Oakley Sound Systems

Euro Dizzy

The Eurorack Power Distribution Board
PCB Issue 1

User Manual and Builder's Guide

V1.3

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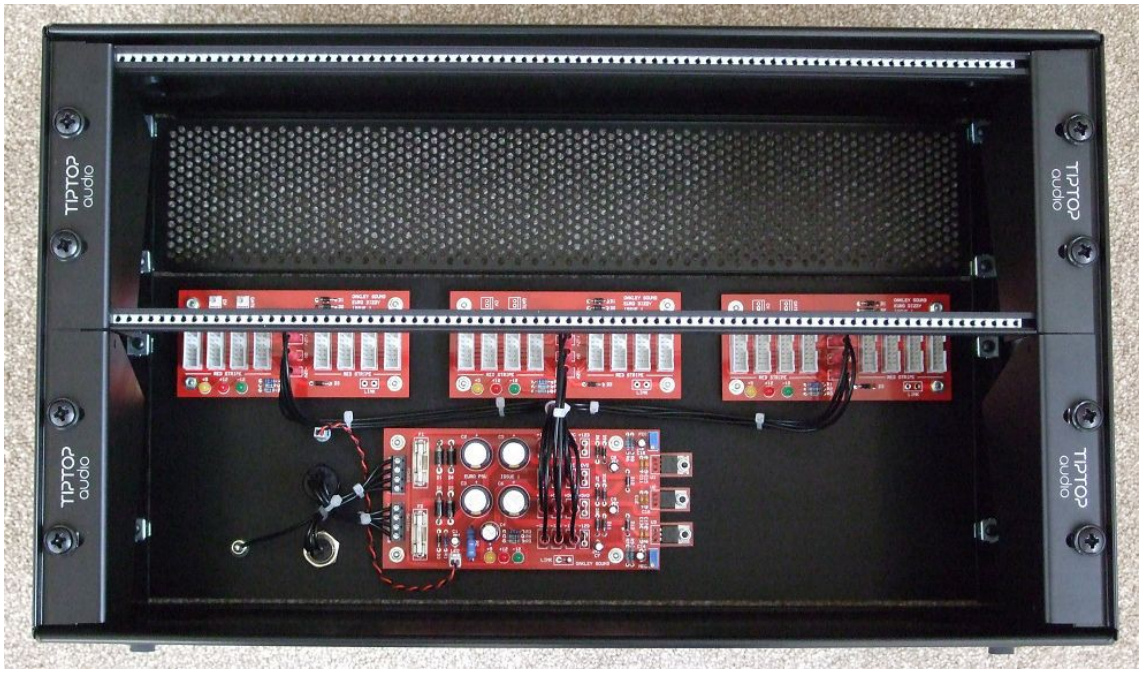
Introduction

This is the User Manual and Project Builder's Guide for the issue 1 Euro Dizzy module from Oakley Sound.

This document contains a basic summary of its operation and some information about how to connect it to your power supply and modules.

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.

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 the project webpage or http://www.oakleysound.com/construct.pdf.

