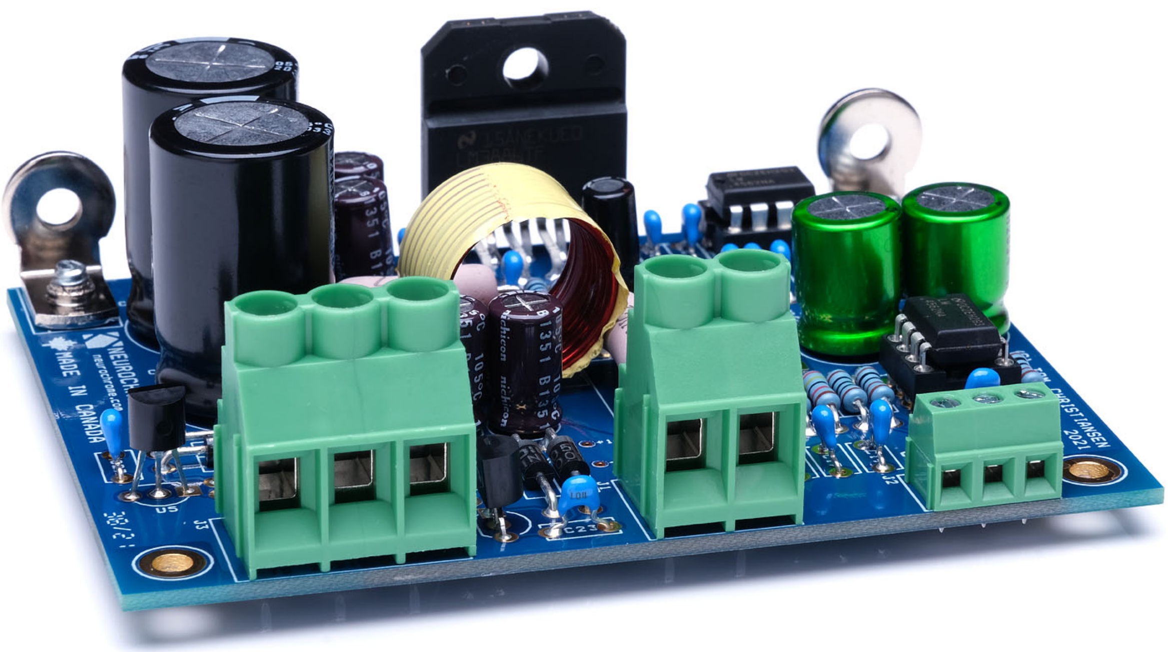
Modulus-86 Rev. 3.0
Data Sheet



Contents

Revision History

Modulus-86 Rev. 3.0 Data Sheet

Revision	Date	Notes
1.0	01 SEP 2024	Document created.

Typical Performance Measurements

The measurements below were performed on the Modulus-86 Rev. 3.0. Except where noted, they represent the typical performance that can be expected from the Modulus-86.

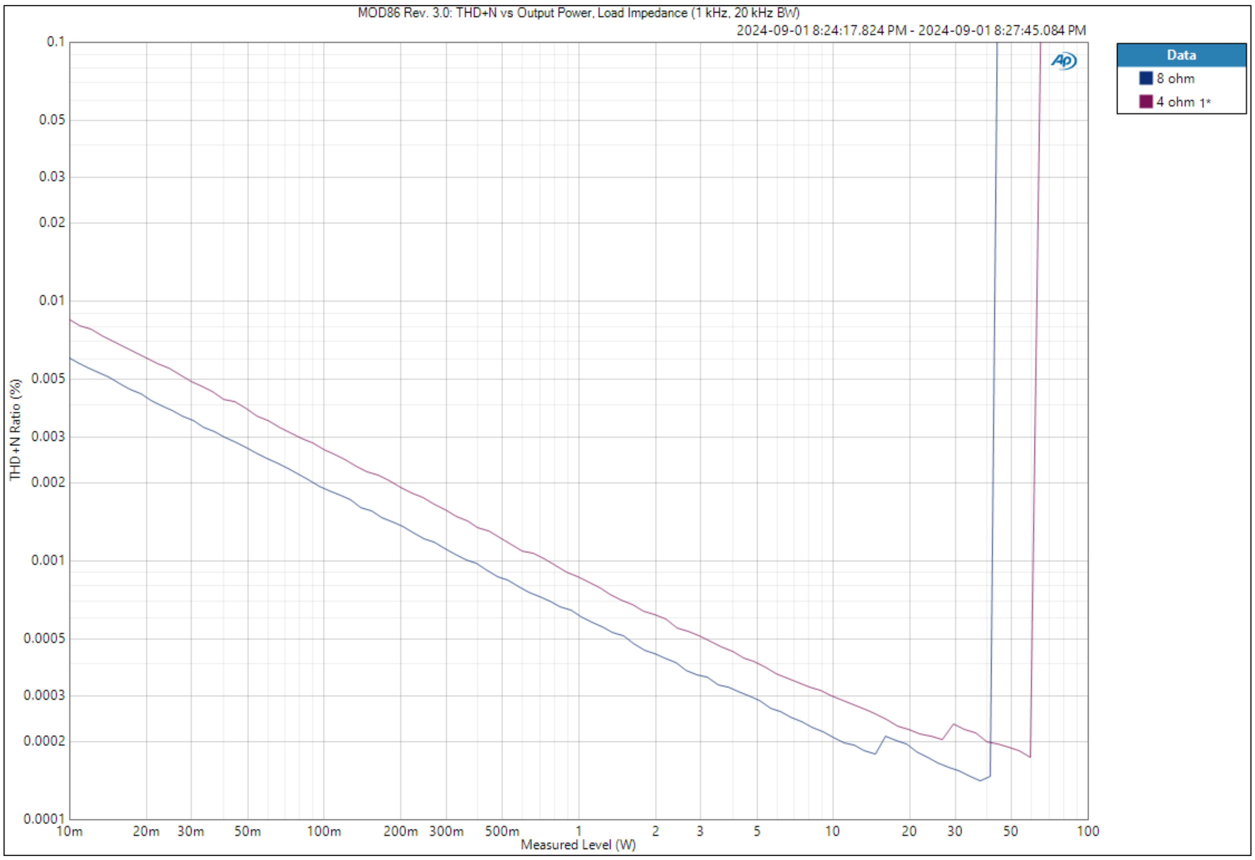
Parameter	Value	Notes
Output Power (8 Ω)	40 W	THD+N < 0.01 % @ 1 kHz
Total Harmonic Distortion	-128 dBc (0.00004 %)	1 kHz, 1 W, 8 Ω
Total Harmonic Distortion	-128 dBc (0.00004 %)	1 kHz, 40 W, 8 Ω
Total Harmonic Distortion + Noise	-117 dBc (0.00015 %)	1 kHz, 40 W, 8 Ω, 20 kHz BW
Output Power (4 Ω)	60 W	THD+N < 0.01 % @ 1 kHz
Total Harmonic Distortion	-121 dBc (0.00009 %)	1 kHz, 60 W, 4 Ω
Total Harmonic Distortion + Noise	-115 dBc (0.00017 %)	1 kHz, 60 W, 4 Ω, 20 kHz BW
IMD (SMPTE: 60 Hz + 7 kHz, 4:1)	-106 dB	20 W, 8 Ω
IMD (DFD: 18 kHz + 19 kHz, 1:1)	-119 dB	20 W, 8 Ω
IMD (DFD: 917 Hz + 5.5 kHz, 1:1)	-109 dB	1 W, 8 Ω
Multi-Tone IMD Residual	≤ -140 dB Ref. 40 W	AP 32-tone, 40 W, 8 Ω
Gain	20 dB	1 kHz
Input Sensitivity	1.8 V RMS	40 W, 8 Ω, 1 kHz
Bandwidth	76 kHz	1 W, -3 dB
Slew Rate	14 V/µs	8 Ω || 1 nF load

