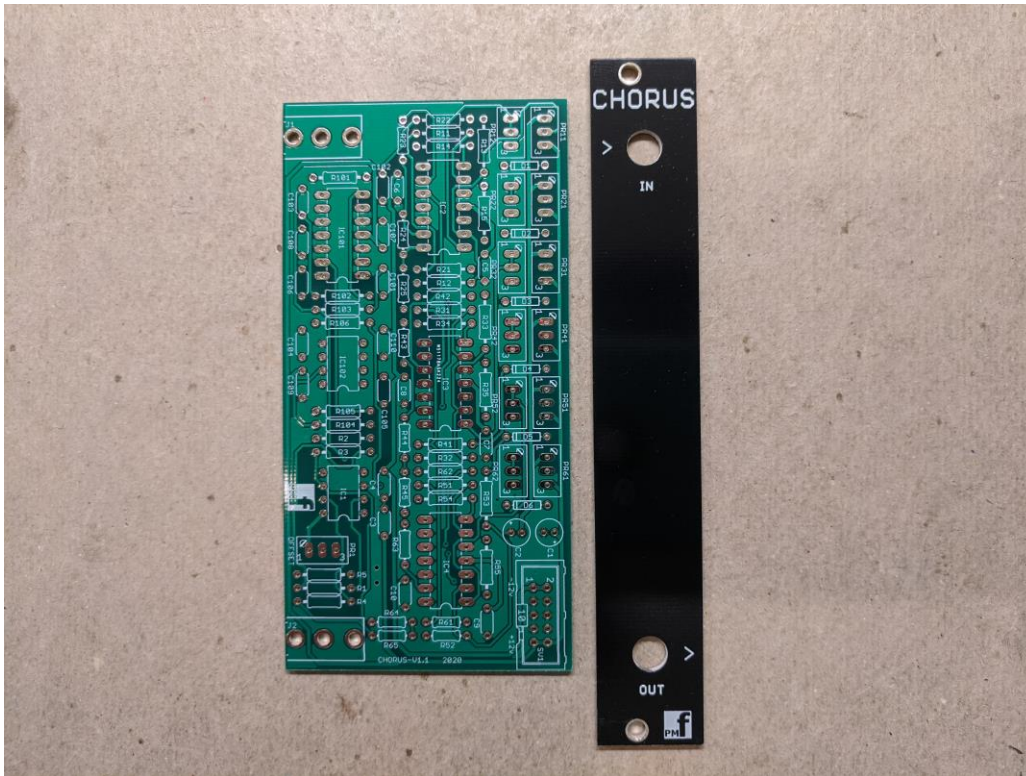


# Chorus v1.1 – Assembly Guide

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Thank you for purchasing this module! This is an easy build but with tightly packed components and some precision integrated circuits. Some of the pads are quite small and you will need a chisel tip or screwdriver tip soldering iron and the skill to solder these tiny joints.



The module is designed and sized for **Euro rack** systems. You will need a 16-10 pin euro rack power ribbon connector with  $-12/0/+12$  which is connected to a synth power supply.

Follow the parts lists, these instructions and the PCB silkscreen text to build the module.

The module consists of 1 PCB board and a front panel.

There are components installed on BOTH sides of the boards. Please ensure that you place the components on the correct side. When referring to the TOP of a board we mean the side with the **pmF** logo. The BOTTOM has no logo.

## Constructing the board

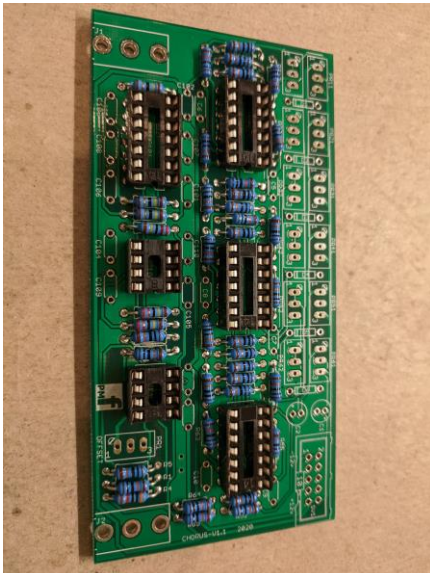
### 1. Resistors

Install the flat resistors on the TOP of the board. Solder and clip the leads.



