

Audio Amplifier Performance Assessment

General use and objective of AAPAP

The program looks at several important aspects of amplifier performance. The assessment process can be used to compare different amplifier designs, be they DIY or commercial. For assessment and scoring, the amplifier is assessed against a set of criteria. The following areas of electrical performance are covered by the assessment:

- 1. Output Power
- 2. Capacitive load drive capability
- 3. Overdrive recovery
- 4. Frequency response into 8 Ohms resistive load and complex load
- 5. Complex load drive capability vs distortion at high power levels
- 6. THD + N at 1 watt into 8 Ohms (0 dBV) and at rated power (dBr measurement)
- 7. IMD 19+20 kHz at 80% of rated power into 8 Ohms
- 8. Noise floor of mains-related noise and hum, including cross-channel ground loop noise
- 9. Speaker and amplifier protection assessment
- 10. \$ Cost per stereo watt (not scored, but must be stated in the assessment)

The assessment program explicitly does not address subjective notions of amplifier quality, only those that can objectively assessed using test instrumentation.

The tool distinguishes between different amplifier technologies and assesses performance within the capabilities of the designer's chosen technology. The technologies currently covered are: -

- Linear solid-state amplifiers with global feedback
- Linear solid-state amplifiers without global feedback
- Vacuum tube amplifiers
- Class D amplifiers will be added to the program once agreement is reached on how certain parameters are assessed

Tool outputs

A report card against which the parameters listed above are scored with a top-level score that places the amplifier in one of 6 categories as detailed below: -

Note, a zero score on any of the tests in amplifiers assessed in the top two categories will force the AUT score to the next lowest overall rating. For example, if an amplifier scores well on all parameters except overdrive recovery, where it scores 0, it must be given a maximum of 4 stars. A standard histogram chart accompanies the report card and is always ordered in the same way as the tests are ordered in the accompanying Excel file. This allows direct, easy visual side by side comparison between different amplifiers. Along with the report card, plots for tests 2-7 must be included for reference. All tests are done in stereo mode. Simulation plots of amplifier performance are not accepted as performance plots.

Score	AAPAP Star Rating	Comments
= > 70	***** (5 Stars)	Amplifier well engineered with good performance across a range of technical measures
60 ~69	****	Acceptable engineering and performance but some areas of the assessment may affect performance and or could be improved
50~59	***	lower scoring areas of the design require attention
40~49	**	General failings on many of the test parameters that require attention
30~39	*	Serious shortcomings as a result of bad engineering leading to suboptimal performance across too many of the technical measures
<= 30	No stars	The amplifier performance in key technical areas is too weak to warrant any grading

Question is if power ins't an amp selection criteria rather then an absolute performance aspect - is really a 50W amp better than a 25W one ?

The trend seems ro be towards lower impedances in general - I think that 4 ohms should be a standard

Seem at least expressed as a white box view. Covered by 6 above?

potentially

White box

But it does due to division into amp technologies.

