



**Norwegian Broadcasting Corporation**

**HEGEL H4 Test report.**

Thursday, 17 February 2000  
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## **Introduction.**

The scope of these tests and measurements was to document the Hegel H4 amplifiers audio quality using objective tests.

## **Summary and conclusions.**

The Hegel H4 represents the best of the amplifiers on the market.

The amplifier has no weak points and excels in all areas.

From our measurements, we can conclude that the H4 has the ability and power reserves to drive even the most challenging speakers on the market.

The amplifier was stable and well behaved into any load we used in our tests.

The distortion figures and background noise levels are very low, probably below audibility at any listening level.

For an amplifier with such a huge power supply, the H4 also behaves very well at power up due to its reliable inrush current circuit.

The mains voltage in our lab dropped to 217 volts RMS when the amplifier was tested at full power, thus the measured maximum output power was somewhat less than expected.

## **Test conditions.**

### Equipment used:

Audio Precision System One Dual Domain audio analyzer

Rohde & Schwartz UPD audio analyser

Tektronix TDS410A digitizing oscilloscope

4 & 8 ohms resistive loads

NRK Baxendall test equipment

### Unless otherwise stated the following conditions apply:

$Z_{gen} = 50 \Omega$  balanced

$Z_{load} = 8 \Omega$

$T_{amb} = 22 \text{ }^\circ\text{C}$

$U_{mains} = 225 \text{ Volts RMS}$

Both channels are driven

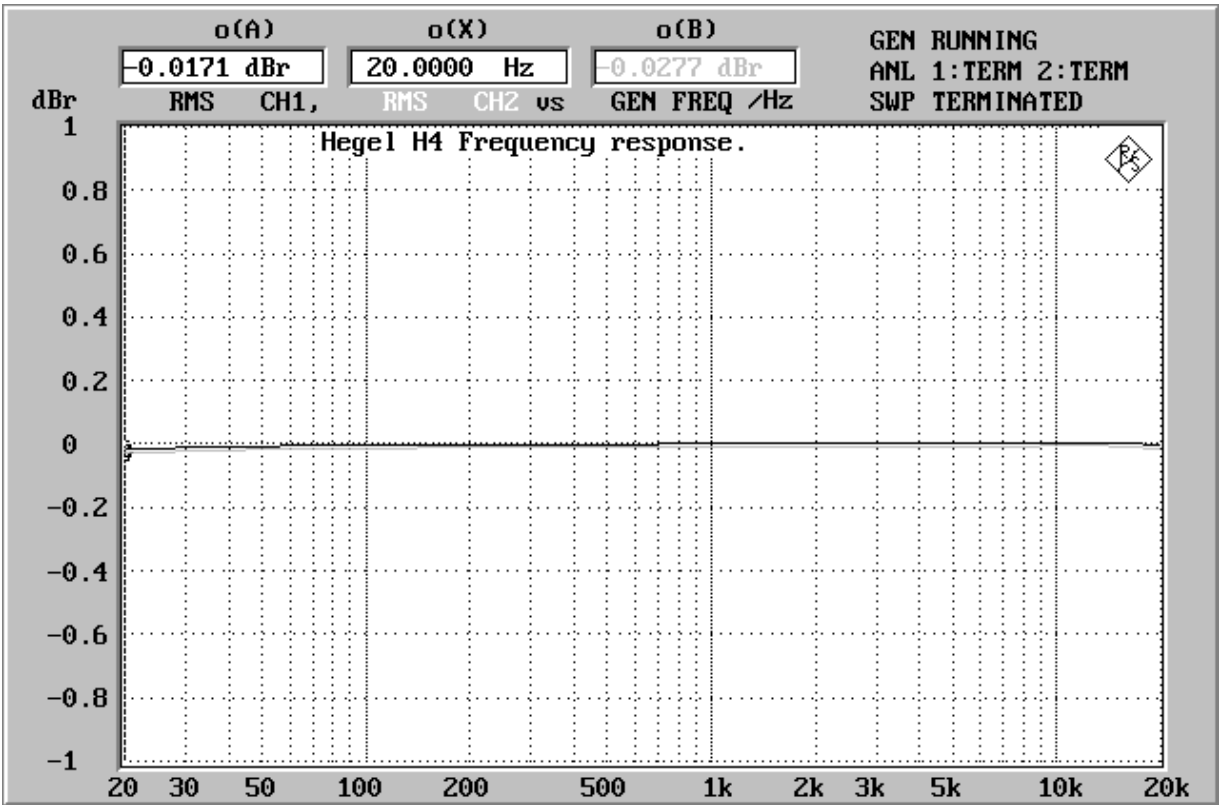
Left channel is solid lines on AP plots

Right channel is dotted lines on AP plots

### "Preconditioning":

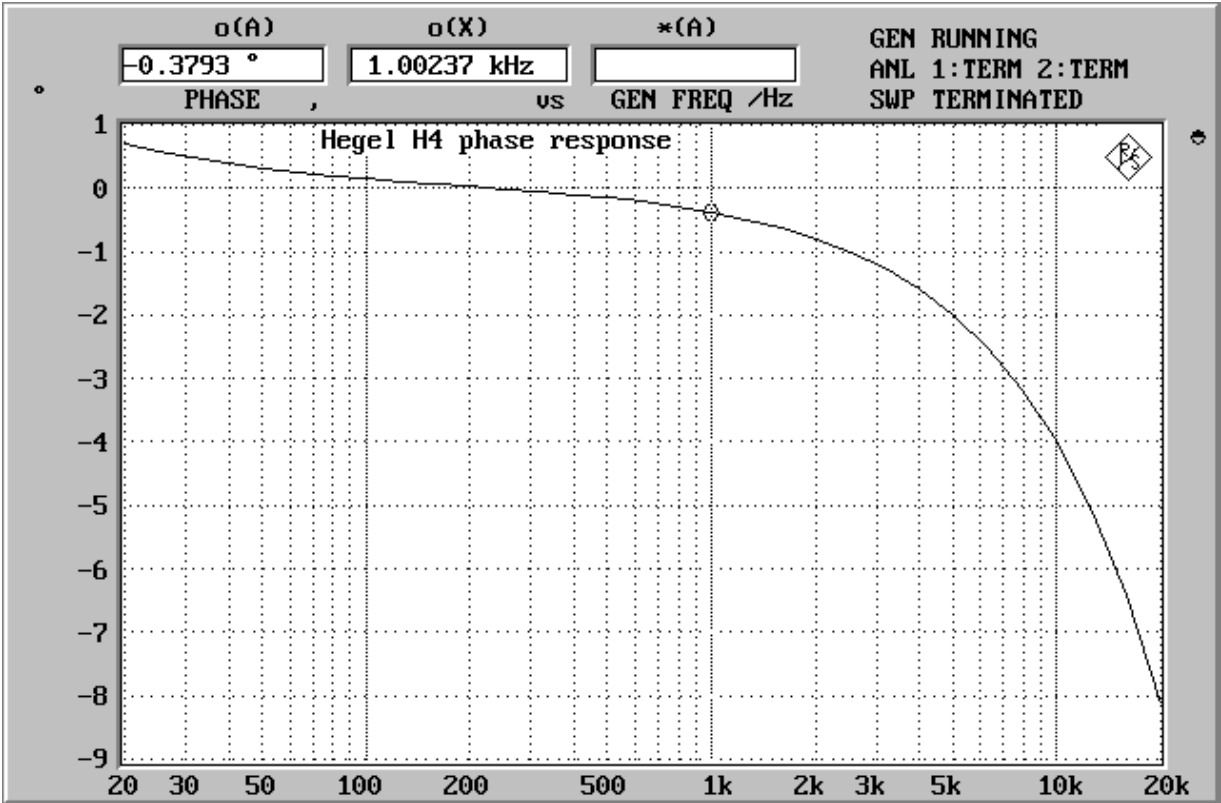
The amplifier was warmed up prior to the measurements.

Frequency response.



