

Specifications Using Standard Output Transformer

All measurements taken in ultra-linear mode with Global Negative Feedback ON. V1: 12AT7 V2: EL34, with RedRoo Kit Output Transformer. Supply Voltage 12.5VDC. HP8903B Audio Analyser used for all frequency response, distortion and power measurements.

Power Output @ 10% Distortion: 5 Watts RMS per channel into 4 or 8 Ohms with EL34 output valves in Ultra-Linear mode. Both channels driven.

Circuit Configuration:

Input stage - Twin-triode CCDA configuration using 12AT7. Alternative input valves include: 6DJ8/E88CC/and all 12A*7 series with minor component changes. PC Board links can convert heater connections for 6 volt heater valves such as 6DJ8/E88CC.

Output stage - Single-ended class-A with cathode bias. Uses EL34 in Ultra-Linear connection. Possible valves include: EL34/6CA7/6V6/KT77 and 6BQ5 with a conversion socket and minor component change. EL34 was found to give the highest output power at the HT voltage used.

DC heaters - Heaters connected in series to 12.5V DC input.

Mode selection - Ultra-Linear, Triode or Pentode by changing wiring configuration on screw terminals on PC board.

Feedback - Global negative feedback can be switched in or out using slide switch on rear panel. Ultra-linear mode: 6dB NFB. Triode mode: 4dB NFB.

Signal Inputs:

Three-position toggle switch selects between two sets of RCA wired inputs or optional Bluetooth wireless module. A 3.5mm jack socket on the rear panel automatically disconnects the second set of RCA connectors when jack plug is inserted.

Input sensitivity: Can be directly connected to any line-level audio source. Sensitivity depends on mode selection, input valves used, and negative feedback (GFB) ON/OFF selection. Ultra-linear mode with 12AT7 and GFB ON– 700 mV RMS / GFB OFF – 350 mV RMS,

Outputs:

Speaker Outputs – Switch selectable 4 or 8-Ohm speaker outputs.

Screw terminals accept banana plugs with Industry standard 0.75 inch terminal separation.

Headphone Outputs - 6.35mm jack socket on front panel for low impedance headphones.

Inserting headphone jack disconnects speakers.

DC Input:

12.5 V @ 5.5 Amps (70 Watts). Input voltage range 12.0 -13.2 VDC. Polarity protected by reverse diode and a fuse.

2.5mm concentric dc plug - centre positive. Can be powered from any nominal 12 VDC power supply including commonly available 12 VDC 10 Amp SMPS desk-top power supply.

Max. Power Output vs supply voltage:

Ultra-linear mode with 6dB GFB.@ 10% Dirstrtion

12.0V	4.5W
12.5V	5W
13.3V	5.6W
13.8V	6W (exceeds heater voltage ratings)

Total Harmonic Distortion vs Frequency @ 1Watt RMS:

Ultra-linear mode. 12.5V DC Input

Frequency	GFB ON	GFB OFF
100Hz	1.5%	3%
1kHz	1.3%	2.7%
10kHz	1.35%	3.1%

Intermodulation Distortion vs Power:

13kHz + 14kHz two-tone test - Ultra-linear mode with 6dB GFB ON.

Output Power (RMS)	IMD Distortion % (to nearest 0.5%)
0.1W	0.5
1W	1
4.5W	3.5

Frequency Response:

Ultra-linear mode with 6dB GFB.

Power	-1dB	-3dB
1 W RMS	10Hz – 16kHz	<10Hz – 33kHz

Ultra-linear mode with global **feedback OFF**

Power	-1dB	-3dB
1 W RMS	24Hz – 16kHz	12Hz – 26kHz

Hum and Noise:

Input terminated in 10K resistor, volume control at max.

<0.5mV RMS un-weighted. (85dB down compared to full power).

Channel Separation:

Better than 60dB – un-driven channel input terminated in 10K resistor.

Channel Balance:

Better than 0.5dB.