Parameter	Value	Notes
Total Integrated Output Noise and Residual Mains Hum	13.7 µV RMS	A-weighted, 20 Hz - 20 kHz
Total Integrated Output Noise and Residual Mains Hum	17.2 µV RMS	Unweighted, 20 Hz - 20 kHz
Output DC Offset Voltage	±0.3 mV ±2.0 mV	Typical performance Guaranteed by design
Dynamic Range (AES17)	119 dB	1 kHz
Common-Mode Rejection Ratio	≥ 60 dB	60 Hz
Damping factor	642	1 kHz, 8 Ω
Damping factor	214	20 kHz, 8 Ω

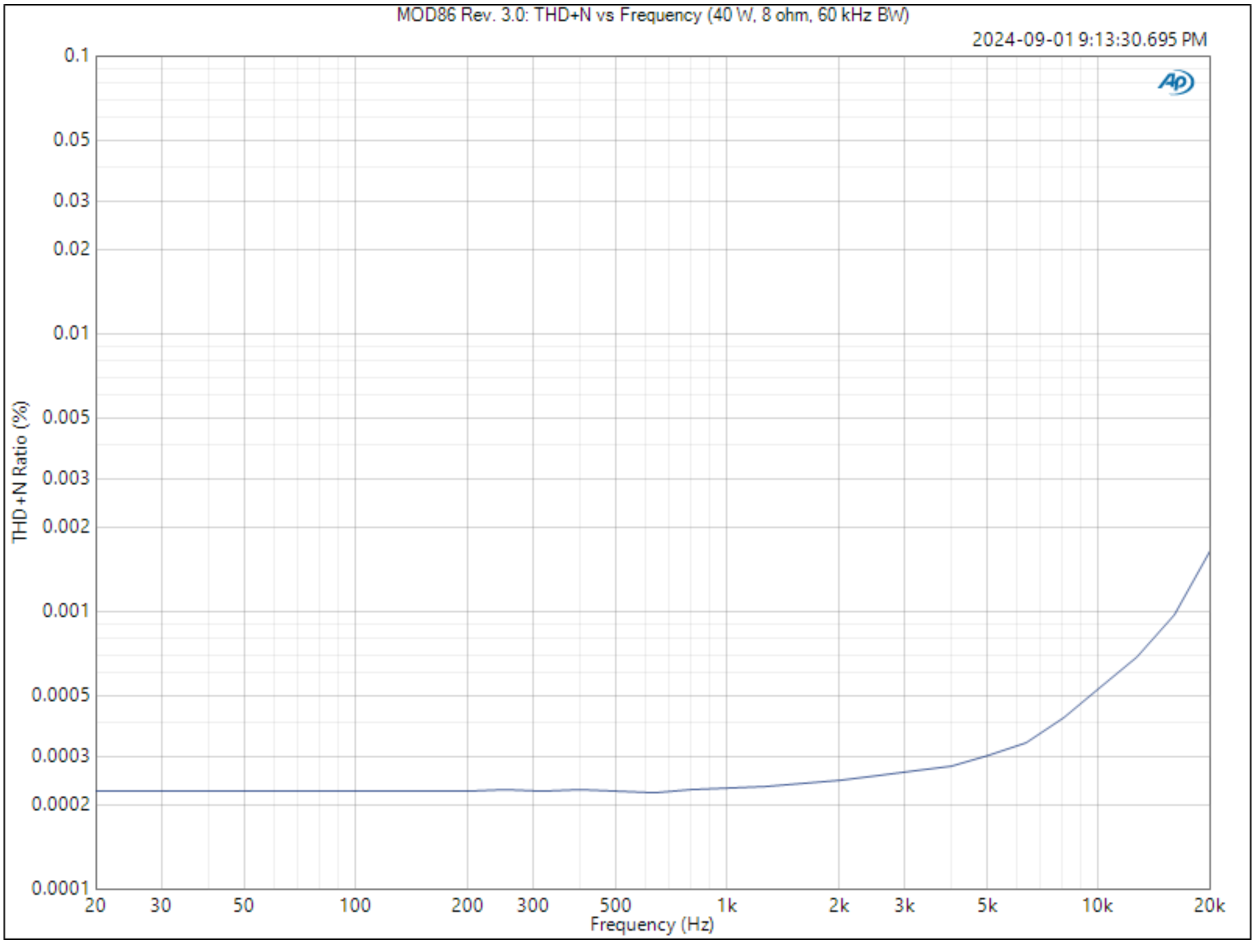
All parameters are measured at a supply voltage of ±30 V unless otherwise noted.