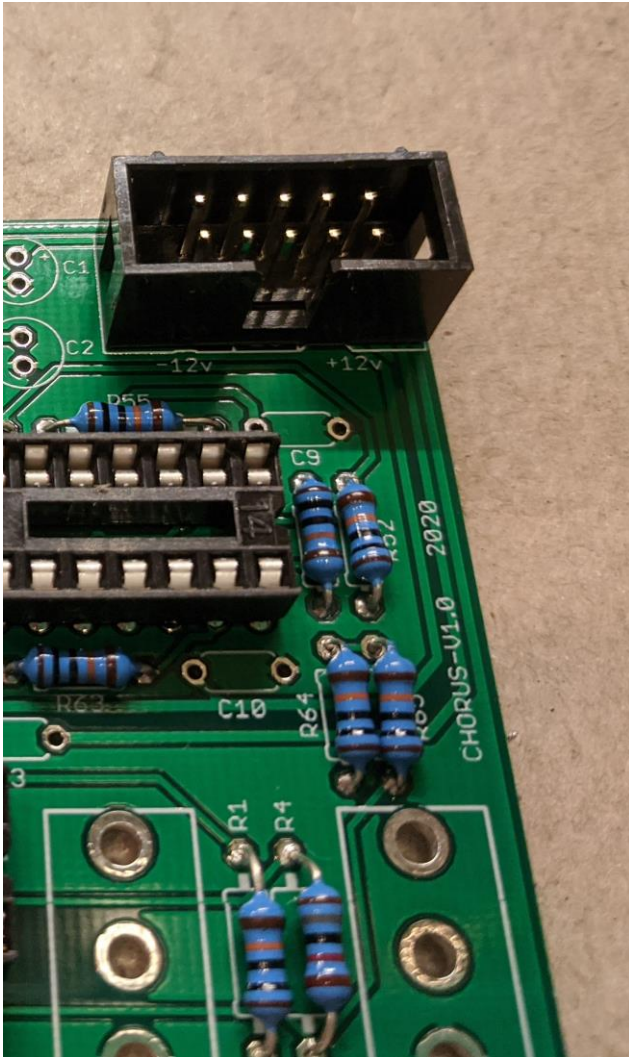
### 2. IC Sockets

Install the sockets on the TOP of the board. Observe the notch or mark on the sockets and align with the notch or mark on the board. Solder.

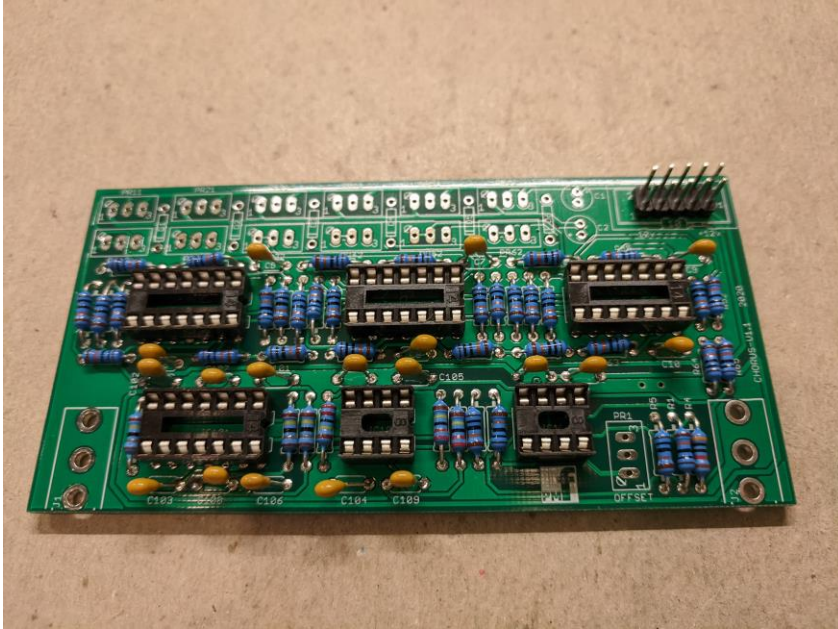


### 3. Power socket

Install the 10 pin power socket on the TOP of the board. The opening in the socket should face the front of the board as shown in the photo. Solder.

