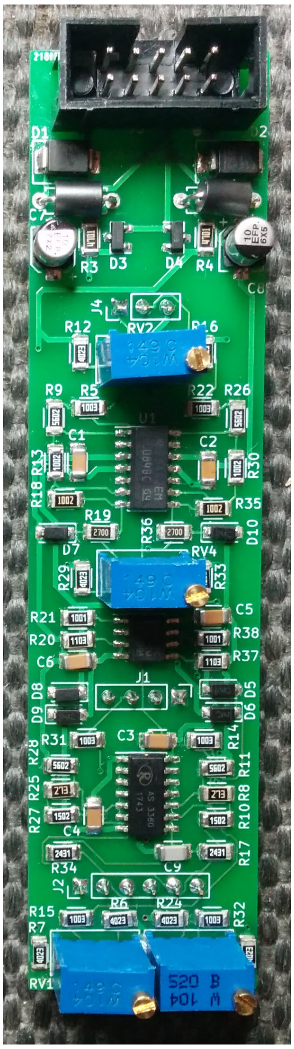
Magwitch Modular
Dual AS3360 VCA

Eurorack Module

Build Guide



Specification

Width	6 HP
Depth	35 mm
Power 12V	+19 mA, -19 mA*
Power 5V	0 mA
Channels	2
Inputs per channel	1 CV, 1 Signal
Outputs per channel	1
Channel modes	Linear or Exponential response via switch
Input Signal	-5V to +5V
CV Signal	0V to 5V

* If you supply a negative CV, this can increase the negative current draw up to -40 mA when -5V is present on both channels. To eliminate this extra draw, don't include diodes D7 and D10. That will mean -ve CV will appear on the AS3360's control inputs, but that hasn't been a problem to date.

Components

Suggested Suppliers

- uk.farnell.com
- www.mouser.com
- www.bitsbox.co.uk – for toggle switches
- www.thonk.co.uk – for AS3360 and jack sockets
- www.ericasynths.lv/shop/diy/diy-accessories – for AS3360
- www.toby.co.uk – for pin headers & shrouded sockets (J1 to J5 on main PCB)

Component Notes

Except where noted in the BOMs below, the following apply:

- Resistors are 1% thick film 1206 surface mount.
- Capacitors are ceramic 1206 surface mount, at least 16V.
- Electrolytic capacitors are 25V, 4mm diameter radial can, e.g. Panasonic EEEFP1E100AR.
- Trimmers are multiturn Bourns 3296W style package. Many alternatives are available.

Other variants of the given op-amps and voltage regulators will likely work. Googling the supplied part numbers should produce results with more information and links to suppliers.

- There are many alternatives available for the suggested pin headers, sockets and power header items.

Main PCB Bill of Materials

Note that J3, R1 or R2 are not present on the board, BOM or schematic.

Parts	Description	Quantity	Package	Recommended
C1-6	100nF Capacitor	6	1206	
C7, C8	10uF Electrolytic Capacitor, 25V	2	Radial can, 4mm diameter	
C9	4.7nF Capacitor	1	1206	
D1, D2	Schottky rectifier diode	2	SMB	STPS1L30U
D3, D4	10V reference	2	SOT-23	LM4040BIM3
D5-10	Schottky diode	6	SOD-123	BAT48ZFILM
J1	2.54mm socket, 4 x 1 row	1		309AE-04-SGN-1-040A3
J2	2.54mm socket, 6 x 1 row	1		309AE-06-SGN-1-040A3
J4	2.54mm socket, 3 x 1 row	1		309AE-03-SGN-1-040A3
J5	Shrouded power header	1		302-S-10-D1R1
L1, L2	Ferrite bead	2		BL01RN1A1F1J
R19, R36	270R resistor, 1%	2	1206	
R21, R38	1K resistor, 1%	2	1206	
R17, R34	2K43 resistor, 1%	2	1206	
R3, R4	4K7 resistor, 1%	2	1206	
R13, R18, R30, R35	10K resistor, 1%	4	1206	
R10, R27	15K resistor, 1%	2	1206	
R8, R25	27K resistor, 1%	2	1206	
R9, R11, R26, R28	56K resistor, 1%	4	1206	
R5, R14, R15, R22, R31, R32	100K resistor, 1%	6	1206	
R20, R37	110K resistor, 1%	2	1206	
R6, R7, R12, R16, R23, R24, R29, R33	402K resistor, 1%	8	1206	
RV1-4	100K multiturn trimmer	4		3296W
U1	TL084 op-amp	1	SOIC	TL084BCD
U2	AS3360 VCA	1	SOIC	AS3360D
U3	TL072 op-amp	1	SOIC	TL072BCD