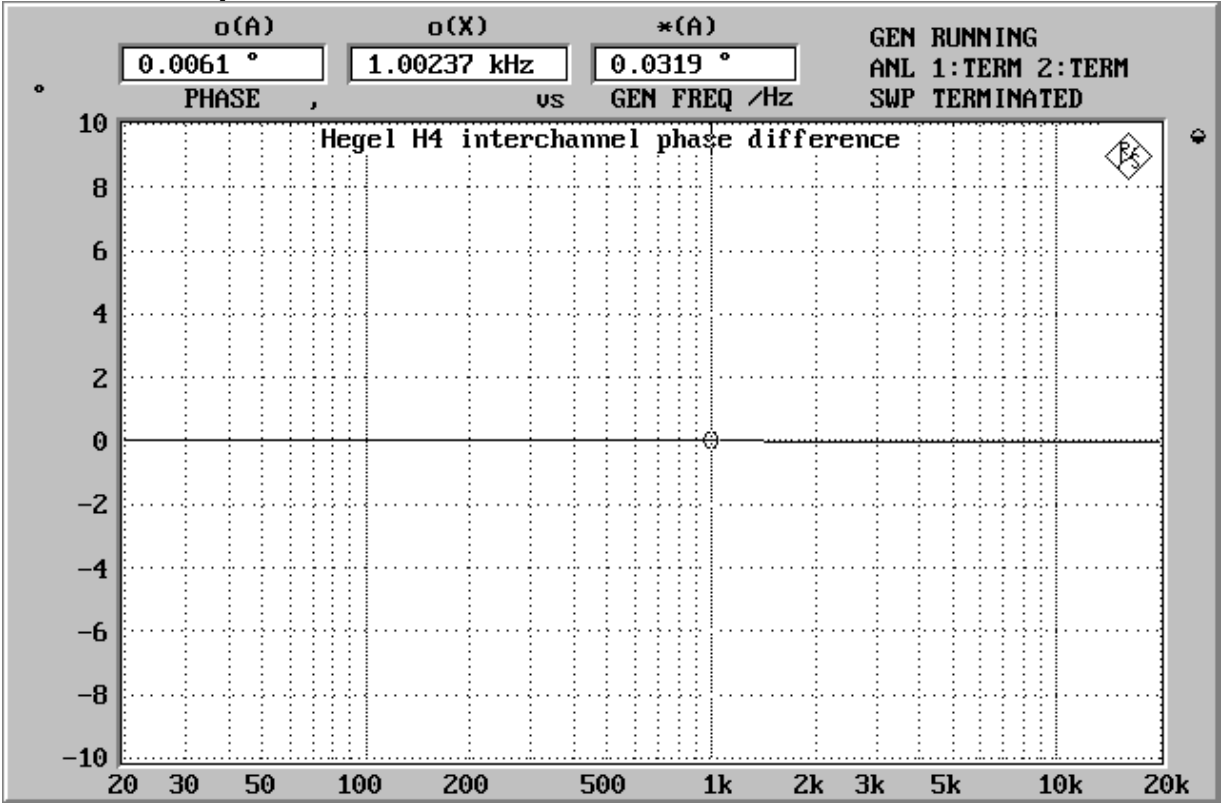
Frequency response measured with output level 10 dB below clipping into 8Ω.

Phase response.



