Oakley Sound Systems

5U Oakley Modular Series

Croglin
Dual Voltage Controlled Filter

Croglin PCB Issue 1

Builder's Guide

V1.0.01

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Introduction

This is the Project Builder's Guide for the issue 1 Croglin Dual Voltage Controlled Filter 5U module from Oakley Sound. This document contains a basic introduction to the board, a full parts list for the components needed to populate the boards, and a list of the various interconnections.

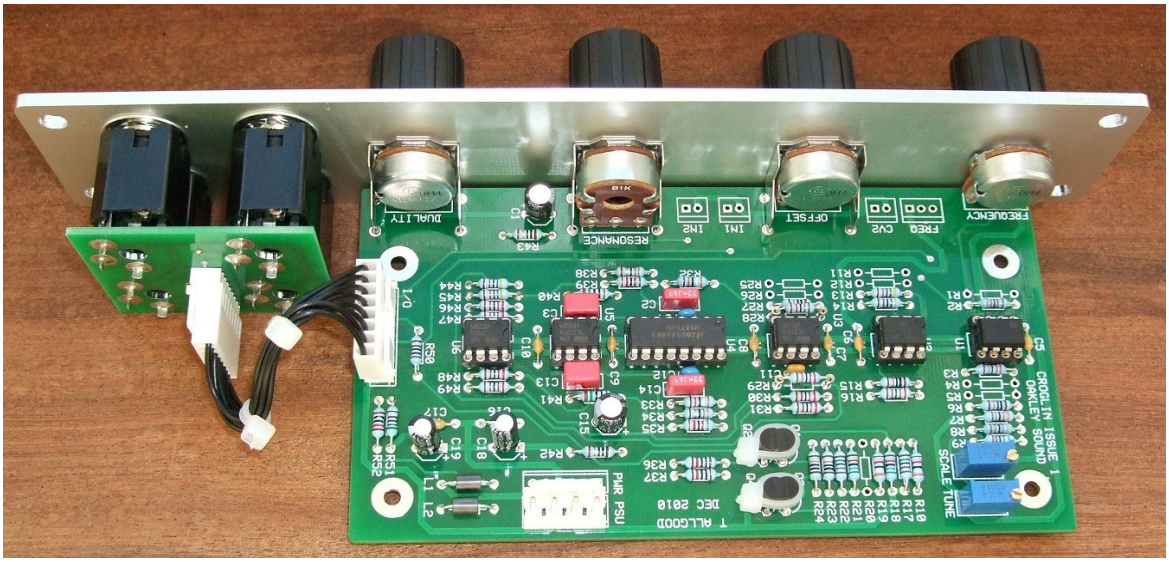
For the User Manual, which contains an overview of the operation of the unit and the calibration procedure, please visit the main project webpage at:

http://www.oakleysound.com/croglin.htm

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 generic Construction Guide at the project webpage or http://www.oakleysound.com/construct.pdf.

The Issue 1 Croglin PCB



This is the issue 1 Oakley Croglin VCF module behind a natural finish 1U wide Schaeffer panel. Note the use of the optional Sock4 socket board to facilitate the wiring up of the four sockets.

On the Croglin printed circuit board I have provided space for the four main control pots. If you use the specified 16mm Alpha pots and matching brackets, the PCB can be held very firmly to the panel without any additional mounting procedures. The pot spacing is 1.625” and is the same as the vertical spacing on the MOTM modular synthesiser and most of our other modules.

The design requires plus and minus 15V supplies. The power supply should be adequately regulated. The current consumption is about 25mA for each rail. Power is routed onto the main PCB by either a four way 0.156” MTA156 type connector or the special five way Synthesizers.com MTA100 header. You could, of course, wire up the board by soldering on wires directly. The four pins are +15V, ground, earth/panel ground, -15V. The earth/panel connection allows you to connect the metal front panel to the power supply’s ground without it sharing the modules’ ground line. More about this later.

The main PCB has four mounting holes for M3 bolts, one near each corner. These are not required for panel mounting if you are using the three 16mm pot brackets.

The board size is 78mm (deep) x 144mm (high).

The main board has been laid out to accept connection to our Sock4 socket board. This small board speeds up the wiring of the four sockets and reduces the chances of mistakes.

Issue 1 Croglin 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 for the 1U Filter Core Module

The following resistors need to be fitted if you are building the 1U 'Filter Core' module.

