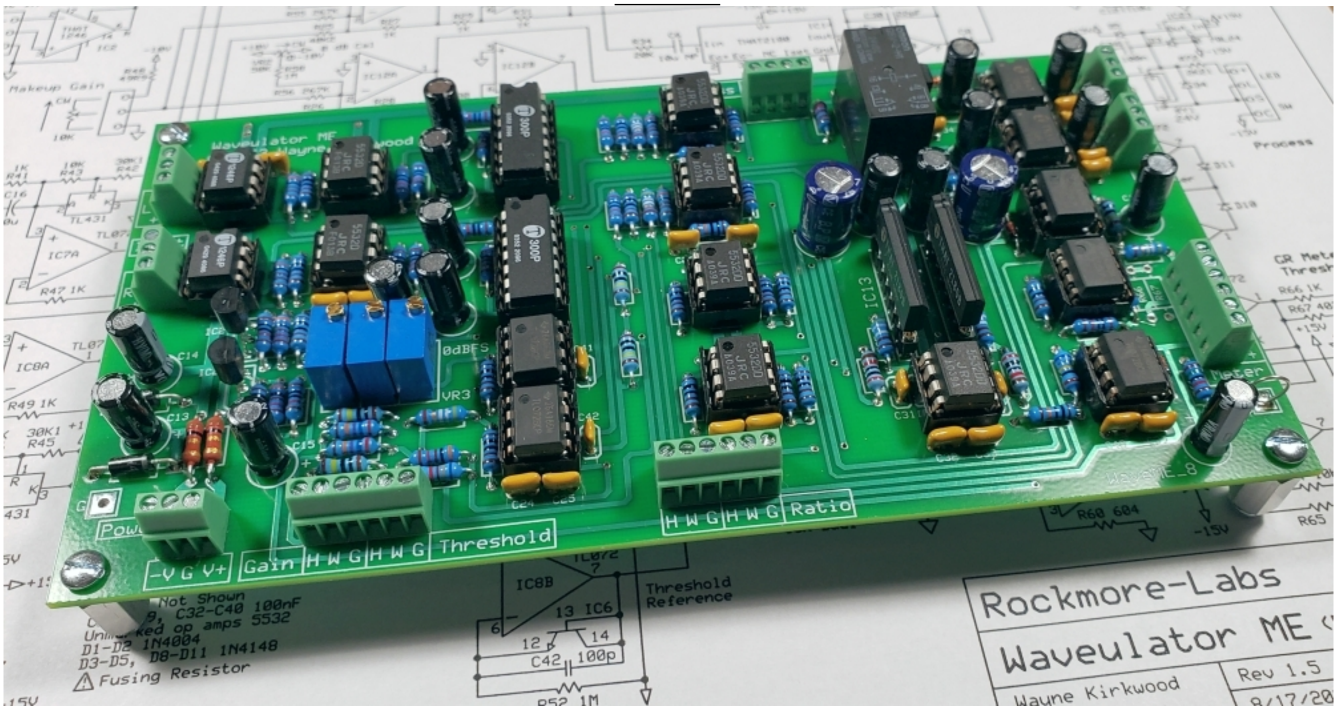
Assembly Instructions for the KA Electronics Waveulator ME Mastering Edition

6.9.25



Waveulator ME Mastering Edition PC Board

Install IC sockets

Place the PC Board on the work bench silkscreen side face up.

Place **(16) 8** pin IC sockets into their respective locations at IC1-IC4, IC7-IC12 and IC15-IC20. Observe orientation of the notch. Make sure that you do not place the sockets in the bypass capacitor holes.

Place **(2) 14** pin IC sockets into IC5 and IC6. Observe orientation of the notch.

Tip: Lift the board up and place a similar-sized piece of cardboard on top of the board to form a "sandwich" of PC board, sockets and cardboard. The cardboard is used to hold the sockets in place so the board can be turned over without the sockets dropping out. Using both hands flip the "sandwich" formed by the board, sockets and cardboard over and slide it back onto the work bench.

Tack solder only two of the corner socket pins. Put downward pressure on the PC board to make certain the sockets are seated on the board as you solder. If they're not seated reheat the corner pins as you push the socket flush to the board.

Once all the IC sockets are tack soldered, flip the board over.

Make certain that each socket is correctly oriented, fully seated on the board and square.

If you're satisfied with the placement of the sockets, solder all of the remaining pins. Do not overfill the connection with solder because it can run underneath the socket and form a short between pins.

Visually check each pin's connection particularly those to the ground plane. Reheat any pins if needed. Do not trim the IC socket leads.

Install **(2) 8 pin SIP** sockets at IC13 and IC14. The SIP sockets have a different height than the rest and will need to be held in place by hand when soldering. Make certain than the SIP sockets are vertical and flush with the board.