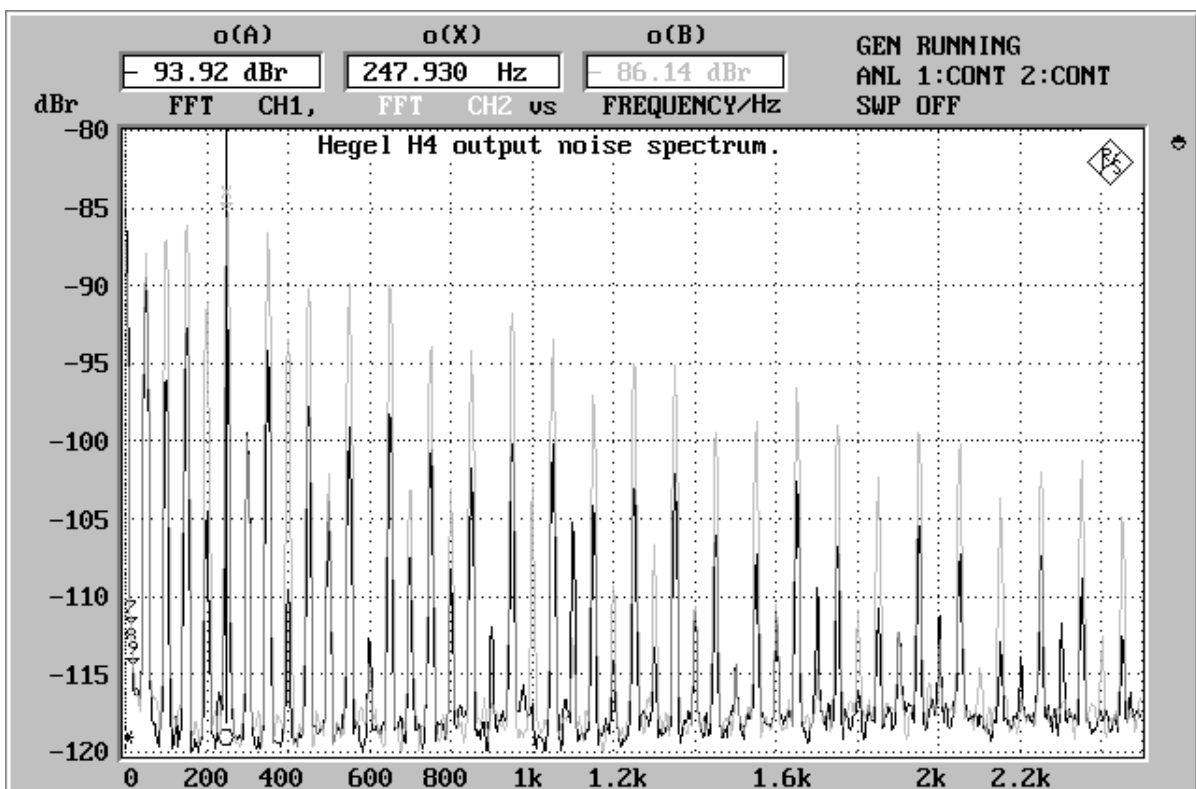
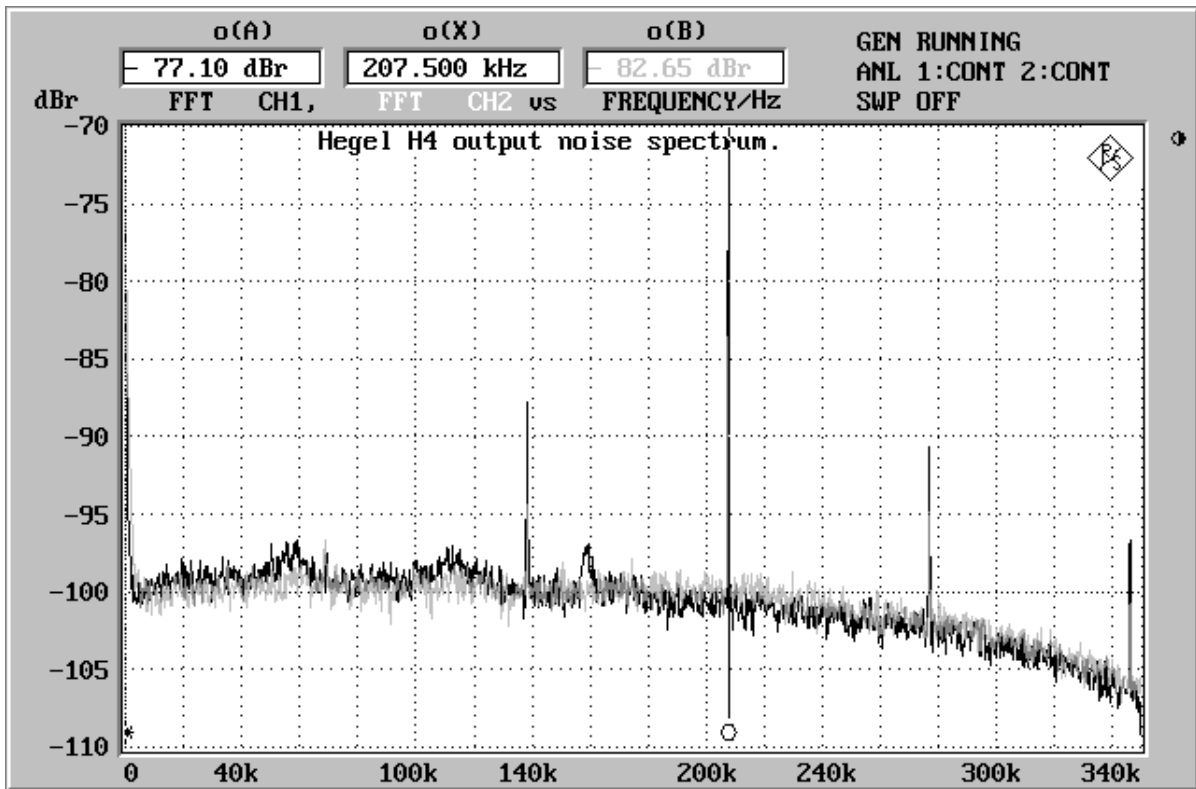
This is the phase difference between the input and output.

