Oakley Sound Systems

5U Oakley Modular Series

Human Voice Module

PCB Issue 1

Builder's Guide

V1.1

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Introduction

This is the Project Builder's Guide for the issue 1 Human Voice Module (HVM) 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.

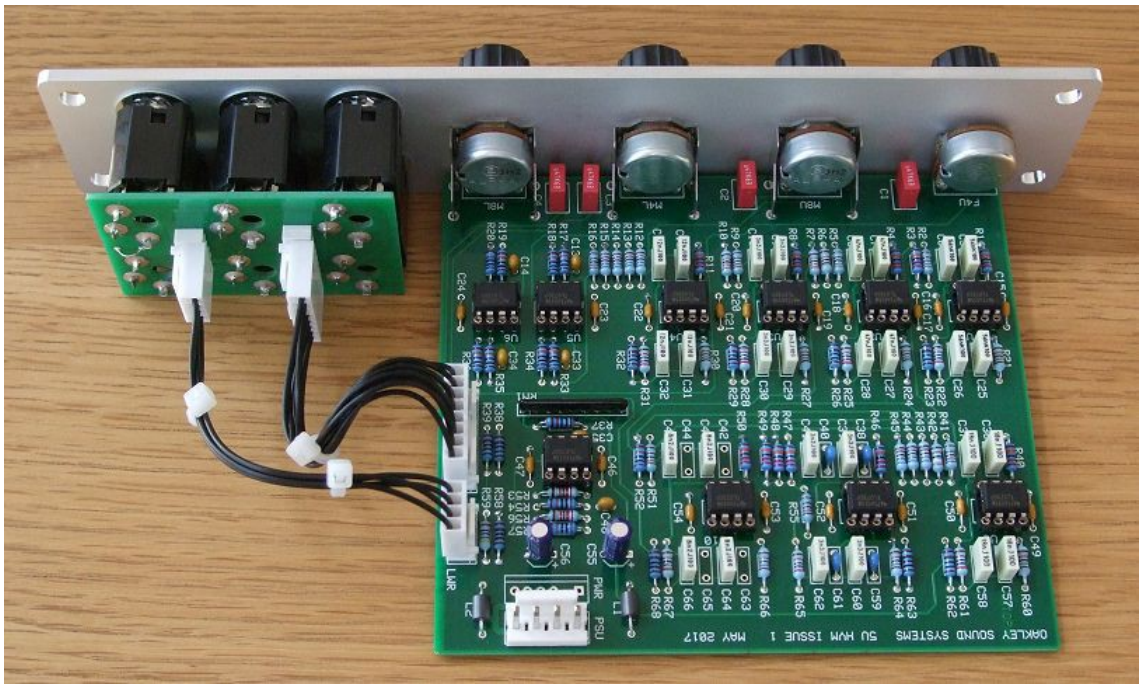
For the User Manual, which contains an overview of the operation of the unit and the calibration procedure, please visit the main project webpage at:

http://www.oakleysound.com/5uhvm.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 HVM PCB



The issue 1 Oakley HVM as a single width MOTM format module in a natural finish Schaeffer panel. Note also the use of the optional Sock6 socket board to help keep the wiring to the sockets neat and tidy.