Panel PCB Bill of Materials

Parts	Description	Quantity	Package	Recommended Part
J1	2.54mm pin header, 4 x 1 row	1		VMHS-1x16-120-065-030
J2	2.54mm pin header, 6 x 1 row	1		VMHS-1x16-120-065-030
J3	2.54mm pin header, 3 x 1 row	1		VMHS-1x16-120-065-030
J4-9	3.5mm mono switched jack socket	6		PJ398SM or PJ301M-12
SW1-2	SPDT miniature ON/ON toggle switch	2		TSM102A2 e.g. Bitsbox

Assembly

This module requires both surface mount and through-hole soldering. You can use various methods for the surface mount soldering, such as hand soldering, heat gun or the hotplate method. If you haven't attempted these before, it is highly recommended to study them and practice first.

- Hotplate method by Hobbytronics – this shows the basics
- Surface Mount Soldering – this shows the heat gun method, both with and without a stencil.

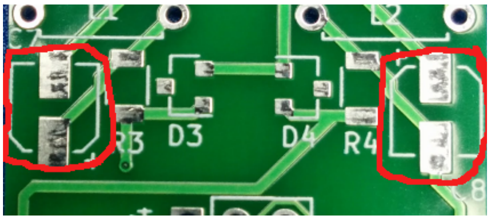
The steps to follow for this module using the hotplate method are as below. Start with the main PCB first, then the panel PCB.

Main PCB

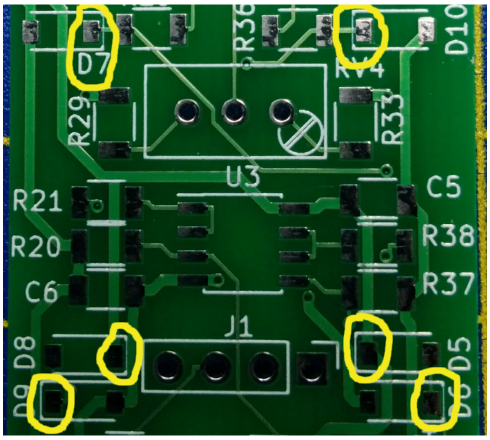
Add solder paste to all the SMD mounting pads on the main PCB, working from top to bottom, then consistently in one horizontal direction (depending left or right handed).

- For reference, the Eurorack power connector is at the top of the board.

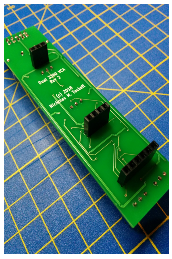
Place the SMD components onto the board using tweezers, seating them into the solder paste. It is recommended to work from top to bottom, then middle out.



- Orient the electrolytic cap bases with the outline on the PCB (highlighted in red, right).
- Orient all diodes correctly; the cathode is the closed end of any diode outline on the PCB, and should line up with the cathode marking on the diode itself, usually a line) (outlined in yellow on the right).
- Orient all the ICs properly; pin 1 on all ICs will be top left pad on the PCB. Any line marking pin 1 on an IC should be at the top when placed, and any sloped edge on the IC should be on the left.



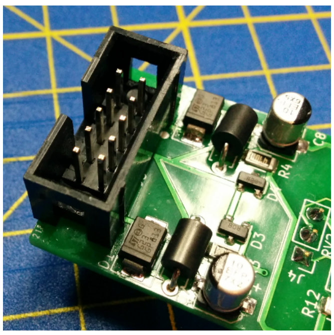
Start heating your hotplate and place the PCB on it. Watch carefully to see that all the solder joints go nice and shiny after a few minutes, then remove the PCB with great care from the hotplate, so as not to disturb the components. Allow to cool.