1% 0.25W metal film types are to be recommended simply because it makes reading the values consistent across the PCB. However, 5% ones can be used in all places except where marked '1%' which have to be 1% or better.

10R	R43, R42
33R	R34, R38
1K	R50
1K5 1%	R17, R22
5K1	R51
10K	R52
18K	R28
22K 1%	R46, R31, R30, R48, R16, R49, R47
27K	R37, R36
39K 1%	R19, R10
47K 1%	R13, R14, R45, R44
56K	R18, R21
62K	R39, R35
82K	R2, R9
100K	R24, R23, R27, R15, R6
220K	R3, R29
330K	R7
390K 1%	R33, R32
470K	R8
10M	R40, R41

Resistors for the 2U Full Module

The following resistors need to be fitted if you are building the 2U 'Full' module.

1% 0.25W metal film types are to be recommended simply because it makes reading the values consistent across the PCB. However, 5% ones can be used in all places except where marked '1%' which have to be 1% or better.

10R	R43, R42
33R	R34, R38
1K	R50
1K5 1%	R17, R22
10K	R11, R12
18K	R28
22K 1%	R46, R31, R30, R48, R16, R49, R47
27K	R37, R36
39K 1%	R19, R10
47K 1%	R13, R14, R45, R44, R18
56K	R21
62K	R39, R35
82K	R2, R9
100K	R24, R23, R27, R15, R6, R25, R5, R1, R26
220K	R29, R4
270K	R20
330K	R7
390K 1%	R33, R32
470K	R8
10M	R40, R41

Links

These are made from either left over bits of wire from the snipped legs of resistors or small lengths of thin solid core wire.

For the 1U Filter Core module only link out each of the two way headers, CV2, IN1 and IN2. That is, join together the two pads of each of the two way headers. Do not link out FREQ.

Capacitors

100nF axial ceramic	C5, C6, C7, C8, C9, C10, C16, C17
33pF C0G 2.5mm ceramic	C11
680pF C0G 2.5mm ceramic	C4, C12
1nF 2.5% polypropylene film	C3, C13
22nF polyester film	C2, C14
2u2, 63V electrolytic	C18, C19
33uF, 35V electrolytic	C1, C15

Discrete Semiconductors

BC549 NPN transistor	Q1, Q3
BC560 PNP transistor	Q2, Q4

Integrated Circuits

TL072CN dual fet op-amp	U1, U2, U3, U5, U6
LM13700N dual OTA	U4

Trimmers (preset) resistors

20K cermet multiturn	V/OCT
100K cermet multiturn	TUNE

Potentiometers (Pots)

All pots Alpha 16mm PCB mounted types

47K or 50K linear	FREQUENCY, OFFSET, DUALITY
1K dual gang (stereo) linear	RESONANCE

Three 16mm pot brackets.

Miscellaneous

Leaded axial ferrite beads	L1, L2	
MTA156 4 way header	PSU	– Oakley/MOTM power supply
MTA100 6-way header	PWR	– Synthesizers.com power supply
Molex/MTA 0.1” header 8-way	I/O	– for connecting to sockets
Molex/MTA 0.1” housing 8-way	I/O	– for connecting to sockets

Other Parts Required

Switchcraft 112APC 1/4” sockets	Four off mounted either on the Sock4 board or on panel

Four knobs

Two cable ties

Around 2m of insulated multistrand hook up wire for the switch and socket connections.

Offboard Pots (2U format only)