Damping Factor:

Ultra-linear mode with 6dB GFB – 3.3

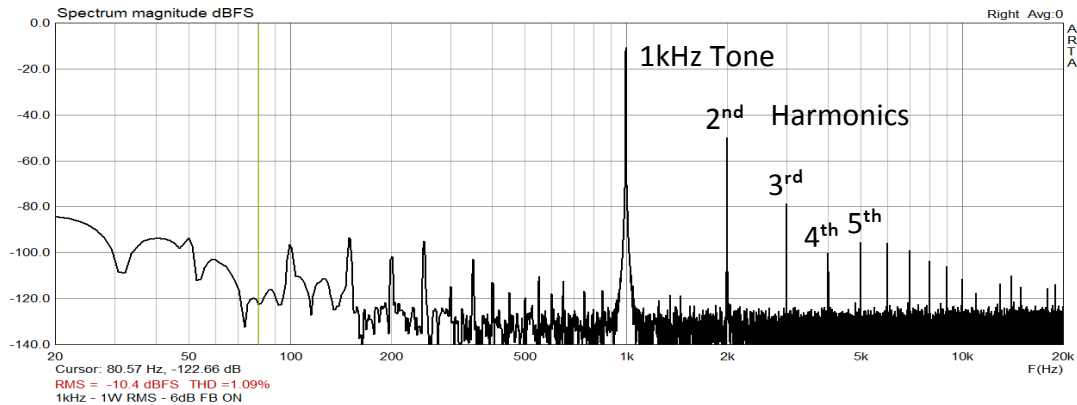
Power Indication:

LEDs shine into in bases of both input valves when power is on. Blue LED's supplied.

Dimensions & Weight:

185mm wide, 215mm deep, 165mm high with EL34 output valves. Weight 4.5kg

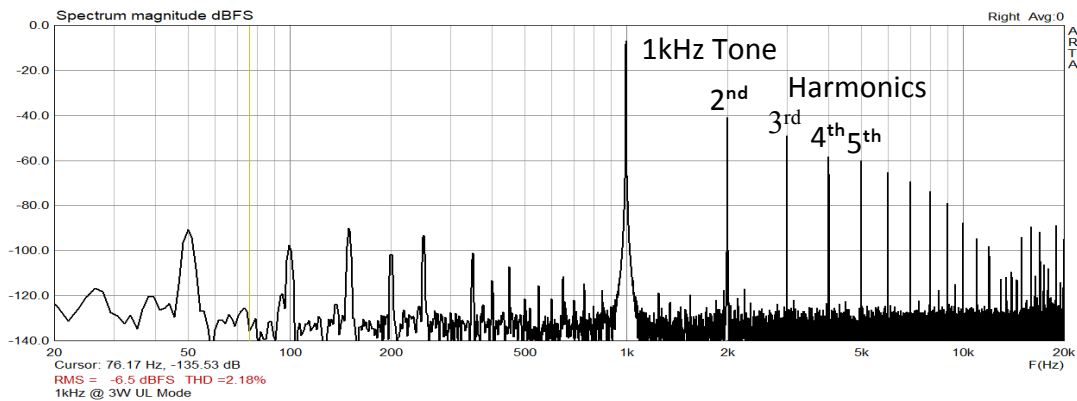
Spectrum Analysis using Standard Output Transformer



Ultra Linear (UL) Mode 1kHz @ 1W RMS Output 6dB Global Feedback.

