Oakley Sound Systems

Parts Guide

A guide to buying parts for Oakley Sound projects

V1.77

2nd May 2017

Tony Allgood
Oakley Sound Systems
CARLISLE
United Kingdom

Introduction

This is my generalised parts guide for all of the Oakley Sound projects. It is intended to be a one stop information pack for all UK builders of Oakley equipment, as well as being, I hope, a great help to those customers in other parts of the world. Some of the information presented here is already found in our project 'User Guides'. Those older style 'User Guides' are being phased out and replaced by a project bundle which contains a Builders Guide, the User Manual, a generic Construction Guide and this parts guide. It is hoped that by splitting things up this way I will be able to keep everything far more up to date. I should mention at this point that you should always ensure that you have the most up to date documentation before starting to build your project. I do make small changes to the parts lists from time to time to incorporate improvements and reflect any changes in sourcing components.

The first part of this document will give details about the sort of parts we use in Oakley projects. It is a generalised round up so don't be too alarmed to find that there will be a few things in here that will have nothing to do with the project you are building right now.

The second part contains Rapid and Farnell part numbers for some of our most common parts. However, it is not a complete list of part numbers, nor is it always up to date, although I try to to keep it as current as possible. All suppliers have a habit of changing their part numbers from time to time as they source from one manufacturer to another. Also, some parts simply become obsolete and are no longer available any more. I do try and make sure all current circuit boards use easily available parts, and if not, I will try to make them available.

If you do find a problem in getting hold of a part, why not ask for help on our online “Oakley Sound Systems” forum at www.muffwiggler.com. It is also worthwhile to have a quick search on the forum to see if someone else has asked the very same question before. Please do not contact myself or Paul Darlow directly for help with supplier's part numbers. Honestly, we would love to help but we haven't got the time to answer these sorts of queries directly.

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

Please note that although I have tried to make sure that no errors have occurred in the preparation of this document, I do not accept any liability for any inconvenience or losses of any kind caused by the information presented in this document. If you do find any errors or obsolete information in this or any other of my documentation please do let me know either directly or via the forum.

The source file for this document can be found at www.oakleysound.com/parts.odt. This is an OpenOffice format and can be freely edited for your own personal use. If you would like to have your additions put into the official version please feel free to send your annotated version to me. All input will be credited. However, I do reserve the right to edit any new material before putting any new version online.

A Guide to the Parts Used in Oakley Sound Projects

Most of the parts for our projects are easily available from your local parts stockist. I use Rapid Electronics, Farnell, CPC and RS Components here in the UK. Rapid are probably the best source of individual parts for UK builders, they are cheap, fast and very rarely make mistakes. Maplin had that honour many years ago but alas have fallen from grace somewhat over the years. They can still prove to be useful from time to time as most towns in the UK seem to have a Maplin shop.

Farnell, and its sibling CPC, are massive and not completely geared up to dealing with the little fellow who only wants to buy the odd component. However, they both do have a good online service and are sometimes cheaper than Rapid, especially if you need something in large quantities. Even though CPC is part of the Farnell group you can sometimes get things cheaper on their site.

Mouser are a US company but sell direct to the UK via their .co.uk website. For many parts, especially the semiconductors and sockets, it is cheaper to buy at Mouser even if you are in the UK. They sort out the VAT and other importing stuff so ordering through Mouser is actually very easy. If you order over £33 worth of items you get free postage. Service is very quick – often faster than Rapid.

Many other parts are available via the various sellers on Ebay. These are particularly useful for the rarer or vintage parts. However, do be aware of the many Chinese sellers that appear to sell an excellent range of parts but are actually selling counterfeit goods or, worse, complete fakes. I have bought several counterfeit devices that actually work quite well but they are very rarely as well made as the original so longevity could be a problem.

On the main modular project page on the Oakley Sound website there is a link to GTXDude's bumper project parts lists. This single zipped file has spreadsheets containing Mouser part numbers for 25 Oakley projects. It is getting a little old now and many of the parts lists are out of date. However, it can be still useful as a source of US based part numbers for any Oakley build. If anyone would like to update any of the spreadsheets then please do so and upload them up to the forum.

Full kits and Panels

SynthCube in the US now sell front panels and complete kits for many Oakley projects:

http://synthcube.com/cart/

Resistors

The through hole resistors can be 5% carbon 0.25W types except where a more accurate part is stated in the parts lists. However, I recommend that you use 1% 0.25W metal film resistors throughout since these are very cheap nowadays and offer exceptional stability and noise. It also means that the colour codes match up on all your resistors; 5% types have often only four bands while metal film have five band codes which can cause confusion.

If you do want to use 5% types, to save money perhaps or because you have a bunch of them stashed away, then please note that sometimes a project will specify that some of the resistors **have to** be 1% or better types. Failure to use good quality parts in these locations will affect the performance of your project. These critical parts are indicated in the project's parts list.

Some high resistance values are not easily obtained in metal film. Values over 1M (one million ohms) are particularly hard to find. However, you can feel reassured that any Oakley project that uses a resistor with these high values can normally use the 5% part.

Some projects make use of precision 0.1% resistors. These are normally available in packs of five or even individually because they are considerably more costly than ordinary metal film resistors. When an Oakley parts list says use 0.1% there is usually a good reason for doing so.

For the Flanger and other projects that use surface mounted parts I do recommend that you use 1% metal film resistors. The size style is 0805 (or 2012 in metric) and they should be rated at 1/8W (125mW or 0.125W). Look for ones with a temperature coefficient of +/-100ppm/K or smaller. I typically use Vishay's CRCW series. For example, Vishay part number: CRCW080533K0FKEA which is a 33K resistor.