47K or 50K Log	IN1 LEVEL, IN2 LEVEL
47K or 50K Linear	FREQUENCY, FREQUENCY CV

Components required if using optional Sock4 board

Molex/MTA 0.1” header 8-way	I/O
Molex/MTA 0.1” housing 8-way	I/O

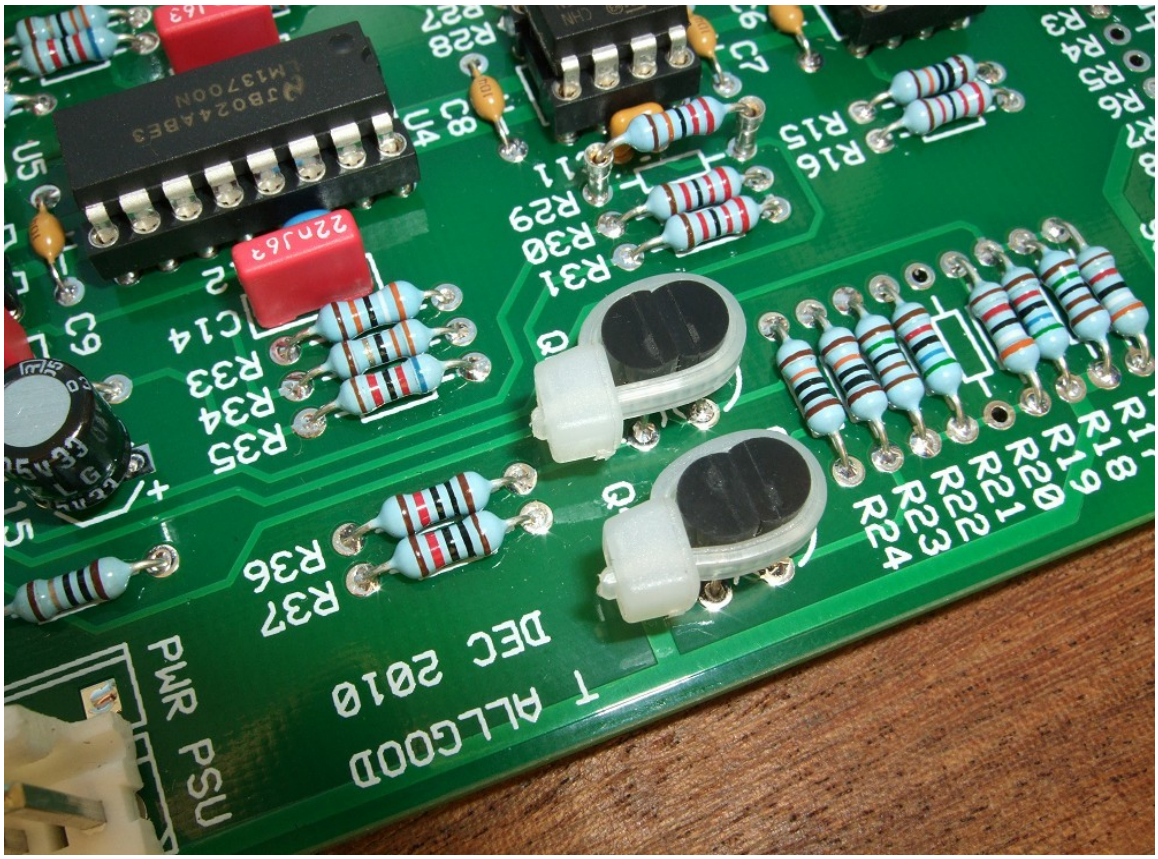
112APC Switchcraft 1/4” socket	SK1, SK2, SK3, SK4

A single wire link is to be fitted to L1 on the Sock4 PCB. L2 is left open.

If using Molex KK you'll also need at least 16 crimp terminals.

Suitable lengths of wire to make up the single 100mm interconnect and two cable ties.

Other Notes



The two NPN/PNP pairs are thermally locked together.

The four transistors require special mention. These should be placed into position on the board, but before soldering you should wrap a small cable-tie around the bodies of the devices. Tighten the cable-ties carefully so that the flat face of each NPN transistor is touching the PNP one opposite it. Snip of any excess plastic from the cable tie. This will hold each pair together to ensure good thermal contact. There is no need for any thermal compound between them, but if you have some, you can add a small bit to ensure good thermal transfer. Now solder and cut all the leads as you would normally.

Connections

Power connections – MOTM and Oakley

The PSU power socket is 0.156" Molex/MTA 4-way header. Friction lock types are recommended. This system is compatible with MOTM systems.

Power	***Pin number***
+15V	1
Module GND	2
Earth/PAN	3
-15V	4

Pin 1 on the I/O header has been provided to allow the ground tags of the jack sockets to be connected to the powers supply ground without using the module's 0V supply. Earth loops cannot occur through patch leads this way, although screening is maintained. Of course, this can only work if all your modules follow this principle.

Power connections – Synthesizers.com

The PWR power socket is to be fitted if you are using the module with a Synthesizers.com system. In this case you should not fit the PSU header. The PWR header is a six way 0.1" MTA, but with the pin that is in location 2 removed. In this way location 3 is actually pin 2 on my schematic, location 4 is actually pin 5 and so on.

