

Oakley Sound Systems

5U Oakley Modular Series

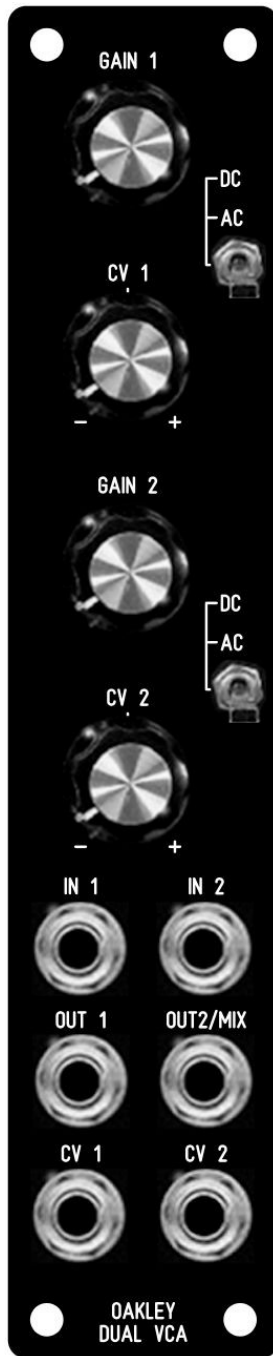
**Dual Voltage Controlled Amplifier
&
Quad Voltage Controlled
Amplifier**

Dual VCA PCB issues 1, 1.1 & 2

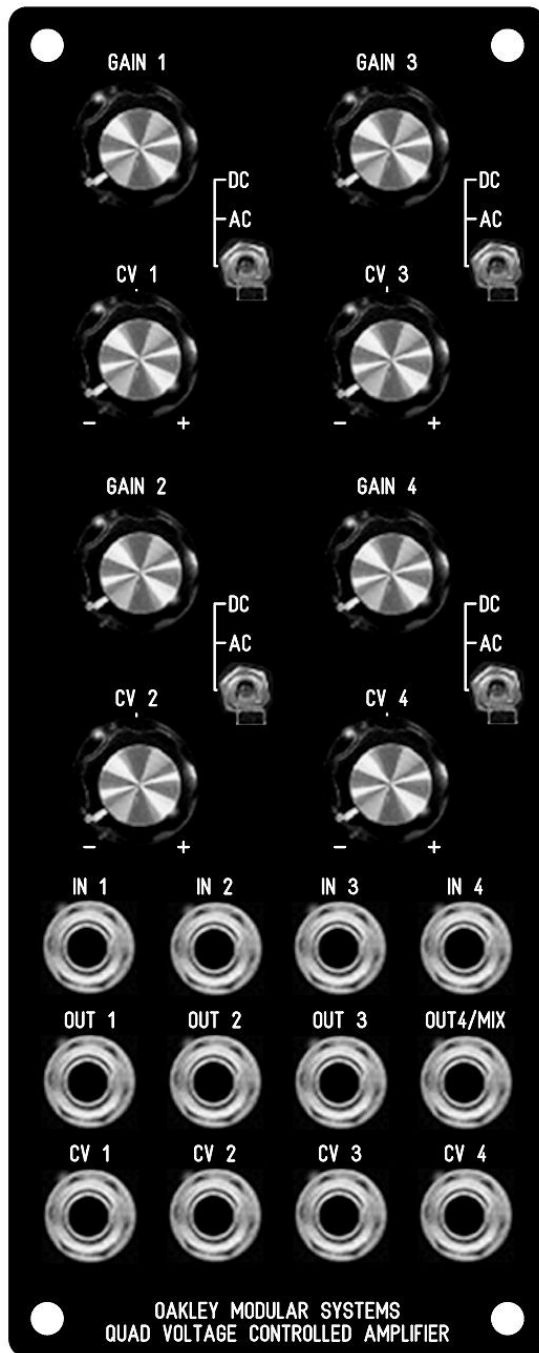
User Manual

V2.3

Tony Allgood
Oakley Sound Systems
CARLISLE
United Kingdom



The suggested panel layout for the single width MOTM format module.



The suggested panel layout for the dual width MOTM format module.

Introduction

This is the User Manual for the Dual and Quad Voltage Controlled Amplifier 5U modules from Oakley Sound. This document contains an overview of the operation of the units and the calibration procedure.