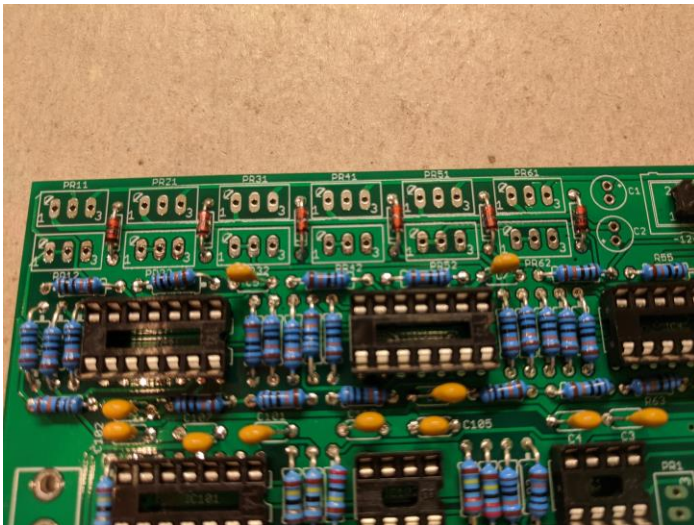


4. Ceramic/film/polypropylene capacitors  
Install the ceramic/film capacitors on the TOP of the board. Solder and clip the leads.



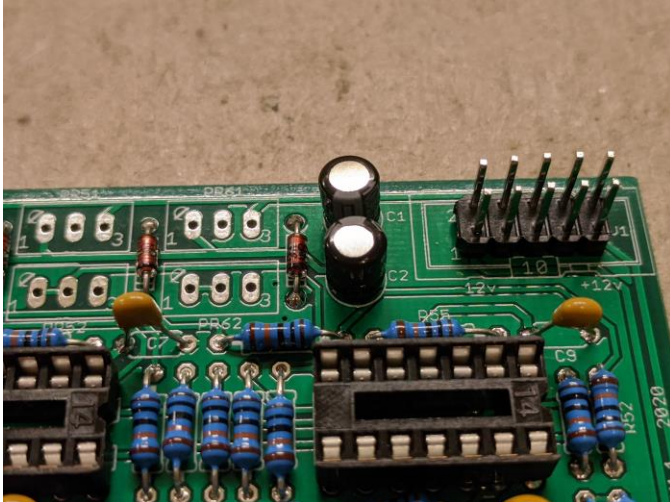
5. Diodes

Install the diodes on the TOP of the board. These are polarized components. Align the stripe on the diode with the stripe marked on the board. Solder and clip the leads.



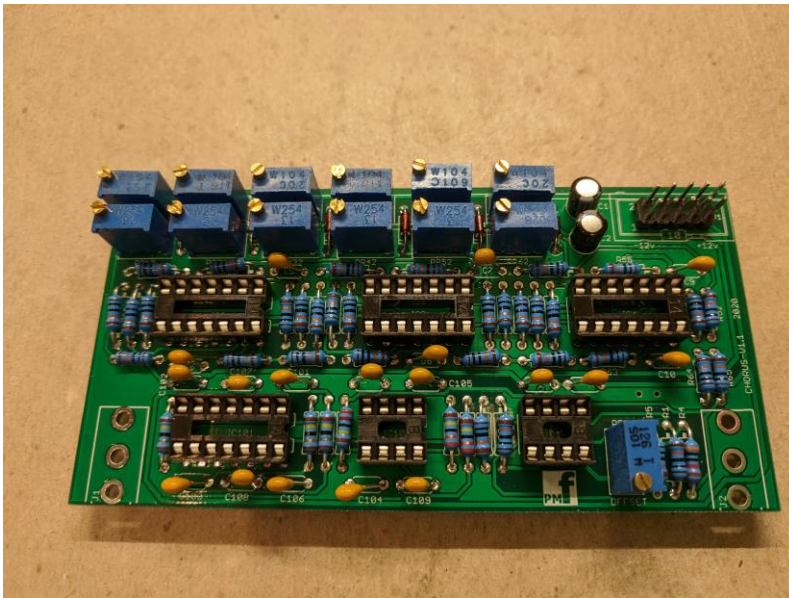
6. Electrolytic capacitors

Install these on the TOP. Make sure you orient these capacitors correctly. The longer lead and/or the lead marked with a + needs to be inserted into the hole that has the "+" marking near it. Leads marked with "-" go in the board hole WITHOUT the "+". Solder and clip the leads.