Install **(1)** “8 pin” **relay socket** at RY1. (The relay socket is a 16 pin frame with only 8 pins installed.)

Install resistors

Install **(5)** 3K01Ω 1% resistors at R1, R2, R15, R16 and R64.

Install **(18)** 1KΩ 1% resistors at R3, R4, R17, R18, R23, R24, R27-R32, R41, R44, R47, R49, R63 and R65.

Install **(12)** 10KΩ 1% resistors at R5-R14, R43, and R46.

Install **(5)** 49R9Ω 1% resistors at R19, R20, R48, R50 and R68.

Install **(5)** 100KΩ 1% resistors at R21, R22, R39, R40 and R59.

Install **(2)** 40K2Ω 1% resistors at R25 and R26.

Install **(4)** 20KΩ 1% resistors at R33, R34, R37 and R38.

Install **(2)** 4K99Ω 1% resistors at R35 and R36.

Install **(3)** 30K1Ω 1% resistors at R42, R45 and R54.

Install **(5)** 1MΩ 1% resistors at R51, R52, R57, R58 and R62.

Install **(1)** 68K1Ω 1% resistor at R53.

Install **(2)** 267KΩ 1% resistors at R55 and R56.

Install **(1)** 604Ω 1% resistor at R60.

Install **(1)** 15KΩ 1% resistor at R61.

R66 and R67 are for the gain reduction meter current outputs. Their values depend on the internal resistance of the meter being used and will be calculated and installed in a later step. The Mouser Project Manager BOM includes values for common 200Ω meters.

R69 is not used.

Install **(2)** 1Ω 1W metal film “fusible” resistors at R70 and R71.

Install **(1)** 2K21Ω 1% resistors at R72.

Install diodes

Install **(2)** 1N4004 diodes at D1 and D2. Observe polarity.

Install **(7)** 1N4148 diodes at D3-D5 and D8-D11. Observe polarity.

D6 and D7 are not used.

Install ceramic capacitors

Install **(19)** 100 nF (0.1uF) at C20-C29, C32-C40.

Install **(2)** 22 pF at C30 and C31.

Install **(2)** 100 pF at C41 and C42.

Install Phoenix connectors

When installing the Phoenix connectors make sure the openings for the wires point outward to the edge of the board. When installing the connectors, tack solder only one pin and reheat it to adjust the position of the connector so that it's square and flush with the board. Once you're satisfied with the orientation of the connector, solder the remaining pins.

Install **(5)** 3 pin Phoenix connectors.

Install **(1)** 4 pin Phoenix connectors.

Install **(3)** 6 pin Phoenix connectors.

Install electrolytic capacitors

Note: The + (positive) terminals for the electrolytic capacitors have a square pad. Where space permits there is also a "+" silkscreen marking. The longer capacitor lead is the positive lead.

Bipolar capacitors, which do not have a polarity, will also be installed in several locations. Make certain that you have the right type of capacitor before soldering it.

Install **(10)** 10uF 35V <u>bipolar</u> electrolytic capacitors at C1-C6, and C9-C12.

Install **(2)** 47uF 35V <u>bipolar</u> electrolytic capacitors at C7 and C8.

Install **(2)** 47uF 35V <u>polarized</u> electrolytic capacitors at C13 and C14. The polarity of these capacitors are critical.

Install **(3)** 10uF 35V <u>polarized</u> electrolytic capacitors at C15-C17. The polarity of these capacitors are critical.

Install **(1)** 2.2uF 35V <u>polarized</u> electrolytic capacitor at C18. The polarity of this capacitor is critical.

Install the relay and reference voltage regulators

Install **(1)** LM78L24 regulator at IC23. Note the orientation of the TO-92 package.

Install **(2)** TL431 shunt regulators at IC21 and IC22. Note the orientation of the TO-92 package.

Install the trim pots

Install **(3)** 50KΩ trim pots at VR1-VR3. The adjustment screw should be at the top.

Note: Do not install the ICs at this time.

Check all solder connections and reheat or re-flow them if necessary

When component leads are trimmed after soldering, the solder joint becomes fractured. It is always a good idea to reflow all solder connections after lead trimming while checking for bridges or pins which may have missed being soldered.

If you add solder during this step do so sparingly particularly under IC sockets. Solder can flow through the PC board vias to the underside of the IC socket and cause shorts between pins.

If you prefer to remove the solder flux residue from the PC board now is a very good time to do it.

When you're finished reflowing and cleaning the PC board, inspect every joint under magnification.

Initial Tests

It is recommended that the board be tested before installing it in a chassis. Doing so simplifies troubleshooting and, if necessary, rework.