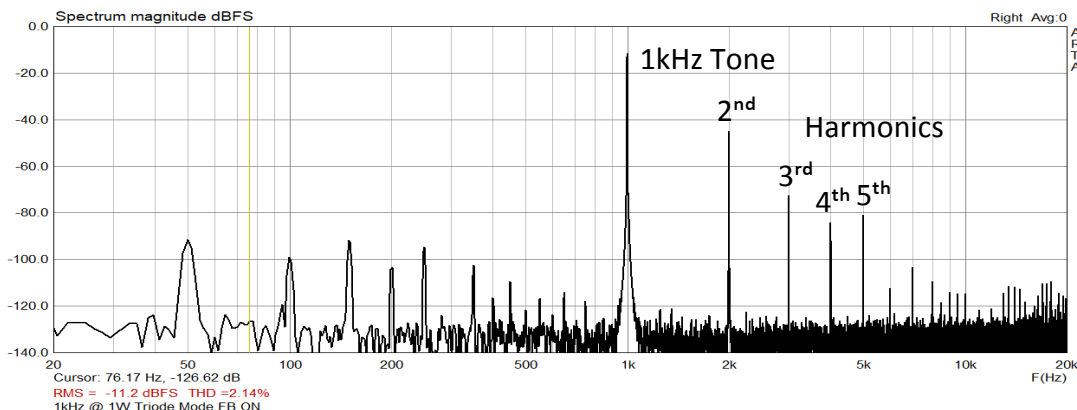
Note the predominance of second (even) harmonic distortion, typical of single ended class-A amplifier.

This is the Mode shown in the construction notes.



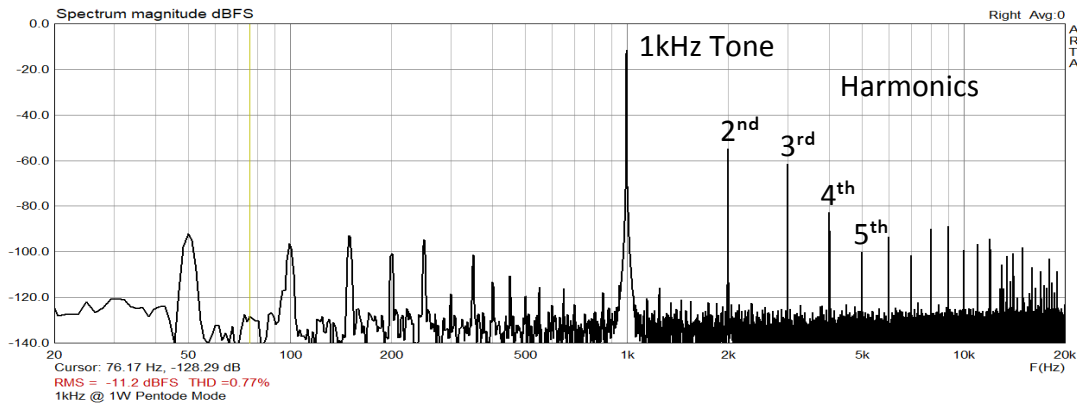
Ultra Linear (UL) Mode 1kHz @ 3W RMS 6dB Global Feedback

Harmonics increasing at 3 Watts output, but second harmonic still highest.



Triode Mode 1kHz @ 1W RMS Output 4dB Global Feedback

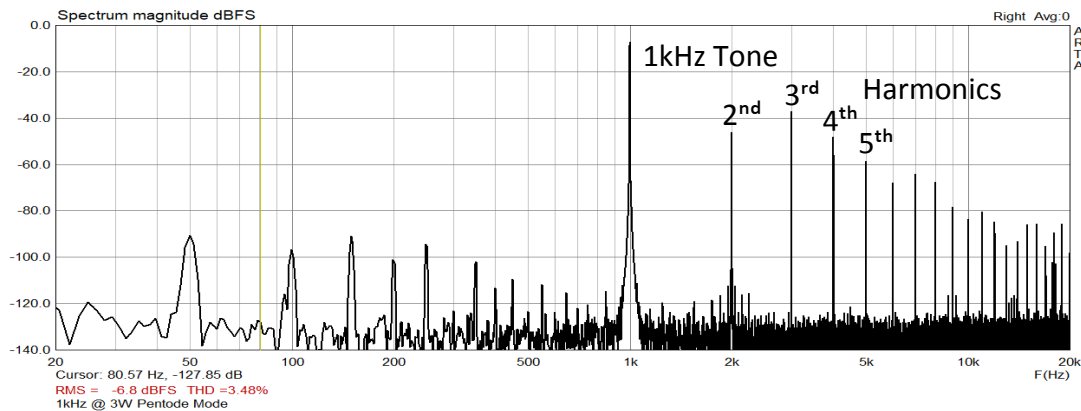
Note the dominance of the second harmonic, typical of a triode amplifier. Not too different from UL Mode at this power level.