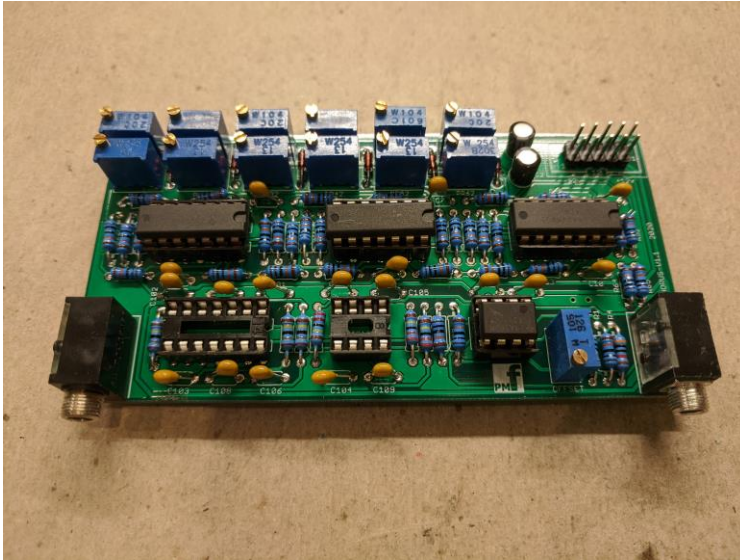
7. Trimmer resistors

Now populate the trimmer pots on the PCB. Make sure they are oriented so that the screw is above the circle on the silk screen. Do not mix the three values.



8. 3.5mm Jack Sockets

Install jacks on the top. Fully solder each one as it is installed. Please ensure they are on the CORRECT SIDE OF THE BOARD.



9. Alignment
  1. Place the front panel over the board so that the 3.5mm jacks align with the holes in the panel.
  2. Put nuts on the jacks and FULLY TIGHTEN all of them. Do not overtighten!
10. Do not install the ICs until the voltage tests are complete.
11. If you do not trust all your soldering and connections, carry out the voltage tests below before installing the ICs

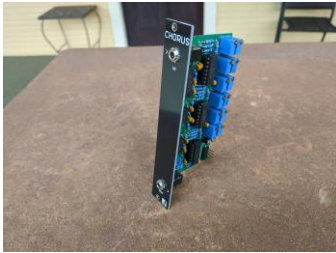
## Voltage tests

1. You do not have to do these tests if you are completely happy with your soldering and are sure there are no bridges or incorrectly placed components. However, these tests will ensure that the correct power supplies are sent to the IC pins to ensure they will not be damaged on power up.
2. Plug in the power supply and connect the -VE probe of a multimeter (set to the 20V DC range) to one of the GROUND pins of the jacks. The GROUND pin is nearest to the edge of the board.
3. Check the voltage at the following points on the board:
  - a. At IC1 pin 8 approx = +12V
  - b. At IC1 pin 4 approx = -12V
  - c. At IC1 pin 3, 5= 0V
  - d. At IC2 pin 11 approx = -12V
  - e. At IC2 pin 4 = +12V
  - f. At IC2 pin 5, 12 = 0V