The board should be tested on a power supply before installing the ICs.

Initial DC Tests

Connect a source of bipolar DC power.

If a variable power supply is used, slowly raise the voltage to about +/-15V.

There should be no significant current draw. A small amount of current, <10 mA, biases the TL431 shunt and 78L24 relay regulators. If excess current is drawn, check the board for solder bridges and correct polarity of D1 and D2 and all the electrolytic capacitors.

The following steps check the voltages at the IC sockets without the ICs installed.

Check the voltages between pins 7 (+) and pin 4 (-) of IC1 and IC2. They should read +30V.

Check the voltages between pins 8 (+) and pin 4 (-) of IC3, IC4, IC7-IC12, IC15, IC18-IC20. They should read +30V.

Check the voltages between pins 1 and 7 (both +) to ground on IC5 and IC6. They should read +15V.

Check the voltages at pin 7 (+) and pin 5 (-) of IC13 and IC14. They should be read about +30V. (Pin 5 has a 4K99 resistor in series with the pin.)

Check the voltages between pins 6 (+) and pin 5 (-) of IC16 and IC17. They should read +30V.

Check the voltage at the Process connector from the LED "+" terminal to the Switch common "-" terminal. It should read about +24V. (There is a 2K21Ω resistor in series with the "+" contact.)

Check the voltage at pin 3 of IC7 to ground. It should read -10V.

Check the voltage at the left-hand side of R59 to ground. It should read +10V.

Check the voltage at the right-hand side of R59 to ground. It should read +60 mV.

If any of the voltages are out of range look for solder bridges or an un-soldered pin or component lead.

If the reference voltages are out of range check R41-R46 to make sure they are the proper value and installed in the correct locations.

Remove power.

Install the ICs and Relay

Install **(2)** THAT1246 at IC1-IC2.

Install **(7)** NJM5532 at IC3, IC4, IC9, IC10, IC11, IC12 and IC15.

Install **(2)** THAT300 at IC5 and IC6.

Install **(5)** TL072 at IC7, IC8, IC18, IC19 and IC20.

Install **(2)** THAT2180 at IC13 and IC14. The 2180 will be a tight fit in the machined pin sockets. Insert it carefully using both hands using one hand to guide and maintain the IC vertical and one hand to push downward. Once the 2180 ICs are installed try not to unnecessarily remove them.

Install **(2)** THAT1646 at IC16 and IC17.

Install the 24V relay in its socket.

Install spacers

Install four 4-40 threaded hex spacers at the board mounting holes. Place the four fiber washers between the PC board and the hex spacer and secure using four 4-40 1/4" screws. Four additional screws are in the bill-of-materials for securing the PC board to the chassis.

Offset and Current Draw Tests

Reconnect power.

If a variable power supply is used slowly raise the voltage to about +/-15V.

Measure the voltages across R70 and R71 1Ω resistors. The voltages should typically be about 130-140 mV indicating a current draw around 130-140 mA.

Connect the wiper "W" terminals to the ground "G" terminal at the Gain, Threshold and Ratio Phoenix connectors.

Measure the DC voltages of the IC pins listed below. Unless specified no input or output should be pinned to a supply rail. Typical offsets will be +/- 15 mV or less. Voltages other than offset are specified.

IC1 and IC2 pin 6 check offset.
IC3 and IC4 pins 1 and 7 check offset.
IC5 and IC6 pins 2 and 6 should read about +0.52V.
IC7 pin 1 should read -10.0V.
IC8 pin 1 adjust VR3 for -1.25V.
IC7 and IC8 pin 7 should read about +0.52V.
IC9 and IC10 pin 1 should read less than +0.2V.
IC9 and IC10 pin 7 check offset.
IC11 pin 1 adjust VR1 for the offset to be less than 1 mV.
IC12 pin 1 adjust VR2 for the offset to be less than 1 mV.
IC11 and IC12 pin 7 check offset.
IC13 and IC14 pin 5 should read about -2.8V. Measure at the top end of R35 and R36.
IC15 pin 1 check offset.
IC15 pin 7 check offset.
IC16 and IC17 pin 1 check offset.
IC16 and IC17 pin 8 check offset.
IC18 pin 1 approximately -13V.
IC18 pin 7 less than +0.6V.
IC19 pin 1 and 7 check offset.
IC20 pin 1 and 7 approximately -13V.

Remove power.

Signal Tests

A signal generator capable of +8 dBu (2 VRMS) (or DAC output running tone) and level meter (or A/D inputs with metering) are required. The instrument connections may be balanced, un-balanced or a combination of both.