Harmonic Distortion

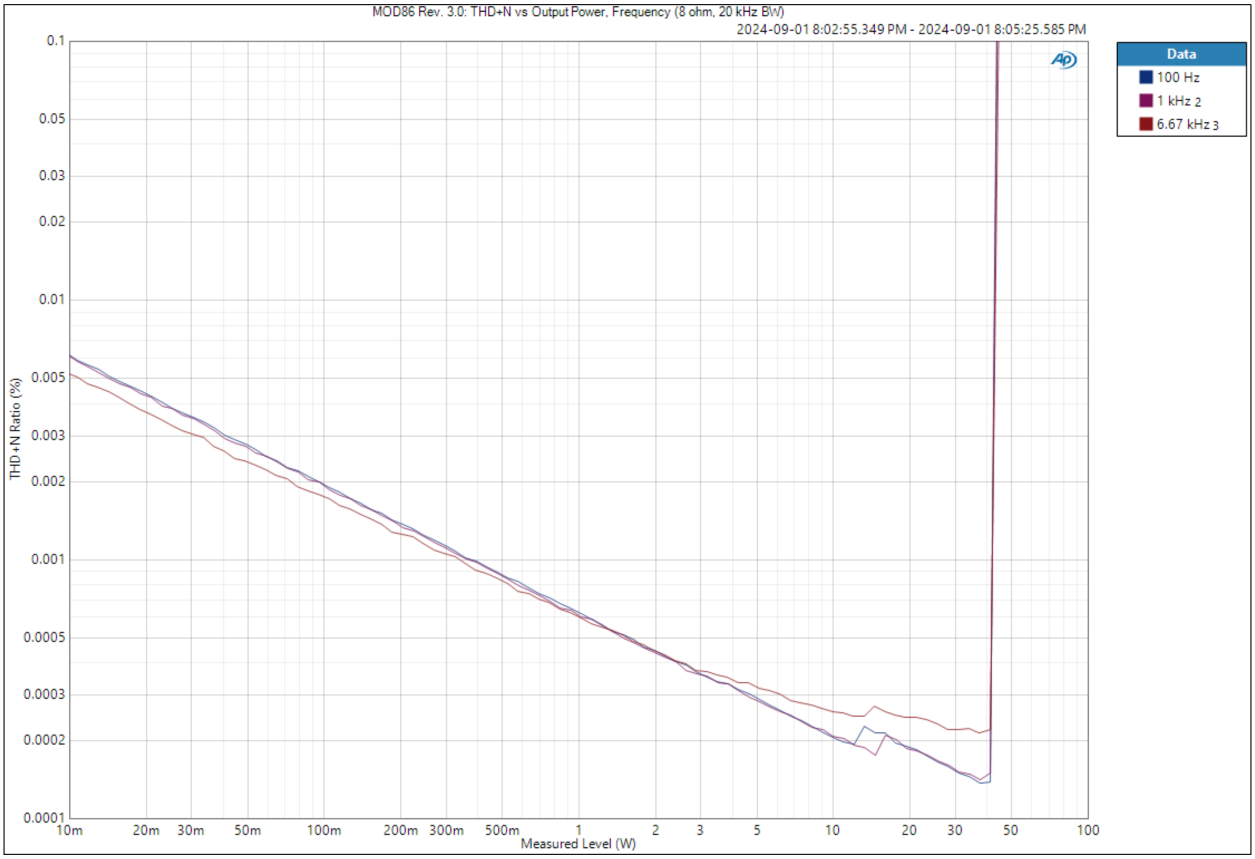
For the measurements below, the Modulus-86 was operating from a ±30 V power supply. The graph below shows the THD+N vs output power for 4 Ω and 8 Ω load. The amplifier delivers 40 W at the onset of clipping with an 8 Ω load; 60 W with a 4 Ω load. Note that the sharp jumps at 15 W (8 Ω) and 30 W (4 Ω) are caused by range switching in the APx555B.



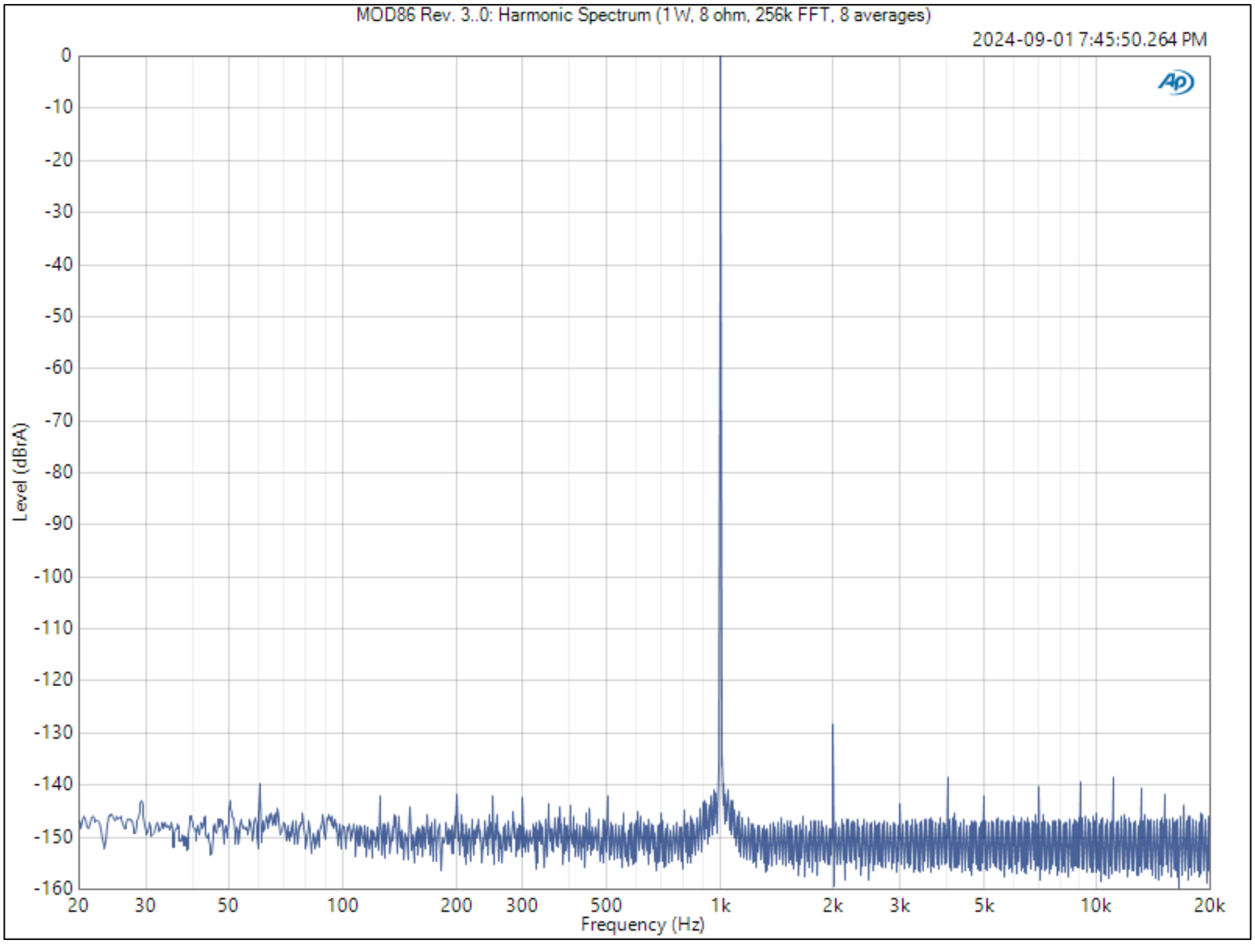
The THD+N vs frequency is shown below. The amplifier delivered 40 W into 8 Ω for this measurement.