Pentode Mode 1kHz @ 1W RMS Output 6dB Global Feedback.

The third harmonic is much higher in pentode mode at this power level.

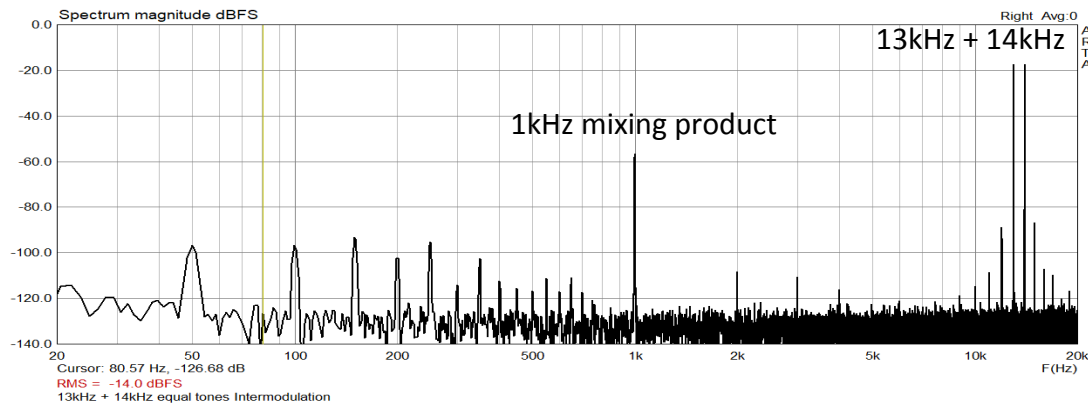
In pentode mode remove C4.



Pentode Mode 1kHz @ 3W RMS Output 6dB Global Feedback.

The third harmonic is dominant at 3 Watts.

In pentode mode remove C4.



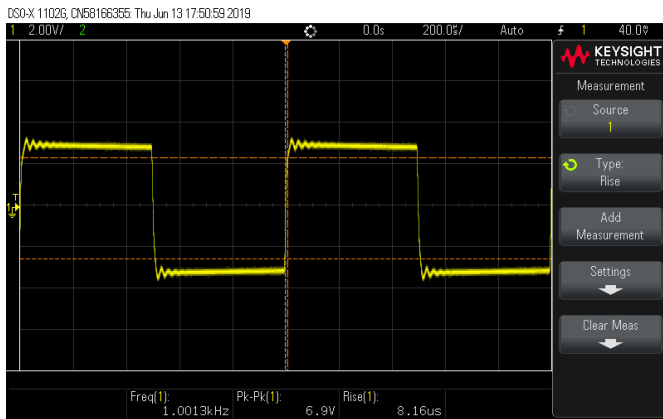
Intermodulation Distortion - Using 13kHz & 14kHz Tones. UL Mode @ 1W RMS Output - No Global Feedback

The 1kHz inter-modulation product is about -40dB

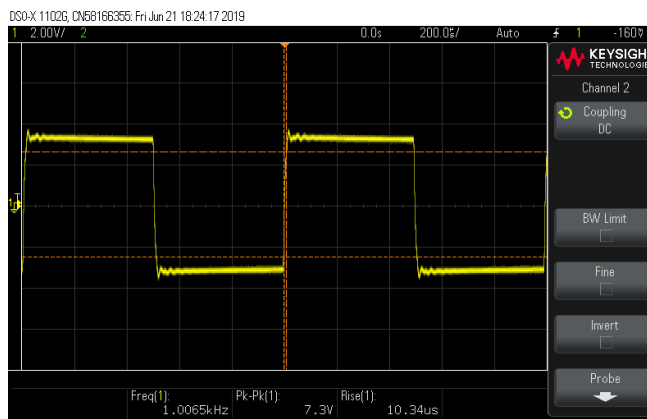
Square Wave Testing - Using Standard Output Transformer

The amplifier was tested in various modes using a fast rise-time square wave using a Keysight DSOX1102G digital oscilloscope. The output voltage is about 7V p-p with a risetime of about 7 μ S.