Resistors being relatively cheap items usually cannot be bought in ones or twos – although as mentioned the more expensive precision resistors may be purchased this way. Resistors therefore tend to come on a long tape usually with at least ten, or more commonly one hundred devices, attached.

Temp Co Resistors

Temp co resistors are positive temperature coefficient (PTC) resistors that I use for temperature compensation in the VCOs and VCFs. Meggitt make a through hole +3000ppm/K type which is slightly less sensitive that the desired +3500ppm/K but it is good enough in many situations. It is available from Farnell and Mouser. The part number is found in the lists later in this document. I typically use this device with less critical projects like VCFs or the LFO.

For the various VCO modules projects I recommend the bulky C-2AQ 1K 1W wirewound resistors with a nominal temperature coefficient of +3500ppm/K. You can buy these from me, Thonk or direct from KRL-Bantry in the US. These are sold as equivalents to the old Tel Labs Q81 series.

For the Flanger and other projects that use a surface mounted temp co resistor I use the TE Connectivity +3900ppm/K part LT7339002A1K0JTE. It's available from various places including Farnell.

Capacitors (Electrolytic)

All the electrolytic capacitors (sometimes abbreviated to ‘elect’ in my parts lists) normally have a maximum working voltage of 35V, 50V or 63V. The suggested working voltage will be given in the parts list along with the capacitance which is measured in uF (microfarads).

Normally my modules use standard electrolytic devices – there is usually no need to get low ESR, low impedance types or extra stable ones unless it is especially mentioned in the parts list.

Generally speaking I would say that the more you pay for a capacitor the longer it is likely to last. You can get some very cheap parts from suppliers on Ebay but do keep your wits about you when using these services. If it sounds too good to be true then it probably is. Capacitors do have a limited lifespan compared to other electronic components but even the cheaper ones should last twenty years. Badly made ones, however, will fail very quickly.

All the electrolytic capacitors used in Oakley modules are radially mounted unless it specifically says so in the parts list. Radially mounted means that they are supplied as little plastic covered cylinders with the leads sticking out of one end. The boards are laid out to accommodate a pitch or lead spacing of 0.2” (5mm), but 0.1” (2.5mm) is the most common type of radial electrolytic capacitor and I use these types all the time. The benefit of using these smaller pitched capacitors is that the device sits just above the board surface allowing the water wash to work very well. Some of the bigger capacitors used in the power supply projects use larger lead spacings. The PSU, EPSU and RPSU projects, for example, use a 7.5mm lead spacing for the smoothing capacitors which gives better physical stability.

A lot of folk get a little confused with what voltage rating electrolytic capacitor they should buy. The suggested voltage rating is given on the parts list and although the values I have written down are technically correct they are sometimes not necessarily the easiest to find from your preferred supplier. So do not take the voltage rating in my parts lists as being the only value you can choose from. The voltage ratings are there for a guide only and many different values can be used with equal success.

No capacitor in any Oakley project will see a voltage higher than 30V. So you can be sure that if you buy a 35V capacitor it will not blow up and will work perfectly. However, purchasing a 35V 1uF capacitor is not that straightforward since radial 1uF electrolytic capacitors will typically only be available in values exceeding 50V. This is fine. Just buy the 50V or 63V version, it will work perfectly well and fit on the board with no problems.

But note I said 'fit on the board'. The higher the working voltage, for a given value of capacitance, the larger the physical size of the capacitor. So while a 1uF 63V may be a small device, a 220uF, 63V capacitor will be huge. With bigger values of capacitance you will need to be more careful with the voltage rating. Don't choose too big a voltage rating as the device

may not fit on the board – it'll also be more expensive and large devices can also act as aerials in audio circuits picking up signals you don't want.

You maybe even more confused now about which voltage to choose. Don't worry it's actually very easy. There's a quick rule of thumb which will help you choose what you need:

For small values of capacitors, for example, 1uF, 2.2uF & 4.7uF, then go for 50V or 63V devices. While for bigger values like 10uF, 22uF, 47uF and 100uF go for 35V.

In special circumstances there may be other ratings you need to choose – like ripple current. In these cases I will make it very clear in the parts list. An example of this is the power supply modules where I even suggest the make and type of capacitor one should use.

Capacitors (Ceramic)

The low value through hole ceramic capacitors should be C0G ceramic plate or dipped multilayer ceramic capacitors. Another way of saying C0G is low-K or NP0. C0G is a type of dielectric used in the capacitor and it determines many of the characteristics of the capacitor. C0G or low-K is a high quality dielectric and offers good stability, low temperature variation and low noise.

The lead spacing for the C0G ceramic caps on my PCBs is predominantly 2.5mm. However, on my older boards you may find it is the larger 5mm or 0.2". The project parts list will usually state if the device needed is a 2.5mm or 5mm fit. However, if it doesn't give any lead spacing at all, it's probably an older board, and you must buy a 5mm or 0.2" part.

For those boards that use surface mount components the parts list will make it clear when surface mount components need to be used. Most of the surface mount multi-layer ceramic capacitors will be the same size as the resistors, that is 0805 (or 2012 metric). If a different size, like the larger 1206, is needed it will be clearly indicated in the parts list. Because of their tiny size the voltage rating is usually much smaller than their through hole equivalent. Look for devices with working voltages of 25V or more. The capacitance tolerance should be +/- 5% or smaller.

Surface mount capacitors can sometimes be bought individually but more often than not you will need to buy them in fives or tens. Thankfully they are cheap parts.