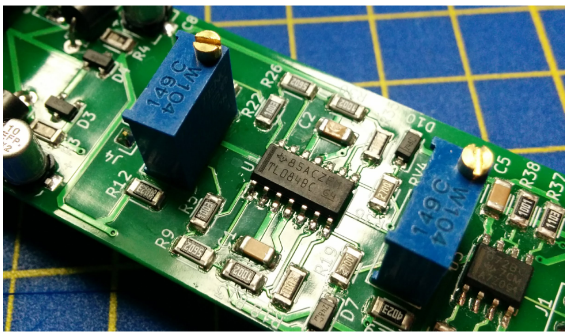


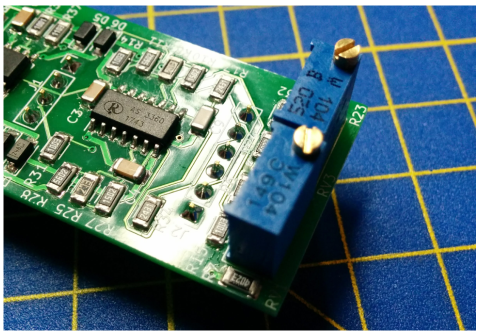
Solder the through-hole single row sockets onto the back of the board; it is suggested to use a dab of glue, sticky tape or other common adhesive to hold them in place and accurately aligned before soldering.

Solder the power connector, ferrite beads and trimmers onto the front of the board. Again, some sort of adhesive or tape is helpful to hold the components in place before soldering them.

- Place the slot in the shrouded power header at the top.
- Before soldering, adjust each trimmer so the resistance between the middle and outer pins is the same (i.e. roughly 50K ohms) , using a multimeter.
- Align the trimmers so their screws match the outlines on the PCBs.

