Oakley Sound Systems

5U Oakley Modular Series

Dual Voltage Controlled Amplifier
&
Quad Voltage Controlled Amplifier

Dual VCA-X PCB issue 1

Builder's Guide
V1.4

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Introduction

This is the Project Builder's Guide for the Dual and Quad Voltage Controlled Amplifier 5U modules that use the issue 1 Dual VCA-X printed circuit boards 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.

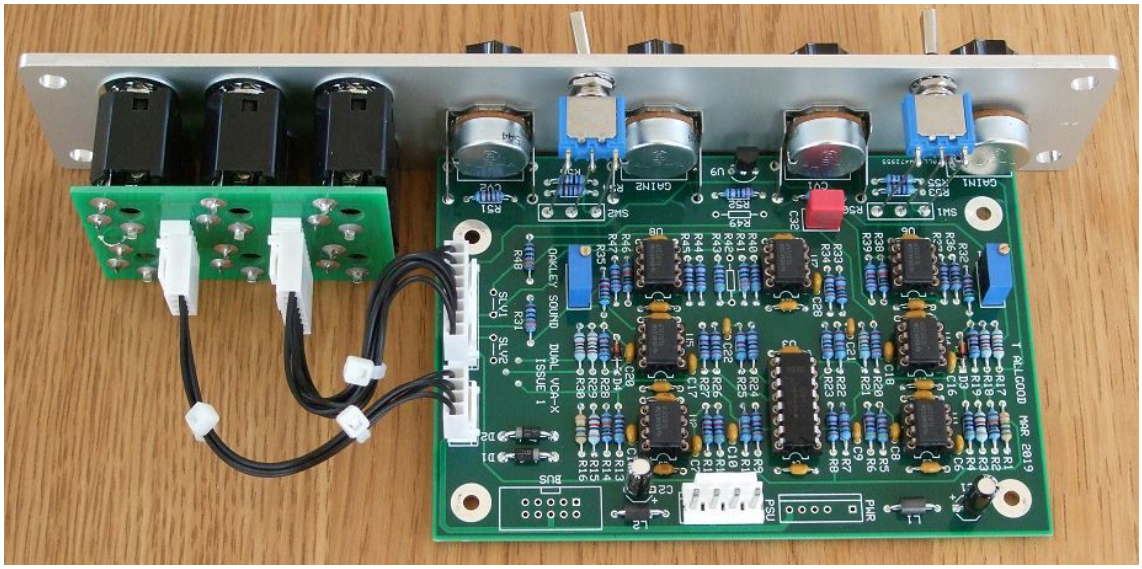
For the User Manual, which contains an overview of the operation of the unit and the calibration procedure, please visit the main project webpage at:

http://www.oakleysound.com/vca-x.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 Dual VCA-X PCB



An Oakley Dual VCA-X module behind a natural finish 1U wide Schaeffer panel. Note the use of the optional Sock6 socket board to facilitate the wiring up of the six sockets.

The Dual VCA-X PCB is 85 mm (depth) x 124 mm (height) in size. The board is a four layer design which means it has copper tracks on both the upper and lower surfaces as well as two internal layers. The upper internal layer is designated solely to 0V. The optional Sock6 socket board is a double sided board with copper on the two outer surfaces.

If you are building the standard design, with the exception of the two switches, there are no components mounted off the boards. All components including sockets and pots are soldered directly to the boards. All the socket wiring can be done via the socket PCB and two MTA100 or Molex KK100 solderless connections. This system will reduce assembly time and possible wiring errors.

Some people will wish to use this Oakley design in a non standard format, such as fitting it to another manufacturer's rack or one of their own invention. This is perfectly easy to do. Simply do not use the socket board and wire the main board to the sockets as per usual.

I have provided space for the four main control pots on the PCB. If you use the specified 16mm Alpha pots and matching brackets, the PCB can be held firmly to the panel without any additional mounting procedures. The pot spacing is 1.375".

Dual VCA-X Parts List

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

There are three ways to populate the Dual VCA-X board and it depends on which module you are building. The Dual VCA needs only one Dual VCA-X board which is populated accordingly. The Quad VCA uses two Dual VCA-X boards, one is the 'master' which handles channels 3 and 4, and the other is the 'slave' which handles channels 1 and 2. The master and slave boards are populated slightly differently and this is indicated in the parts lists below.

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

1% 0.25W metal film types are to be recommended simply because they are better quality components. However, 5% ones can be used in all places if you wish.