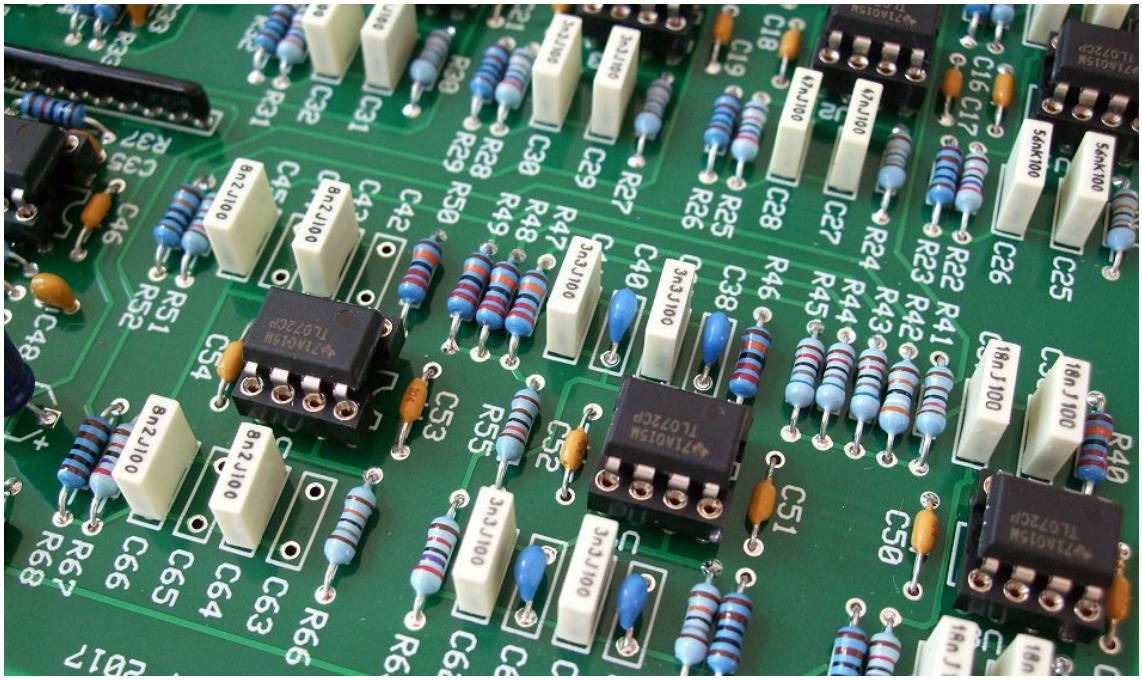
On the printed circuit board I have provided space for the four main control pots. If you use the specified 16mm Alpha pots and matching brackets, the PCB can be held very firmly to the panel without any additional mounting procedures. The pot spacing on this board is different to some of our other 5U modules, instead of 1.625” it is 1.375”. Used in conjunction with smaller 20mm diameter knobs this still allows for an attractive module design and finger friendly tweaking.

The board is a four layer design. This means that the board has layers of copper on top and bottom sides and two internal copper layers. You'll notice that the board feels heavier than ordinary two layer boards of a similar size. It is more expensive to make a board this way but it does mean that fewer compromises need to be made when laying out the design. The HVM uses some sensitive circuits and being able to use ground planes and dedicated power layers does help in keeping unwanted noise out.

With the exception of the solder pads, the underside is one solid copper plane which is connected to module ground (0V). Some components are connected to 0V and therefore their solder pads are directly connected to the ground plane. I use what are called 'heat relief' pads at these locations. This is where the solder pad is separated from the copper plane by some additional air gaps in the copper and not just joined all the way around. This prevents the ground plane from drawing a lot of the heat away from the pad during soldering. If the pad can't get hot enough the solder will not flow freely and the connection will not be as strong. Even so, some heat is lost to the plane and soldering these pads can be more difficult than the other pads. You may find that you need to hold your soldering iron tip for longer at these locations. If you can't get enough heat onto any joint then try using a bigger tip on your soldering iron. Remember to heat the joint up before you apply solder.

The design requires a power supply of +/-12V to +/-16V. The power supply should be adequately regulated. The current consumption is around +45mA and -45mA at +/-15V. Power is routed onto the main PCB by either our standard four way 0.156” MTA156 type connector or the special five way Synthesizers.com MTA100 header. 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 board size is 109mm (deep) x 124mm (high).



The ICs, all of them are TL072CPs, are fitted into turned pin DIL sockets in this build.

Alternate Voicing Option

The original instrument that the HVM takes its inspiration has four 'presets' or tabs. Each tab being represented by an input socket and level pot on the HVM. However, the four original tabs are shared over the separate upper and lower sections of the instrument's keyboard – each keyboard section having only two tabs and each tab actually controlling a different octave as well as the basic tone. This works well in the original keyboard, but the 'Male 8ft Upper' and 'Male 4ft Lower' sound almost identical when used with the same input signal. It is therefore worth thinking about using an alternative voicing for one of the 'tabs' and moving away from the original design slightly.

Option B in the parts list does this and makes the 'Male 4ft Lower' sound different to the other three voices – yet still retaining an obvious vocal quality. For typical usage within a modular synthesiser I recommend that you build option B.

HVM issue 1 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.

Many of the parts for this circuit board are surface mount devices but not all of them. Take special care when ordering your parts that you order the correct type of part. This parts list shows the type of part needed whereas the circuit diagram does not.

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.

470R	R59
1K	R29, R58, R39, R63, R32, R38, R23, R62, R68, R26
1K2	R16, R2, R51, R9, R41, R5, R55
10K	R37
22K	R53, R56
27K	R22, R31, R65, R61, R25, R28, R67
68K	R13, R44, R45, R14, R15
100K	R34, R36, R18, R33, R35, R17, R20, R19, R52, R57, R54
180K	R66, R24, R27, R30, R64, R21, R60
220K	R8, R40, R11, R47, R4, R1, R46, R48, R3, R50
330K	R10, R7
390K	R42

Option A: Original VP330 Instrumentation.