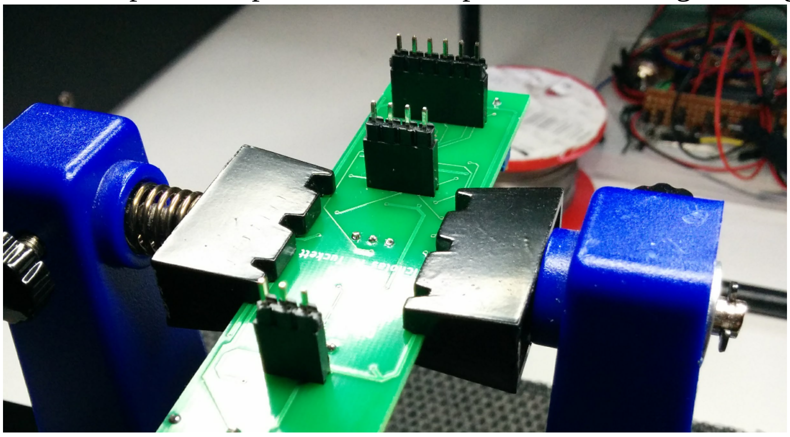


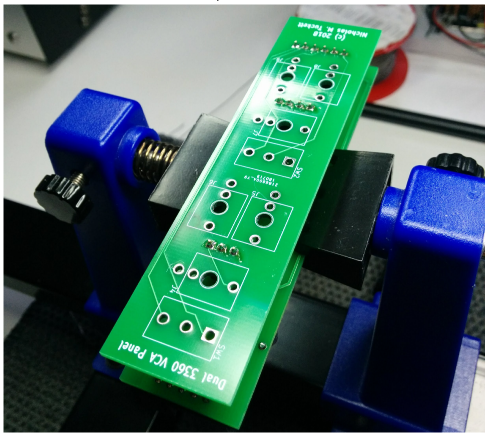




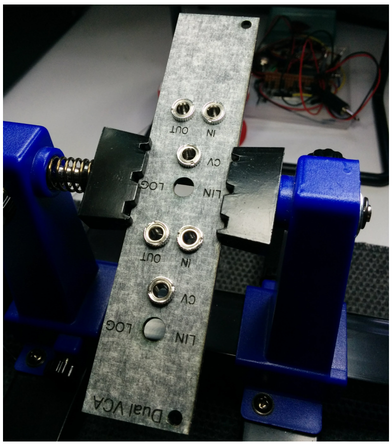
Panel PCB

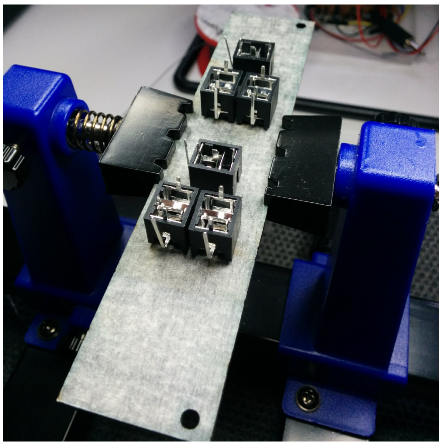
Place the main PCB upside down in a holding device, insert the three pin headers into the sockets and then place the panel PCB on top so the headers go through the relevant holes, and solder.

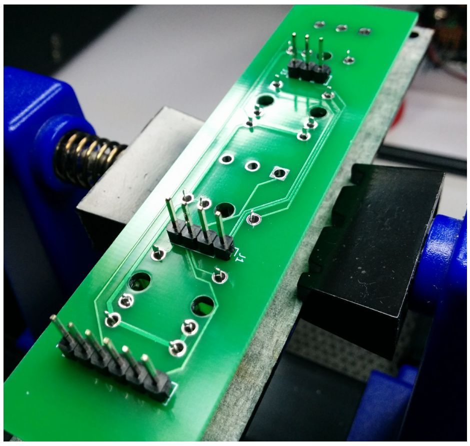




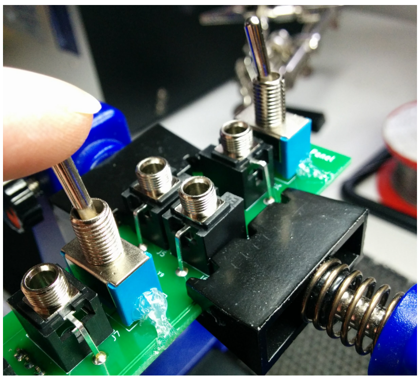
Screw in the jack sockets into the panel to be finger tight and aligned to match the PCB holes, and place it into a holding device upside down. Align the panel PCB with the jack sockets, fit it over and solder the sockets to the PCB.

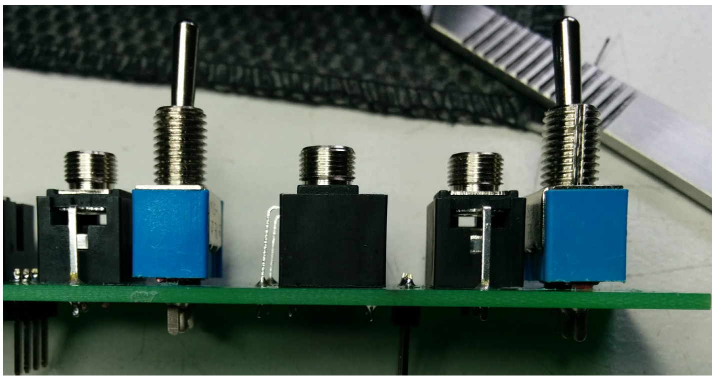




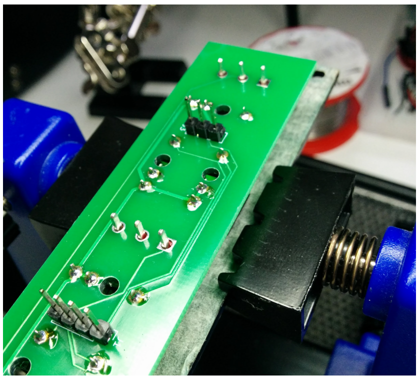


Place each toggle switch and secure with a dab of hot glue; the pins widen close to the switch body with some insulating material, so don't go all the way into the PCB. They should align with the top surfaces of the jack sockets; it is best to hold them in place completely straight and vertical while the glue sets.





