Oakley Sound Systems

Eurorack Modular Series

Eight Step Sequencer

User Manual

V1.0

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Introduction

This is the User Manual for the Sequencer module from Oakley Sound.

This document contains an overview of the operation of the unit and all the calibration procedures.

For the Builder's Guide which contains information on how to construct the module from the PCB set please visit the main project webpage at:

http://www.oakleysound.com/sequencer-e.htm

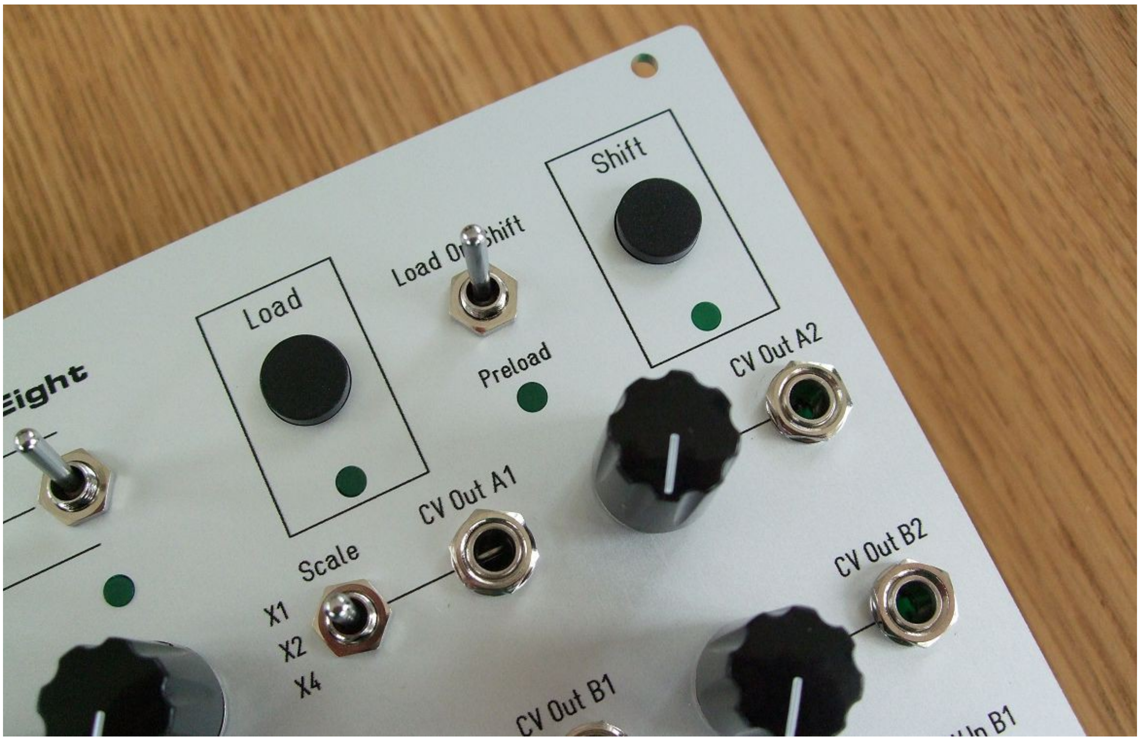
For general information regarding where to get parts and suggested part numbers please see my useful Parts Guide at the project webpage or http://www.oakleysound.com/parts.pdf.

For general information on how to build my modules, including circuit board population, mounting front panel components and making up board interconnects please see my generic Construction Guide at the project webpage or http://www.oakleysound.com/construct.pdf.

The Oakley Sequencer

The Oakley Sound Sequencer is a 50HP wide eurorack analogue sequencer with a maximum of eight steps and multistage loading capability. Each step can be selected to reset the sequence back to the start, or to skip and go straight to the next step without being engaged. Through a set of switches at the top of the module it is possible to load multiple stages so that more than one step at a time can be made active. In this way, the notes on each active step are added together to form a new control voltage.

The Sequencer is designed to be played as the sequence is running, new notes can be selected, steps can be changed to skip or reset, and the number of active steps can be altered on the fly. This hands on approach produces a real time controllable musical instrument that can create constantly changing sequences that belie the initial number of available steps.