Interchannel phase difference.



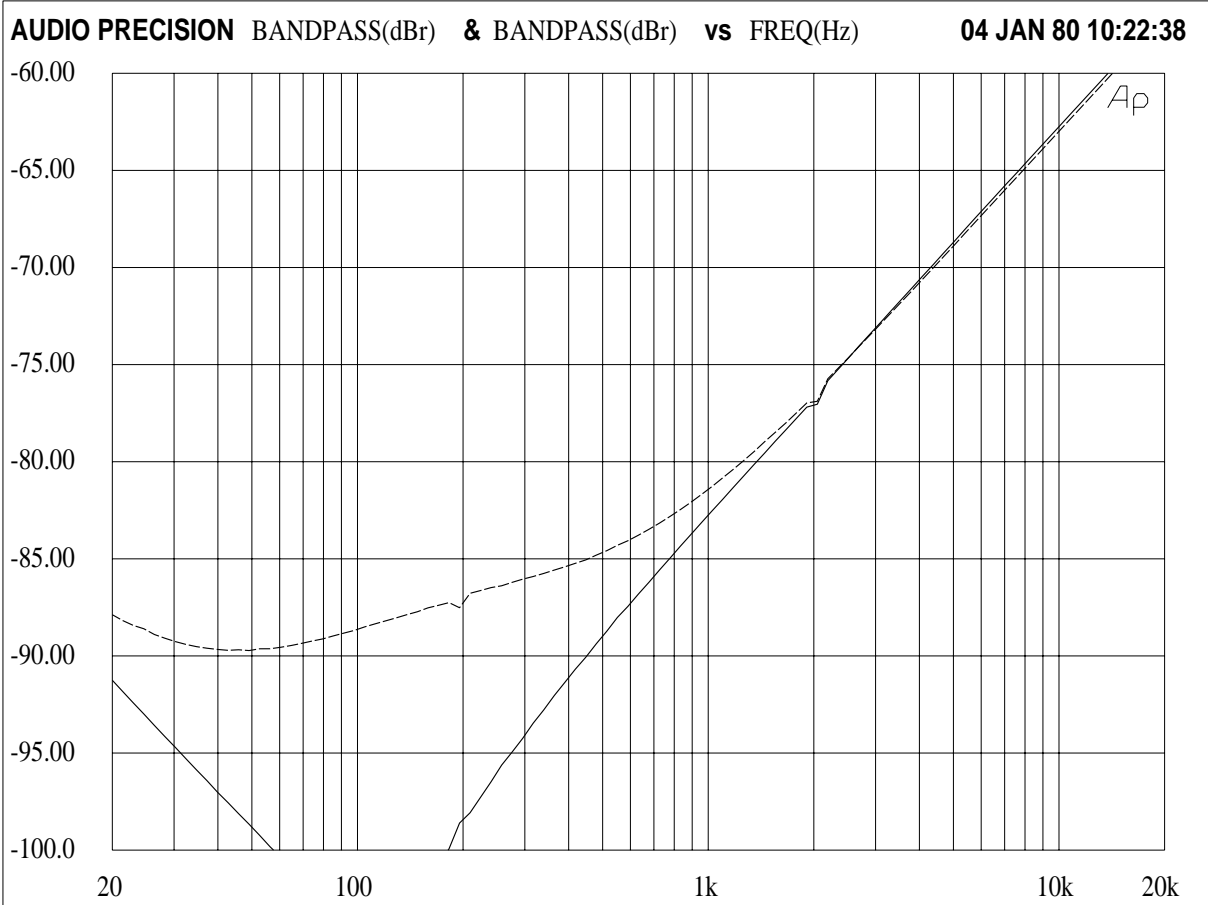
This is the phase difference between the two outputs.