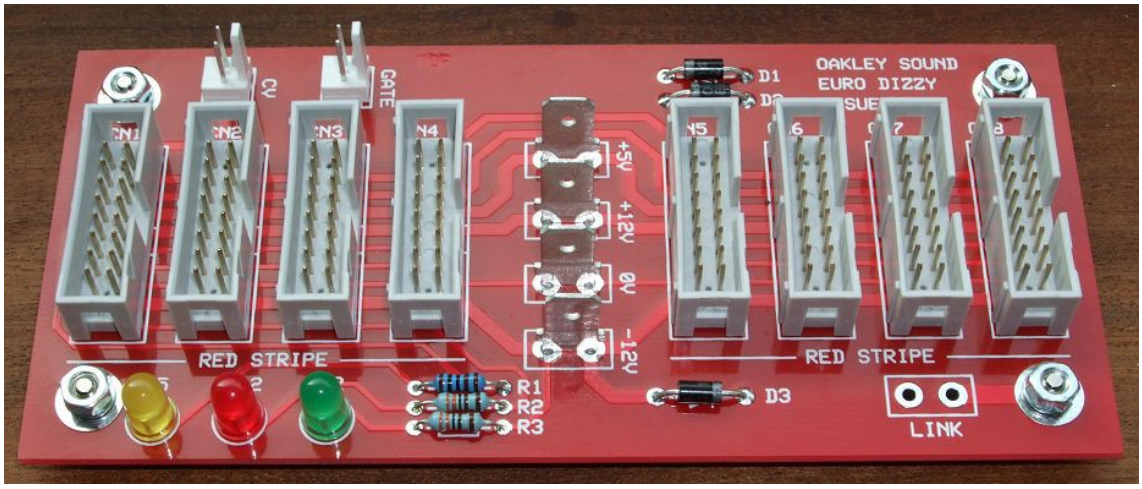


An example 6U modular system case showing hree Dizzy distribution boards fitted to a rear mounted 4U high blank 3mm aluminium 19" rack panel which also holds an Oakley Euro PSU and associating sockets and switches.

The Euro Dizzy – A Modular Distribution Board

This is a simple distribution board that enables you connect up to eight standard eurorack modules together. It also features two 0.1” headers to allow for CV and gate connections to the keyboard CV and gate bus featured on the standard 16-way headers.

The larger headers are arranged in two blocks of four. Power is sent to the board via four 1/4” (6.35mm) Faston 250 connectors. An optional earthing point is provided to connect the 0V connection to right hand bottom mounting hole. This then allows any fitted screw to be connected to 0V and thus providing an easy way to tie the case metalwork to 0V.



A fully populated issue 1 Euro Dizzy board fitted with eight Oupiin 3012-16C00SYA headers and two Molex KK 0.1” headers for CV and gate. The link has not been soldered as there is no need to do so in this particular case.

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. R is shorthand for ohm. K is shorthand for kilo-ohm. R is shorthand for ohm. So 22R is 22 ohm, 1K5 is 1,500 ohms or 1.5 kilohms. For capacitors: 1uF = one microfarad = 1000nF = one thousand nanofarad.

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, 6n8 is a 6.8 nF capacitor.

Resistors

All resistors, except were stated, are 1/4W and either 5% carbon or 1% metal film types.

1K	R1
3K3	R2, R3

Diodes

1N4004	general purpose 1A diode	D1, D2, D3

You can also use any of the 1N400X family. For example, 1N4001, 1N4002, etc.

Light Emitting Diodes

Yellow LED	standard 5mm	+5V
Red LED	standard 5mm	+12V
Green LED	standard 5mm	-12V

You can, of course, use any colour LEDs but I'll be sticking with this standard for all my power supply projects. Blue, white and high efficiency LEDs will probably require higher values of resistors otherwise they will probably be too bright.

Connectors

16-way 2.54mm straight boxed header	CN1 – CN8
'Faston' 0.25" single blade terminal	+5V, +12V, 0V, -12V
2-way 2.54mm Molex KK header	CV, GATE

Populating your Euro Dizzy printed circuit board

The circuit board is 5.6" (142mm) long by 2.35" (60mm) wide. There are four mounting holes provided and the hole size suits M3 screws. The board is double sided which means it has copper tracks on both sides to carry the electrical current around the board. The bottom side of the board is almost entirely dedicated to the 0V, or ground, connection. The copper layer is 2oz grade which means it is twice as thick as most ordinary circuit boards. This keeps the electrical resistance of the tracks low which reduces the chances of the connected eurorack modules interacting with each other.

Thick tracks and lots of copper mean that not only does the board carry electricity well, it also means that the copper carries heat well. So when you solder your board you will find you will require more heat than normal to melt the solder effectively. A good well powered soldering iron is essential for getting a good solder joint.

If you find that when soldering you are not getting your solder to wet both parts of the joint then you may need a hotter iron or a more powerful iron. I would recommend that you allow the tip of the iron to touch the solder pad first before applying the solder shortly after.

Not all parts have to be fitted for the board to work as intended. The three resistors and three LEDs are only there to provide indication that power is connected to the board. If you do not need the LEDs to be lit all the time then don't fit these parts and save a few milliamps. The LEDs use about 3mA each.

The three diodes are also optional but are there to prevent some types of bad connections and power faults. They are not there to protect individual modules from reversed power cables. However, they may help if, for some reason, the main power supply partially fails or is connected up to the Euro Dizzy in the wrong way. They do not provide permanent protection against power reversal if your main power supply does not feature sensible current management.

Some 16-way headers are unshrouded and unkeyed and you can, of course, use these to build your euro dizzy board. Indeed, several eurorack companies do this. The mantra is always 'red stripe down'. And if you can see your board when you are plugging in cables this is no bad thing. If, however, you have a crowded case and you are trying to insert cables by feel alone then you need to be very wary.