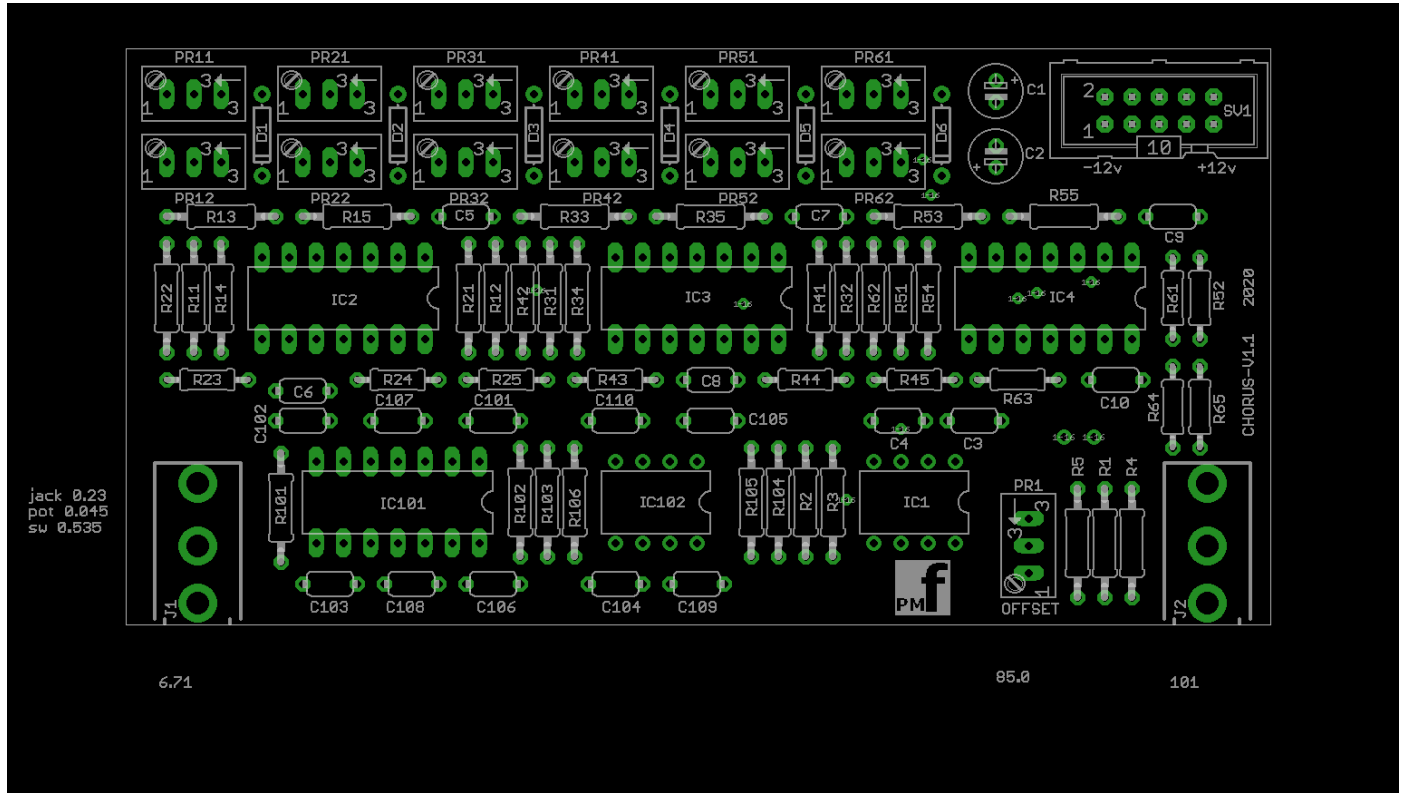
- g. At IC3 pin 11 approx = -12V
  - h. At IC3 pin 4 = +12V
  - i. At IC3 pin 5, 12 = 0V
  - j. At IC4 pin 11 approx = -12V
  - k. At IC4 pin 4 = +12V
  - l. At IC4 pin 5, 12 = 0V
  - m. At IC101 pin 11 approx = -12V
  - n. At IC101 pin 4 = +12V
  - o. At IC101 pin 3, 5, 10, 12 = 0V
  - p. At IC102 pin 4 approx = -12V
  - q. At IC102 pin 8 = +12V
  - r. At IC102 pin 3, 5 = 0V
4. If any of these tests fail to match the readings given, you should check the components and soldering before progressing and/or check with us for further analysis.

