Oakley Sound Systems

5U Oakley Modular Series

Multimix issue 5
Four channel mixer with reversible attenuators

Builder's Guide

V5.1

Tony Allgood
Oakley Sound Systems
CARLISLE
United Kingdom

Introduction

This is the Project Builder's Guide for the issue 5 Multimix 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 board, interconnections and some basic testing methods.

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

http://www.oakleysound.com/multimix.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 5 Multimix PCB
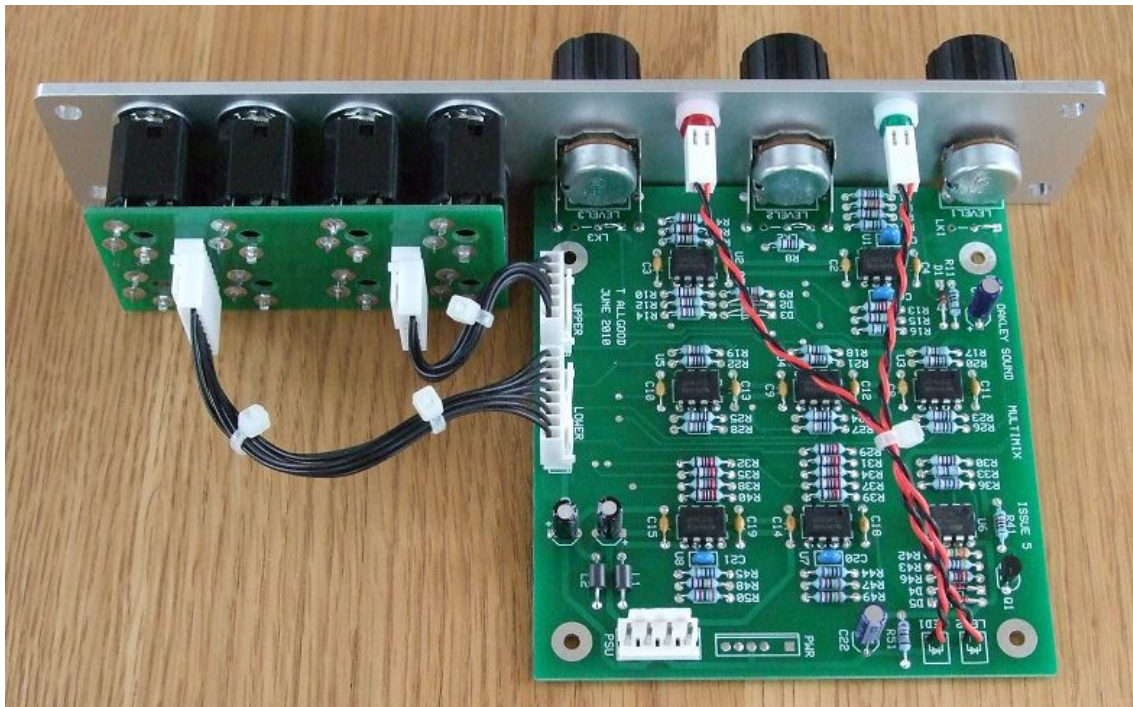
The Multimix 5 in a natural finish Schaeffer panel. Note the use of the optional Sock8 board that holds and connects the eight 1/4" sockets to the main board.

I have provided space for the three 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 1.625" 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 35mA for the positive rail and 30mA for the negative rail. Power is routed onto the PCB by 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 PCB has four mounting holes for M3 bolts, one near each corner. These are not required if you are using the two 16mm pot brackets.

The board size is 104mm (high) x 112mm (deep).

The board has been laid out to accept connection to our Sock8 socket board. This small board speeds up the wiring of the eight sockets and reduces the chances of mistakes.

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

All resistors should be 0.25W 5% carbon or better. Parts labelled MF should 0.25W or 0.4W 1% metal film types.

To save confusion with different colour codes I recommend all resistors be 0.25W or 0.4W 1% MF types.