Power	***Location number***	***Schematic Pin number***
+15V	1	1
Missing Pin	2	
+5V	3	2
Module GND	4	3
-15V	5	4
Not connected	6	5

+5V is not used on this module, so location 3 (pin 2) is not actually connected to anything on the PCB.

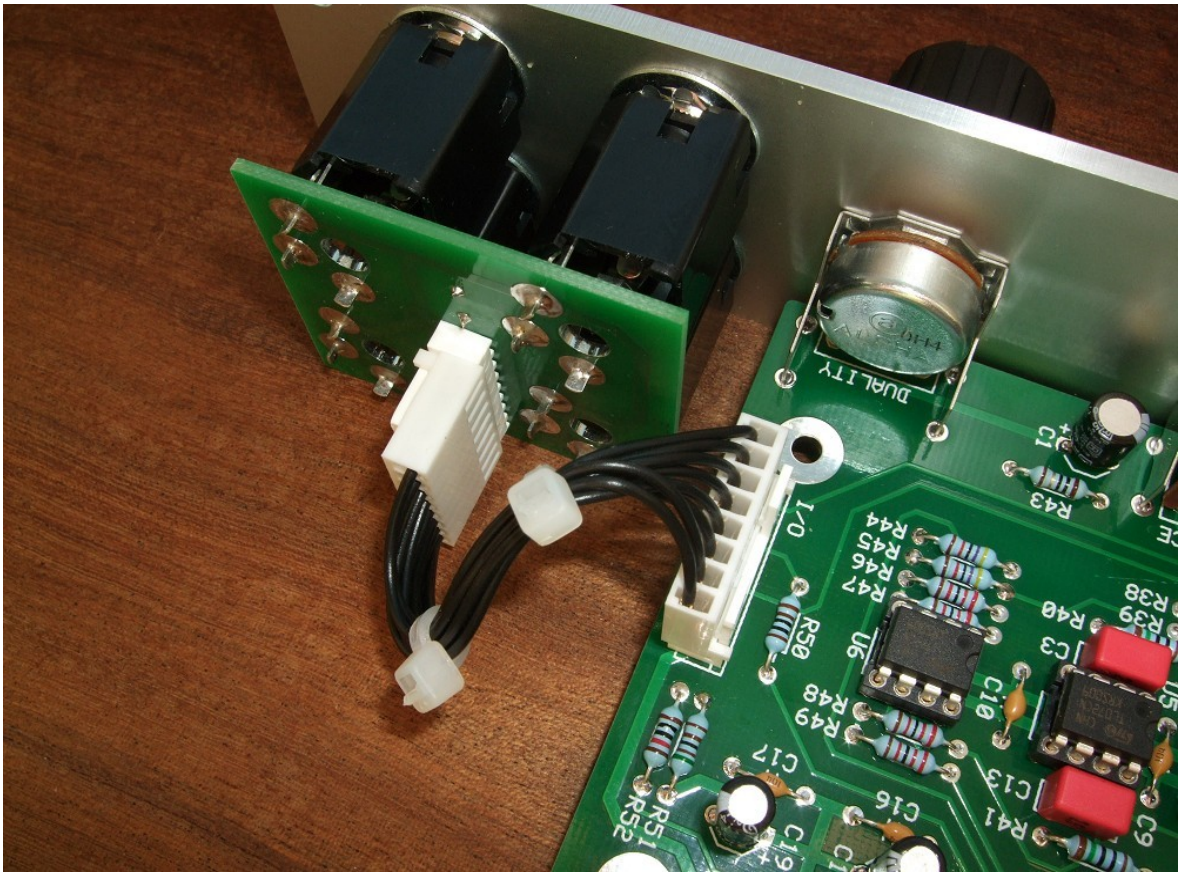
If fitting the PWR header, you will also need to link out pins 2 and 3 of PSU. This connects the panel ground with the module ground. Simply solder a solid wire hoop made from a resistor lead clipping to join the middle two pads of PSU together.

Building the Filter Core 1U wide module using the Sock4 board

This is the simplest way of connecting all the sockets to the main board. The Sock4 board should be populated in the way described in our construction guide found on the project webpage. There is only one eight way header and it is to be fitted to the bottom side of the board.