Place the panel upside down into a holding device and mount the panel PCB on top so the switch pins come through, and solder them. Then remove any glue – e.g. for hot glue, warm it to soften first, then cut or scrape it away.



Final Assembly

1. Screw the panel onto the panel PCB components firmly.
2. Connect the main board to the back of the panel PCB.
3. It's ready to calibrate!

Calibration

The CV inputs should control the VCA from fully closed at 0V to fully open at 5V.

The following trimmer controls are available for calibration:

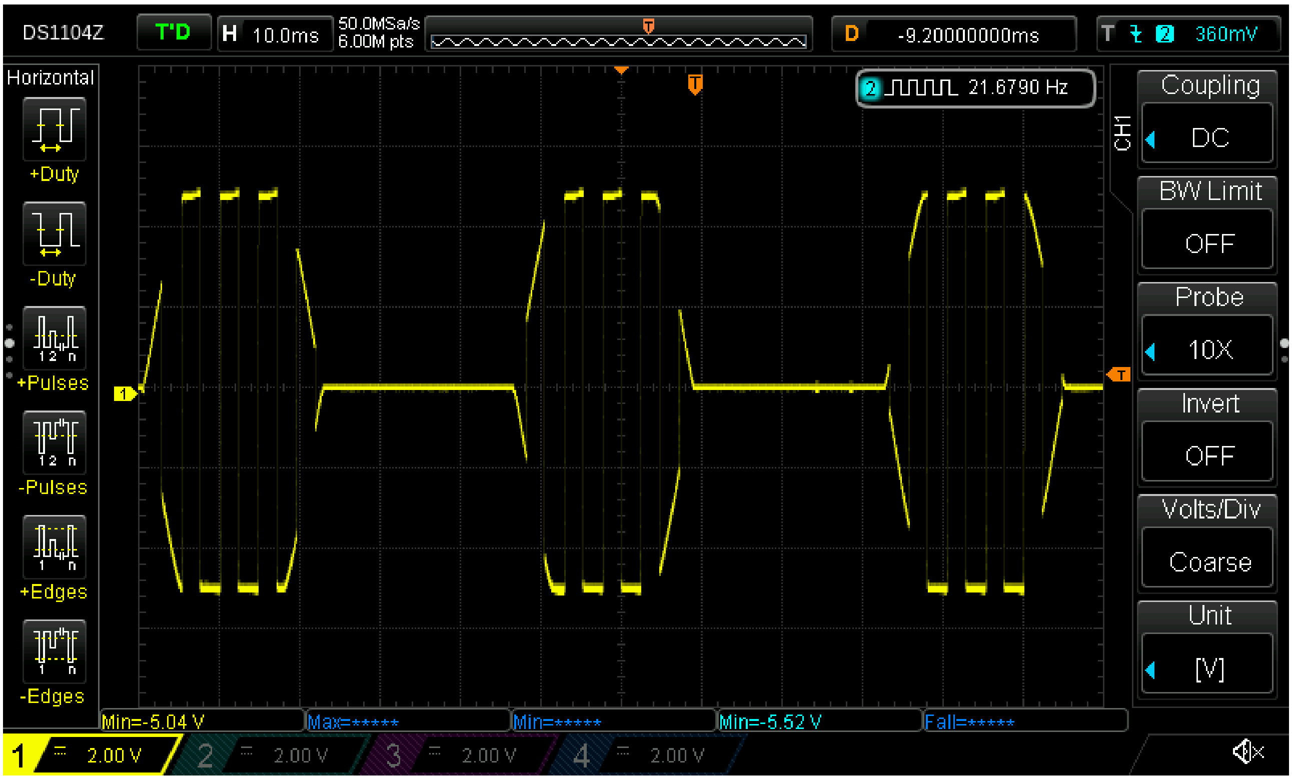
Channel	**Trimmer**	**Control**
1	RV1	Input signal offset
1	RV2	CV offset
2	RV3	Input signal offset
2	RV4	CV offset

When a trimmer is in the centre of the range, it has no effect. Turning the trimmer away from the centre of its range will have a positive or negative offset affect on the corresponding voltage.

