Oakley Sound Systems

5U Oakley Modular Series

Fourmix
CV and Audio Mixer

Fourmix PCB Issue 1

Builder's Guide

V1.0.00

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Introduction

This is the Project Builder's Guide for the issue 1 Fourmix 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.

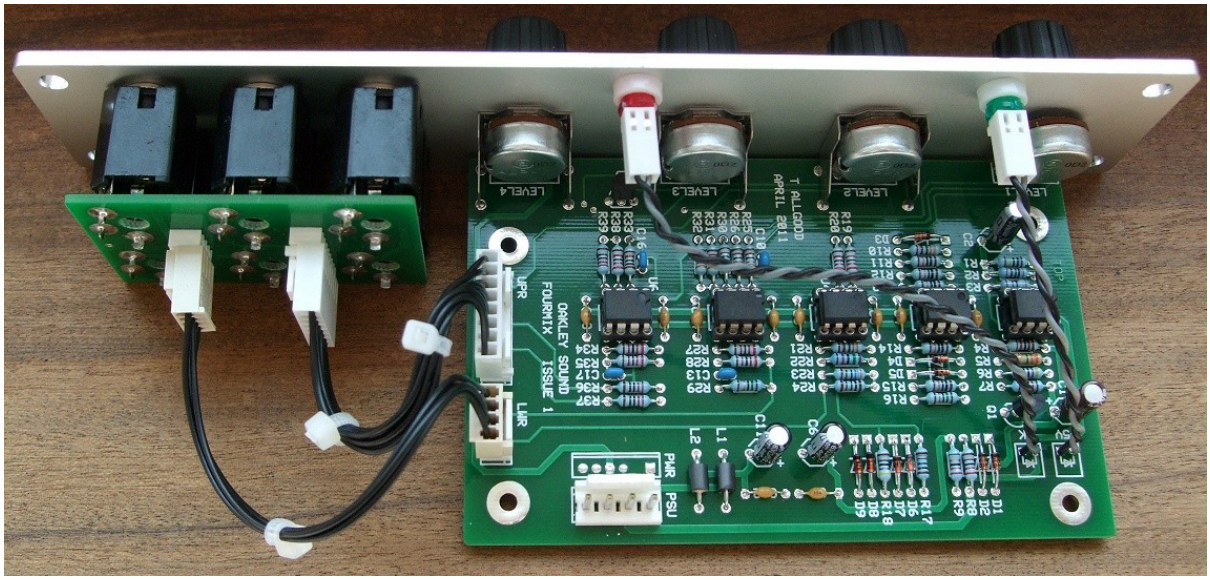
For the User Manual, which contains an overview of the operation of the unit and the calibration procedure, please visit the main project webpage at:

http://www.oakleysound.com/fourmix.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 Fourmix PCB



This is the issue1 Fourmix 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.

On the Fourmix 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 many of our other 5U modules, instead of 1.625" it is 1.375". Used in conjunction with smaller 20mm or 13/16" diameter knobs this still allows for an attractive module design and finger friendly tweaking.

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 123mm (high).

The main board has been laid out to accept connection to our Sock6 socket board. This small board speeds up the wiring of the six sockets and reduces the chances of building mistakes.

Issue 1 Fourmix 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.

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 and lower noise components. However, 5% ones can be substituted in any of the places if you wish. R5 will probably have to be a 5% type since getting hold of a 1% metal film resistor in this value is sometimes not trivial.