Audio Amplifier Performance Assessment Program

Initial Release 13th January 2024

					Performance Assessment					
Test Number	Assessment Parameter	What is being tested for	Test conditions	Test	Solid State Linear Amplifiers with Global Feedback	Solid-state Linear Amplifiers with Zero Global Feedback	Vacuum Tube Amplifiers	Class D amplifiers	Assessment outputs	Notes
1	Output Power	Is the amplifier capable of comfortably driving a range of domestic loudspeakers from 85dB to 100 dB sensitivity in a typical home listening environment ?	The rated output power of the amplifier is the output power into 8 ohms at 1% distortion; 4 and 2-ohm performance must be quoted under the same distortion conditions, but the figures will not be used for the assessment score.	Output power vs distortion using an audio test set or suitable sound card	1 point for up to 10 Watts; a further 1 point for every 10 Watts above 10W up to a maximum of 5 points for amplifiers stated at 50 Watts or more			Measurement format still to be determined	Numerical score only plus 4 ohm and 2 ohm powers at 1% distortion.	
2	Capacitive load drive capability	Stability with capacitive loads. Deduces amplifier gain and phase margins through inspection of small signal square wave performance into a range of capacitive loads and is designed to expose potential problems in real-world use.	The amplifier is driven with a 3 kHz square wave with rise/fall times of ~1us so that it is outputting 2.8V pk~pk into a 2 Ohm resistive load. The waveform is noted into just the resistive load. The following capacitive loads are then applied in turn in parallel to the 2 Ohm load: 3.3nF, 10nF, 50nF, 150nF, 470nF, 1uF 2.2uF whilst monitoring the amplifier output.	Square wave response into load monitored with oscilloscope	0 points for any visible signs of overshoot and ringing into just the 2-ohm load; if any of the subsequent capacitive load tests result in oscillation, 0 points. 5 points are awarded only if ringing can be deduced to be that of the amplifier output coupling inductor and the capacitive load. See formula to calculate this.		TBA	TBA	Numerical score only	
3	Overdrive recovery	Assesses whether the amplifier exits overdrive cleanly and without rail sticking which can lead to excessive VAS currents and/or oscillatory behaviour as the amplifier exits clipping	The amplifier is overdriven by 25% into an 8 ohm load and the rail sticking on both the positive and negative peaks in the overdriven condition measured. A note is also made of any overshoot or oscillatory behaviour as the amplifier exits clipping.	Signal generator and oscilloscope	5 points for 1us or less rail sticking on both rails; subtract 1 point for each rail for each 1us over the base line 1us; amplifiers that show any signs of overshoot and/or oscillatory behaviour on exiting overdrive get 0 points.		TBA	TBA	Numerical score only	
4	Frequency response into resistive and complex load	This assesses the amplifier output impedance impact on frequency response	Plot the response at 0dBV over the range 20 Hz to 20 kHz into both a resistive load and the dummy load	Frequency response using an audio test set or suitable sound card	5 points for equal to or less than 0.5 dB pk-pk deviation from a flat response; subtract 1 point for every 0.2 dB deviation above the 0.5 dB baseline	5 points for less than 0.7 dB pk-pk deviation from a flat response; subtract 1 point for every 0.3 dB deviation above the 0.5 dB baseline	TBA	TBA	Numerical score and two plots	The response into just the resistive load over 20-20kHz must be quoted.
5	Complex load drive capability	Examines the amplifier OPS power deliver capability with highly reactive loads that induce large phase angles within the audio bandwidth where most music energy is present using a standard loudspeaker dummy load. Seeks to identify protection schemes that are audibly intrusive and output stages not adequately rated for the claimed output power specification. Examines dynamic amplifier distortion inducted by the large current and phase demanded by the test load. May also trigger oscillation in sub optimally compensated amplifiers.	The amplifier is driven to 80% of its rated output power vs frequency into 8 Ohms and the THD noted. The eight-ohm load is then replaced with the standard loudspeaker dummy load and the dBr THD vs Frequency is plotted and noted; NB, this test may stress the amplifier OPS and the Zobel network in some amplifiers.	Frequency response and THD vs Frequency using an audio test set or suitable sound card	5 points for <50ppm increase in distortion at any frequency within the audio band. Deduct 1 point for every additional 100ppm increase in distortion at any point within the audio band.	5 points for <150ppm increase in distortion at any frequency within the audio band. Deduct 1 point for every additional 200ppm increase in distortion at any point within the audio band.	TBA	TBA	Numerical score and two plots	If the amplifier cannot drive the load, or goes into protection mode, 0 points are awarded.
6	THD+N	Assesses basic amplifier harmonic distortion and noise. This test will also highlight the care taken in the mechanical layout, PCB design and any internal wiring.	This test is measured at 0 dBV (c. 2.8V pk~pk). The test must sweep frequency from 20 Hz to 20 kHz, producing a plot.	THD vs Frequency using an audio test set or suitable sound card	1 point for -60 dBV. Add 1 point for every -10 dB improvement up to -110 dBV	1 point for -60 dBV. Add 1 point for every -5 dB improvement up to -85 dBV	TBA	TBA	Numerical score and plot of noise floor reference 0 dBV	This measure will be refined at a later date to weight harmonic structure of the measured THD.
7	IMD 19+20 kHz	Examines amplifier HF linearity at high power including SID/TIM problems	The amplifier is driven to 80% of its rated power into 8 Ohms using 19 kHz 20 kHz tones of equal amplitude and a plot of all harmonics over 20 Hz to 20kHz produced. See formula for how to calculate the power in the tones. Note, overheating of the Zobel components may occur	THD vs two-tone IMD using an audio test set or suitable sound card	1 point for highset peak harmonic lower than -70 dB. Add 1 point for every -10 dB improvement	1 point for any peak harmonic lower than -60 dB. Add 1 point for every -10 dB improvement	TBA	TBA	Numerical score and plot of IMD	
8	Mains related noise and hum	This test determines the quality of the power supply, amplifier PSRR under load, and whether sufficient care in wiring and PCB design has been taken.	Drive the amplifier to full 8 ohm power with a single 65Hz tone in 50 Hz regions and 75 Hz in 60 Hz regions. One plot in dBV must be produced.	Uses an audio test set or suitable sound card. The generator is not needed for this test.	1 point for better than -70 dBV; add 1 point for every -10 dB improvement	1 point for better than -60 dBr; at 1 point for every -10 dB improvement	TBA	TBA	Numerical score and dBV plot of noise floor reference	
9	Speaker and Amplifier Protection	Does the amplifier have mechanisms that will protect the loudspeaker, and the amplifier where possible, in the event of a catastrophic failure	No physical test for this criteria but simply points awarded for the protection(s) the amplifier has as quoted in the specification.	Refer to amplifier specification	2 points for DC offset protection; 2 points for short-circuit overcurrent protection; 1 point for thermal shutdown; Amplifiers that do not have mains primary side fusing get 0 points.		TBA	TBA	Numerical score only	
10	Cost per watt	Does the amplifier the amplifier represent value for money in engineering terms	Calculate the cost per RMS watt into 8 Ohms	N/A	Not awarded points, but the stereo \$/RMS watt is quoted in the assessment		TBA	TBA	Quote for reference only	