68K	R12, R43
220K	R49
470K	R6

Option B: Alternate M4 LWR Voicing

75K	R43
180K	R49
270K	R6, R12

10K x 8 common resistor array, 9 pin single in line package RN1

RN1 must be fitted so that the line or dot on the device package lines up with the square solder pad on the PCB.

Capacitors

100nF axial multilayer ceramic	C51, C20, C23, C46, C47, C53, C49, C19, C17, C24, C22, C52, C54, C16, C15, C21, C50, C18
33pF, C0G 2.5mm ceramic	C48, C33, C34, C14, C13
220pF, C0G 2.5mm ceramic	C35
560pF, C0G 5mm ceramic	C59, C61, C38, C40
3n3, 100V polyester	C30, C29, C10, C9, C41, C39, C62, C60
8n2, 100V polyester	C45, C64, C66, C43
12nF, 100V polyester	C11, C12, C31, C32
18nF, 100V polyester	C58, C36, C57, C37
47nF, 100V polyester	C7, C28, C8, C27
56nF, 100V polyester	C25, C26, C5, C6
470nF, 63V polyester	C1, C2, C3, C4
2u2, 63V electrolytic	C55, C56

C63, C65, C42 & C44 are not fitted.

In case you cannot obtain any 8n2 capacitors, provision has been made on the board to substitute two smaller value capacitors instead which when combined make up a close approximation of the required value. For example you could use:

1n5 polyester	C63, C65, C42, C44
6n8 polyester	C45, C64, C66, C43

Likewise the capacitors surrounding U9 should ideally be 3.9nF. I have recommended that you use a combination of 560pF and 3n3 since these are easier to obtain. However, you could fit four 3n9 capacitors to C41, C39, C62 & C60 and leave C59, C61, C38 & C40 empty. Any combination that gets you close to 3.9nF is viable, for example:

1n2 polyester	C41, C39, C62, C60
2n7 polyester	C59, C61, C38, C40

The pin spacing is 5mm for all filter capacitors.

Integrated Circuits

TL072CP	U1, U2, U3, U4, U5, U6, U7, U8, U9, U10

IC sockets can be used if you wish. You need ten 8-pin DIL sockets.

Potentiometers (Pots)

All pots Alpha 16mm PCB mounted types.

47KB (or 50KB) linear	F4U, M8U, M4L, M8L

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	Six off mounted either on the Sock6 board or on panel

Four 20mm knobs.

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

Components required if using optional Sock6 board

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 wire link, L1 on the Sock6 PCB, is to be fitted. Simply solder a wire hoop made from a resistor lead clipping to join the two pads of L1 together.

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

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.