22R	R51
75R	R5, R16, R45, R44
120R	R41 *This sets the brightness of both LEDs. Increase this value to reduce brightness.*
470R	R43
3K	R36
3K3	R9
3K9	R33
10K	R1, R4, R21, R22, R8, R20
11K	R30
22K MF	R29, R37, R34, R6, R40, R38, R35, R32, R13, R2, R31, R39, R46
24K MF	R49, R50, R48, R7, R47, R3, R15
33K	R10
47K	R14, R12
100K MF	R24, R27, R25, R28, R23, R26
470K	R19, R17, R18
1M	R11
3M3	R42

Capacitors

100nF axial multilayer ceramic	C18, C19, C11, C2, C4, C15, C9, C3, C14, C13, C10, C5, C8, C12
1uF, 63V radial electrolytic	C7
22uF, 35V radial electrolytic	C22
2u2,63V radial electrolytic	C16, C17

| 33pF ceramic 2.5mm | C1, C21, C20, C6 |

Discrete Semiconductors

1N4148	D1, D2, D3, D4, D5
BC560 PNP transistor	Q1
Green LED 5mm	LED2 – mounted off board
Red LED 5mm	LED1 – mounted off board

Integrated Circuits

| TL072 dual FET op-amp | U1, U2, U3, U4, U5, U7, U8 |
| LM2903 dual comparator | U6 |

IC sockets are recommended. You need eight 8-pin DIL sockets.

Potentiometers

| 47K linear Alpha 16mm | LEVEL1, LEVEL2, LEVEL3 |

Two Alpha pot brackets are also required. The LEVEL1 pot has no bracket.

Miscellaneous

| Leaded Ferrite beads | L1, L2 |
Knobs to fit 6mm shafts	Three off
Molex or MTA 4 way header	PSU – Oakley/MOTM power supply
MTA100 6-way header	PWR – Synthesizers.com power supply
Molex/MTA 0.1" header 6-way	UPPER – for connecting to sockets
Molex/MTA 0.1" header 8-way	LOWER – for connecting to sockets
Molex/MTA 0.1" housing 6-way	UPPER – for connecting to sockets
Molex/MTA 0.1" housing 8-way	LOWER – for connecting to sockets
Molex/MTA 0.1" housing 2-way	LED1, LED2
1/4" sockets	Eight off mounted either on the Sock8 board or on panel

Hook up wire (26awg).

Wire Links

You will also need three 2cm long pieces of solid core wire to make the three links on the board.
The actual position of these links determines how the three level controls work, either as a simple
level control or as a reversible attenuator. The links can be made from component leg clippings or
uninsulated tinned copper wire. Simply solder a small hoop of the wire joining the relevant pads of

each link. For each of the 'three pad links', LK1, 2 & 3, pad 1 is the square pad at one end, pad 3 is middle pad, and pad 2 is the round pad on the end.

If the Multimix is to be built with three reversible attenuators (the 'Stooge' variant) then each of the three links need to have pads 1 and 3 linked. That is the middle pad to the square pad.

If the Multimix is to be built with three standard level controls (the 'Sum' variant) then each of the three links need to have pads 2 and 3 linked. That is the middle pad to the end round pad.
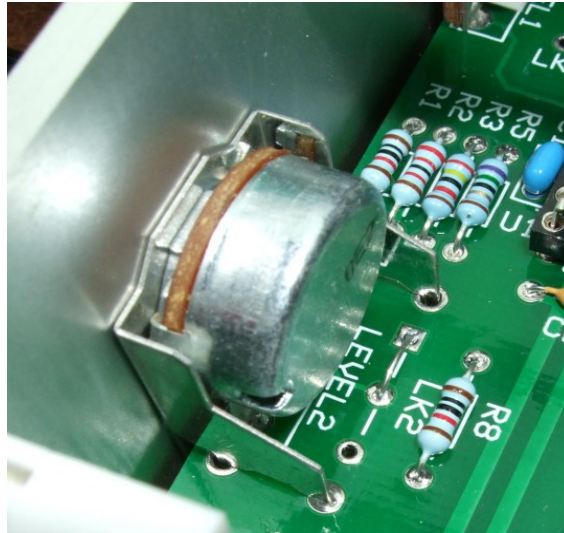
The link LK2 configured in 'Stooge' mode with pads 1 and 3 linked together.