## Final Assembly

1. Place the following ICs in place by aligning the notch with the notch graphic on the PCB Silk Screen and notch on the sockets: IC1, 2, 3, 4. **DO NOT install IC101 and 102 at this time.**



# PCB Layout

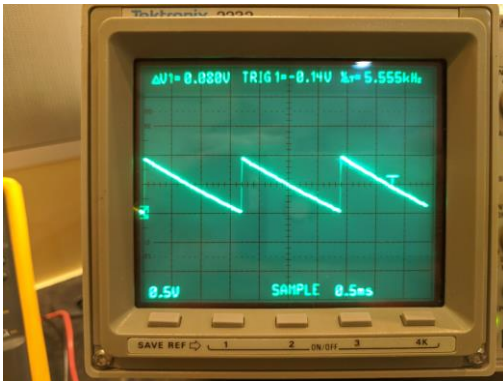




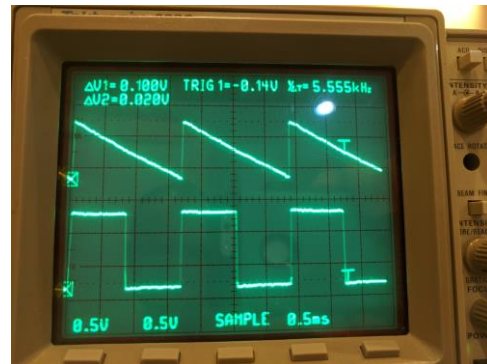
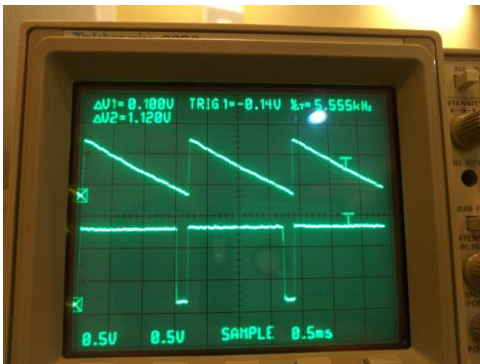
## Calibrating the Chorus

### Calibration Phase 1

1. The chorus module requires an input saw or ramp waveform of +5/-5V. An attenuated signal will not operate the comparators correctly and a higher signal will distort the waveform copies. If you have multiple VCOs that you would like to use with the Chorus you may prefer to calibrate for each one and set the trimmers to be a good compromise. The best results will be achieved by calibrating the Chorus to a dedicated VCO.



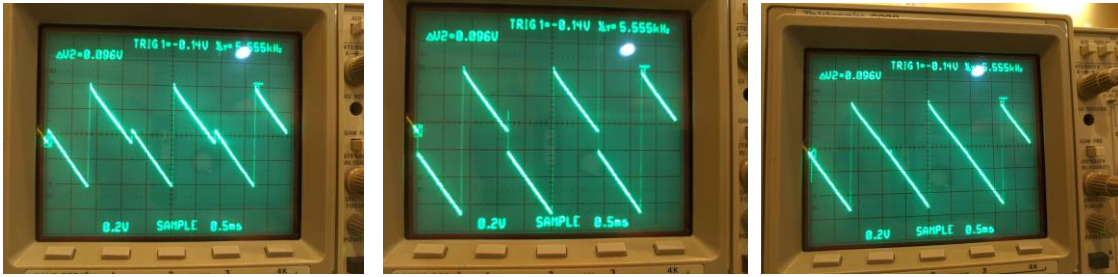
2. **DO NOT** install IC101 and 102 at this time.
3. Input a +/-5V saw/ramp wave of about 500Hz into the input jack.
4. Monitor diode D1 anode (non-stripe) pin on the oscilloscope. Adjust trimmer PR11 until there is an approximate square wave (50% duty cycle). You may get a flat line. If so, keep turning each way until a pulse wave forms and finely adjust from there.



5. Repeat for D2/PR21, D3/PR31, D4/PR41, D5/PR51, D6/PR61 until all six square waves have been calibrated.
6. Now continue with phase 2....

### Calibration Phase 2

1. Monitor IC2 pin7. You should see a copy of the input saw wave. Zoom in on the 'scope to the center of one cycle. Adjust PR12 to remove the 'glitch' so that it is smooth from top to bottom.