No 0805 capacitor will have its value stamped onto its body so it is difficult to tell them apart. Take special care when placing them on the board and storing them to ensure you don't get the values mixed up. Generally, the larger values will be taller than the smaller values, but this is unlikely to help you tell the difference between a 820pF and 560pF device.

Capacitors (Polyester)

I use through hole metallised polyester film capacitors in my designs that need a good quality non polarised capacitor with values between 1nF and 2.2uF. These come in little plastic red, yellow, grey or blue boxes with short legs that stick out of the bottom. The ones we need

always have a pitch spacing of 5mm (0.2”). Try to get ones with operating voltages of 50V, 63V or 100V. Anything much higher than that will probably be too physically large. It is also possible to use the newer dipped multilayer C0G ceramics in place of the polyesters although these have yet to become widely available in values over 1nF in through hole packages.

Capacitors (100nF Multi-layer Ceramics used for power supply decoupling)

Most of my through hole PCBs require 50V or 63V 100nF axial ceramics for the power supply decoupling. The PCB package shape for these devices has a lead spacing of 0.3” (7.5mm) which means the standard polyester box capacitor will not fit. There are a few different types of axial ceramic capacitors – the chief difference being their dielectric which then affects their price. The dielectric is the insulator used in the manufacture of the devices. There are the more expensive C0G types which have an excellent performance but the other cheaper types with X7R or Y5V dielectrics are perfectly good enough for our needs.

The projects that use surface mount capacitors use a 0805 (metric 2012) ceramic capacitor. These are not available in C0G but the X7R dielectric is again good enough for the job. Tolerance is not really important but +/- 5% is typical. They are available from various manufacturers. An example would be AVX's 08055C104JAT2A which is a 50V part.

Integrated Circuits

Virtually all of the ICs I use in my projects are in dual in line (DIL or DIP) packages. These through hole, as opposed to surface mount, parts are generally, but not always, suffixed with a CP or a CN in their part numbers. These are the traditionally shaped silicon chips that most of us, of a certain age, are familiar. They are typically 0.3” across and have pins, spaced at 0.1”, running down each of the long sides.

Surface mounted parts (SMD or SMT) are much smaller in size and do not have pins that go through the board to the underside. They are soldered from the top side of the board and, like their names suggests, sit directly on the surface of the PCB. A through hole TL072ACP is not physically compatible with a surface mount TL072ACD, even though its the same circuit inside the package. Most of the ICs used will be in small outline (SO) packages. The TL072ACD being in an SO8 package, the number eight representing how many pins the device has.

The parts list in the relevant project Builder's Guide will make it explicitly clear when you need to buy surface mount parts. If it doesn't mention surface mount in the parts list you can safely assume you will be using standard through hole parts.

We use a variety of different ICs in our projects. These are our most common:

The through hole TL072CP dual op-amp is probably the most used of any IC in our whole range of modules. Various manufacturers make it and it is available virtually everywhere. The TL072ACP is an improved version of it and, if the price is similar to the ordinary version, it is worthwhile using this one instead.

The DG403 is an analogue switch. A variety of companies make this part, although Vishay-Siliconix is probably the most common version. The part you need is DG403DJ. We use this part on our Discontinuity, VC-LFO and D-LFO 5U modules and our SE330 rack project.

The 4558 dual bipolar op-amp is chosen for its latch up free behaviour and its increased output current capability. We use it in a few modules and it is a popular audio chip, but I would not recommend its use in all places where you need a dual op-amp. In the UK, Farnell and RS sell the little chap for peanuts. Various manufactures make the device, eg. MC4558CN and RC4558P.

The LM13700N is a dual operational transconductance amplifier. It is sometimes not found in the op-amp section of your parts catalogue but listed as a 'special' or under 'OTA'. The LM13700 can usually be substituted with the LM13600 (still available from JRC although not common in the UK) or the now defunct NE5517 with no loss of performance.

The THAT2180LC is used in our voltage controlled cores in our ADSR envelope generator. THAT transistor arrays, THAT300P, 320P and 340P, are used in some of our modules. THAT Corporation parts are available from Farnell in Europe or direct from the manufacturer's main online distributor Profusionplc.com. Sadly THAT parts are not particularly cheap any more.

The 2164 quad VCA chip is a popular IC amongst the Synth-DIY and stompbox community. It was originally from Analog Devices and their version is called SSM2164. However, although these do still seem to be available from various places you may find it easier and cheaper to obtain the Coolaudio clone of it called the V2164D. This is available from various guitar effects shops but Mammoth Electronics in the US carry it at a very good price.

The Panasonic MN3207 bucket brigade delay IC can be had from most good online 'guitar effect' parts stores. You can also use Belling Lee's BL3207 or Coolaudio's V3207. Musikding.de are a recommended supplier for the V3207.

Transistors

The BC550 and BC560 devices are discrete low noise NPN and PNP transistors respectively. They are 'European' types and are normally available from most online retailers including the smaller guitar effects builders' suppliers like Banzai and Bits Box. They are typically manufactured by either Fairchild, On-Semiconductor or NXP.

Quite often you see an A, B or C suffix used in their full part name, eg. BC550B. This letter depicts the gain or grade of the transistor (actually hfe range of the device). Oakley modules are usually designed to work with any grade device unless stated specifically in the parts list.

A BC550 can be substituted with a BC549 of any grade in an Oakley project. Like wise the BC560 can be substituted with a BC559. The only real difference between a BC550 and BC549 is the maximum operating voltage, Vce(max). Both devices have a Vce(max) that is greater than anything they will experience in any Oakley module.

Various manufacturers are rationalising their BC5XX product line at the moment. As such some suppliers are taking their time catching up. So if you find the BC550B suddenly not available try searching for a BC550C.