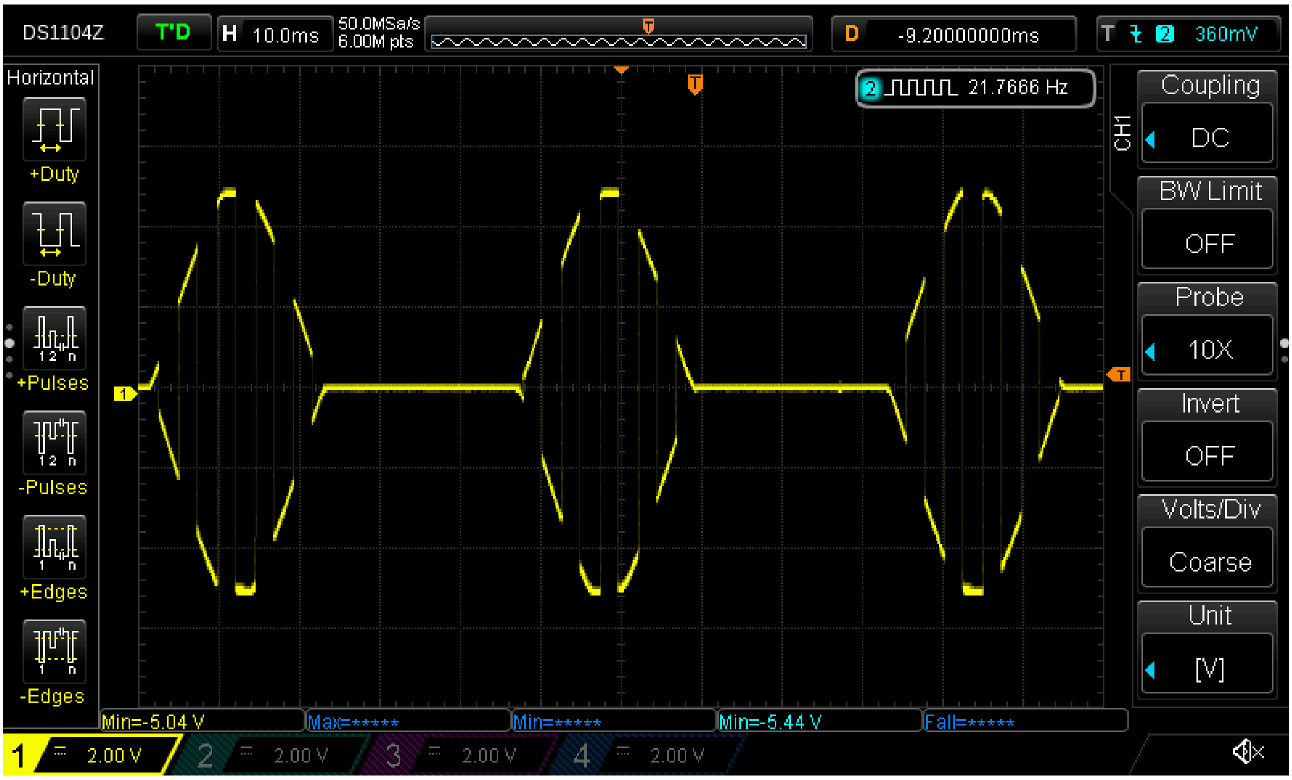
The easiest way to calibrate the VCA requires an oscilloscope, an oscillator and an LFO.

1. Power up all the modules
1. Set the oscillator to around 200Hz and ensure it outputs a 10V peak-to-peak square wave that is evenly centered around 0V.
2. Set the LFO to around 20Hz and ensure it outputs a 10V peak-to-peak triangle or trapezoid wave.
3. Set the VCA channel switch to linear response (LIN).
4. Connect the oscillator to the input of the VCA channel.
5. Connect the LFO to the CV input of that VCA channel.
6. Connect the output of the VCA channel to one oscilloscope channel. You can do this via a jack cable, or touch a probe to the top leg of the output jack socket
7. It is suggested to connect the LFO output as well to another oscilloscope channel, and use that channel to synchronise the scope for a more stable display.