Each step on the sequencer has two control voltage channels, A and B, each controlled by its own row of pots. Each channel has two outputs. One output has a fixed range determined by a three way toggle switch that can be set so that a single active step can be varied from either 0 to 1V, 0 to 2V, or 0 to 4V. The second output is fully variable and can be adjusted so that a single active step can be varied from 0V to a maximum of 9.5V. If multiple steps are selected than the output CV will increase linearly, so with two active steps producing 1V each, the final output will be 2V.

A reset output (+5V when active) will go high when the sequencer returns back to first active step. This can be used to trigger other modules such as a sequential switch which can allow both channels to be alternatively switched to allow sequences of up to 16 steps long.

The sequencer is advanced by use of the external shift input or the front panel's shift button. The external shift input can be any positive going signal above 1V. The sequencer can be shifted at very high speeds, over 20kHz, so it is possible to use the sequencer to generate audio waveforms and divide down effects. Some other sequencers use the word 'sync' or 'clock' to designate the shift function. An LED lights up whenever a shift command is active.

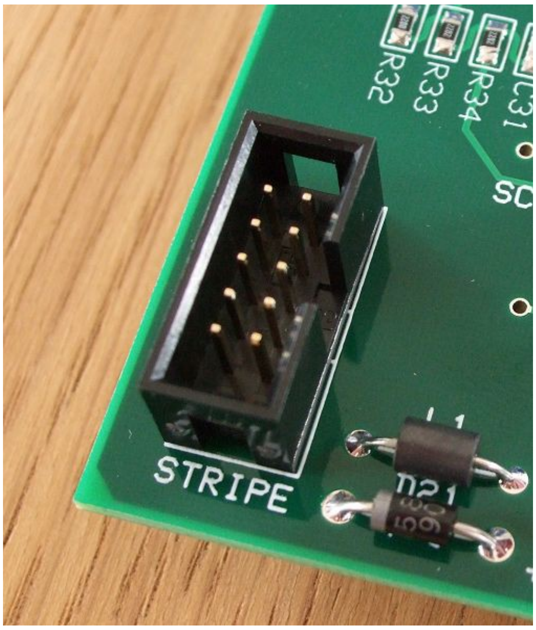
Each of the eight steps has a three way gate switch. This selects whether any active steps control one of two gate outputs. Each step can be set to trigger either Gate A, Gate B or neither. A third gate output goes high when either Gate A or Gate B is active. All gate outputs are +5V when active and 0V when off. A toggle switch selects whether the gate outputs are high whenever any selected step is active, or are only high when both the selected step and the shift command is active.

Multiple steps can be selected by the Oakley Sequencer's load function. Like the shift command, load can be instigated by either an external gate type signal or a push button. At the top of each step is a three way switch. On a load command, each switch can be set to force that stage to either, be switched on, be switched off, or left in whatever state it is already in. Traditional one step sequencing is simply obtained by having all switches in the off state bar the first one. Pressing load is then the equivalent of a simple reset. Through the 'load on shift' switch the load command can either be set to load the moment the load is activated, or to wait until the next shift command is received. The latter is very useful for keeping things in time with the master tempo clock. An LED lights once the load is activated and is waiting for the next shift command.

Current consumption is +85mA and -40mA at +/-12V.

Power Supply

The design requires plus and minus 12V supplies. The power supply should be adequately regulated. The current consumption is around +85mA and -40mA. The 45mA difference between the positive and negative rails is almost entirely due to the LED drivers. These LED constant current driver circuits ensure that the module takes the same current whether the LEDs are on or off. This eliminates sudden changes in current when the LEDs are turned on and off and therefore reduces unwanted noise on the power supply lines in your modular.