In the UK Rapid sell the BC549C and BC549B. They also sell the BC559C.

My most commonly used JFET (junction field effect transistor) in the Oakley range is the J201. However, Fairchild, the original makers of this fine product have recently deleted it from their stock in the standard through hole form. It is still available from them as a surface mount part but this will not fit most of the Oakley boards. Thankfully, both Linear Systems and InterFET are now producing the device in a variety of packages including the TO-92 through hole package. Mouser are selling the InterFET one. A quick search on the internet should reveal your local supplier. You may also find that some Ebay suppliers still have stock of the Fairchild part at a reasonable price. However, you should be aware that buying from Chinese suppliers does carry a risk of getting fake parts. Oakley Sound can normally supply genuine InterFET J201 for your Oakley project.

In the 5U 'One of three' VCO project I use the J112 which is available at both Rapid and Farnell.

The SVCO uses the classic Japanese FET the 2SK30A-GR. These excellent devices are no longer being made by the manufacturer but worldwide stocks are still very high. These are normally available from guitar effects places like Banzai and Musikding but can also be found on Ebay and Dalbani, the rare parts supplier. Issue 2 SVCO boards have an additional footprint to allow other FETs, like the J112, to be used. However, I have not yet had a chance to try any other FETs other than the 2SK30.

Diodes

The standard signal diode is the 1N4148. This is a very common part and is available pretty much everywhere. Alternatively you can use the 1N914 or 1N4448. The through hole 1N4148 is an axial component which means it is like a resistor in that the device is housed in a small cylindrical container with the leads sticking out each end. For the those boards that require the surface mount version, you need to find the 1N4148WS which is housed in a tiny SOD-323 package.

Another common diode I use is the BAT42. This is a Schottky diode which behaves differently at low voltages when compared to the 1N4148. It often comes in a package that looks identical to the 1N4148 but for the tiny writing on its side. The surface mount version is called the BAT42WS which has even smaller writing on its top.

My standard power diode is the through hole 1N4002. However, you can also use the 1N4003 or 1N4004. In most cases it should also be fine to use the 1N4001, but in the power supplies I would recommend the 1N4004 because of its higher voltage capability. You can get them with different lead diameters too, but it does not matter which one you get for Oakley projects.

The newer issues of the PSU and RPSU use a much beefier diode. The 1N5401. This device has a much larger body and lead diameter. It can really only be used where the board design, such as the later issue PSU board and RPSU, allows for the increased size.

Zener diodes are sometimes used in Oakley projects. These are different than ordinary diodes and should not be used in place of them. The through hole ones I use are 500mW types with axial leads. At first glance they look identical to 1N4148 signal diodes but they will have their reverse voltage rating written in small print on their sides.

Surface mount zener diodes are also used. Being smaller than their through hole counterparts the maximum power rating is only 300mW. Typical part numbers will start with BZX384-C and then the voltage rating, eg. BZX384-C5V1 which is a 5.1V device. The device size is typically the same as the other SMD diodes I use, that is SOD-323.

Light Emitting Diodes

These are a standard part and available in most places. The biggest problem is choosing the right one from the bewildering array of parts on offer from the suppliers. Generally speaking buy the cheapest round diffused ones they sell and you'll probably get it right.

Rack mounted and eurorack modular projects typically use 3mm diameter LEDs, while our 5U modular projects use 5mm diameter LEDs.

Some LEDs can be bought with internal series resistor. These types normally have an operating voltage specified like 5V, 12V or 15V. You do not want these types. Instead get the ones with operating voltages that vary from 1.8V to 2.4V as these have no internal resistor.

Some of my modules use bi-colour LEDs. These have two different coloured LEDs in one clear or diffused package. Do not get tri-colour types as an alternative to bi-colour ones; these have three legs not two, and cannot be made to work in my circuits. For the bi-colour LEDs I prefer to use ‘red-green’ types, although other colours are available.

Only one module, the later issues of the 5U VC-LFO, uses a tri-colour LED. As stated above these have three legs not two and both LEDs can be lit simultaneously to create varying colours. A bi-colour LED cannot be used in place of a tri-colour LED. Again I prefer to use ‘red-green’ types, although other colours are available.

The 5U modules when they have need for an LED use 5mm round dome LEDs. The Schaeffer panels assume that you will be using these with a mounting lens clip. The LED clips I now use I get from Rapid which are described as '5mm low profile lenses'. They fit flush with the front panel and hold the LED very firmly. They also require a low profile lens clip. This holds both clip and LED securely to the front panel. Red LEDs should use a red clip, green LEDs should use a green clip and so on. For bi-colour and tri-colour LEDs, it is best to get an uncoloured or clear lens.

I used to use Maplin's Cliplite range of lenses, which are also sold by Rapid as 'standard lenses'. These stick out proud from the panel surface and look very nice. However, since trying the low profile ones, the standard ones now look somewhat old fashioned.

The HVM, SE330, Filtrex and TM3030 use 3mm LEDs. These are usually mounted direct to the board. They normally require no LED clip to hold them in place.

Pots (aka Potentiometers)

All of our current projects that have board mounted pots use the 16mm Alpha device. These are very much an industry standard part and are used in all sorts of gear, including most of the Doepfer and Analogue Systems modulars. These are also attached to the PCB with pot brackets. The brackets are different to the Vishay/TT pot brackets we used to use in that they have a larger footprint and smaller mounting hole. The brackets are considerably cheaper to purchase since they are a stock part from Omeg Ltd. They are supplied as part of the pot bracket kits that we sell, but we can sell them individually as well on request.