I recommend that you do use shrouded and keyed headers. There is an argument that keyed headers mean that there is an over reliance on trusting your power cable vendor to get their cables correct, but if you check your cables before plugging them in – the little triangle on the plug should line up with the red stripe on the cable – then a keyed header is surely a good thing. But the 'red strip down' is still true so if any cable isn't aligned this way then don't power up until you have checked and checked again.

On the PCB LINK is an optional wire link. A small piece of uninsulated solid core wire – a resistor lead clipping for example – can be used to connect the two solder pads of LINK together. This should only be fitted if you are mounting your Euro Dizzy on a metal panel and require the metal panel to be connected to 0V. If the panel is already being connected to 0V

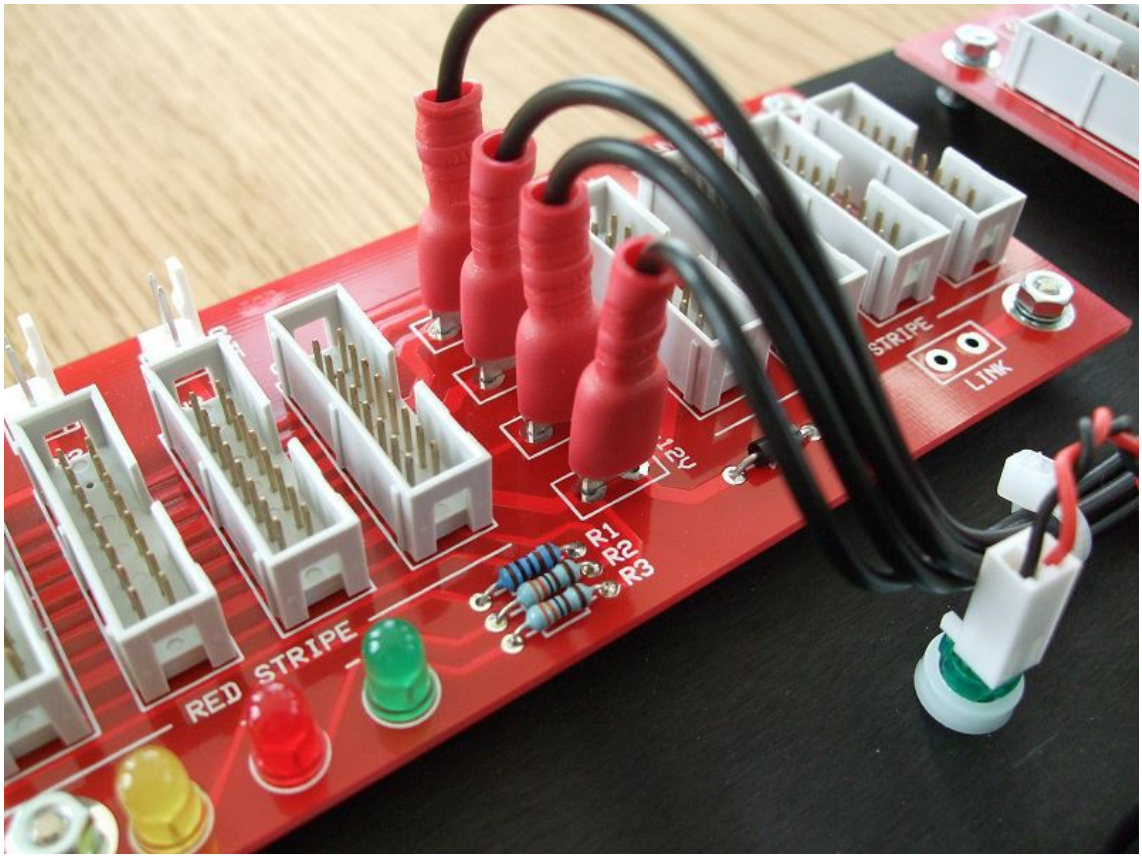
by another means, for example a central earth bonding point, then there is little need to connect it again via the Euro Dizzy.

The PCB hole size for the 1/4” (6.35mm) faston single blade terminals is around 1.5mm in diameter. This may not be tight enough for some types of faston terminals to held in place when the board is upside down and ready to be soldered. I recommend fitting all four at the same time while the board is held upright. Then with a something flat and stuff, a small bit of MDF sheet will do, to hold them in place on the board, the board can be inverted and placed onto your work surface. The fastons can then be soldered while you hold the board steady and in a position where the fastons are mostly perpendicular to the board's surface. You can gently bend them if they are a little wonky.