330R	R41, R48, R31
510R	R22, R7, R10, R25
2K2	R52
4K7	R56, R4, R54, R55, R13, R40, R53
22K	R47, R50, R51, R39
30K	R37, R36, R20, R23, R45, R24, R34, R27, R9, R8, R44
39K	R15, R3
47K	R5, R6, R11, R12
56K	R35, R32
68K	R19, R28
82K	R30, R18
100K	R2, R14, R38, R33, R46
200K	R17, R29
560K	R21
5M6	R1, R16

For the Dual VCA module only:

4K7	R43
30K	R26

R42 and R49 are not fitted.

For the Quad VCA 'Master module':

4K7	R42, R43, R49
30K	R26

For the Quad VCA 'Slave' module:

R26, R42, R43 and R49 are not fitted.

Capacitors

100nF axial ceramic	C26, C12, C25, C19, C4, C30, C23, C31, C24, C27, C3, C29, C14, C15, C13, C5
47pF C0G 2.5mm ceramic	C7, C8
100pF C0G 2.5mm ceramic	C20, C11, C18, C16, C6, C17
560pF C0G 2.5mm ceramic	C22, C10, C9, C21, C28
2u2, 50V polyester	C32
2u2, 63V electrolytic	C1, C2

Discrete Semiconductors

1N4148 signal diode	D3, D4
1N5818 Schottky diode	D1, D2

Integrated Circuits

TL072ACP dual FET op-amp	U1, U2, U6, U7, U8
OPA2134 dual FET op-amp	U4, U5
V2164D Quad VCA	U3
LM4040DIZ-10.0 10V reference	U9*

* The LM4040CIZ-10.0 is also suitable.

IC sockets are recommended, especially for U3. You will need seven 8-pin DIL sockets and one 16-pin DIL socket. U9 can be soldered into the board as you would a transistor.

Trimmers (preset) resistors

Both trimmers are multiturn types such as Bourns 3296W.

10K	PR1, PR2

For the 'Slave' module it is recommended to fit side adjust trimmers (eg. Bourns 3296X) and fit them so that the screw points towards the rear of the module. Otherwise it will be impossible to trim the 'slave' module without removing the 'master' module from the front panel.

Potentiometers (Pots)

All pots Alpha 16mm PCB mounted types

47K or 50K linear	GAIN1, CV1, GAIN2, CV2

Three 16mm pot brackets.

Switch

Two SPDT (single pole double throw) 'on-off-on' toggle switches are required for the VCA response selection.

Miscellaneous

Leaded ferrite bead	L1*, L2*	
MTA156 4 way header	PSU*	– Oakley/MOTM power supply
MTA100 6-way header	PWR*	– Synthesizers.com power supply

* Fit the ferrite beads and power header only if building the Dual VCA module or the master board of the Quad VCA module. The slave board of the Quad VCA gets its power from the master board and needs no ferrite beads or power header fitted.

Molex/MTA 0.1” header 8-way	UPR	– for connecting to sockets
Molex/MTA 0.1” housing 8-way	UPR	– for connecting to sockets
Molex/MTA 0.1” header 4-way	LWR	– for connecting to sockets
Molex/MTA 0.1” housing 4-way	LWR	– for connecting to sockets

For Dual VCA modules only:

Do not fit BUS.

For Quad VCA modules – both 'master' and 'slave':

2 x 5 0.1” IDC boxed header	BUS
2 x 5 0.1” IDC socket	Two off for cable interconnect
10-way 0.05” IDC cable	120mm long

The two boards used in the Quad VCA are connected together with the BUS cable. This flat ribbon cable carries the two outputs of the first two VCA channels to the master board and carries the power to the slave board.

Wire 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 Dual VCA only:

Links SLV1 and SLV2 are left unfitted although you may wish to fill the unused pad holes with a bit of solder.

For the Quad VCA 'slave' PCB only:

SLV1 and SLV2 should each have a wire link fitted.

For the Quad VCA 'master' PCB only:

SLV1 and SLV2 are left unfitted although you may wish to fill the unused pad holes with a bit of solder.

Other Parts Required

Switchcraft 112APC 1/4” sockets Six off (Dual VCA) or twelve off (Quad VCA)

Four 20mm knobs for Dual VCA module, and eight 20mm knobs for Quad VCA module.

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

Components required if using optional Sock6 board

One Sock6 board is required for each D-VCA board. That is you'll need two for a Quad VCA module.

Molex/MTA 0.1” header 8-way	UPR
Molex/MTA 0.1” housing 8-way	UPR
Molex/MTA 0.1” header 4-way	LWR
Molex/MTA 0.1” housing 4-way	LWR
112APC Switchcraft 1/4” socket	SK1, SK2, SK3, SK4, SK5, SK6

A single wire link is to be fitted to L1 on the Sock6 PCB.