	Amplifier	New Horizons 40+40			
	Amplifier type	Linear class AB			
	Product status	Commercial			
	Test Number	Assessment Parameter	Score out of 5	Findings	Notes/observations
	1	Output Power	4	40 W RMS per channel into 8 ohms	
	2	Capacitive load drive capability	5	Exempliary performance	No oscillation into resistive load. Output L calculated at 1 uH. Output L ringing with capacitive test loads assessed as normal and no additional oscillations observed.
	3	Overdrive Recovery	3	2us rail sticking on -ve rail	Other than rail sticking, no oscillation of overshoot
	4	Frequency response into resistive and complex load	3	0.9 dB ripple observed into complex load	20 Hz to 20 kHz measured at +0dB -0.15 dB into resistove load.
	5	Complex load drive capability	4	0.012% measured	
	6	THD + N	3	-79 dB	
	7	IMD 19+20 kHz	3	-100 dB residual at 1 kHz; others all below this figure	
	8	Mains related noise and hum	3	-100 dB peak mains component	
	9	Speaker and Amplifier Protection	4	Overcurrent and DC offset protection included	Mains is correctly fused
	10	Cost per stereo RMS watt in \$ watt (not scored, but must be stated)	15		
		Total Score	32		
		Normalized to 100	71		
		Rating	*****		
	<div><div>AAPAP for New horizons 40+40</div><div><div>Speaker and Amplifier Protection</div><div>Mains related noise and hum</div><div>IMD 19+20 kHz</div><div>THD + N</div><div>Complex load drive capability</div><div>Frequency response into resistive and complex load</div><div>Overdrive Recovery</div><div>Capacitive load drive capability</div><div>Output Power</div></div><div><div>0</div><div>1,25</div><div>2,5</div><div>3,75</div><div>5</div></div><div>Assessment score out of 5</div></div>				