Test Configuration

Note: When making level measurements on THAT1646 outputs use a high impedance or "bridging" (approx. 10KΩ or greater) loading. A THAT1646 loaded in 600Ω will read approximately -0.7 dB less. If a 600Ω load is anticipated in final use, take this into account.

Unless specified all AC and DC measurements are made relative to ground.

In the previous tests the Gain, Threshold and Ratio Phoenix connectors had jumpers installed from "W" to "G."

Make sure the gain connector still has a jumper from "W" to "G."

Move the Threshold jumper so it links "H" and "W."

Make sure the Ratio jumpers still link "W" and "G" on both the left and right connectors.

Connect an LED to the Meter Phoenix connector at "L" and "+". The longer LED lead, the anode, connects to the "+" terminal.

Connect an LED to the Process Phoenix connector at "L" and "+". The longer LED lead, the anode, connects to the "+" terminal.

Connect a short length of wire to the Process connector at "-". The other end will be connected to the "S" terminal in a later step to act as a switch.

Apply power.

Check the Audio Path

Feed a +8 dBu (1.95 V RMS) 1 kHz tone into the Left and Right Inputs. The generator can be either balanced or unbalanced. If unbalanced, ground both the G and "-" inputs.

Measure the output level at the Left and Right Outputs. If a single-ended unbalanced instrument is used, ground the "-" output. The output levels for both channels should measure +8 dBu.

Connect a wire between the Process "S" and "-" connections to engage the relay. The Process LED should light.

Measure the output level at the Left and Right Outputs. Adjust VR1 so the left channel reads +8 dBu. Adjust VR2 so the right channel reads +8 dBu.

Check the Sidechain Path and Gain Reduction Metering

Feed a +8 dBu (1.95 V RMS) 1 kHz tone into the Left and Right Inputs.

Confirm that -1.25 VDC is measured at the Threshold "W" terminal. Make sure that **the Threshold jumper links terminals "H" and "W."**

The Threshold LED will either be lit or unlit. If unlit, adjust VR3 counterclockwise until it just lights and then adjust clockwise until it is just extinguished. If the LED is initially lit, reverse the direction of rotation and adjust until the LED is just extinguished.

Note: *The preceding adjustment calibrates the maximum clockwise rotation of the Threshold control to the converter's 0 dBFS reference level. In a later step VR3 will be adjusted to the A/D converter's actual 0 dBFS value.*

Note: *When the Threshold control is set at its' minimum, the LED will be continuously lit in the absence of input signal.*

Move the Ratio jumpers so they link "H" and "W" on both the left and right connectors.

Move the Threshold jumper so it links the "W" and "G" terminal.

Measure the output voltage at the Meter "V" terminal. It should read approximately +2.5 VDC indicating just over 10 dB of peak compression.

Check Peak Compression and Makeup Gain at the Outputs

Using the setup in the previous step measure the output peak compression.

An oscilloscope or editor can be used to visualize peak compression and it most can certainly be heard on tone. Note that the GR Meter indicates peak reduction and not the gain reduction measured on an RMS, average-responding or mechanical VU meter. As the peaks get squashed, the waveform gets "fatter" causing the RMS or average level to not decrease at the same rate as the peak reduction.

Make sure a wire is connected between the Process "S" and "-" connections to engage the relay. The Process LED should light.

With +8 dBu at the input and maximum Ratio, the output level should measure approximately 0 dBu with an RMS-responding instrument. An average-responding meter will read about 0.4 dB hotter.

Move the jumper link on the Gain Phoenix connector so it links terminals "H" and W."

Measure the output level on the Left and Right channels. They should measure approximately +11.5 dBu RMS.

Calibrating the Gain Reduction Meter

The Waveulator is designed to be used with a 1 mA analog meter or voltage input LED bargraph. An external SPDT switch selects a 5 or 10 dB gain reduction scale.

To use the Waveulator with a 1 mA meter the values R66 and R67 are determined by the meter's internal resistance. R66 sets the full scale deflection at 10 dB peak reduction; R67 sets the 5 dB full scale value. For 1mA = 10dB a total resistance of 1.2K is required. For 1mA = 5dB the total resistance is 600Ω.

The schematic shows values for a meter having a 200Ω internal resistance.

If the meter's internal resistance is not published it can be measured with an Ohmmeter.

1200Ω – Rmeter = R66. For a 200Ω meter R66=1KΩ
600Ω – Rmeter = R67. For a 200Ω meter R67=402Ω

Note that the meter has it's own ground connection on the Phoenix connector and it's recommended this connection be used for the meter "-" terminal.

A voltage input bargraph can be used. For the 5 dB scale use the "V" output with a meter FS value of 1.2V. To implement the 10 dB scale make R66 49.9Ω with a meter FS voltage of 1.2V.