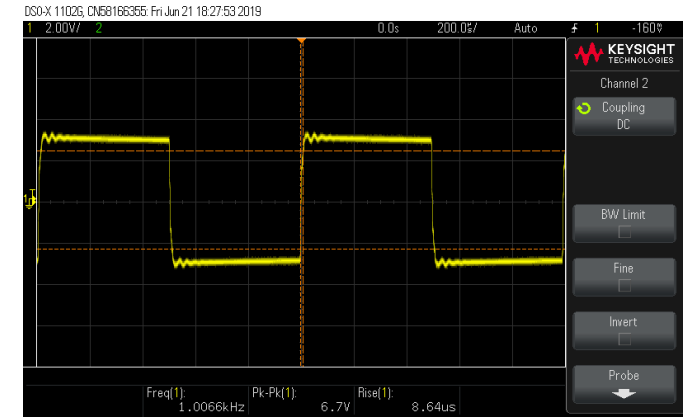
All modes are similar. A small amount of ringing is evident on leading and trailing edges due to output transformer resonance's evident in medium cost output transformers. There is no detectable sonic effect.



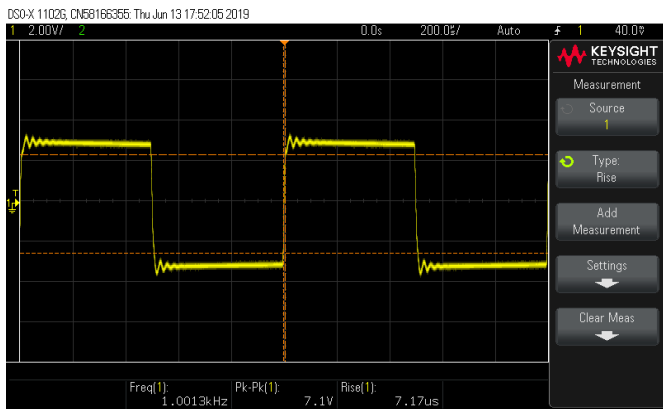
1kHz U-L Mode into 8 Ohms- Small ringing.



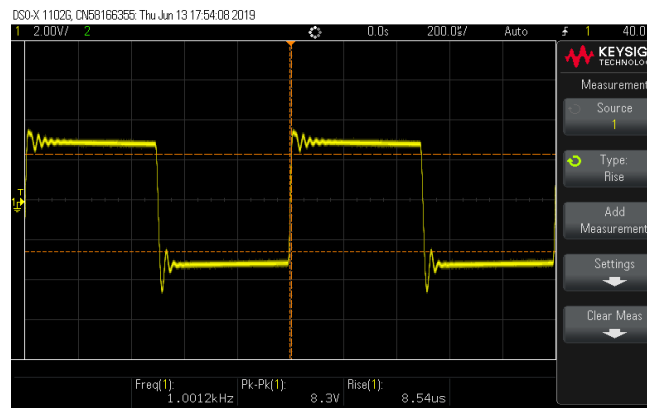
1kHz Triode Mode 8 Ohms- Small ringing



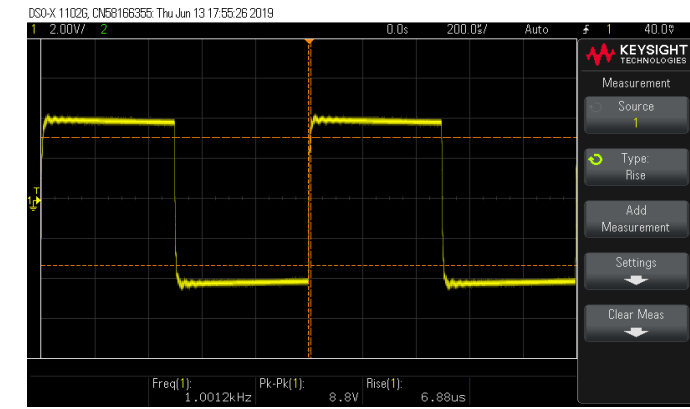
1kHz Pentode Mode 8 Ohms- Small ringing



1kHz into 8 Ohms // 0.1uF - Stable.