Do not forget to solder in the wire link L1. Link L2 must be left open.

You need to make up only one eight way interconnect. It should be made so that it is 100mm long.



The prototype Croglin filter core module showing the detail of the board to board interconnect. Here I have used the Molex KK 0.1" system to connect the Sock4 to the main PCB.

Hand wiring the sockets

If you have bought Switchcraft 112A sockets you will see that they have three connections. One is the earth or ground tag. One is the signal tag which will be connected to the tip of the jack plug when it is inserted. The third tag is the normalised tag, or NC (normally closed) tag. The NC tag is internally connected to the signal tag when a jack is not connected. This connection is automatically broken when you insert a jack.

Once fitted to the front panel the ground tags of each socket can be all connected together with solid wire. I use 0.91mm diameter tinned copper wire for this job. It is nice and stiff, so retains its shape. A single piece of insulated wire can then be used to connect those connected earth tags to pin 1 of I/O. Pin 1 is the square solder pad.

All the other connections are connected to the signal or NC lugs of the sockets. The tables below show the connections you need to make:

Pin	*Pad name*	*Socket Connection*	*Lug Type*
Pin 1	PANEL_GND	Connect to all sockets	Earth lugs
Pin 2	OFFSET_CV	Connect to OFFSET	Signal lug
Pin 3	OFFSET_NC	Connect to OFFSET	NC lug
Pin 4	FREQ_CV	Connect to FREQUENCY	Signal lug
Pin 5	GND	Connect to FREQUENCY	NC lug
Pin 6	OUTPUT	Connect to OUTPUT	Signal lug
Pin 7	GND	Connect to INPUT	NC lug
Pin 8	INPUT	Connect to INPUT	Signal lug

2U Croglin full format

I am not going into great detail with this format as the PCB has been designed with the 1U filter core module in mind. However, I will mention a few things that may be useful to you if you do decide to build the larger format design.

The 2U format contains seven sockets and four additional pots. As with the 1U module, you need to ground the sockets' earth lugs. Do this by joining together the earth lugs for each row with stiff single core wire. Then with a piece of insulated wire, or a well placed piece of stiff wire, connect together the two horizontal pieces of stiff wire. Now all your socket ground lugs are connected together. Then with a piece of insulated wire connect one of the stiff pieces to pin 1 of the I/O header on the PCB. Pin or pad 1 of I/O is connected to panel ground on the power sockets, ie. pin 3 on the MTA/Molex connectors.

The pads in box labelled I/O at the bottom of the board are mainly set up for the 1U version, but you will need to use these pads too.

Pin	*Pad name*	*Socket Connection*	*Lug Type*
Pin 1	PANEL_GND	Connect to all sockets	Earth lugs
Pin 2	OFFSET_CV	Connect to OFFSET CV	Signal lug
Pin 3	Not used		
Pin 4	FREQ_CV	Connect to 1V/OCT	Signal lug
Pin 5	GND	Connect to FREQ CV, 1V/OCT, OFFSET CV	NC lugs
Pin 6	OUTPUT	Connect to OUTPUT	Signal lug
Pin 7	GND	Connect to IN1, IN2, IN3	NC lugs
Pin 8	INPUT	Connect to IN3	Signal lug

All your other connections will be made via the four 0.1" headers that are situated on the board near the pots. These are labelled appropriately to help you connect up your module correctly. These are FREQ (which goes to the Frequency pot), CV2 (which goes to the Frequency CV pot), IN1 (In1 Level) and IN2 (In2 Level).

Pots have three pins. For the In1 level, In2 level and Frequency CV pots two of these pins will be connected to PCB, whilst the remaining one will be connected to the appropriate socket's signal lug. For the Frequency pot only, all three pins are connected back to the board.

The Frequency pot is connected to the three way header, FREQ. The wires should attach to the board from the underside and thus be soldered from the top of the board.

Pin 1	-15V	CCW
Pin 2	Input	Wiper
Pin 3	+15V	CW

CW is 'clockwise' end of pot's resistive track (from the rear this is the left hand side with the pins facing down). CCW is the 'counter-clockwise' end of the pot. The wiper is the middle pin.