Now this is where it gets complicated. Even if you buy 16mm Alpha or ALPS pots you still need to make sure you have the correct pot shaft. It is the shaft that the knob will fit onto. They come in three basic types; splined, round, and D-shaft. The knobs you will need to buy should then fit onto the shaft you have chosen. The D-shaft types are probably not going to be easy to find although they are the most common in commercial mass produced applications. The most likely one you will see from the parts suppliers is the 6mm diameter splined shaft which work with low cost push fit knobs. The shaft is split down the middle so that the natural springiness of the metal holds the knob in place. Round types have perfectly smooth cylindrical shafts and tend to be found on the ALPS pots you can buy. However, you need to use the more expensive grub screw or collet knobs on these.

Grub screw knobs can be used with splined shafts. However, you have to be very careful that you don't over tighten the screw other wise the shaft can become distorted. I haven't found this to be a problem on the modular synthesiser projects. On these modules the grub screw tends to line up with the split in the splined shaft and thus makes a good contact with both halves of the shaft. However, on our rack modules this is not the case as the board sits horizontally so the grub screw will push onto one half of the shaft only. It is therefore better to use push on knobs with our standalone rack projects.

Now just to make things really annoying, the shaft length also varies with vendor. In most cases a longer shaft can be simply cut down with a hack saw to the smaller lengths. It is a good idea to then use a file to round off any sharp edges though. I strongly recommend that you cut and file the pot shafts down before you fit them to the board.

Almost all the 16mm pots come with a little metal tang that is supposed to locate into a small hole in the front panel. Once fitted into the hole the tang stops the pot from rotating if the nut is loose. However, with the Schaeffer panels or any other flat panel you will not need these little tangs. Indeed, they will actually be in the way. You must therefore break them off before fitting them into the pot brackets or the PCBs. It's a simple job though with a decent pair of pliers.

In the UK a very good supplier of 16mm Alpha pots is Doctor Tweek – although as I write this, his webshop is currently, but temporarily closed. He has a good range of pots and they come with the smaller length of pot shaft so you don't have to do any cutting down to fit the

Moog style knobs or smaller Euro ones. Many of the Doctor Tweek pots come with a clear plastic sheath around them. They are there to keep out dust from the pot's internal workings. These sheaths will need to be prised off to allow the pot to fit into our pot brackets and it's not that easy to do as the sheaths are a pretty tight fit. He does supply the 'standard' type without the sheath though but not in all the values we need.

Rapid Electronics sell the most, but not all, of the Alpha pots we need at a very good price. However, the Rapid pots have long shafts that need to be made shorter if you are using most styles of knobs. If the shaft is not shortened the knob will sit well above the panel surface which looks untidy. However, Rapid's 27mm matt black knobs can be used without cutting down the shaft.

Bits Box at www.bitsbox.co.uk looks a worthy supplier of all sorts of parts. And they have a good selection of the 16mm pots we need too.

Yet another supplier for pots in the UK is ESR Electronic Components Ltd. They have good prices and again offer all the values we need. The shaft length is of the longer variety though.

Banzai are in Germany, but deliver worldwide, also sell Alpha pots. These come with a nice short shaft, so they don't need cutting down. Banzai also sell stereo (also called dual gang) pots which we use on some modules. They are the only European source of the 1K dual gang pot we use on the Croglin VCF module.

Das Musikding is always worth a look. Their stock isn't as big as Banzai but they can often be cheaper and quicker.

In the US there is Small Bear. An absolute gold mine of a place with more than just 16mm pots for you to purchase.

In the parts list you may find that the value of some of the pots is given as 47K. Your chosen supplier may not sell this value but instead offers 50K. This is perfectly acceptable as either value will do. Indeed, I sometimes use 50K in place of 47K in some parts lists and schematics and this does not indicate a preference to one value or the other. This small change in absolute value normally matters not. You will see it also with 22K and 25K, with 220K and 250K, and with 470K and 500K. Again these are relatively small differences and should not affect the operation of the circuit. Furthermore, if you were to measure the track resistance of most commercial grade pots you will normally find it to be out as much as 10% from the stated value on the body of the pot. So the accuracy of any pot's overall track resistance should not be relied upon.

One last thing to mention about the far eastern pots is that they use a different nomenclature compared to European designs. Like most engineers in the UK I called a linear taper pot A-type and a logarithmic taper pot B-type. The Alpha pots, like the original Japanese ALPS pots they've copied, are labelled the opposite way around. A is 'audio' or log taper, and B is linear. I have tried to ensure that I don't use either nomenclature in my newer documentation and stick with the words 'linear' or 'logarithmic' – often shown as LIN and LOG on the schematic respectively.

Trimmers

When I was a lot younger the standard term for this device was preset, but I think trimmer is pretty much universal now.

I use three basic types in Oakley projects, the multiturn cermet, the standard horizontal and the 6mm horizontal.

The multiturn trimmers are the ones that have the adjustment on the top of the box. Vishay/Spectrol and Bourns make these. Some types are 20 turns, while others are 25 turns. Either will do. They should have three pins that are in a line at 0.1” pitch. I generally use the Bourns 3296 series.

The standard horizontal types are traditional sealed carbon units. These are adjusted from the top and, as such, are called horizontally mounted or vertically adjusted. Piher and other companies make suitable types. Lead spacing is 0.2” for the track ends, and the wiper is 0.4” away. Rapid, Farnell and RS sell these parts at reasonable cost. You can use the more expensive cermet types that fit this footprint if you wish, but stability is not critical for any Oakley application that uses these trimmers.