22R	R9
75R	R29
120R	R7
470R	R6
1K	R17, R24
2K2	R36, R39, R37
3K	R2
3K3	R21, R10
3K6	R23
3K9	R3
4K7	R18
11K	R4, R33
15K	R22
22K	R38, R8, R35, R34, R19, R20, R27, R28
33K	R25, R32, R31, R30, R26
100K	R12, R15, R14, R11, R13
150K	R16
1M	R1
3M3	R5

Capacitors

100nF axial ceramic	C9, C3, C15, C7, C5, C12, C8, C18, C14, C4
33pF C0G 2.5mm ceramic	C10, C13
100pF C0G 2.5mm ceramic	C16, C17

1uF, 63V electrolytic	C2
2u2, 63V electrolytic	C6, C11
22uF, 35V electrolytic	C1

Discrete Semiconductors

BC560 PNP small signal transistor	Q1
1N4148 signal diode	D1, D2, D3, D4, D5
3V9 zener diode	D8, D9
5V1 zener diode	D6, D7

LEDs

5mm red round LED	PK
5mm green round LED	+5V

Two LED clips for front panel and two LED securing rings if required

Integrated Circuits

TL072ACP dual FET op-amp	U3, U4, U6
OP-275 dual audio op-amp	U5
LM2903 dual comparator	U2
LM4040DIZ-10.0 10V reference	U1*

* The LM4040CIZ-10.0 is also suitable.

Potentiometers (Pots)

All pots Alpha 16mm PCB mounted types

47K or 50K linear	LEVEL1, LEVEL2, LEVEL3, LEVEL4

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	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

Other Parts Required

Switchcraft 112APC 1/4” sockets Six off mounted either on the Sock6 board or on panel

Four 20mm or 13/16” Moog style knobs.

Four cable ties.

Around 2m of insulated multistrand hook up wire for the 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

The link L1 is not to be fitted 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

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.

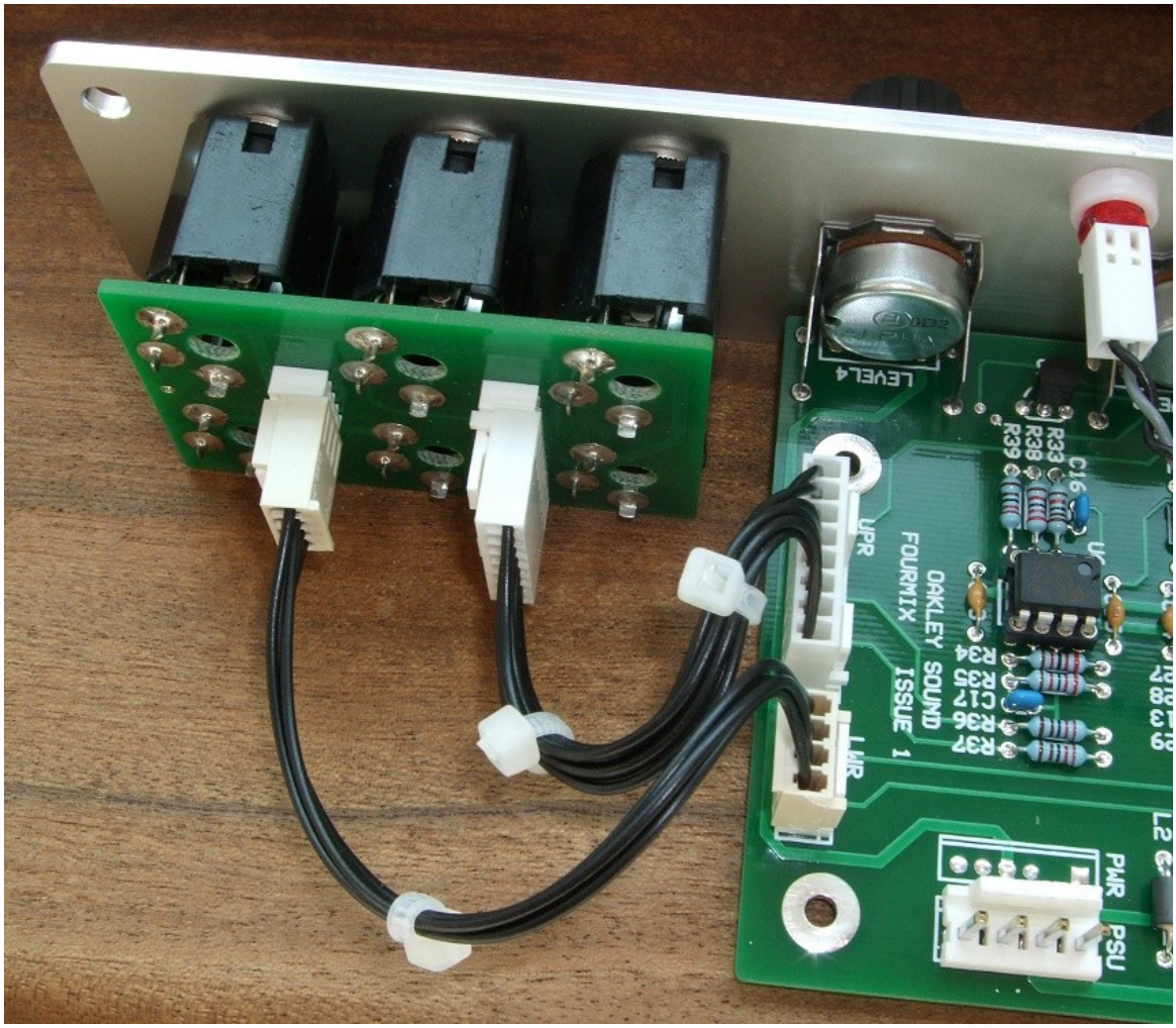
If fitting the PWR header, you will also need to link out pins 2 and 3 of PSU. This connects the panel ground with the module ground. Simply solder a solid wire hoop made from a resistor lead clipping to join the middle two pads of PSU together.