You should see something like this as the output of the VCA for a trapezoid LFO CV waveform:



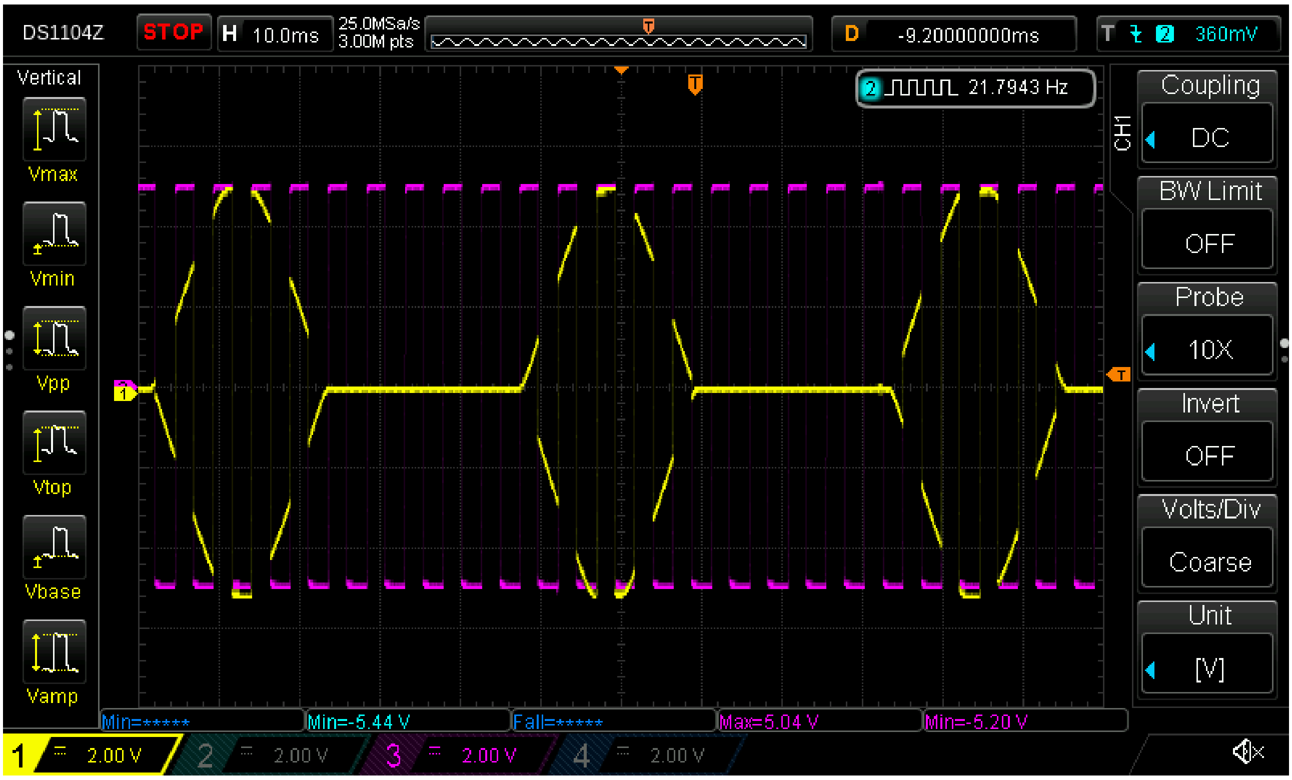
A triangle LFO wave would look like this:



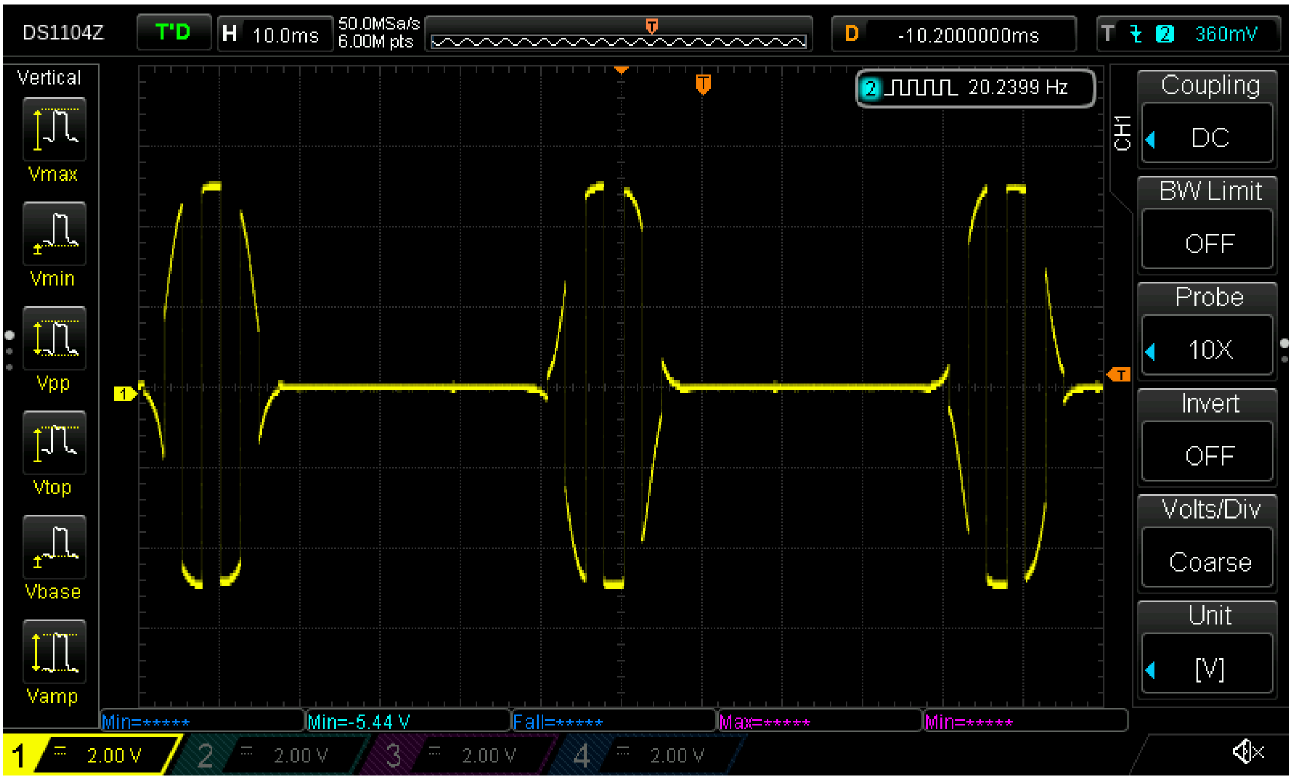
In both cases, you're seeing the VCO output being amplitude modulated by the LFO output. When the LFO signal goes negative, the VCA cuts off completely, giving rise to this 'stripey pulse' appearance.

The waveform should be symmetrical around the 0V line; if it is not, adjust the **input offset trimmer** for this to ensure it is. This also depends on whether your VCO output is symmetrical; if you're not sure about that, best to check it also with your oscilloscope. You could overlay the VCO output on the VCA output via another oscilloscope channel, and adjust the input offset trimmer so the VCO and VCA peaks and troughs align.

Here's a shot of an oscilloscope showing the VCO signal in magenta and the VCA signal in yellow. Some slight adjustment needed to the offset here when comparing the peaks and troughs of the two:



Next, switch the channel to logarithmic response (the switch position labelled LOG). You should see the edges of the pulses change shape to follow a logarithmic curve, like this:



Toggle the switch between the linear and logarithmic response, and check that the VCA output amplitude of both modes is the same. If not, adjust the **CV offset trimmer** for the channel until they do match. This trimmer will affect the amplitude of both linear and logarithmic responses, so you will need to switch back and forth between the two to get a nice match. You may also find you need to tweak the input offset adjustment afterwards in case the signal has become not quite symmetrical.

Repeat this calibration for the other channel, and your dual AS3360 VCA is now set up!