The Modulus-86 operates in Class-AB, so the plot below may appear a bit out of place as it shows the THD+N vs output power and frequency measurement commonly found in data sheets for Class-D amplifiers. It is included here to showcase that the Modulus-86 performs 10-100× better than most Class-D amplifiers.

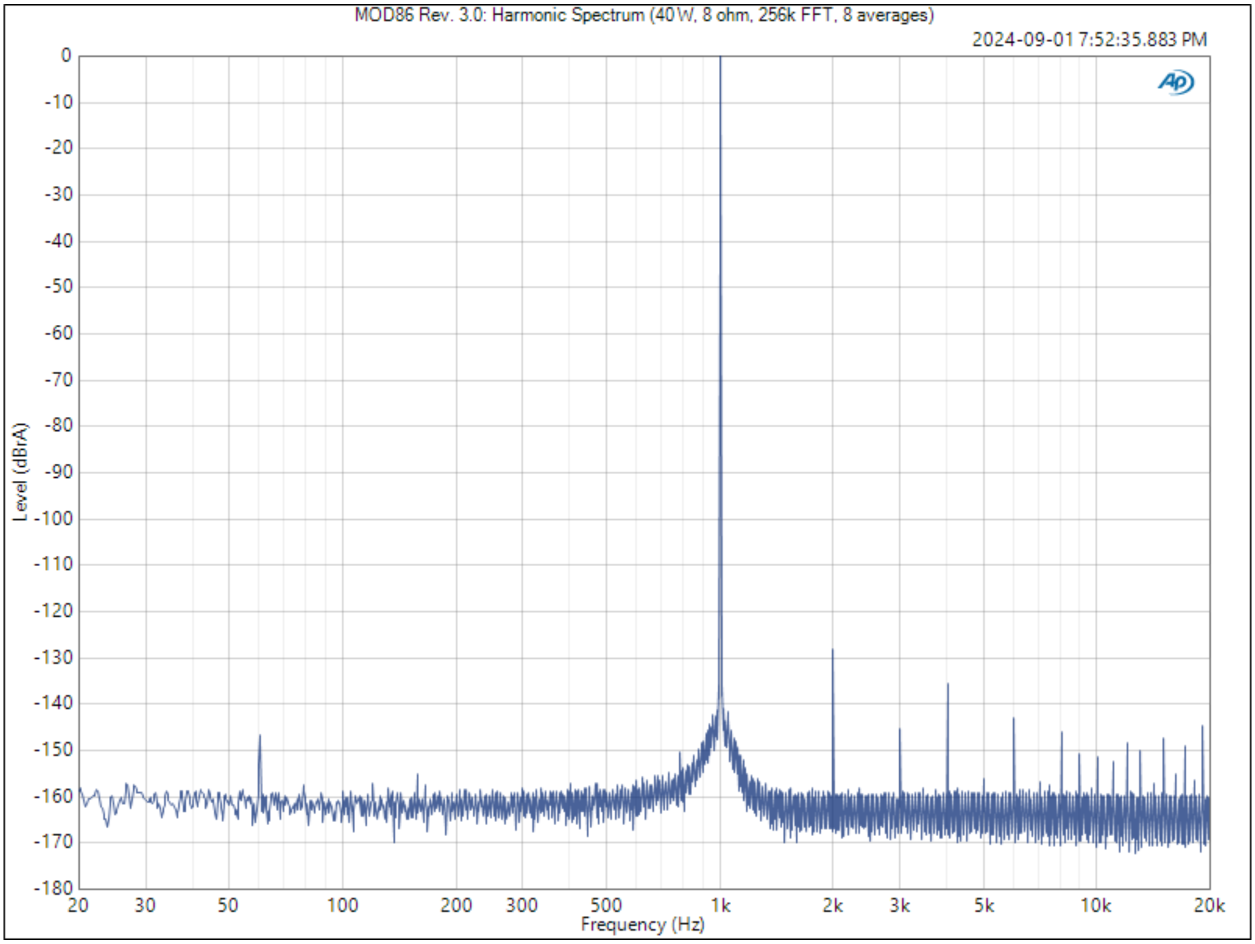


While good performance at high output power is a good indicator of the quality of an amplifier, stellar performance at lower power is an even better indicator. After all, a typical stereo amplifier will often operate at power levels in the 0.1-10 W range during critical listening. The graph below shows the output spectrum of the Modulus-86 when providing 1 W into 8 Ω at 1 kHz.



It is noteworthy that the distortion is dominated by the second harmonic.