The 6mm trimmers I specify are sealed, or semi-sealed, carbon or cermet units with a smaller footprint than the traditional horizontal types. Like the others they are adjusted from the top and, as such, are called horizontally mounted types. Spectrol, Bourns (eg. 3306F or 3386F) and other companies make their own versions of this popular size. Lead spacing is 0.2” (5mm) for the track ends, and the wiper is 0.2” (5mm) away. Rapid and Farnell sell these parts at reasonable cost. You can again use the more expensive cermet types if you wish but stability is not critical on most of those projects using these types of trimmers. However, if it says 'cermet' in the project parts list then you are recommended to use the better quality cermet types.

Switches

What type of switch is very much up to you on most of the 5U modules. The switches are not attached to the PCB so can be any sort for the most part. The ones we use are the Series 5000 by APEM in France, and have a flat toggle. Farnell sell them and their part numbers can be found at the rear of this guide.

The Eurorack modules use a horizontally mounted switch that goes from side to side as you look at board when it's laid flat on your workbench. Both Farnell and Rapid sell versions of this switch. However, I prefer the ones with a metal bush over the red plastic ones because they look nicer.

The SE330, Filtrex, TM3030 and HVM use a similar type of switch as the eurorack modules but this time they work so the toggle goes up and down when the board is laid flat. Again, the switches are available with either metal or plastic bushes. I prefer the metal ones simply for aesthetics.

The switches for the rack projects I use are made by Multicomp. The manufacturer's part numbers are 1MS1T2B4M7RE for the standard SPDT, 1MS3T2B4M7RE for the three position SPDT and 1MD1T2B4M7RE for the DPDT.

PCB mounted switches as used on the eurorack modules and the rack projects are very much preferred over wired types. It keeps the module together when it is not in the front panel and reduces the chances of wiring errors.

Ferrite Beads

Most boards are fitted with leaded ferrite beads, usually labelled L1 and L2 on the circuit diagrams. These are little axial components that look like little blackened resistors. They are available from most of the mail order suppliers including Rapid and Farnell. Find them in the EMC or Inductor section of the catalogues.

Heatsinks

The ones found on the old Compact PSU project are the dual vaned TV35 from Aavid Thermalloy. These are actually built to take up to two TO-220 devices but we use them for one device each. They are rated at 7.2 deg C/W. Rapid sell them in the UK.

The TO-220 clip on heatsinks for the Filtrex can bought from a variety of places. I rather like the little 21 deg C/W ones by Fischer Electronik. Their part number is FK237 SA220 O. Farnell sell them.

Jumper Interconnects

The multiway jumper interconnects are used on projects that use more than one circuit board. They are used to transport signals from one board in the module to another. They are a one piece assembly bought ready made from several places including Farnell. They are flat grey plastic covered strips that have a number of multistrand conductors arranged 2.54mm apart. They come with their conductors pre-stripped and often pre-tinned with solder too. The jumpers can be bought in a variety of different widths and lengths. 2” or 55mm is just the right length to get from the main board to the pot boards in our double width 5U high projects. Fewer conductors can simply be obtained by cutting the wider versions down with a knife or pair of scissors. That is, a six way conductor can be made from an eight way one by chopping the last two strips off.

0.1” interconnects

For the flexible 0.1” (2.54mm) interconnections between the various boards within a module I use the either the 26 awg MTA parts, or Molex KK or their equivalents.

The MTA parts are made by Amp which are now part of the TE Connectivity (formerly Tyco) group. To use these effectively you need a special insertion tool to poke the wires into the

special ‘housings’. The housing contains specially shaped contacts that cut through the insulation of the wire so you don’t need to do any stripping. Just simply push down on the wire with the tool to lock it into place in the housing.

The Molex KK strip and crimp systems are actually cheaper although perhaps not quite as neat or as quick to use. These use simple plastic housings that hold the individual crimps. The crimps are normally bought in reels but some places sell them individually. The crimpers, that attach your wire to the crimp, can be quite expensive if you don't shop around. However, they are not nearly as expensive at the MTA insertion tool. There is a lot more information about these parts in our Construction Guide.

Wire

I typically use 7/0.2 insulated multi-strand wire for all my general audio and low current interconnections. This can be bought in a variety of different colours and will work well with 2.54mm Molex KK housings and crimps.

For higher current connections, like power cables and such like, I prefer to use 27/0.2 insulated multi-strand wire.

Sockets

We use the Switchcraft 112APCX 1/4” sockets in all of our ready made 5U modules. These excellent parts are also used on the Moog and MOTM modulars. This part is stocked by most suppliers. The PC part of the name means 'printed circuit' mounting, while the X bit denotes the RoHS friendly lead free compliance. Both Rapid and Farnell sell them at a reasonable price if you buy enough of them. Buying them singly is an expensive business.

Rapid also sell a Far Eastern clone of the 112APCX part that is considerably cheaper, but doesn’t look as nice. Actually, the socket itself seems fine but the mounting nut is a bit cheap. These sockets were made by Lih Sheng Precision in Taiwan. However, Rapid's part, even though their part number hasn't changed, seems to be now made by someone else in mainland China. Some 5U manufacturers are using the Lih Sheng part.

Please note that the standard 112A will not fit into our socket boards as it has solder tags. However, the 112A is a great socket for hand wired modules like the Overdrive and the 5U Ring Modulator

Tony Allgood at Oakley Sound

Cumbria, UK

Preferred Parts Numbers for UK buyers

Part Name	Rapid Electronics	Farnell
Resistors		
1K +3000ppm/K		1174306
0R82, 2W		1219198
2R2, 3W		1900124

Rapid have moved to a new supplier for their metal film resistors and their part numbers are changing. However, if you search for the part number listed below their website should suggest the new part if they have no stocks of the old one.