1kHz into 8 Ohms // 1uF - Stable.



1kHz into Open Circuit - Stable.

Test Results Using Optional Audiophile Grade Output Transformer

As an experiment, and to show the contribution of the output transformer to overall performance, a series of tests were carried out using a more expensive Audiophile grade output transformer. As the transformer does not have an ultra-linear screen tap, tests were performed in triode and pentode modes only. No other component changes were made to the amplifier circuit.

Improvements were observed in frequency response, power output (due to lower transformer primary DC resistance), damping factor (due to lower secondary DC resistance) and square wave response. Some measurement results are below.

This transformer is available from Red Roo epoxy potted into a slightly larger metal housing. It can be supplied with the kitset as an option.

Max. Power Output

@ 10% Distortion, GFB ON, 12.5V DC Input:

Triode mode - 3.25W rms

Pentode mode - 7W rms

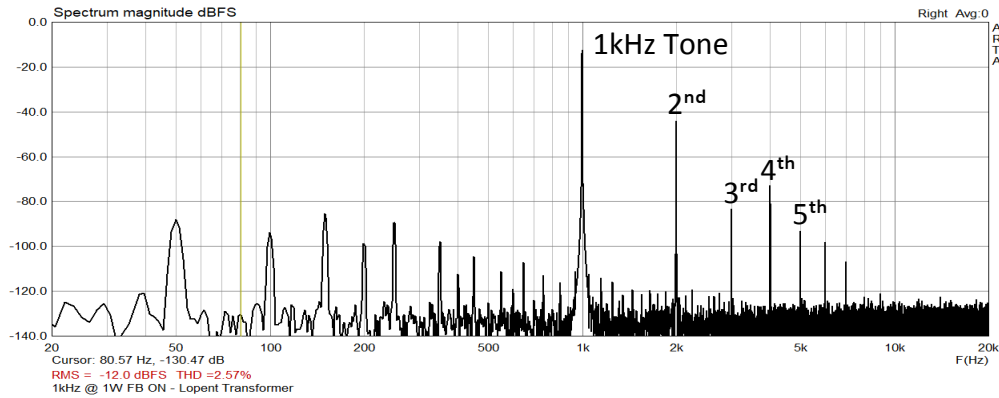
Frequency Response

Triode GFB OFF	1dB @ 14Hz - 22kHz / 3dB @ <10Hz - 44kHz
Triode GFB ON	1dB @ <10Hz - 27kHz / 3dB @ < 10Hz - 53kHz
Pentode GFB OFF	1dB @ 60Hz - 30kHz / 3dB @ 24Hz - 50kHz
Pentode GFB ON	1dB @ 15Hz - 44kHz / 3dB @ <10Hz - 73kHz

Total Harmonic Distortion @1kHz vs Power Output (rms)

Power Output	Triode No GFB	Triode With GFB	Pentode NO GFB	Pentode With GFB
100 mW	0.95	0.6	1.4	0.4
1W	3.45	2.5	3.4	1.3
3W	8	6.5	5.5	2.4
6W	-	-	10	5.6
7W	-	-	-	10