Building the Fourmix 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 must not be fitted on 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 Fourmix prototype 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:

UPR

Pin	*Pad name*	*Socket Connection*	*Lug Type*
Pin 1	Module ground	IN2	NC
Pin 2	IN2	IN2	Signal
Pin 3	-5V	IN4	NC
Pin 4	IN4	IN4	Signal
Pin 5	+5V	IN3	NC
Pin 6	IN3	IN3	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	OUT_SOFT	OUT (SOFT)	Signal
Pin 3	Not Connected		
Pin 4	OUT_MAIN	OUT (MAIN)	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.

The next thing to do is to make sure that the internal voltage references are working correctly. Measure the voltage with respect to ground from the MAIN (OUT) socket. With all the front panel pots turned to their minimum value the output voltage should be close to zero volts give or take a few millivolts. Now turn up LEVEL3 to its maximum setting. The voltage should now be at just under +4.5V. Check that neither the +5V green LED or PK red LED come on. Now keeping LEVEL3 still at its maximum setting turn LEVEL4 up to its maximum setting too. The output voltage should now fall to very close to zero volts again give or take a few mV. Now reduce LEVEL3 to its minimum value and the voltage should drop to -4.5V. Turn LEVEL4 down to its minimum value and the voltage should again drop to zero volts.

Now send an audio signal into IN1. Check that by turning up the LEVEL1 pot you can control the signal level heard at OUT (MAIN) and OUT (SOFT). Repeat this procedure for the other three input channels.

Using a triangle wave signal into IN1 check that the SOFT (OUT) produces a soft clipping effect. If you use a 440Hz triangle wave signal you should be able to hear the difference as you turn the input level pot up. Not only will you hear a change in output volume you will also hear the triangle wave's higher harmonics become more muted. At the top of the pot's travel the triangle wave will sound almost sine like. If you have a oscilloscope (or a waveform monitor on your computer DAW) you can see the effect in action.

Using a 'mult' or multiple module connect the first three inputs of the Fourmix to one single signal source. The triangle wave signal is perfect for this. Check that with LEVEL1 turned up full and LEVEL2 just turned up slightly the +5V LED glows green. Turning LEVEL2 up all the way and then having LEVEL3 turned slightly up should activate the red PK LED. The sensitivity of the LEDs switching circuits are determined by your power supply voltages so you may find your LEDs may need slightly more or less signal to be activated.

If all this happens, the chances are that you have a working module.

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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