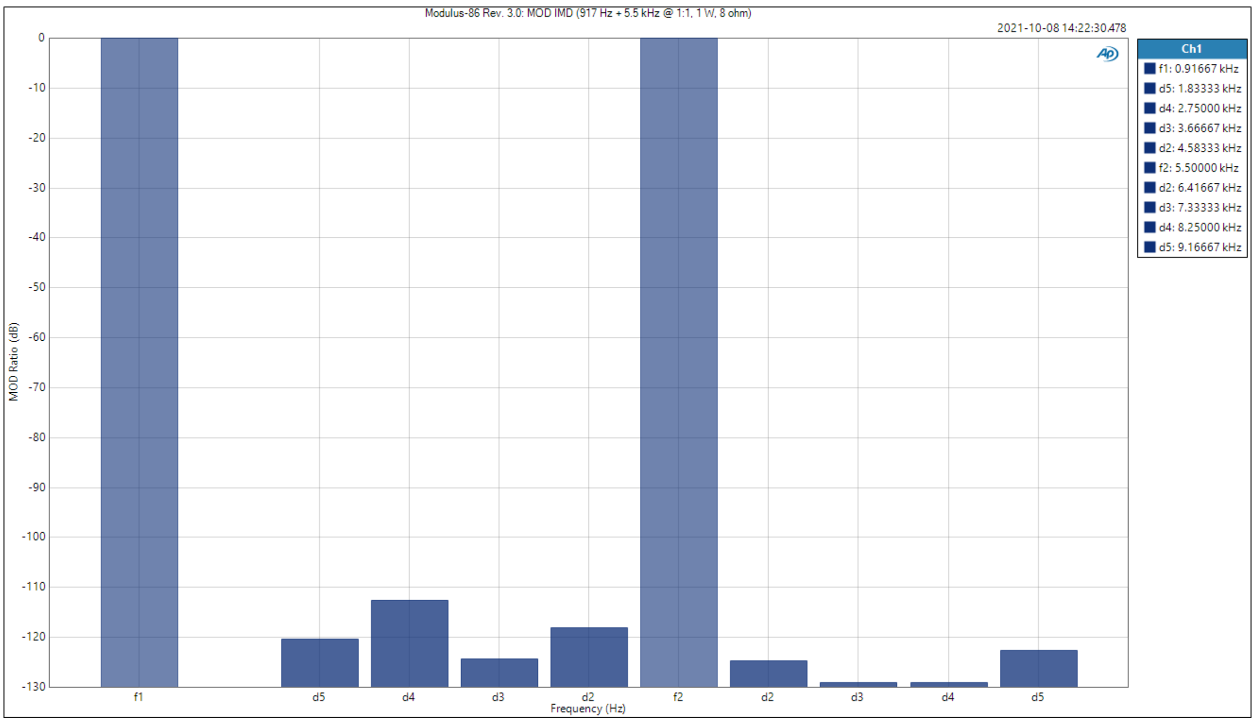
The graph below shows the harmonic spectrum at 40 W output into 8 Ω.