Additional components required if using optional Sock8 board

Molex/MTA 0.1" header 6-way   UPR
Molex/MTA 0.1" header 8-way   LWR
Molex/MTA 0.1" housing 6-way   UPR
Molex/MTA 0.1" housing 8-way   LWR

112APCX Switchcraft 1/4" socket   SK1, SK2, SK3, SK4, SK5, SK6, SK7, SK8

If using Molex KK you'll also need at least 28 crimp terminals.

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

Wire Link

You also need to fit a wire link into the location on the Sock8 PCB marked as L1. This ensures that the NC lug on the IN4 socket is grounded.

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 LWR 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 the PSU header. This connects the panel ground with the module ground. Simply solder a solid wire hoop to join the two middle pads of PSU together.

Building the Multimix 5 module using the Sock8 board

This is the simplest way of connecting all the sockets to the main board. The Sock8 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 six way, and LWR (for lower) which is eight way. Both headers are fitted to the bottom side of the board.

You need to make up two interconnects. The six way one should be made so that it is 80mm long. The eight way should be made to be 130mm.
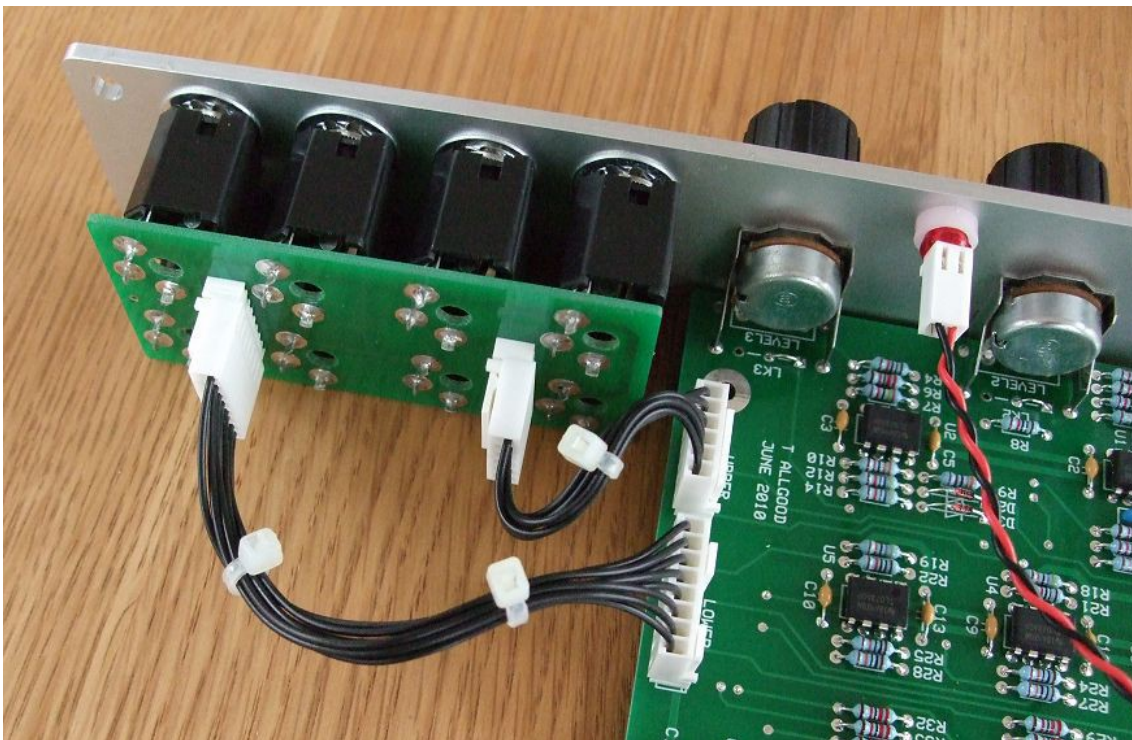
The prototype Multimix module showing the detail of the board to board interconnects. Here I have used the Molex KK 0.1'' system to connect the Sock8 to the main PCB.