The middle pin of the other three pots, the wiper, will carry the signal to the appropriate two way header on the PCB. Like before the pots' wires will attach to the underside of the board at each header, and thus be soldered from the topside of the board. For each header, pin 1 is connected to the wiper of the pot. Pin 1 again is the square pin so its easily spotted even from the underside of the board.

The pot has two other pins, one will be connected to ground, the other to the signal lug on the socket it controls.

With pins facing down and looking at the back of the pot, the right hand pin (CCW) should go to the ground connection of the header, that is pad 2 on each of the headers. Take a wire from the right hand pin to the round pad on the PCB next to the one that the associating wiper connects.

Now each pot will have one unsoldered pin left, the CW pin. Connect these to the appropriate socket. The wire should go to the signal lug of the socket. IN 1 goes to the signal lug on the socket labelled IN 1, and so on.

There are a quite lot of wires here, but it should be quite neat once it is all done.

A little harmless experimentation...

I am always keen to hear how people may have modified their Oakley projects for their own purposes. This is especially true for those projects that are relatively new to the Oakley stable. There are two things you may like to try with the Croglin:

Changing the filter capacitors

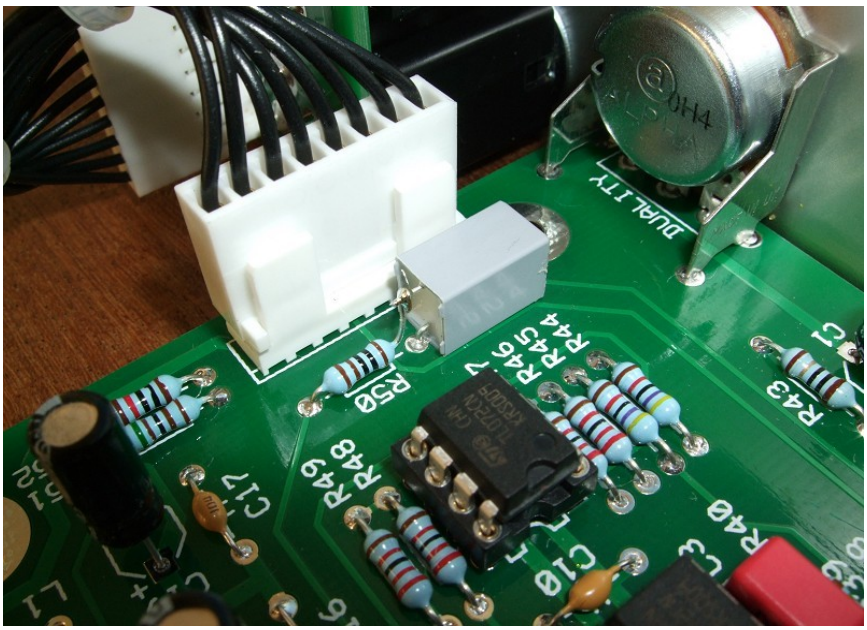
This alters the range over which the filter will operate. Currently this is set to give a maximum cut off frequency of 13kHz or so. The value that sets this is the two integrator capacitors, C3 and C13.

You may wish to experiment with these values. Increasing them reduces the maximum frequency, while reducing them to say 680pF will increase the maximum cut-off frequency to above 19kHz. It also has a knock on effect on the lower cut-off frequency too so if you are playing about with C3 and C13 do be sure to check you can still get your filter to work low enough.

Adding a DC blocking the output

The Croglin is completely DC coupled. This means it will pass through very low frequencies and stable fixed voltages. This can be useful in a modular synthesiser since you can filter control voltages. However, it can lead to unwanted pops if DC gets into a VCA's signal input and the VCA is turned on and off very quickly.

The Croglin does not produce any appreciable DC output of its own unless the cut-off frequency is set very high. The prototype generated up to 400mV at its highest frequency setting which in most cases is nothing to be concerned with. However, should you wish to filter this out then you can add a decent quality 1uF polyester capacitor in series with the output resistor R50. You can add this in the lead going to the socket or add it neatly to the PCB as the photograph shows below.



Final Comments

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

If you 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, Tony Allgood, 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 builder's guide, or have a found a mistake in it, then please do let me know. But please do not contact me or Paul Darlow directly with questions about sourcing components or general fault finding. Honestly, we would love to help but we do not have the time to help everyone individually by e-mail.

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 the Synth-diy, Oakley-Synths and Analogue Heaven mailing lists and those at Muffwiggler.com.

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