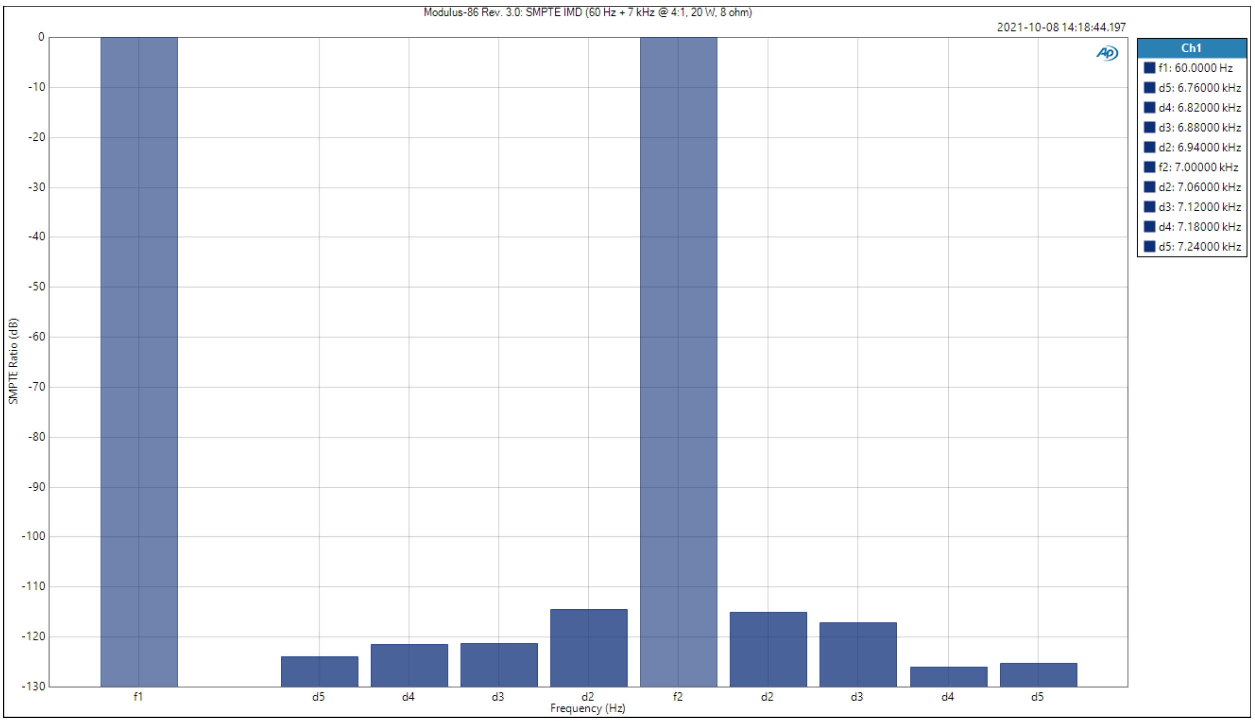
Intermodulation Distortion

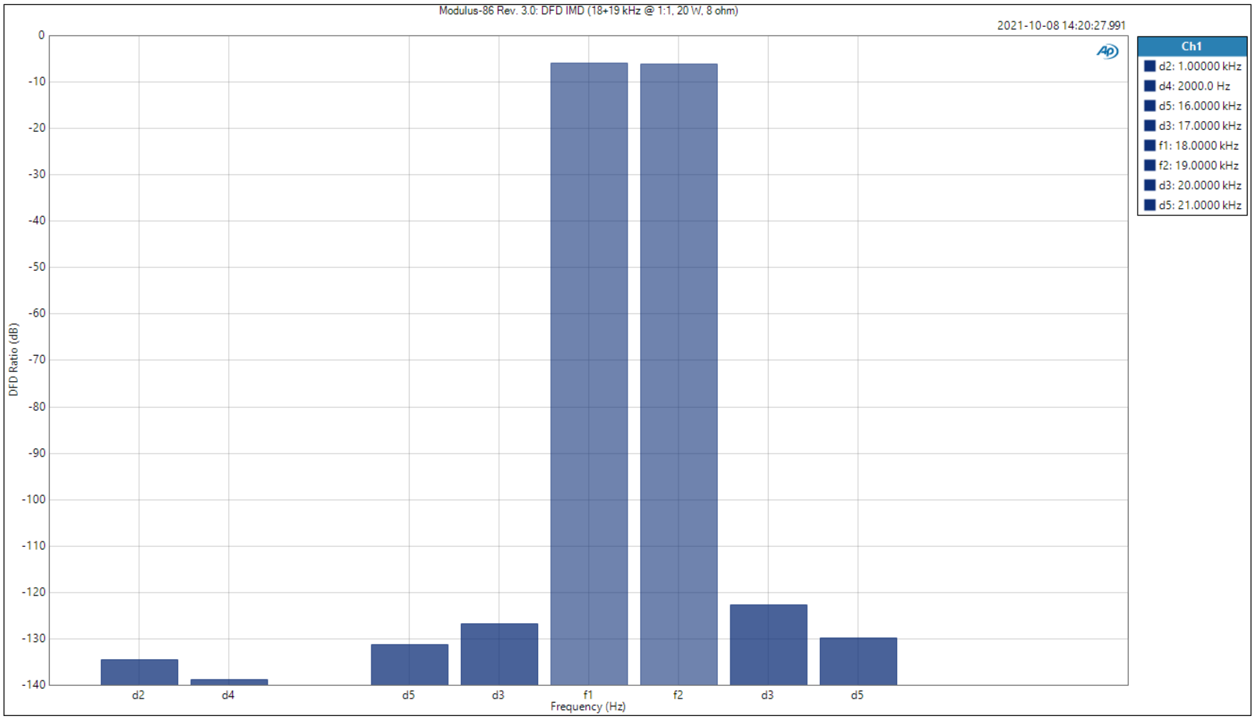
Siegfried Linkwitz argues that the 1 kHz + 5.5 kHz intermodulation distortion (IMD) measurement correlates well with the perceived sound quality. He bases this argument on the fact that IMD products in this measurement fall in the frequency range where the ear is the most sensitive.

The graph below shows the result of this measurement with the Modulus-86. Note that due to a limitation in the DFD IMD source of the APx555B, the frequencies used must be an integer multiple of each other. Thus, the measurement was performed at 917 Hz (5500/6) + 5.5 kHz. Note that the performance of the Modulus-86 is over 20 dB better than the performance of any of the amps shown on Linkwitz's website.

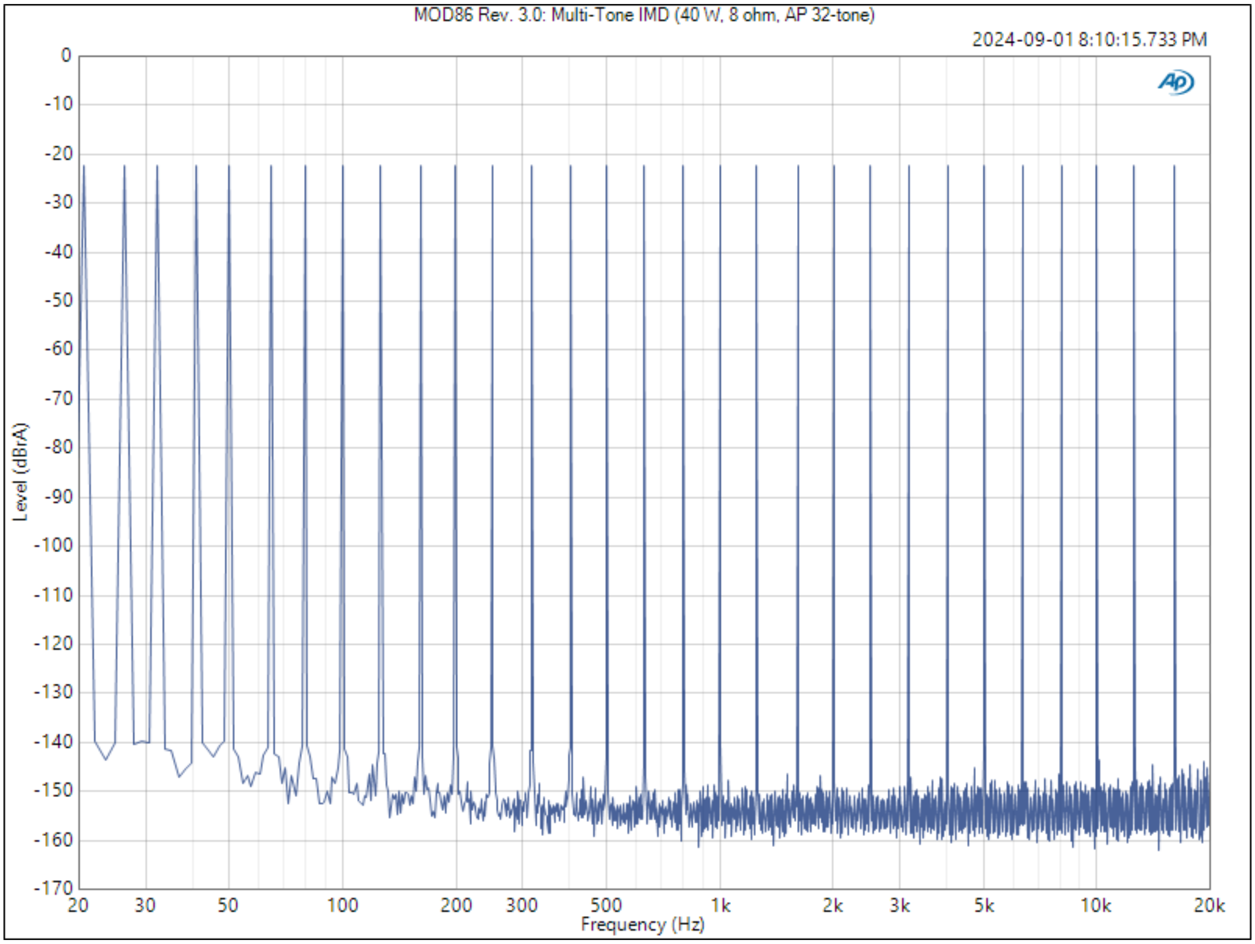


The more conventional IMD measurements are shown below. The two plots show the SMPTE (60 Hz + 7 kHz @ 4:1) IMD and DFD (18 kHz + 19 kHz @ 1:1) IMD, respectively. Poor SMPTE IMD is often indicative of thermal issues or power supply issues in the amp. The 18k+19k IMD is indicative of the loop gain available in the amp near the end of the audible spectrum, which can be telling of an amplifier's sound quality. The Modulus-86 provides excellent performance on both of these measurements.