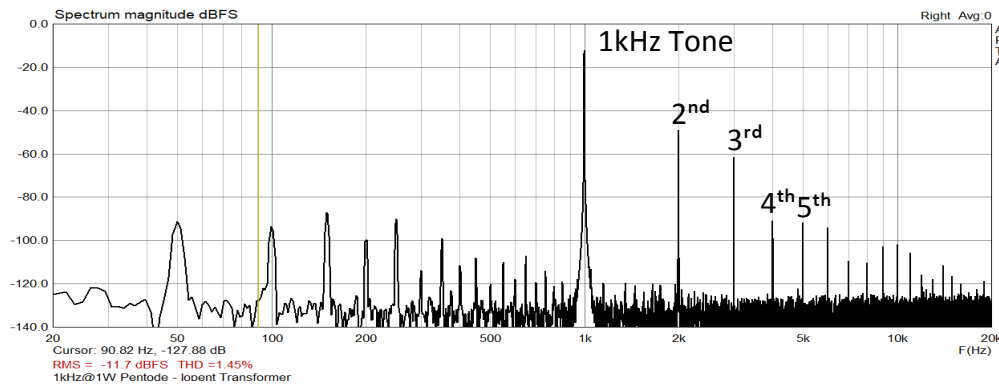
Test Results Using Optional Audiophile Grade Output Transformer



Triode Mode 1kHz @ 1W RMS Output 3dB Global Feedback

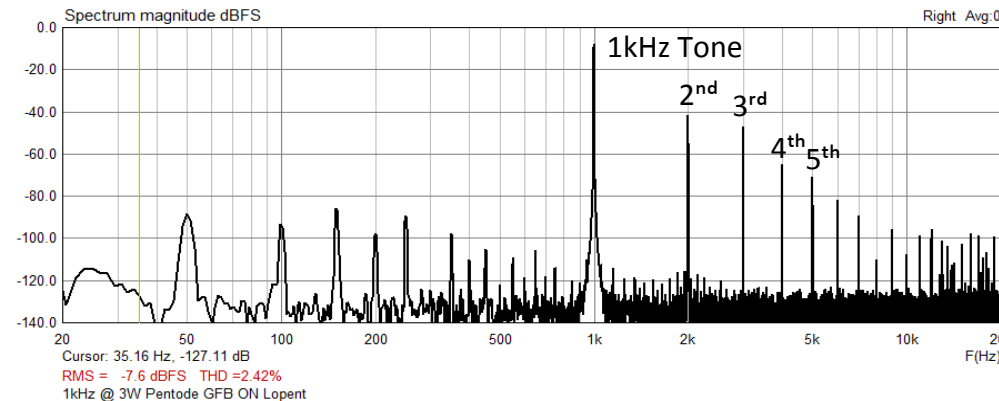
Note the dominance of the second harmonic and the low 3rd harmonic.

Triode Mode is recommended for small rooms or for predominant headphone use. Maximum power is about 3 Watts RMS.



Pentode Mode 1kHz @ 1W RMS Output 7dB Global Feedback.

The third harmonic is higher, typical of a pentode/tetrode amplifier, but the 2nd harmonic is still dominant.



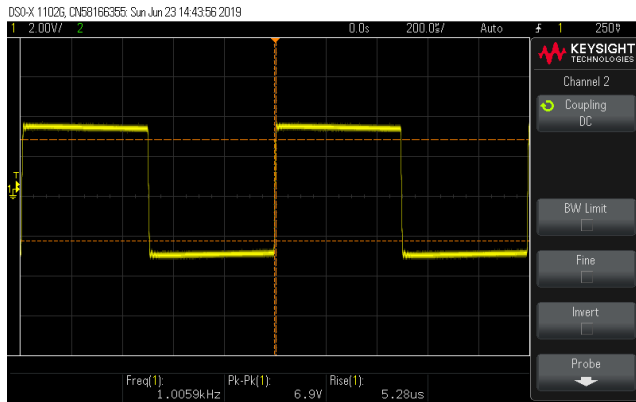
Pentode Mode 1kHz @ 3W RMS Output 7dB Global Feedback.

All harmonics are higher, but the 2nd harmonic is still highest.