If using Molex KK you'll also need at least 24 crimp terminals.

Suitable lengths of wire to make up the two interconnects and four cable ties.

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 ground (0V)	2
Socket ground	3
-15V	4

Pin 3 on the LWR header is connected to pin 3 of the PSU header and has been provided to allow the ground tags of the jack sockets to be connected to the power supply ground without using the module’s 0V supply. Earth loops cannot occur through patch leads this way, although screening is maintained.

MU and 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 the pin in location 2 is 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 ground (0V)	4	3
-15V	5	4
Socket Ground *	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 and using it with a standard MU power distribution system, you will also need to connect together the middle two pads of the PSU header on the main board. This link connects the socket and panel ground with the module ground. Simply solder a solid wire hoop made from a resistor lead clipping, or bit of solid core wire, to join to the two middle pads of PSU.

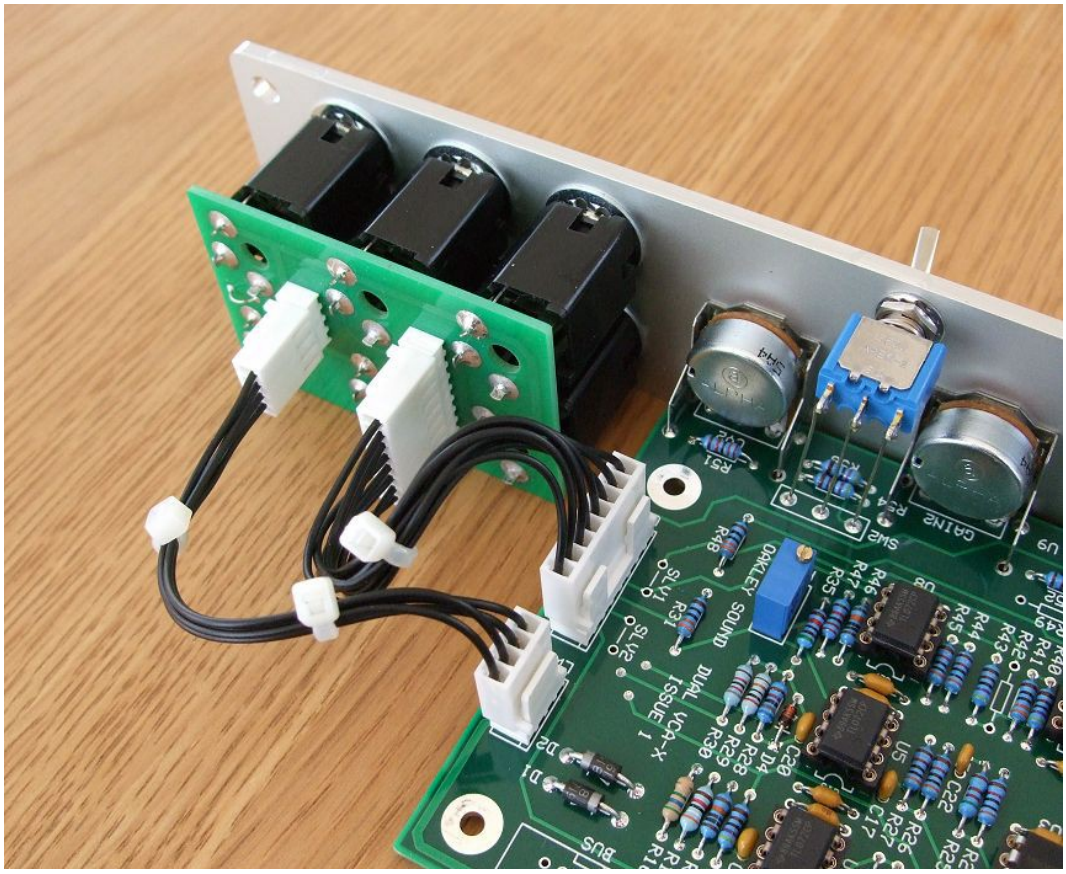
* The DVCA-X boards connect the unused pin 6 of the MU connector to socket ground. With the link on PSU not fitted, and using an Oakley MU Dizzy distribution board with a five way power cable, will allow the socket ground to be kept separate from module ground to prevent ground loops.

Building the Dual VCA module using the Sock6 board

This is the simplest way of connecting all the sockets to the main board. The Sock6 board should be populated in the way described in our construction guide found on the project webpage. There are only two headers, UPR (for upper) which is eight way, and LWR (for lower) which is four way. Both headers are fitted to the bottom side of the board.