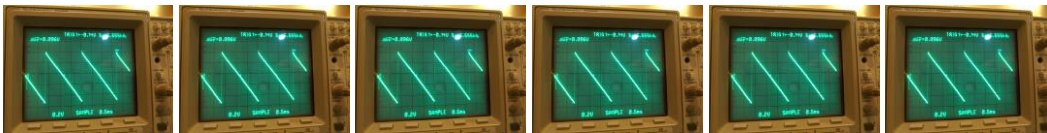


No

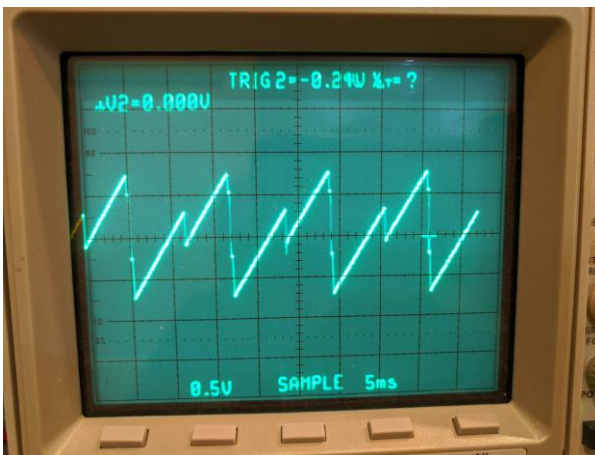
No

Yes!

- Repeat for IC2:14/PR22, IC3:7/PR32, IC3:14/PR42, IC4:7/PR52, IC4:14/PR62 until there are six perfect saw waves.



- Monitor the output from the output jack. There should be a double saw with an additional peak at half way through each cycle.



- Adjust the Offset trimmer PR1 until the output is centered about 0V.
- Now continue with phase 3....

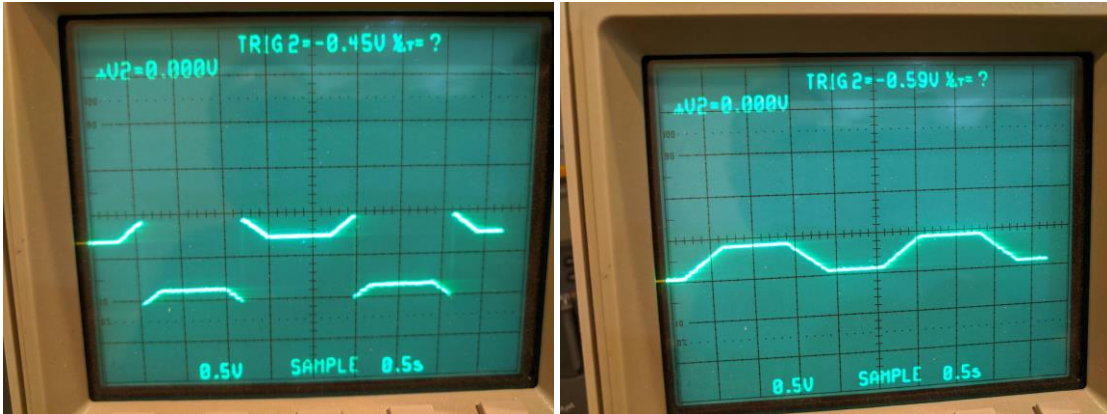
### Calibration Phase 3

- Install IC101 and 102
- Set the scope horizontal to 0.5s/division (NOT 0.5ms).
- Plug in a patch cord to the input jack and ground the other end of the patch cord. There should be no signal going in and the cord should not be left floating.
- If possible, also monitor the audio output from the output jack. You may here clicks as the comparators switch on and off.

- Observe each pin 7 and 14 of IC1, 2, 3, 4 on the oscilloscope. Each should be a trapezoidal wave of about 0.5Hz. If the waveform is broken, splitting the trapezoid, adjust the corresponding PR1x trimmer until the wave form smoothes out.

The correct trimmer to adjust is as follows:

IC2:7/PR11, IC2:14/PR21, IC3:7/PR31, IC3:14/PR41, IC4:7/PR51, IC4:14/PR61



- At this point the audio output should be silent with no clicks.