### FFT of output noise.



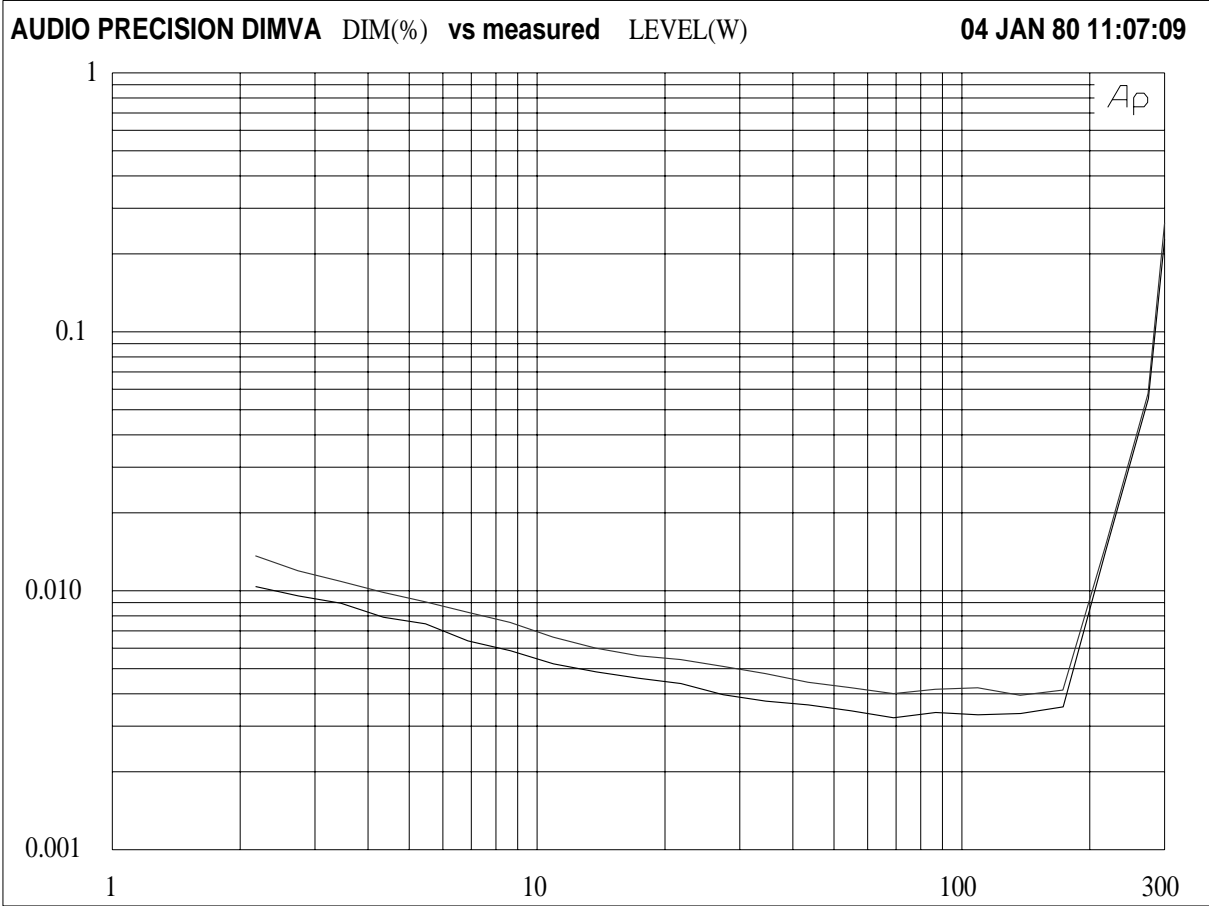
These plots show the signal composition of the output noise with respect to frequency. The dB reference is 2.83V. This is the voltage which produces 1W in an 8Ω load. The sound pressure can be easily calculated if the sensitivity of the loudspeaker is known. If the loudspeaker sensitivity is given to be 90 dB SPL/W, then the levels shown on the graphs will be equal to dB SPL if one adds 90 to them.