The wire link L1 should also be fitted to the Sock6 board.

You need to make up two interconnects. The eight way one should be made so that it is 95mm long. The four way should be made to be 110mm.



The Dual VCA-X issue 1 module showing the detail of the board to board interconnect. Here I have used the Molex KK 0.1" system to connect the Sock6 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 LWR. 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:

Dual VCA

UPR

Pin	*Pad name*	*Socket Connection*	*Lug Type*
Pin 1	Module ground	IN2	NC
Pin 2	IN2	IN2	Signal
Pin 3	NC2	Not used	
Pin 4	OUT2	OUT2	Signal
Pin 5	NC1	OUT1	NC
Pin 6	OUT1	OUT1	Signal
Pin 7	Module ground	IN1	NC
Pin 8	IN1	IN1	Signal

LWR

Pin	*Pad name*	*Socket Connection*	*Lug Type*
Pin 1	Panel ground	Connects to all sockets	Ground lugs
Pin 2	CV2	CV2	Signal
Pin 3	Module ground	CV1 & CV2	NC lugs
Pin 4	CV1	CV1	Signal

Tables continued overleaf...

Quad VCA channels 1 and 2

UPR

Pin	*Pad name*	*Socket Connection*	*Lug Type*
Pin 1	Module ground	IN2	NC
Pin 2	IN2	IN2	Signal
Pin 3	NC2	OUT2	NC
Pin 4	OUT2	OUT2	Signal
Pin 5	NC1	OUT1	NC
Pin 6	OUT1	OUT1	Signal
Pin 7	Module ground	IN1	NC
Pin 8	IN1	IN1	Signal

LWR

Pin	*Pad name*	*Socket Connection*	*Lug Type*
Pin 1	Panel ground	Connects to all sockets	Ground lugs
Pin 2	CV2	CV2	Signal
Pin 3	Module ground	CV1 & CV2	NC lugs
Pin 4	CV1	CV1	Signal

Quad VCA channels 3 and 4

UPR

Pin	*Pad name*	*Socket Connection*	*Lug Type*
Pin 1	Module ground	IN4	NC
Pin 2	IN2	IN4	Signal
Pin 3	NC2	Not used	
Pin 4	OUT2	OUT4	Signal
Pin 5	NC1	OUT3	NC
Pin 6	OUT1	OUT3	Signal
Pin 7	Module ground	IN3	NC
Pin 8	IN1	IN3	Signal

LWR

Pin	*Pad name*	*Socket Connection*	*Lug Type*
Pin 1	Panel ground	Connects to all sockets	Ground lugs
Pin 2	CV2	CV4	Signal
Pin 3	Module ground	CV3 & CV4	NC lugs
Pin 4	CV1	CV3	Signal

Wiring the Switches

Channel 1's EXP/LIN switch using an APEM single pole double throw switch. Make sure the switch and PCB are secured to the panel before soldering the two wires.

The panel design features two switches. Both are wired in exactly the same way with three pieces of straight solid core wire going to the solder pads directly beneath each of the switch's lugs as shown in the picture above.

Testing

Apply power to the unit making sure you are applying the power correctly. Check that no device is running hot. Any sign of smoke or strange smells turn off the power immediately and recheck the polarity of the power supply, and the direction of the ICs in their sockets and the polarity of the electrolytic capacitors.

The next thing to do is to make sure that each VCA is passing audio. Send an audio signal into the input socket for each VCA and make sure that its Gain pot acts as a simple volume control. The volume should change from completely off to unattenuated in a smooth fashion as you turn the pot. Moving the relevant CV pot should do nothing at this stage. You should notice a small dead zone at the start of the Gain pot's rotation. This is to ensure that the VCA is turned fully off with the pot at its minimum value.

Introduce a little bit of CV modulation to check the CV input. A simple LFO waveform like a triangle is a good start. Set the gain pot to middle, and the CV pot should control the depth of modulation. Set the CV depth pot to its maximum position. You should hear the volume of the output signal rising and falling with the LFO. Reduce the CV depth with the pot and hear how the modulation depth decreases to nothing with the pot in the middle and then increases again as the pot moves around to the inverting position.

Make sure all VCA channels work identically. Check also that the output of VCA1 passes to the Mix output (OUT2 in the Dual VCA or OUT4 in the Quad VCA) if there no jack inserted into the OUT1 socket.

If all this happens, the chances are that you have a working module and it is now time to calibrate. The User Manual gives full details on how to calibrate your module.

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.

If you can't get your project to work and you are in the UK, 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 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.

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 and Analogue Heaven mailing lists and those at Muffwiggler.com.

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