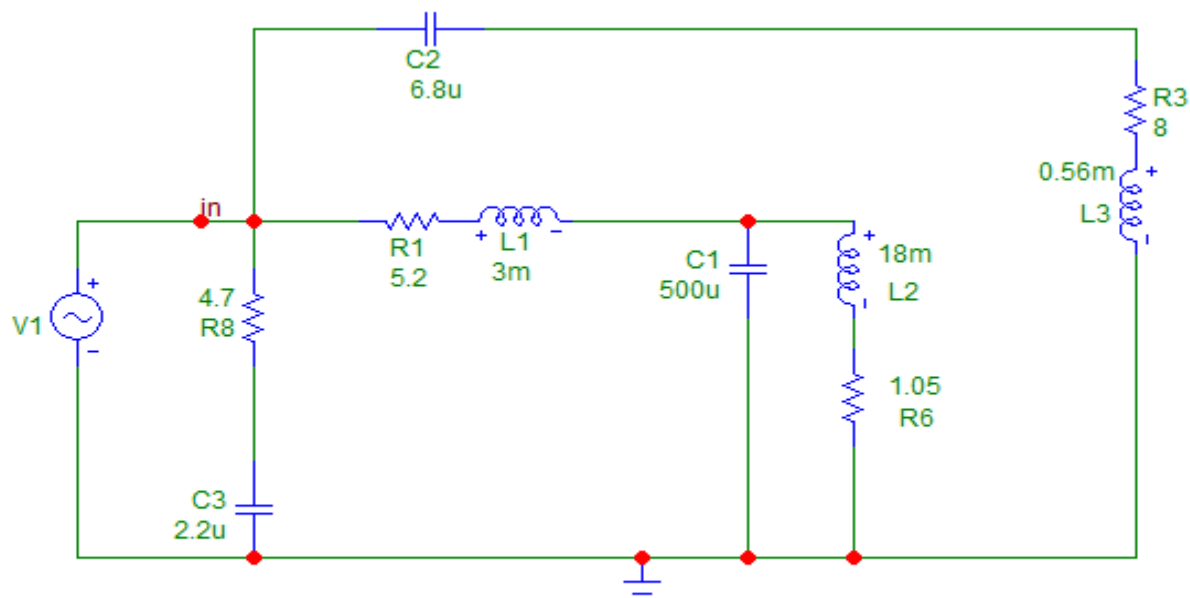
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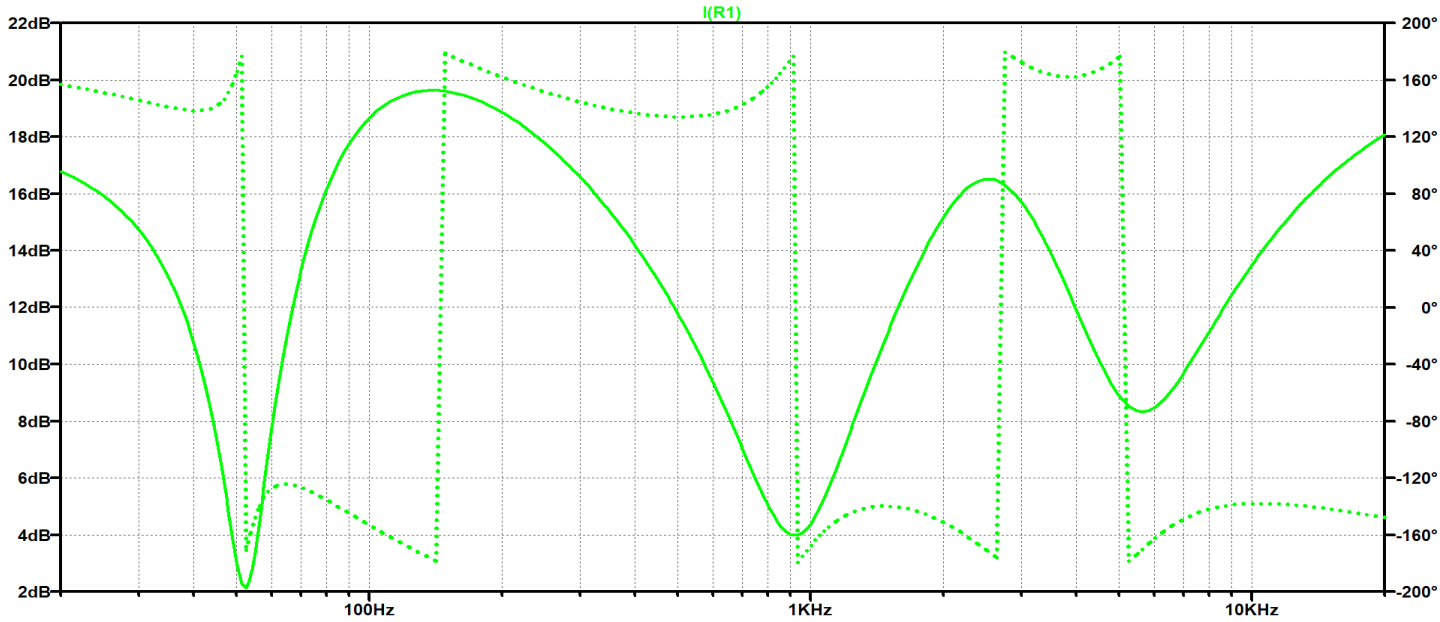
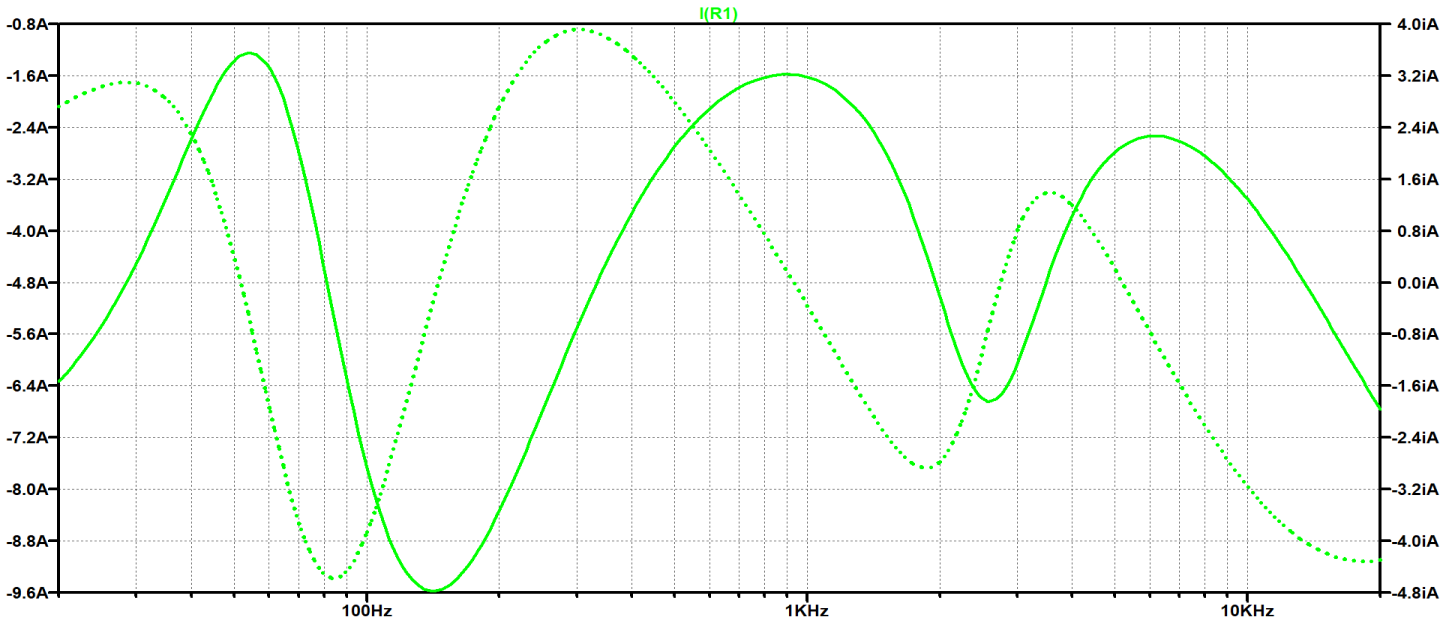
Dummy Test Load

This a test load was developed by P. Macura and has been adopted as the reactive load test standard for the assessment program.



DUMMY LOAD PMA

The plots below depicts the load current and phase demands to a 50V pk to pk signal. In the first, the load current demands and complex phase are shown, and in the second, current and phase angle vs frequency



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			Pavel Macura	
			TNT	
			A. Russell	