Building the Multimix 5 module by wiring the sockets manually

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 shown in the tables below:

UPPER

Pin	Pad name	Socket Connection	Lug Type
Pin 1	OUT2	Connect to OUT2	Signal lug
Pin 2	NC2	Connect to OUT2	NC lug
Pin 3	NC1	Connect to OUT1	NC lug
Pin 4	OUT1	Connect to OUT1	Signal lug
Pin 5	module ground	Connect to IN1 & IN2	NC lugs
Pin 6	IN1	Connect to IN1	Signal lug

LOWER

Pin	Pad name	Socket Connection	Lug Type
Pin 1	Panel ground	Connects to all sockets	Ground lugs via wire frame
Pin 2	MIX+	Connect to MIX OUT	Signal lug
Pin 3	IN4	Connect to IN4	Signal lug
Pin 4	OUT3/MIX	Connect to OUT3/MIX	Signal lug
Pin 5	module ground	Connect to IN3	NC lug
Pin 6	IN2	Connect to IN2	Signal lug
Pin 7	module ground	Connect to IN4	NC lug
Pin 8	IN3	Connect to IN3	Signal lug

Light Emitting Diodes
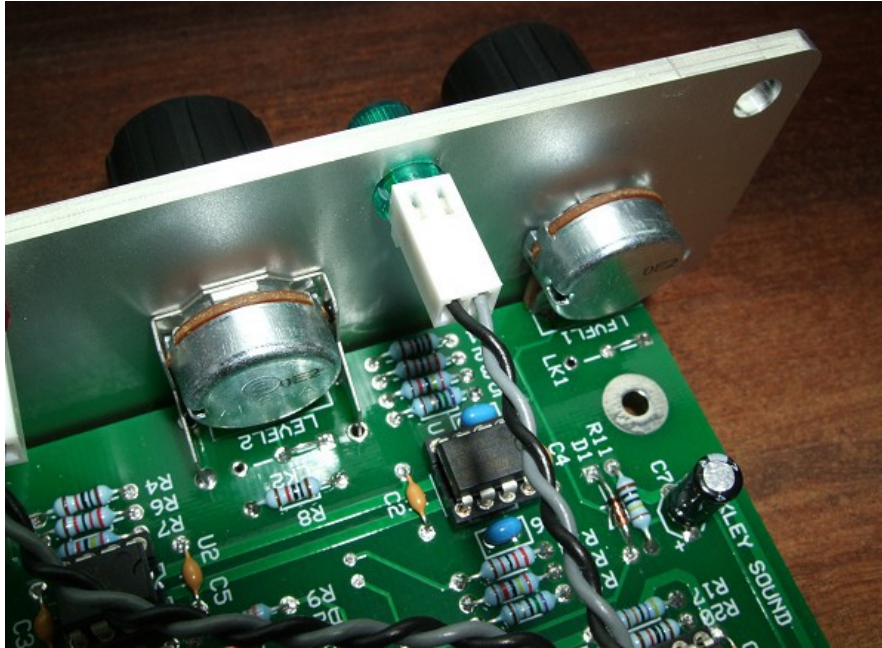
The 5V LED fitted to the panel with a translucent green cliplite. A two way Molex KK housing is used to make the connection to the LED device. This allows the LED to be removed easily.
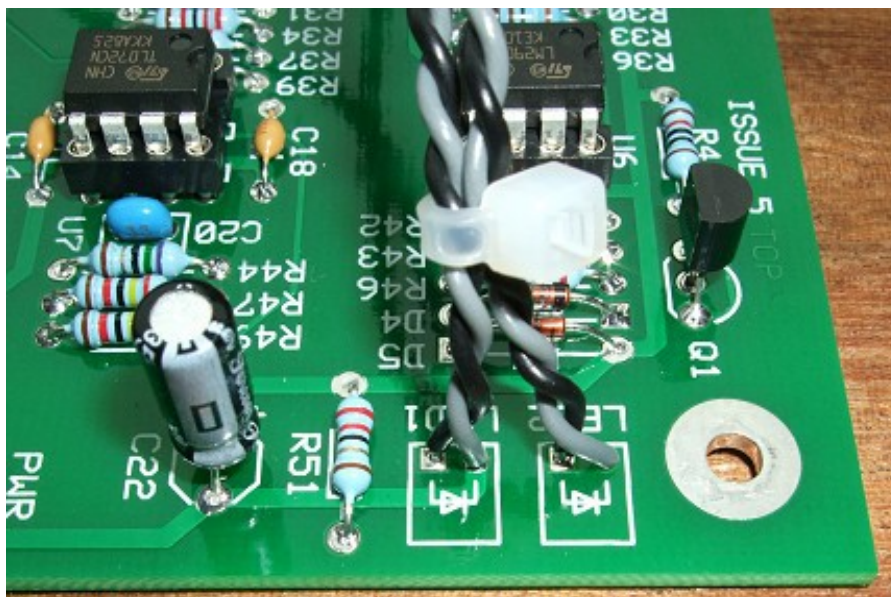
Both LEDs are wired to the board via flying wires. I twist the wires and cable tie them together to keep them neat. The cathode of the LED is connected to the round pad on the board.