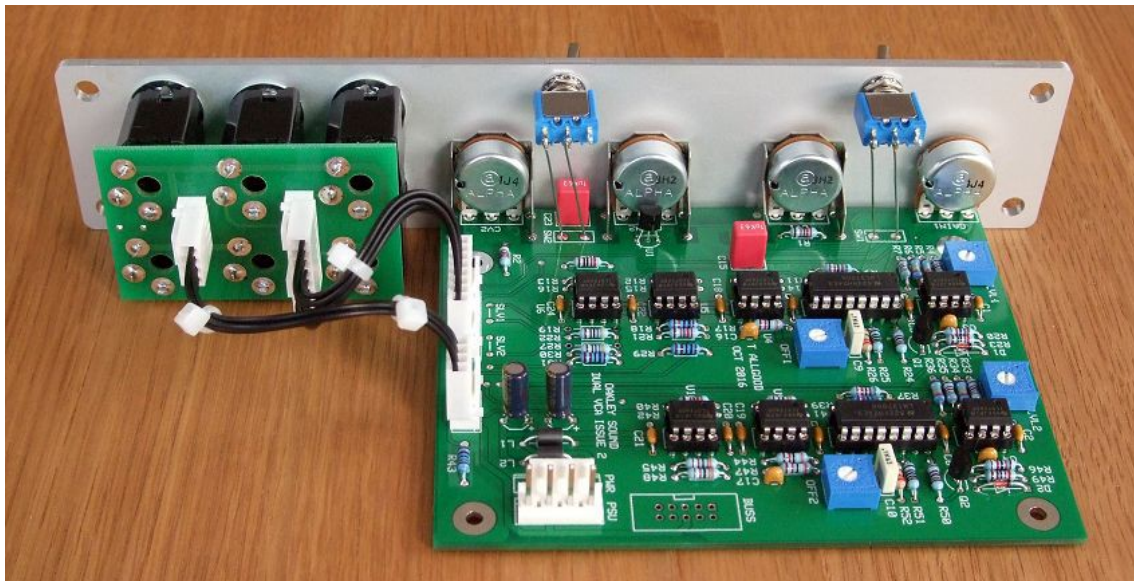
For the Builder's Guide, which contains a basic introduction to the board, a full parts list for the components needed to populate the boards, and a list of the various interconnections, please visit the main project webpage at:

<http://www.oakleysound.com/vca-d.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 Oakley Dual and Quad Voltage Controlled Amplifiers



This is an issue 2 Oakley Dual VCA module behind a natural finish 1U wide Schaeffer panel.

This is an excellent VCA module based in part on Mike Sims' design published in EDN in 1995. The module can be built either as a single width two channel VCA or a double width four channel VCA. Each VCA stage is identical and each features a high quality analogue linear response VCA with low noise and low CV breakthrough.

If the output socket of any VCA channel is unused then that signal will be mixed with the output of the final channel. That is, in the four channel version you have in this module a four channel voltage controlled mixer. However, any VCA channel can simply be taken out of the mixing process by inserting a jack lead into its respective output socket.

Each VCA has two controls. Firstly, there is GAIN, a fixed bias to set the initial gain of the VCA, it can also be used as a volume control. Secondly, the CV pot allows you to alter the sensitivity of the external CV that controls the VCA's gain. The pot is a 'reversible attenuator', so you are able to control not only the depth of the modulation but also the polarity. With the CV pot set straight up no CV signal reaches the VCA. With it fully right the CV is applied so that positive CVs increase the gain of the VCA. With the pot fully left then increasing positive CVs reduce the gain of the VCA.

Each VCA can be either direct coupled (DC) or high pass filtered (AC). The former allows DC and low frequency signals to be processed. While the latter provides a DC block to process only alternating audio frequencies.

The History of the Oakley 5U Multi-Channel VCA

There have been three main revisions to the Oakley 5U VCA.

1. The Basic VCA

My first design and centred around a single channel BA6110 OTA chip. The R-Ohm BA6110 was an excellent chip and was an updated version of the less able BA662 that Roland used in pretty much all their later analogues. The Basic VCA could be built as a Triple-VCA when three boards were used. The Basic VCA formed part of a series of small project boards, originally called 'the basic series' but eventually changing their names to 'the little series'. Other boards included the Little-EG, Little-Lag and Little-LFO.

2. The Triple VCA

Demand for ready made Oakley modules meant that building the triple version of the Basic-VCA had to be made simpler. Putting three boards behind one panel and wiring it all up took far too long. The Triple-VCA was developed, which was a single board three channel VCA circuit. The excellent BA6110 had been discontinued by R-Ohm so a new VCA design was used. This was based, in part, on an excellent design by Mike Sims first published in EDN magazine in 1995.

3. The Dual VCA

This version. Again based on my take on Mike Sims core circuit this is an updated version of my Triple-VCA. The biggest difference is the move to a two board solution for a possible four channels in a double width panel. Other new features include the reversible attenuator for the CV input, a precision low noise reference voltage for the CV control and a normalising mixing mode similar to that used on the Oakley Multimix and as originally devised by Larry Hendry and Dave Bradley.

