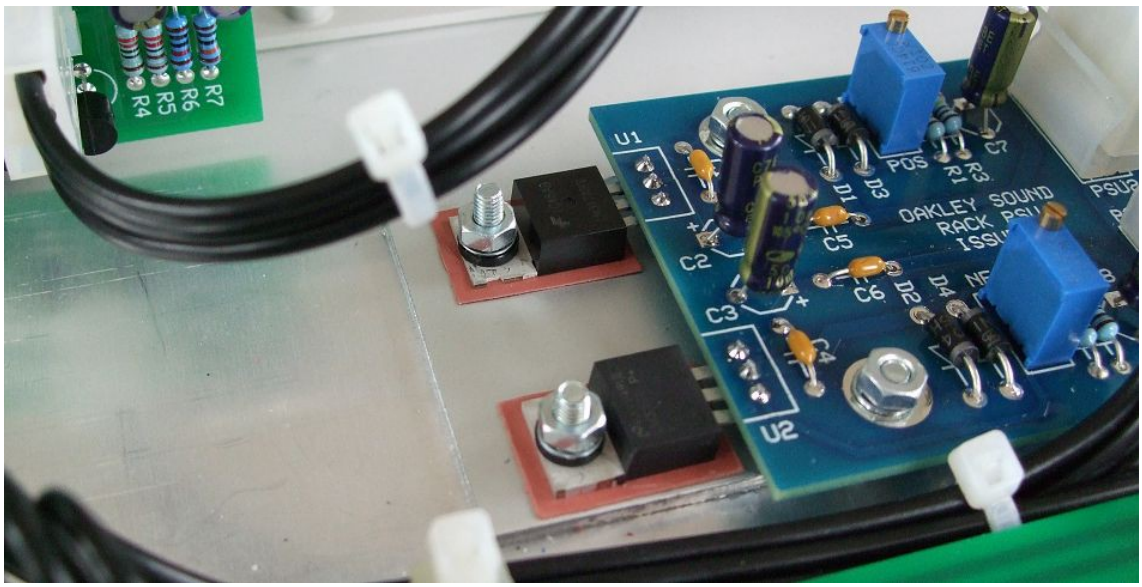
The regulators are both TO-220 devices. They both need to be fitted to the panel mechanically and thermally but not electrically. That is the metal tab on each device that will be mounted to the panel should not make electrical contact with the metal panel. To achieve both thermal transfer and electrical insulation we use an insulator. These can be made of a 'soft' flexible material in the form of an insulating pad or a rigid thin glass like plate made from mica. If using the mica you will also need to use heat transfer paste. Since the paste is somewhat messy I recommend you use the insulating pads. Both types are normally available in 'mounting kits'. Also in the kit is a mounting bush. This top hat shaped piece of stiff plastic prevents the mounting screw from touching the regulator's metal tab.

Now place the mounting bush into the hole of the power device, with the flange of the bush lying on the top side of the device. Take one of the insulating pads and place it against the rear of the regulator. It should fit flat against the device and the bush should stick out a little allowing you to align the pad correctly.

Now place the power device, bush and pad, flat against the rear of the panel so that the bush fits into the panel hole. Make sure the pad does not slip out of place when you do this. Insert a 10mm M3 screw into the hole from the reverse side of the panel, and fit a spring washer and nut onto the screw but do not tighten. Do the same for the other regulator making sure, of course, that the correct device is in its proper location.

If you have drilled your holes correctly, you should find that the when the power supply PCB is lowered back its four mounting screws, you can coax the power devices' legs through the respective solder pads on the board. Now tighten the four nuts holding the RPSU board in place. You should have a flat washer and shakeproof washer under each nut. Gently tighten the screws holding the power devices. Do not tighten them too much as this will crush the insulating pad. Once secured you can solder the regulators' leads from the top side of the board and clip off any excess lead lengths.

If the bottom panel of your case, or the power device's mounting tab, is too thin, you may find that the insulating bushes stick out too far to allow the use of countersink screws. Countersink screws can look better since they sit flush with the surface of the case. However, if the insulating bush protrudes too far into the hole it may not allow a countersink screw to seat properly. Tightening the screw will then inevitably crack the insulating bush and possibly allow the screw to make contact with the power device's metal tab. In this scenario it may be better to use standard pan head screws with no countersunk holes and accept that they stick out a little on the outside. Alternatively, you could use a 1.5mm or 2mm thick aluminium shim plate to go between the case panel and the power devices. The size of such a plate is not crucial but 30mm by 60mm would be appropriate.




*The first SRE330 prototype built with an issue 1 RPSU board. Note the aluminium shim beneath the power devices so that the insulating bushes could not be damaged by the countersunk mounting screws.*

# Interconnections


*The power distribution within a SRE330. The five way interconnect carries +/-15V, 0V and case ground. The three way interconnect carries just +15V and 0V.*

The power connections should be made with 24/0.2 cable fitted to Molex 0.156” KK crimp housings. You can use MTA type connections or even directly solder the wires if you prefer.

24/0.2 cable is an excellent choice for short lengths of power distribution as it has a low enough resistance for most applications under 1A. You can use thinner cable but long thin cables have a higher resistance which can cause significant voltage drops along the length of the wire. If the voltage drops are big enough they can cause unwanted signal interference.

The RPSU has two power headers, PS1 and PS2, for its outputs.