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.

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. Middle A, 440Hz is a good note to use.

Connect up an amplifier or mixing desk input to the OUT3/MIX socket. Now connect your signal to the first input. You should be control the level with the top pot. If you have built the Stooge version, you should be able to silence the input by moving the pot to its middle position. If you have built the Sum version, the pot should act as an ordinary volume control.

Input channels two and three should perform identically

Now listen to the output coming from MIX OUT. This should behave much like the OUT3/MIX socket, but it should also be able to pass any signal connected to IN4. Connect your VCO to IN4 and check you can hear the VCO's output through MIX OUT. None of the level pots should have an affect on the level of the signal coming into IN4.

If you are using a modular VCO as a source for your input signal, check that the green LED turns on when the input level is turned to its maximum. The LEDs track the output signal coming from the MIX OUT socket. The green LED will turn on when the signal level reaches over +/-5V which should be obtained when the input level is fully clockwise (and also fully anti-clockwise in the case of the Stooge variant). You should note that the actual trigger value does depend a little on input wave shape and frequency. The red LED only turns on when the output level exceeds +/-11V. To test this function on your modular the easiest thing to do is use two VCOs, each one going to a separate input on the Multimix. With two sawtooth input signals, and both their level controls set to maximum, the peak LED should light in time with the audible beating of the two VCOs. If your LEDs fail to light make sure you haven't reversed the connections to the LEDs.

Another way to check the LED's operation is to use a voltage source. The Oakley midiDAC is an excellent source of voltage that can be used to test the Multimix. Simply connect the modulation wheel output to IN1 and turn its level pot fully up. Then as you rotate the mod wheel on your controller the midiDAC will put out an increasing positive voltage. At just under half way it will put out around 5V and the green LED should light. Fully up the midiDAC will be producing 10.6V and this should be easily enough to tickle the RED LED to light.

You should now check the output from OUT1 and OUT2. OUT1 should be a pot controlled version of IN1, and OUT2 should be a pot controlled version of IN2. Inserting a jack plug into either OUT1 or OUT2 will cut the respective input from the OUT3/MIX socket, but not from the MIX OUT socket. The MIX OUT socket will always sum IN1, IN2, IN3 and IN4 together regardless of any jack plugs inserted into OUT 1, OUT2 or OUT3/MIX.

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.

Tony Allgood at Oakley Sound

Cumbria, UK
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