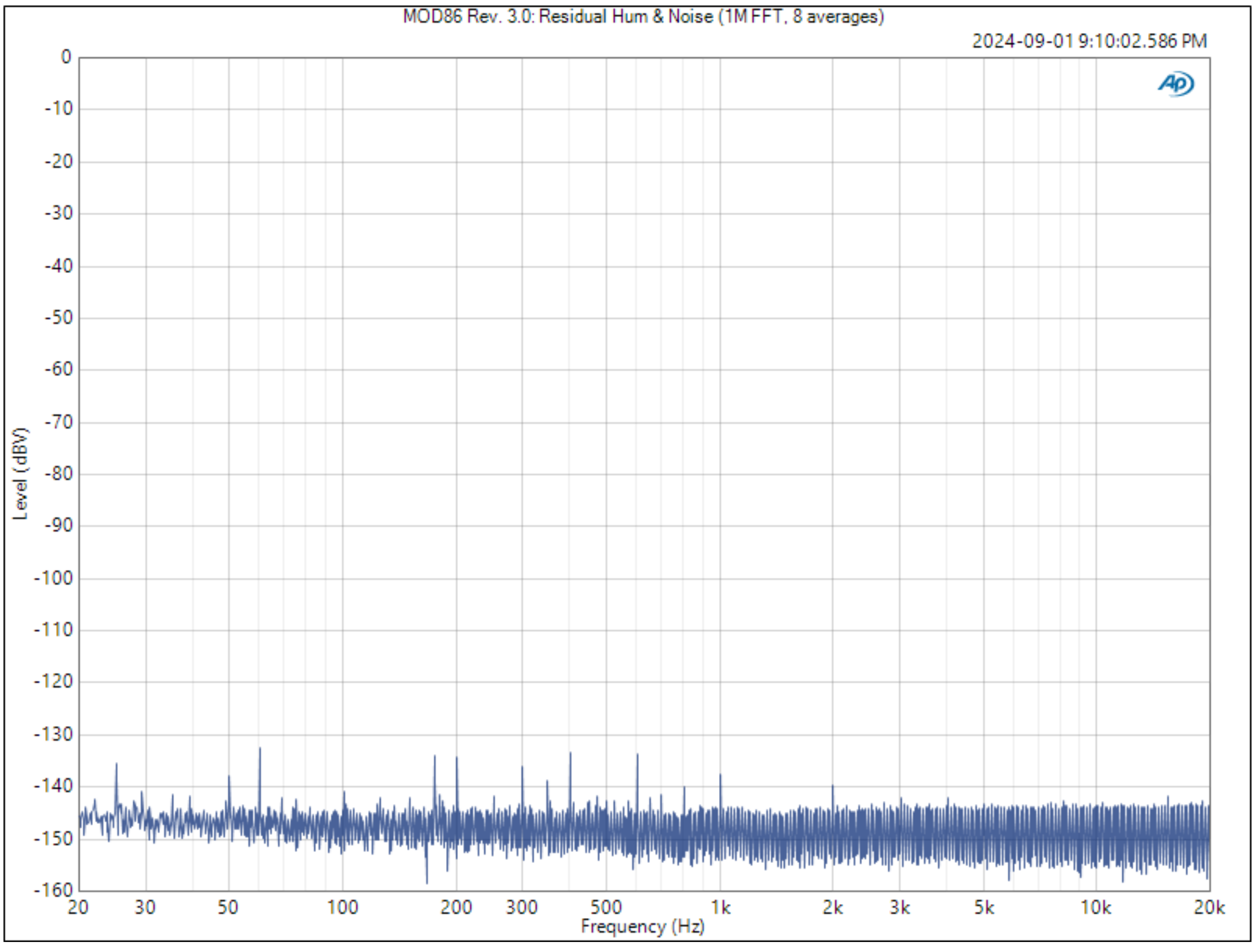

Modulus-86 Rev. 3.0: DFD IMD (18+19 kHz @ 1:1, 20 W, 8 ohm)
2021-10-08 14:20:27.991
Ch1
d2: 1.00000 kHz
d4: 2000.0 Hz
d5: 16.0000 kHz
d3: 17.0000 kHz
f1: 18.0000 kHz
f2: 19.0000 kHz
d3: 20.0000 kHz
d5: 21.0000 kHz
DFD Ratio (dB)
Frequency (Hz)
d2
d4
d5
d3
f1
f2
d3
d5

Audio Precision has developed a multi-tone test signal, which contains 32 tones from 15 Hz to 20 kHz, logarithmically spaced in frequency. This test signal sounds a bit like an out-of-tune pipe organ. It is the best approximation to music available in a deterministic test signal. Thus, this multi-tone signal should be used in an IMD test for the best correlation between measurements and perceived sound quality. This test is run just below clipping (40 W, 8 Ω). Note that even the tallest IMD components are at least 140 dB below clipping level!