Connecting the Dizzy to the Power Supply

Cables

The cables connecting the power supply with the Euro Dizzy board should have thick wires and be as short as possible. I recommend using wire that has a cross sectional surface area of at least 0.5mm^2 and be no longer than 30cm. Wire that is defined as 24/0.2 is particularly suitable, its cross sectional surface area is 0.75mm^2, and this can be used with red 0.25" (6.35mm) faston connectors.



Red faston connectors being used with 24/0.2 wire. Although I haven't done it here, colour coding your wires is a good idea.

The Euro Dizzy should be mounted as close the power supply as possible. It is far better to keep the four interconnecting wires short and the module power leads long rather than the other way around.

One of the problems encountered by people when building up large modular systems is unwanted interaction between modules. For example, an LFO module may be modulating the pitch of a VCO even though there is no cable connecting the two. Or perhaps you can always faintly hear a VCO from your main output even though it's not patched up. These are examples of crosstalk. There are two mains causes of this. Firstly, signals can be radiated through the air, much like a radio transmitter. Simply moving the offending module from more sensitive ones can help here. Secondly is by the power supply, and although there are different

types of power supply crosstalk the main one will be due to the resistance of the power supply cables.

Unless we have access to superconducting materials we cannot have electrical cables without resistance. The thinner and longer the cable, the more resistance. When electric current travels through a cable with resistance a voltage is developed across it. The bigger the resistance, the bigger the voltage drop. That voltage drop along the whole system of wires and circuit boards in the modular means that the voltage any module sees at the end of its own power cable will not be what it was designed to deal with. But worse still, this voltage drop will not be constant. Each module in the modular system will be taking varying amounts of current and this unsynchronised battle for current will see the voltage across the power supply of every module be different and be continuously changing. Even the best designed modules cannot be expected to work flawlessly with that amount of noise on the power supply.

So if we cannot rid ourselves of crosstalk completely we must try to reduce it as much as possible. However, do bear in mind what is an acceptable amount of crosstalk inevitably depends on the user of the system. After all, the VCS3, a modular synthesiser of a sort, has problems with crosstalk for a multitude of reasons, but is still very much regarded as a classic instrument. That said if the problems are slight with a small modular system then they will almost certainly get worse as the system grows unless steps are taken to prevent it.

We must do three things to reduce crosstalk when using separate power distribution boards:

a) Minimise the resistance of the cable feeding the distribution boards. That is, the cable from the power supply to the distribution board must be as thick and short as possible.

b) Reduce the current travelling along the cables that connect to each distribution board. This means that each distribution board should not have too many modules attached to it. A single large distribution board feeding over twenty power hungry modules is going to develop an excessive voltage drop along its feeder cables and within the distribution board itself.

c) Reduce the resistance of all connections on the distribution board. This means that the distribution board must be as physically small as possible, use thick copper traces and be arranged so that each header has the shortest distance back to the power entry points as possible.