**PS1:**

| | |
|---|---|
| Pin 1 | +15V |
| Pin 2 | 0V |
| Pin 3 | 0V |
| Pin 4 | -15V |
| Pin 5 | CASE |

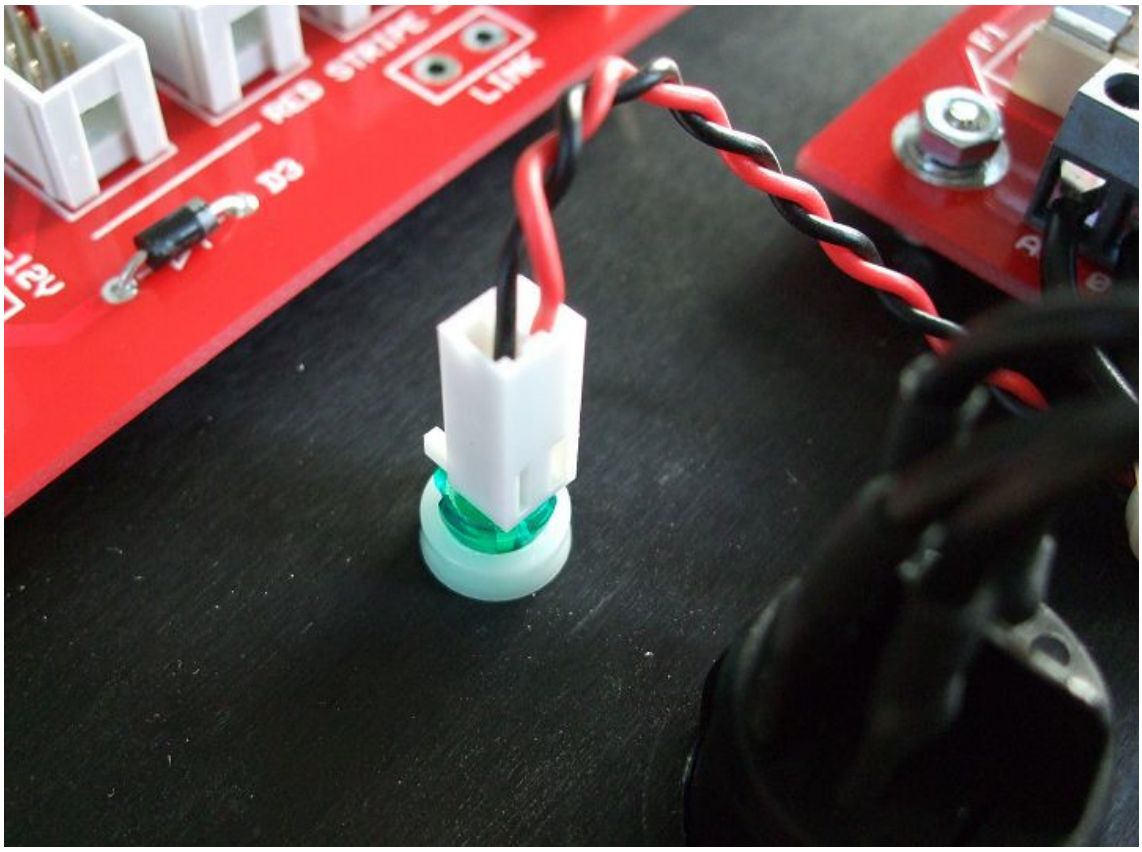
**PS2:**

| | |
|---|---|
| Pin 1 | +15V |
| Pin 2 | 0V |
| Pin 3 | 0V |

Pin 1 on both headers is the uppermost solder pad.

You can use just the top four pins of PS1 and ignore pin 5 if you do not need the CASE connection. In this way, PS1 is compatible with the standard Oakley/MOTM four way power headers on all our 5U modules. Just fit a four way 0.156” MTA or Molex connector to the uppermost four pads and connect to the Oakley module as normal.

The RPSU provides an optional LED to indicate that AC power is being supplied. The LED must be fitted the correct way around to light up. The cathode of the LED should be connected to the square pad on the board. You can fit the LED direct to the board or attach it to the front panel and connect it to the board with wires.




*Here I have used a green translucent plastic LED holder and mounting ring. The LED simply pushes into the clip and is held there quite firmly. Rather than soldering direct to the LED leads I have used a Molex KK 0.1” (2.54mm) housing and crimps to make the connections.*

# Final Comments

If you have any problems with the module, an excellent source of support is the Oakley Sound Forum at Muffwiggler.com. I am on this group, as well as many other users and builders of Oakley modules.

I'd love to hear about what you have done with your module. Please do post pictures of your finished module at the Oakley Sound forum on Muffwiggler.

If you are in the EU and can't get your project to work, then Oakley Sound Systems are able to offer a 'get you working' service. If you wish to take up this service please e-mail me at my contact e-mail address found on the website. I can service either fully populated PCBs or whole modules. You will be charged for all postage costs, any parts used and my time at 25GBP per hour. Most faults can be found and fixed within one hour, and I normally return modules within a week. The minimum charge is 25GBP plus return postage costs.

If you have a comment about this user guide, or have a found a mistake in it, then please do let me know. But please do not contact me directly with questions about sourcing components or general fault finding. Honestly, I would love to help but I do not have the time to help everyone individually by e-mail. The forum is the best place to ask these sorts of questions.

Last but not least, can I say a big thank you to all of you who helped and inspired me. Thanks especially to all those nice people on Muff's Forum and the SynthDIY and Analogue Heaven mailing lists.

***Tony Allgood at Oakley Sound***

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