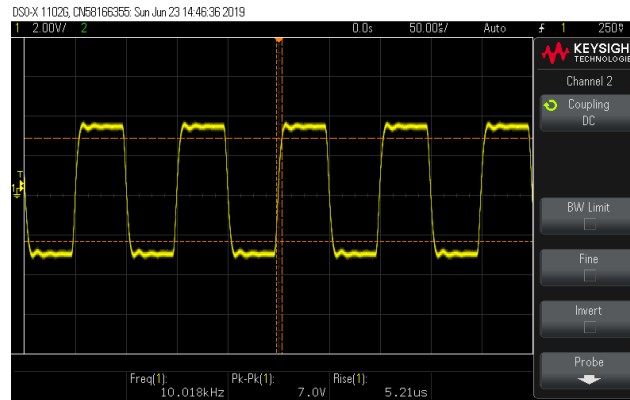
Comment: Using the audiophile output transformer in triode or pentode mode is looking like a good but pricier choice.

Test Results Using Optional Audiophile Grade Output Transformer

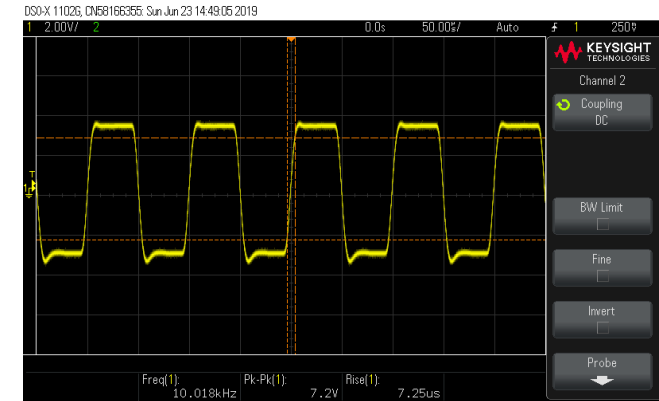
@ 7Vp-p output voltage into specified load.



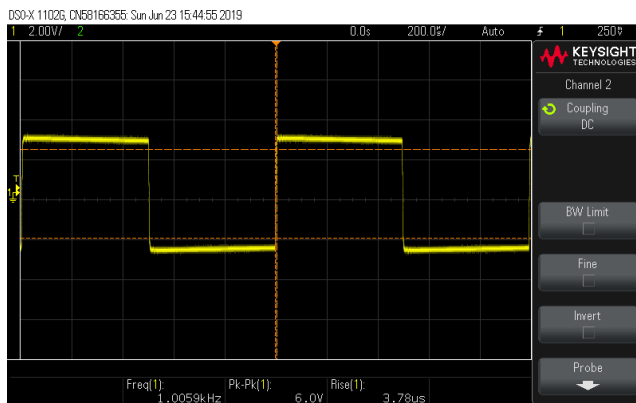
1kHz Triode Mode - very slight ringing @ about 75kHz, 5uS Risetime, 8 Ohm load



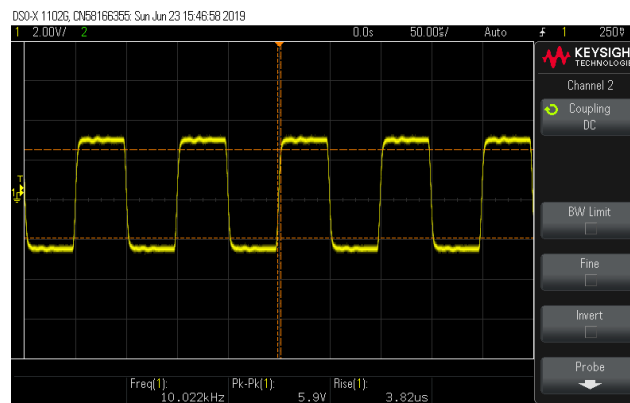
10kHz Triode Mode, 8 Ohms load, 5uS risetime



10kHz Triode Mode driven into 8 Ohms//1uF load



1kHz Pentode Mode - very slight ringing @ about 75kHz, 4uS Risetime, 8 Ohm load



10kHz Pentode Mode into 8 Ohm load, 4uS Risetime