Calibrate the Threshold 0 dBFS Setting

The following adjusts the Threshold maximum setting to the 0 dBFS point of the A/D converter to maximize the adjustment range of the control and provide a known calibration to 0 dBFS. The following assumes a +18 dBu 0 dBFS.

Feed a +18 dBu 1 kHz tone into the Left and Right Inputs.

Make sure that **the Threshold jumper links terminals "H" and "W."**

The Threshold LED will either be lit or unlit. If unlit, adjust VR3 counterclockwise until it just lights and then adjust clockwise until it is just extinguished. If the LED is initially lit, reverse the process and adjust until the LED is just extinguished.

The Threshold LED lights approximately 0.5 dB above threshold. For a more accurate 0 dBFS calibration perform an FFT, set the Threshold at maximum and increase VR3 upward until the third harmonic is about 70 dB below the fundamental level.

The Threshold control can be a stepped switch calibrated in -dBFS. With a 24 position stepped switch the rotation point can be adjusted in -0.5 dB steps over a 0 to -11.5 dB range. At full CCW rotation, with the wiper grounded, the Threshold is about -2 dBu and the full waveform is effectively processed.

This completes functional checkout of the Waveulator.

Detailed Parts List

A complete bill of materials is available from Mouser Electronics:

Waveulator ME PCB with THAT ICs:

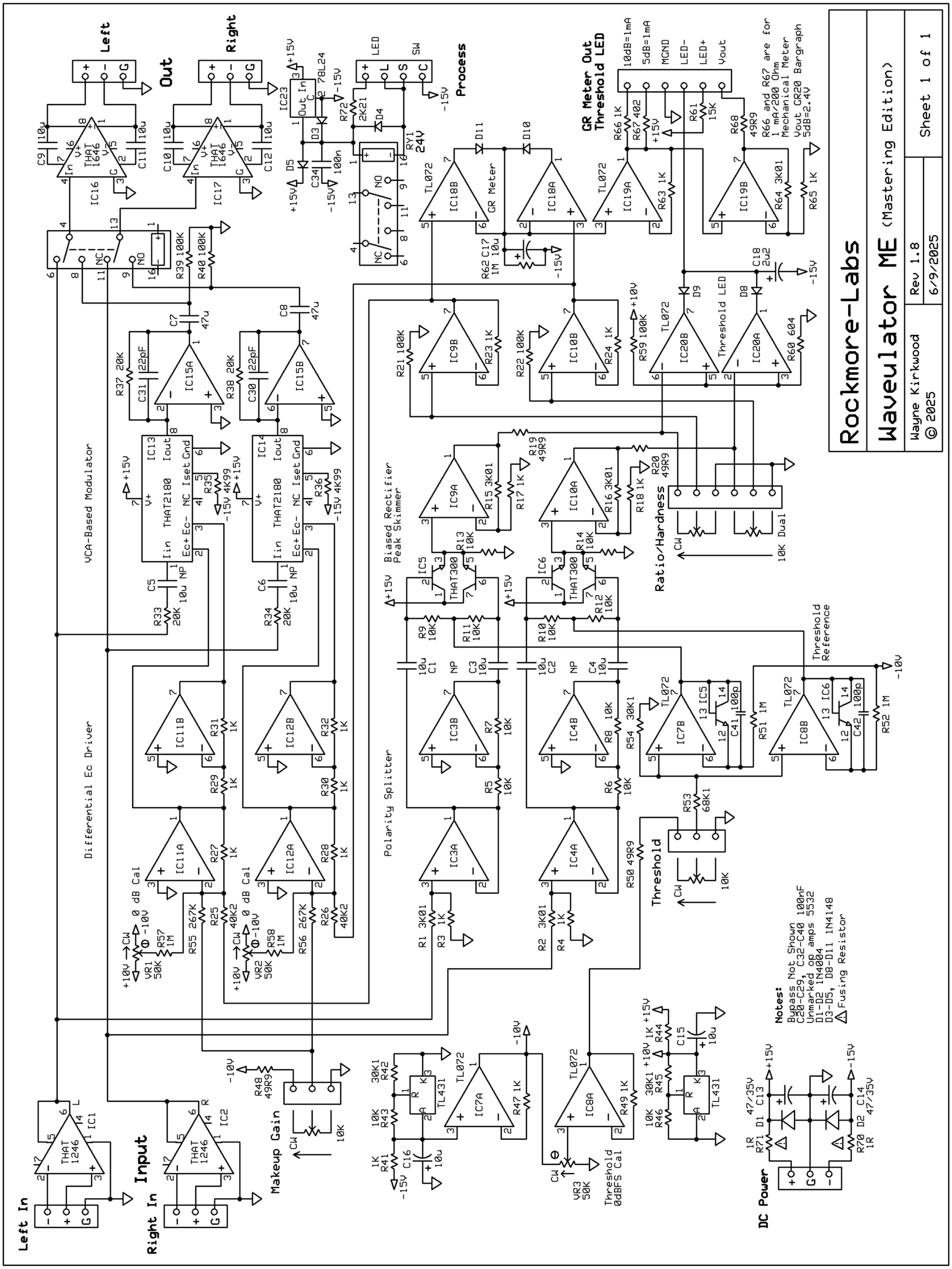
https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=f3d4856470