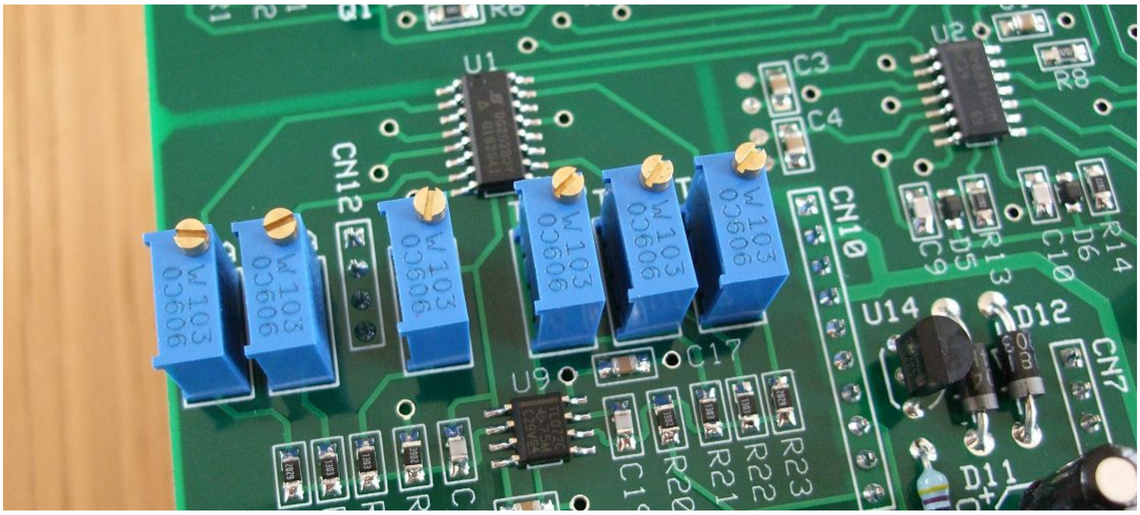
Power is routed onto the main board via the usual 10 way keyed IDC header. The stripe on the ribbon cable should line up with the word 'STRIPE' on the circuit board surface.

Reverse polarity protection is provided by two Schottky diodes in series with the +12V and -12V lines. Internally the Sequencer uses three 0V connections. One is used exclusively for the digital circuitry and LEDs, another solely for the analogue circuitry like the pot drivers, and the third one for grounding the front panel, ground lugs of the sockets and the pot's metalwork. These three 0V connections are made using two pins each of the middle block of six pins on the 10 way power lead. It is imperative therefore that any power supply distribution system connects all six middle pins of the ten way power lead to the power supply's 0V (ground). This is the expected behaviour of any Eurorack power system but should the Sequencer not behave correctly be sure to check your power lead and power distribution system first.

Calibration

Although you can adjust the trimmers with a small blade screwdriver, Vishay, Bourns and others make special trimmer adjusters, which are easier to use and less likely to damage the trimmers.

Power up your modular and make sure it has been powered up for at least twenty minutes prior to calibration. It is a good idea to have the room temperature close to what it would normally be when playing your modular.



The six multiturn trimmers that adjust the maximum output voltage of the A1 and B1 sockets.

Maximum Output Voltage Calibration – Method 1

Method 1 is quick and easy although its accuracy depends on the quality of your voltmeter. The voltmeter should be able to read voltages up to 4V with an accuracy of at least +/-10mV.

Set the sequencer so that only step 1 is active. That is, only step 1's LED should be lit. Set both A and B scale switches to their x4 positions.

Insert a patch lead into the 'CV Out A1' output socket and measure the voltage between the tip and sleeve connections at the free end of the patch lead. Rotate the top pot on step 1 to its minimum value. Check that the voltage is very close to 0.000V (+/-10mV).

Rotate the top pot on step 1 to its maximum value. Adjust **T1A** so that the voltage is 4.00V (or 4.000V if your meter will do this).

Set the scale switch to x2. Adjust **T2A** so that the voltage is 2.00V (or 2.000V).

Set the scale switch to x1. Adjust **T3A** so that the voltage is 1.00V (or 1.000V).

Insert the same patch lead into 'CV Out B1' and measure the voltage between the tip and sleeve connections at the free end of the patch lead. Rotate the bottom pot on step 1 to its minimum value. Check that the voltage is very close to 0.000V (+/-10mV).

Rotate the top pot on step 1 to its maximum value. Adjust **T1B** so that the voltage is 4.00V (or 4.000V if your meter will do this).