Issue 1 Dual VCA boards featured additional power supply decoupling local to the two LM13700 ICs used in the design. However, investigations during the prototype stage revealed that decoupling this way actually made CV breakthrough worse so the components were omitted from the build. Issue 1.1, released in 2011, tidied up the circuit board design by removing the extraneous component locations completely.

Issue 2, released in 2016, leaves the basic circuitry the same but adds a copper ground plane to the PCB design and two additional capacitors to filter any possible noise on the power supply from affecting the signal outputs. The issue 2 board is also smaller making the overall module 10mm less deep.

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.

<i>Power</i>	<i>Pin number</i>
+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 fitted for use with a Synthesizers.com compatible system. 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.

<i>Power</i>	<i>Location number</i>	<i>Schematic Pin number</i>
+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 the PWR header has been fitted and you are using the module with a standard MU power distribution system, the middle two pads of the PSU header on the board should be connected together. This link connects the socket and panel ground with the module ground.

* The DVCA issue 2.1 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.

Calibrating

There are four 6mm trimmers, or presets, on each Dual VCA PCB. If you have a Quad VCA module you'll see that you will have two Dual VCA boards fitted, one of which is the master and the other the slave. The master handles channels 3 and 4, while the slave handles channels 1 and 2. Each set of trimmers should be visible to you as you look at your module. Channels 1 and 2 have their trimmers mounted to the underside of their circuit board (the slave), while channels 3 and 4 have their trimmers in the usual place on the topside of their board (the master). Since both boards are actually labelled the same way, it should be noted that the master's OFF1 and OFF2 trimmers actually control channel 3 and 4 respectively.

The actual position of the trimmers will depend on the characteristics of the LM13700N that has been fitted and your power supply. If you swap the OTA chips over or change your power supply, you'll need to recalibrate the module. But don't worry it's fairly easy, and you don't need any special equipment at all. Changing any other component will not require any recalibration.

Offset trimming

The two trimmers in the middle of the board, OFF1 and OFF2, trim out the offset of the OTA used for that particular VCA channel. For each channel the calibration procedure is identical.

Set the Gain pot to its minimum setting. Set the CV pot to fully clockwise, ie. fully on and positive. Listen to the audio output of the VCA by hooking up your mixer/amplifier to the output of the VCA you intend to calibrate.

Send a triangle wave signal of around 400Hz from a VCO or VC-LFO to the CV input. You should hear that signal bleeding into the your VCA's output. It'll probably be very quiet, so turn your amp up so you can hear it clearly. Now turn the trimmer until the bleed through almost disappears. It won't go completely, but you should be able to find a spot on the trimmer that minimises it. Repeat this for both channels on each VCA board.

Alternatively, you can also trim offset by measuring the output voltage of each VCA channel. Simply set the gain pot of the relevant channel to its maximum. Now adjust OFF so that the voltage gets as close to zero volts as you can get it. Do channel 1 first and then channel 2 and, if you have a Quad VCA, make sure you do Channel 4 last. This is because the last channel is also the mix output and thus will have the offsets of all the VCAs added together.

Level adjustments

The two other trimmers near the top of each Dual VCA board are the LVL1 and LVL2 trimmers. These allow you to accurately set the gain of each of the VCA channels. The object of this calibration is to ensure that the VCA's gain is unity or 0dB when the gain pot is turned fully up and there is no external CV being applied to the CV input. In other words, with the gain pot fully up, the VCA simply passes through the input signal neither amplifying it or attenuating it.

If you have an oscilloscope this bit is easy. Connect up a signal source, say a VCO output, to the VCA's input. Then simply set the gain pot to its maximum value and adjust LVL1 until the output amplitude is the same as the applied input signal. Repeat for VCA channel 2 using LVL2.

If you do not have an oscilloscope then you can do it by using a CV source. Use a control voltage source from any module that puts out a constant DC voltage. You could use your midi-CV converter's KeyCV or gate output, the output of an Oakley Control module, or the output of an ADSR with the gate activated. Either way you need a source of voltage that isn't going to go up or down while you measure it. Measure this voltage with a meter and write it down. Now plug it into the VCA's input and make sure the AC/DC switch is set to DC. Now adjust LVL so that the voltage on the output of the VCA channel is the same as what you have written down. There is no need to do this that accurately. Just adjust LVL so that the output voltage is within 0.1V of the input voltage.

If you have no oscilloscope or meter then simply set both LVL trimmers to their middle position. You may not have exactly set the gain to be unity but in practice it doesn't make a great deal of difference.

Final Comments

I hope you enjoy using the Oakley Voltage Controlled Amplifier module.

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 have a comment about this user manual, or have found a mistake in it, then please do let me know.

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.

Tony Allgood at Oakley Sound

Cumbria, UK

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