Other Resources

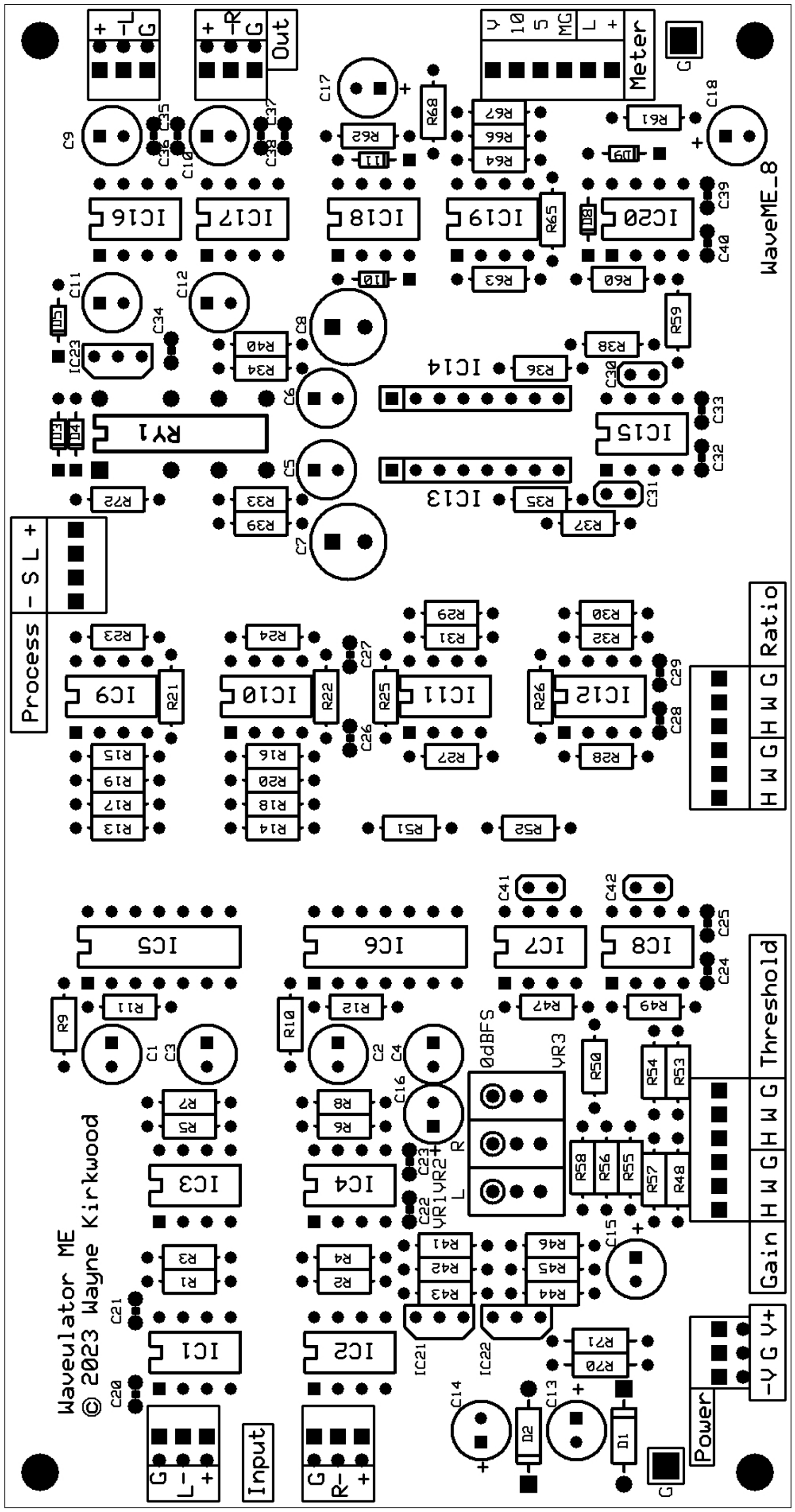
Pro Audio Design Forum Waveulator ME Build Thread:

https://proaudiodesignforum.com/forum/php/viewtopic.php?t=1331

For more information contact: sales@ka-electronics.com



Rockmore-Labs
Waveulator ME (Mastering Edition)
Wayne Kirkwood
© 2025
Rev 1.8
6/9/2025
Sheet 1 of 1
Notes:
Bypass Not Shown
C20-C29, C32-C40 100nF
Unmarked op amps 5532
D1-D2 1N4004
D3-D5, D8-D11 1N4148
Fusing Resistor
Input
Left In
Right In
Out
Left
Right
Process
DC Power
Makeup Gain
Threshold
Ratio/Hardness
GR Meter Out
Threshold LED
VCA-Based Modulator
Differential Ec Driver
Polarity Splitter
Biased Rectifier
Peak Skimmer
GR Meter
Threshold Reference
Threshold 0dBFS Cal
R66 and R67 are for
1 mA/200 Ohm
Mechanical Meter
Vout GR20 Bargraph
5dB=2.4V


Waveulator ME
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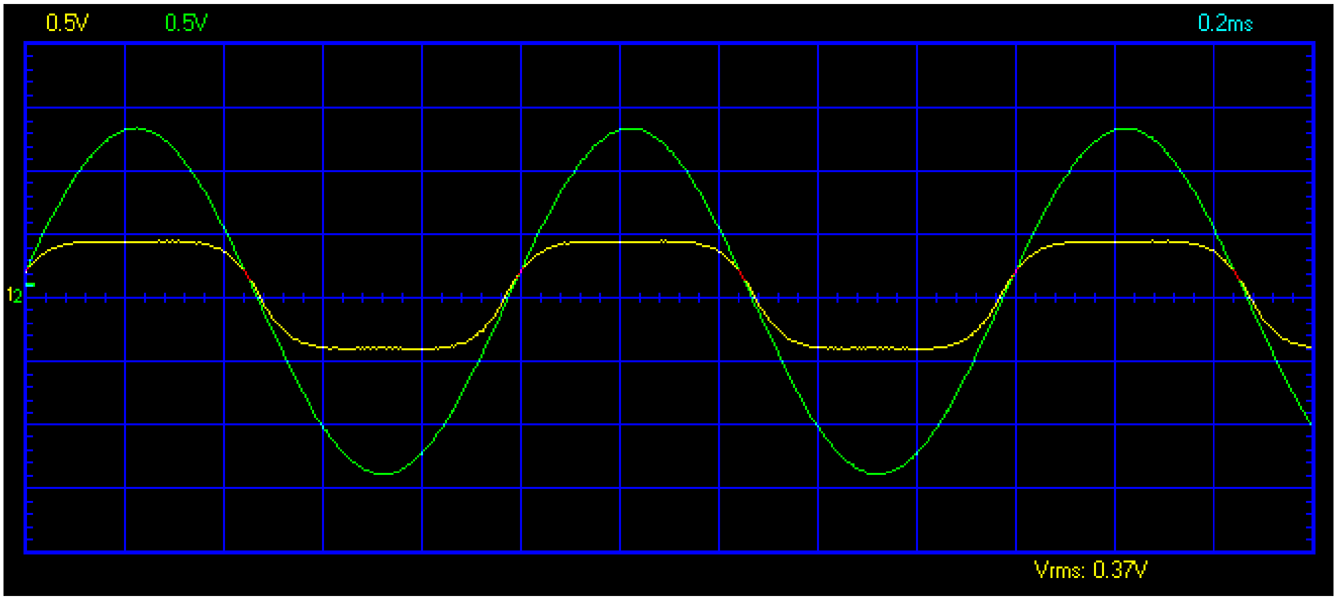
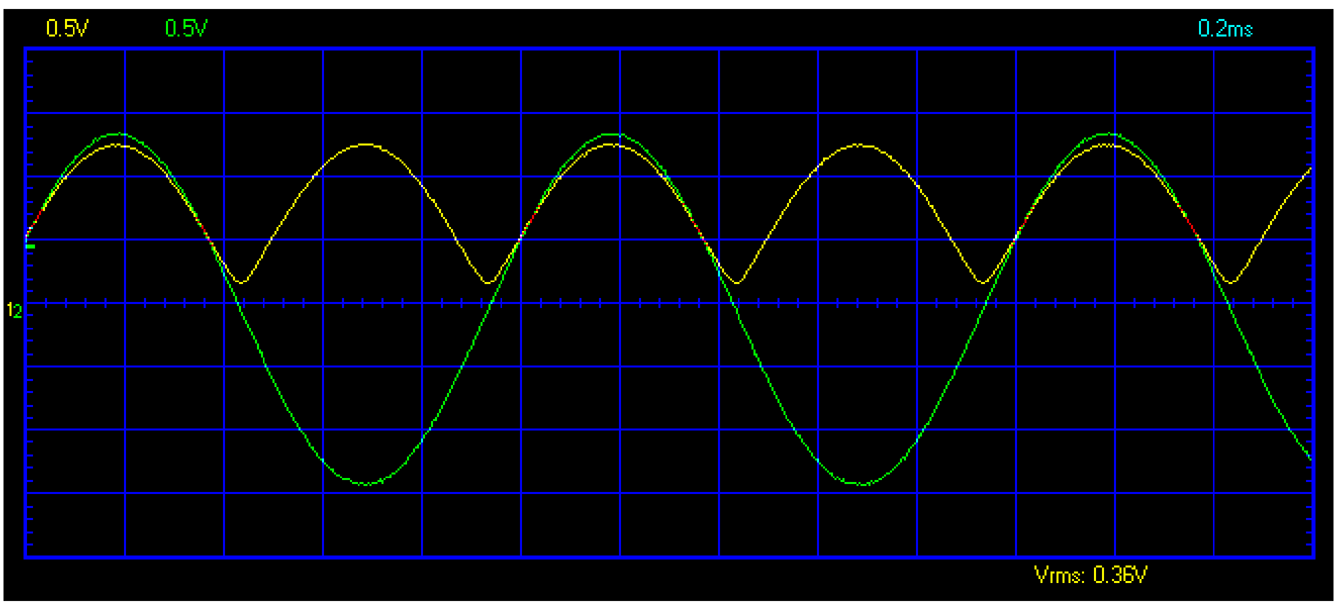
WaveME_8
Input
Out
Meter
Process
Ratio
Threshold
Gain
Power
0dBFS