22R		62-0724
75R		62-0752
100R		62-0762
110R		62-0763
150R		62-0767
330R		62-0792
1K		62-3450
2K		62-0844
2K2		62-0847
2K7		62-0852
3K6		62-0894
4K7		62-0862
5K1		62-0864
6K2		62-3466
6K8		62-3467
8K2		62-0882
10K		62-3474
10K	0.1% (singles)	63-1448
11K		62-3475
12K		62-0904
15K		62-3478
19K6	0.1% (singles)	63-1506
20K	0.1% (singles)	63-1508
20K		62-0917
22K		62-3482
22K	0.1% (singles)	63-1516
27K		62-0927
30K		62-0932
33K		62-0934
47K		62-3490
51K		62-0944

56K	62-0947	
68K	62-0952	
75K	62-0954	
100K	62-3498	
100K 0.1% (singles)	63-1658	
120K	62-0972	
200K 0.1% (singles)	63-1718	
220K	62-0984	
300K	62-0989	
330K	62-0992	
470K	62-0997	
560K	62-1002	
680K	62-1004	
910K	62-1009	
1M	62-1012	
10M		336-907
100K x 4 sil pack	63-0280	
100K x 8 sil pack	63-0245	

Capacitors

100nF axial ceramic	11-3560	1100417

All 2.5mm and 5mm ceramic capacitors should be low-K, C0G or NP0.

10pF ceramic 2.5mm	11-3426	
15pF ceramic 2.5mm	11-3401	
18pF ceramic 2.5mm	11-3402	
22pF ceramic 2.5mm	11-3427	1216407
33pF ceramic 2.5mm	11-3428	1216408
47pF ceramic 2.5mm	11-3429	
100pF ceramic 2.5mm	11-3430	1216416
150pF ceramic 2.5mm	11-3409	
220pF ceramic 2.5mm	11-3431	
330pF ceramic 2.5mm	11-3432	1216419
470pF ceramic 2.5mm	11-3433	1216420
680pF ceramic 2.5mm	11-3412	
1nF ceramic 2.5mm		1216421
4p7 ceramic 5mm		303379
10pF ceramic 5mm		
18pF ceramic 5mm		303446
22pF ceramic 5mm		
33pF ceramic 5mm		1216412
47pF ceramic 5mm		
150pF ceramic 5mm		

100pF ceramic 5mm		1216414
220pF ceramic 5mm		1216415
330pF ceramic 5mm		1100509
470pF ceramic 5mm		1100510
1nF polyester	10-3240	146072
1n5 polyester	10-3242	
2n2 polyester	10-3244	
3n3 polyester	10-3246	
4n7 polyester	10-3248	9752935
6n8 polyester		9752943
10nF polyester	10-2204 or 10-1950	1669192
15nF polyester	10-3252	1669193
22nF polyester	10-2208	1669194
33nF polyester	10-3256	1669195
47nF polyester	10-2212	
68nF polyester	10-2214	1669197
100nF polyester	10-2216	
150nF polyester	10-3262	
220nF polyester	10-2220	9750894
330nF polyester	10-2222	
470nF polyester	10-2224	
680nF polyester	10-3270	1166042
1uF polyester	10-2228	1006040 / 1215509
1u5 polyester		1166008
2u2 polyester	10-2200	
1nF polypropylene	10-1430	
6n8 polypropylene	10-1455	
10nF 100V polypropylene	10-1460	
10nF 63V polypropylene		1890175 (Sample/Slew iss 5)
1nF 1% polystyrene		9520236
2.2nF 1% polystyrene		9520244
10nF 1% polystyrene		9520830
1u0 elect	11-1280	
2u2 elect	11-3931	9692894
2u2 elect - low profile		8766797
4u7 elect	11-3932	
10u elect	11-3933	
22u elect	11-3934	
47u elect	11-3936	
470uF 35V radial elect		1848452 (Euro PSU iss 1)
1000uF 35V radial elect	11-0760	
1000uF 50V radial elect	11-3938 (RPSU)	
1800uF 35V radial elect		9692339 (PSU iss 3)
1800uF 35V radial elect		1744973 (Euro PSU iss 1)

3300uF 35V radial elect		9692355 (PSU iss 2)

3mm LEDs

Green	55-0105
Red	55-0150
Yellow	55-0110
Bi-colour red/green	56-0600

5mm LEDs

Green	55-0120	
Red	55-0155	
Yellow	55-0125	
Orange	55-0124	1142516
Bi-colour	55-0172	
Tri-colour	56-0685	
Low profile green lens	55-0960	
Low profile yellow lens	55-0965	
Low profile red lens	55-0950	
Low profile clear lens	55-0970	
Lens clip	55-0975	

Discrete Semiconductors

BC182L	81-0034	
BC212L	81-0044	
BC549B	81-0068	
BC549C	50-0298 or 81-0441	
BC550B		1467880
BC559C	50-0301 or 81-0442	
BC560C		1467886
TIP35C		9294350
TIP145		9294562
J201		Mouser
J112		1017712 or 1611623
BAT-42	47-3102	9801430
1N4148	47-5608 or 47-3416	

1N4004		9556109
1N5401		9556125
1N5819	47-2566	9801219
2V7 zener	47-3000	
3V6 zener	47-3006	
5V1 zener	47-3014	
5V6 zener	47-3016	
8V2 zener	47-3024	
10V zener	47-3028	
12V zener	47-3032	

Integrated Semiconductors (ICs)

4000 series CMOS:

4001B	83-0316	
4011B	83-0328	
4013B	83-0332	
4016B	83-0338	
4049UB	83-0380	
4050B	83-0382	
4051B	83-0384	
4052B		1014041
4066	83-0392	
4093B	83-0420	
4104		385890

Opto-couplers:

6N137		1021197
6N139		1021341

74 series logic:

74HC04	83-0042	

Power ICs:

78L05	47-3278	9489444
78L09		7204078
7812		9490280
7815	47-3295	
79L05	47-3284	
7906		1013824
7915	47-3301	
LM317T	47-3318	
LM337T	47-3328	

LM723	47-3336	9489355
MC78M05		9665374
OKI-78SR-5/1.5-W36-C		2102101

Voltage References:

LM329DZ		9488510
LM336Z-5		9488502
LM4040DIZ-10		9486097
LM4040CIZ-10		1673988
REF02		1079390

Transistor arrays:

SSM2220		9605096
THAT300P		1354175
THAT340P		1354180

Op-amps:

4558	82-0716	1106010
AD712		9604898
CA3140	82-0686	
LF412	82-5048	9487042
LM358 (replaces AN6562)		1459520
LM1458 or MC1458		9486852 or 1103044
LT1013CP		1470376
NE5532		1106091
OP177GPZ		9604685
OP275GP		9603760
OPA2134		1097574
OPA2277 (see also LT1013)		1459562
TL072	82-0050	
TL072ACP		1103005
TL074	82-0054	
TL074ACN		1105902

Special (analogue switches, OTAs, VCAs, comparators):

DG403DJ		1077116
LM13700	82-5038	1651866
LM311	82-0208	
LF398		9487140
LM2901		2292828
LM2903	82-0842	9487638
THAT2180LC		1354168

Alpha Pots

See main text for more information.

10K lin Alpha 16mm	65-0715	
47K lin Alpha 16mm	65-0725	
1M log Alpha 16mm	65-0845	

Trimmers

500R m/t cermet		9353283
1K m/t cermet	68-0315	
2K m/t cermet	68-0320	
5K m/t cermet	68-0325	
10K m/t cermet	68-0330	
20K m/t cermet	68-0335	1141406
50K m/t cermet	68-0340	9353305
100K m/t cermet	68-0345	9353194 / 1141408
200K m/t cermet	68-0350	
1M m/t cermet	68-0360	

500R 6mm		9354689
2K 6mm		9354620
5K 6mm	68-0570	
20K 6mm	68-0574	
50K 6mm	68-0576	9354719
100K 6mm	68-0578	9354573

1K horiz	67-0215	
2K2 horiz	67-0220	
10K horiz	67-0230	
22K horiz	67-0235	
47K horiz	67-0240	
100K horiz	67-0245	1227542
470K horiz	67-0255	
1M horiz	67-0260	

IC Sockets

8-pin DIL	22-1720
14-pin DIL	22-1721
16-pin DIL	22-1722
18-pin DIL	22-1723
28-pin skinny DIL	22-1726
20-way SIL	22-1750

Heatsinks

TV35 7.2 degC/W	36-0196	
TO-220 clip on (Filtrex)		4621141
TO-220 mounting kit		522636

Interconnects

4-way terminal block	21-0116	
2-way jumpers	22-0692	
Faston 250 single terminal blade		2506365
4 way 0.156” MTA hdr		589068
4 way 0.156” MTA cover		589007
4 way 0.156” MTA hsg		1098723
2 way 0.1” MTA hdr		588570
3-way 0.1” MTA hdr		588581
4-way 0.1” MTA hdr		588593
5-way 0.1” MTA hdr		588600
6-way 0.1” MTA hdr		588611
2-way 0.1” MTA hsg		1098459
3-way 0.1” MTA hsg		1098438
4-way 0.1” MTA hsg		1098455
5-way 0.1” MTA hsg		1098439
6-way 0.1” MTA hsg		1098456
0.1” 2-way MLX hdr	22-0838	9731148
0.1” 3-way MLX hdr	22-0840	9731156
0.1” 4-way MLX hdr	22-0842	9731164
0.1” 5-way MLX hdr	22-0844	
0.1” 6-way MLX hdr	22-0846	
0.1” 8-way MLX hdr	22-0848	9731180
0.1” 2-way MLX hsg	22-0820	143126
0.1” 3-way MLX hsg	22-0822	143127
0.1” 4-way MLX hsg	22-0824	143128
0.1” 5-way MLX hsg	22-0826	
0.1” 6-way MLX hsg	22-0828	
0.1” 8-way MLX hsg	22-0830	
16 way IDC box header	19-0510	1642020

Sockets & Plugs

1/4” 112APC socket	20-1430	1192839
1/4” Chinese Neutrik plug	20-2183	
5-pin socket (midi)	20-0314	

Miscellaneous

Ferrites	26-4860	9526820
4MHz Xtal	90-1074	1368786
Cable ties (pack of 100)	04-0631	
20mm PCB fuseholder	26-0165	
Cable grommet	04-0275	

Switches

DIL SW (4-way)	80-0304	9471570
DPST power switch		1634648

Modular 5U:

SPDT toggle (on-on)	1082301
SPDT toggle (on-off-on)	1082308
SPDT toggle (mom-off-mom)	1082303
DPDT toggle (on-on)	1082315

Rack projects (eg. TM3030, Filtrex, SE330 and HVM):

SPDT PCB mount (on-on)	9473297
SPDT PCB mount (on-off-on)	9473300
DPDT PCB mount (on-on)	9473319

Euro modules:

DPDT PCB mount on-on	9473270