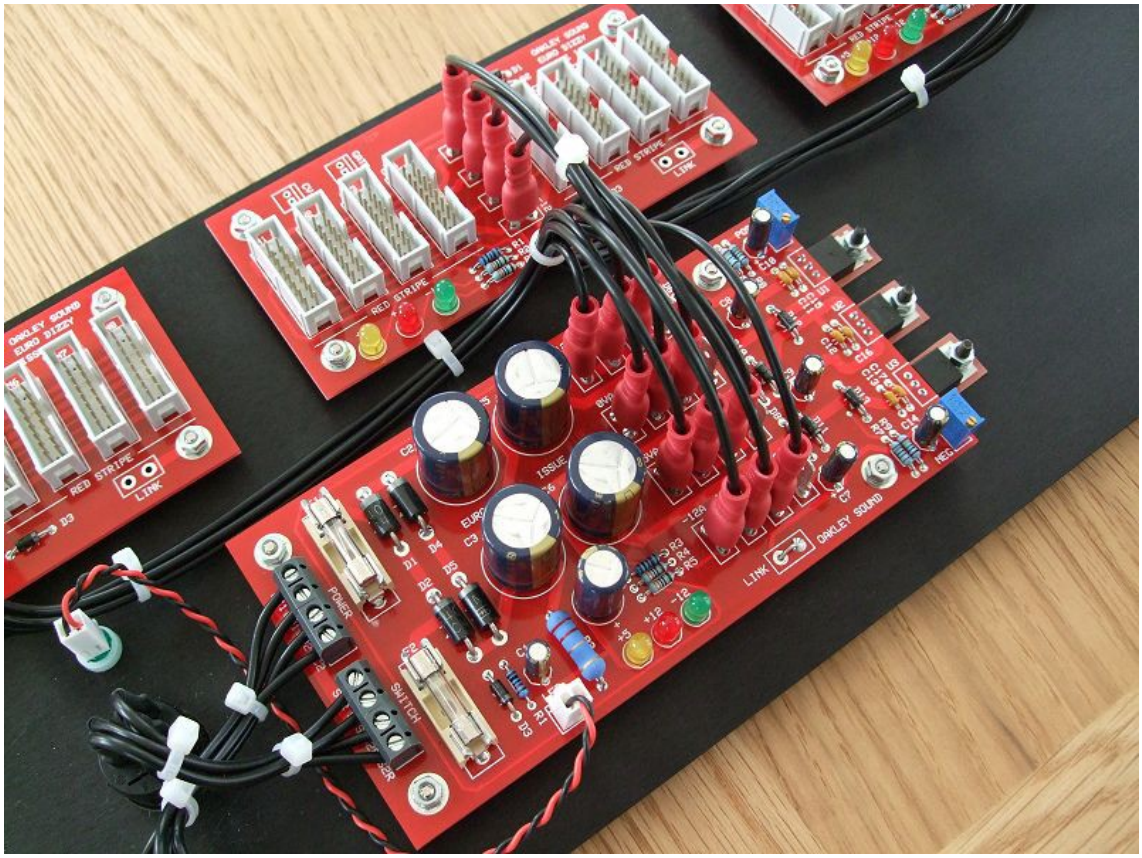
The first point's objectives are clear and the third point should be achieved by using the Oakley Euro Dizzy. The second point though requires a little more thought even if you are using the Euro Dizzy. It may, in some circumstances, be preferential to put all your heavy current modules on one Dizzy even though this seems to go against point two. If one Dizzy was to power, say, a single digital sequencer (complete with flashing lights) and then a bunch of low current analogue modules, you may find that the varying clock and LED current pulses from the sequencer would be picked up by the more sensitive of the analogue modules. So even though the current draw from that particular Dizzy was average, the fact that the power lines had to supply that one noisy module was detrimental to a sensitive analogue module.

Sometimes the greedy modules, even though they may be the source of the problem, are the least sensitive to crosstalk from other modules. In this case it may be better put them together

rather than shared across your system. Ultimately it pays to swap things around in your modular so you can achieve the quietest operation without sacrificing usability.

The Power Supply

My own recommendation is always to use several smaller power supplies with a small number of distribution boards rather than one big power supply driving multiple arrays of distribution boards. I think a good system would have four Euro Dizzy boards per power supply. This could allow for up to 32 modules to be powered from each power supply. Even though this is potentially more expensive there are several reasons for doing this. However, the main reason is if your single big power supply breaks you don't lose the whole modular. And if it breaks in a way that, say, puts an unregulated 22V on your +12V line you don't smoke your whole modular.



Three Oakley Dizzy boards, giving you up to 24 power headers, connected to an Oakley Euro PSU and mounted on a 4U rear mounted 19" rack panel.

If you do chose to use multiple smaller power supplies then a good solid connection must be made between each power supply's 0V. Not a huge amount of current needs to travel down this cable or cables but if you can use a thick cable connection then any problems of hum and crosstalk will be minimised.

Not many eurorack modules require +5V. However the Oakley Euro Dizzy, in accordance with the standards of the Eurorack 16 pin header, does provide a connection for this. If none

of your modules require a +5V supply then you do need a power supply that will provide it. All you will need is a power supply capable of supplying +12 and -12V and you can simply leave the +5V faston connector on the Euro Dizzy unconnected. The yellow +5V LED will not light up in this instance.

One final point about using multiple Euro Dizzy boards; watch your maximum current draw. Just because you can have up to 32 power headers does not mean you can actually power 32 modules. Each module takes current – the actual amount should be given in the documentation that came with your module – and your power supply can only supply a certain amount of current.

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