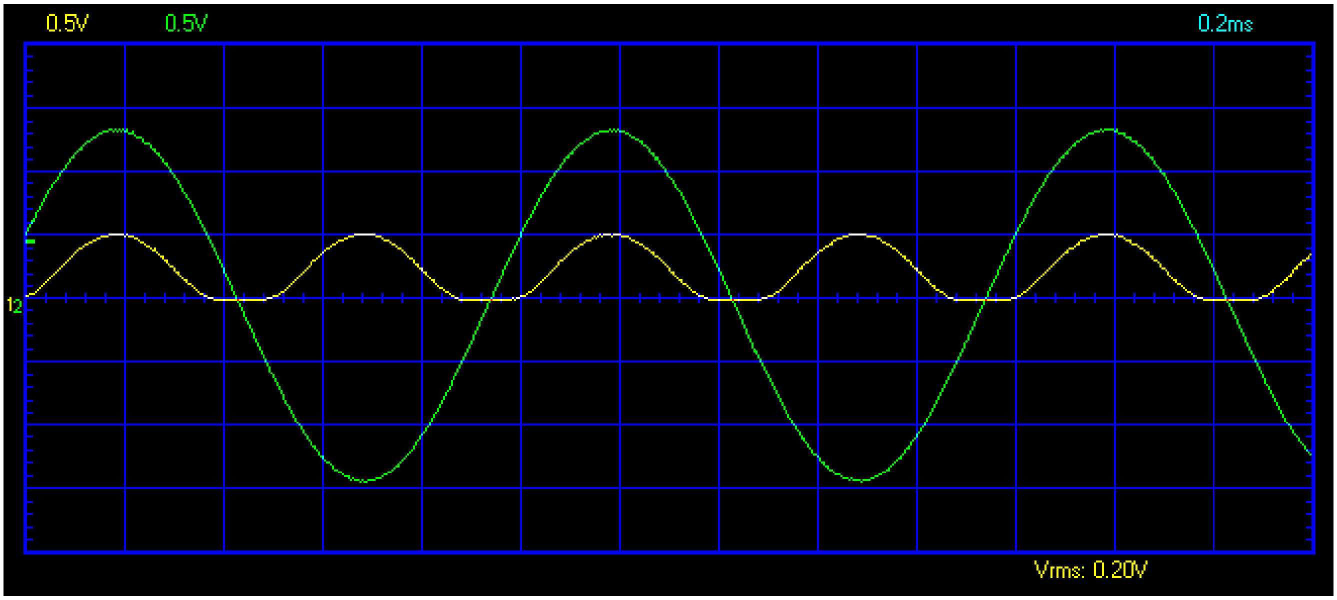
Oscillogram photos. Input and Ouput levels are 6 dB below actual.



Waveulator input versus output at +8 dBu in, Threshold minimum, Ratio maximum.



Input versus "H" Ratio Terminal. Threshold minimum.



Input versus "H" Ratio Terminal. Threshold -6dB below 0 dBFS.