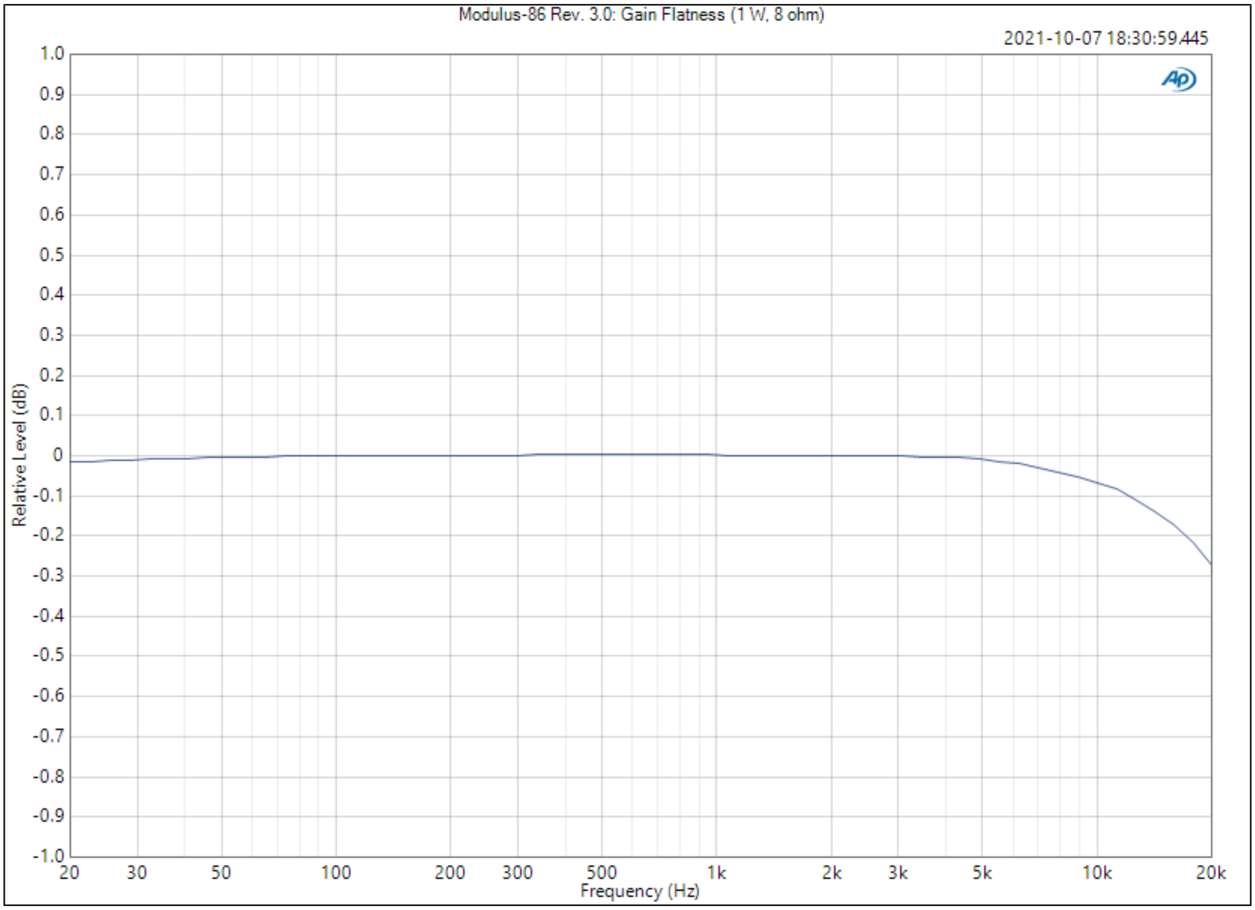
Residual Mains Hum and Noise

The Modulus-86 shows only a tiny amount of residual mains hum. Note that this measurement was taken with the amplifier board sitting unshielded on a lab bench, thus, actual performance once enclosed in a metal chassis will be better. The plot below shows the noise floor of the amplifier when powered by a pair of well-regulated laboratory power supplies (HP 6654A).

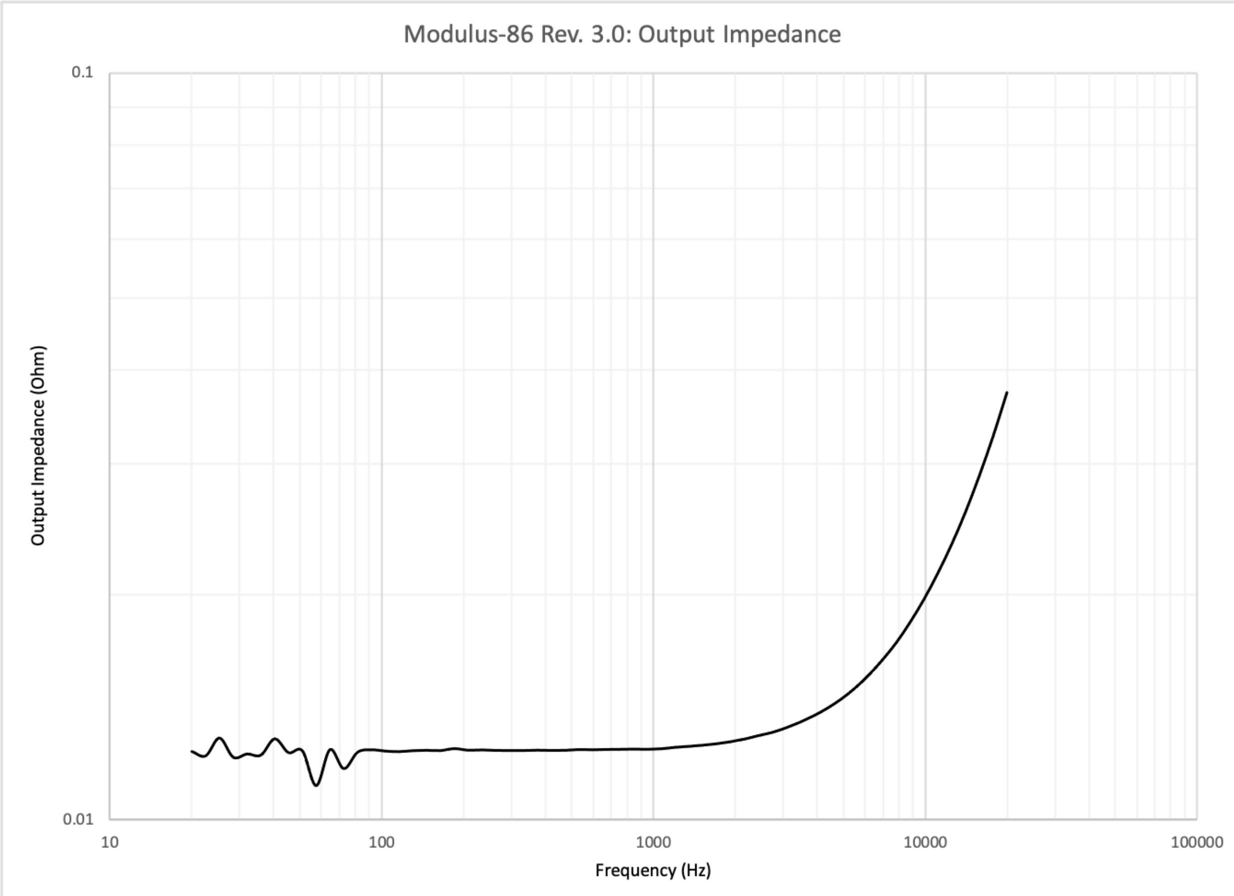


Gain Flatness, Output Impedance, and Damping Factor

The gain flatness of the Modulus-86 is shown below.



The output impedance is shown below.



The corresponding 8 Ω damping factor is shown below.