Set the scale switch to x2. Adjust **T2B** so that the voltage is 2.00V (or 2.000V).

Set the scale switch to x1. Adjust **T3B** so that the voltage is 1.00V (or 1.000V).

You must trim each set of three trimmers in the order presented above. That is, T1A must come before T2A, which must come before T3A.

Maximum Output Voltage Calibration – Method 2

This is the more accurate method assuming you don't have a particularly good voltmeter but do have a good quality midi-CV convertor like Mutable Instruments Yarns or equivalent, or a suitable digital sequencer/keyboard with a CV output. What this method does is compare a known stable voltage from the midi-CV or digital sequencer/keyboard with the output of the Oakley Sequencer and try to match them to be the same. Even a cheap voltmeter can measure voltages close to zero volts.

Both the Oakley Sequencer and other device should be in the same case and preferably powered from the same power supply.

Set the Oakley Sequencer so that only step 1 is active. That is, only step 1's LED should be lit. Set both A and B scale switches to their x4 positions, and both the upper and lower pots on step 1 to their maximum.

Insert a patch lead into the CV output socket of your midi/CV convertor, or sequencer/keyboard, and measure the voltage between the tip and sleeve connections at the free end of the patch lead. Play a note on your keyboard or sequencer until the voltage gets to as close to 4.00V as possible. It should be a C, but as to which octave you play will depend on the device in question.

Now insert another patch lead into the 'CV Out A1' socket on the Oakley sequencer. Now measure the voltage between the tip connections of each of the inserted patch leads. This will give us voltage difference between the two. One should be calibrated already and the other, the Oakley Sequencer, will be trimmed to match it.

Adjust **T1A** so that the voltage between the two devices is as close to 0mV (0.000V) as possible.

Now play a note two octaves below so that your device now produces an accurate 2V output. Set the Scale switch on the Oakley Sequencer to x2. Adjust **T2A** so that the voltage again measures 0mV.

Now play a note one octave below that so your device now produces an accurate 1V output. Set the Scale switch to x1. Adjust **T3A** so that the voltage again measures 0mV.

Now repeat the process for the 'CV Out B1' socket. Again measure the voltage difference between the two devices. **T1B** adjusts for x4, **T2B** adjusts for x2, and **T3B** adjusts for x1.

You must trim each set of three trimmers in the order presented above. That is, T1A must come before T2A, which must come before T3A.

CV Input Calibration

There are two CV inputs and each one is summed (mixed) with the output of that particular sequencer channel. 'CV In A' sums with Sequencer channel A, and 'CV In B' sums with Sequencer channel B. Since the idea of these inputs is to provide real time transposition of the sequences the CV inputs must conform to the 1V/octave standard. That means the gain of the summing stage must be precisely one. This means were we to put exactly 1V into 'CV In A' then the sequencer output would be transposed up by exactly 1V. Trimmers **SCL_A** and **SCL_B** adjust the gain of the summing stage to be exactly one.

There are several ways to calibrate the CV inputs but probably the easiest method is to use a midi-CV or sequencer's 1V/octave output CV and a VCO module. Simply route the CV output from the keyboard/sequencer to the VCO via the Oakley Sequencer's 'CV In A1' input socket and 'CV Out A1' output socket. Then ensure that no steps are active on the Oakley Sequencer, that is, all steps are turned off. And trim SCL_A to allow the VCO to be played in tune.

Start by patching the VCO direct to the keyboard/sequencer module you wish to use. Play a highish note, so the CV controlling the VCO is over 3V or so. With a tuner check the actual note that is being heard. Then route the CV through the Oakley Sequencer as described above. The new note heard from the VCO will probably be slightly off. Adjust the SCL_A trimmer to bring it back into tune so that it is playing the same note as it was without the Sequencer in place.

Repeat the process for the B Channel using 'CV In B1' and 'CV Out B1' to process the CV. Use SCL_B to tune the VCO back to the original note.

Final Comments

I hope you enjoy using the Oakley Sequencer

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 have a comment about this user guide, or have a 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 the great people on the Synth-diy and Analogue Heaven mailing lists and those at Muffwiggler.com.

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