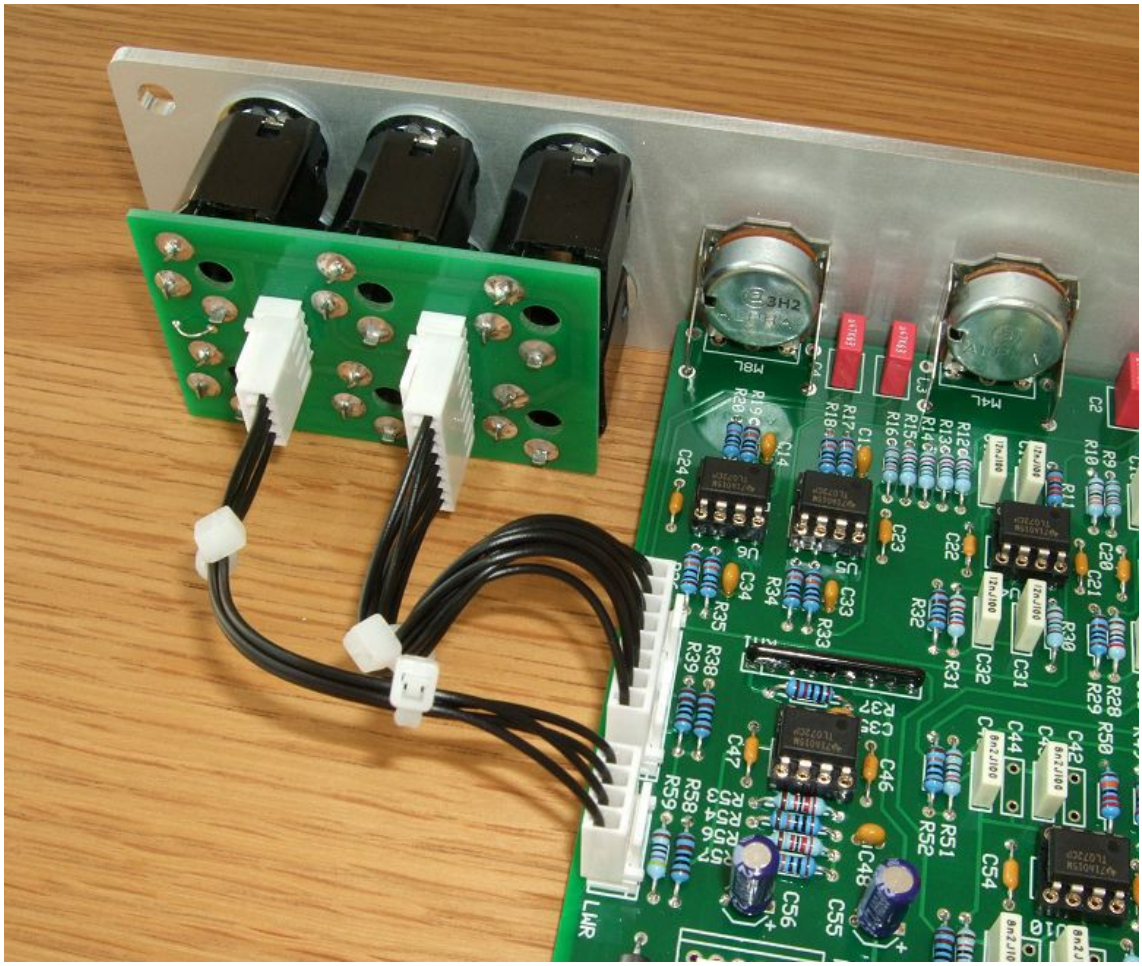
If fitting the PWR header, you will also need to link out pins 2 and 3 of PSU. This connects the panel ground with the module ground. Simply solder a solid wire hoop made from a resistor lead clipping to join the middle two pads of PSU together.

Building the HVM 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 be fitted to the Sock6 board. Simply solder a wire hoop made from a resistor lead clipping to join the two pads of L1 together.

You need to make up two interconnects. The eight way one should be made so that it is 100mm long. The four way should be made to be 120mm.



The Sock6 board makes it much easier to build the module. Here I have used Molex 0.1" KK headers and housings. This is a 'strip and crimp' system that is cheap but very reliable.

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 the 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.

UPR

Pin	*Pad name*	*Socket*	*Lug Type*
Pin 1	Not Used		
Pin 2	OUT	OUTPUT	Signal
Pin 3	IN_BUF_M8U	M8 UPR	NC
Pin 4	IN_M8U	M8 UPR	Signal
Pin 5	IN_BUF_F4U	F4 UPR	NC
Pin 6	IN_F4U	F4 UPR	Signal
Pin 7	Module ground	INPUT (ALL)	NC
Pin 8	IN_ALL	INPUT (ALL)	Signal

LWR

Pin	*Pad name*	*Socket*	*Lug Type*
Pin 1	Panel ground	Connects to all sockets	Ground lugs
Pin 2	IN_M8L	M8 LWR	Signal
Pin 3	IN_BUF_LWR	M4 LWR & M8 LWR	NC
Pin 4	IN_M4L	M4 LWR	Signal

Testing, testing, 1, 2, 3...

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.

Assuming everything is OK so far, it is time to apply an audio input. Use a bright signal like a sawtooth output from a VCO and connect this to the socket INPUT (ALL). The A below middle C, 220Hz, is a good note to use.

Connect your amplifier or mixing desk input to the OUTPUT socket. Turn each pot up and down one at a time and listen to the resultant output. Each pot should produce a different tone, although the middle two pots will sound very similar if you have built option A. Try playing some different notes, or vary the frequency of the VCO. You should hear the distinctive vocal sound.

Remove the input signal and connect it to the F4 UPR socket. Only the FEMALE 4 UPR pot should now have any effect on the output. Repeat for the other three inputs checking that only the dedicated pot for that input has an effect on the sound.

If this all works you probably have a working module. However, be sure to listen to the online examples of a working module to make sure all seven of the modules band pass filters are working at the right frequencies.

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 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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