**Balanced input common mode rejection ratio v. frequency.**



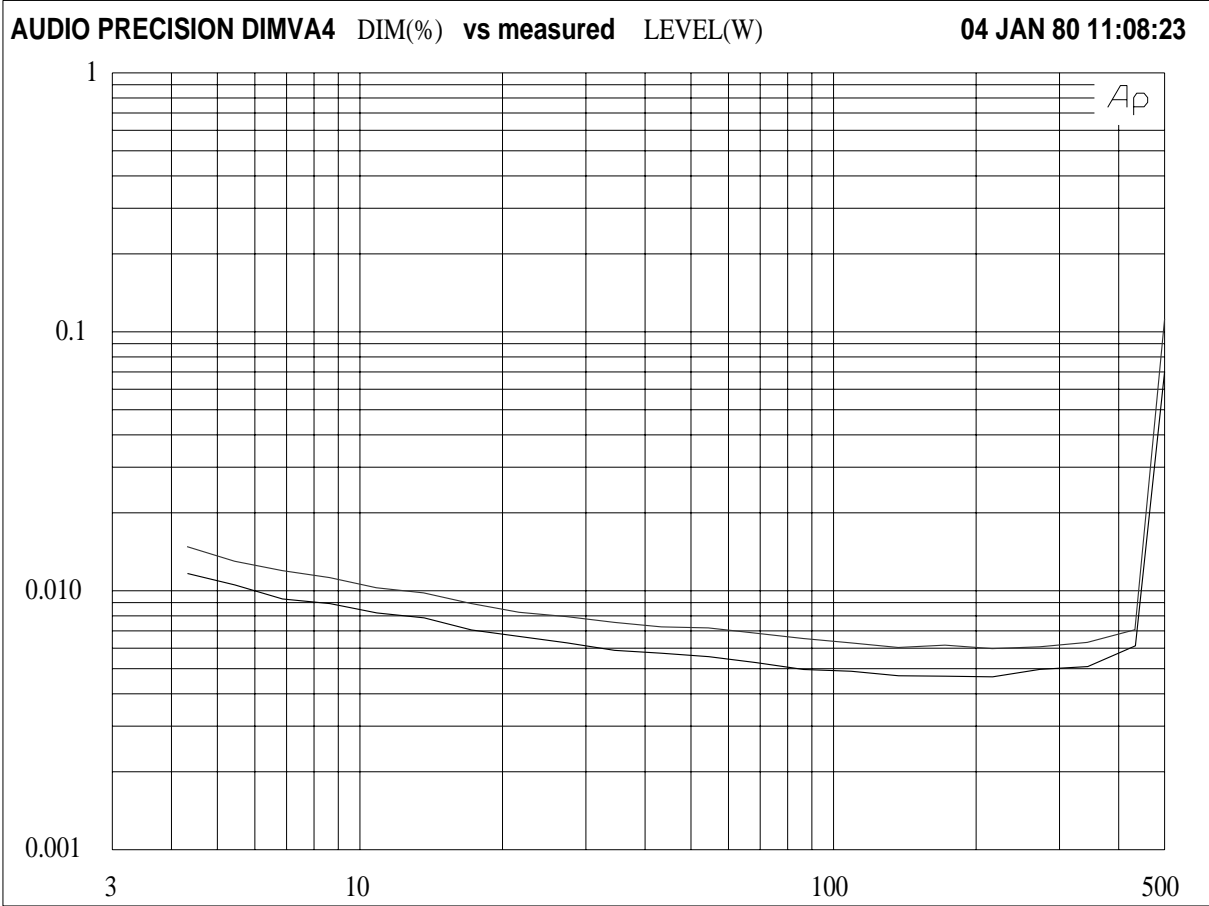
This shows the ability of the balanced input to reject interference signals.

**Dynamic intermodulation distortion v. output level, 8Ω load.**



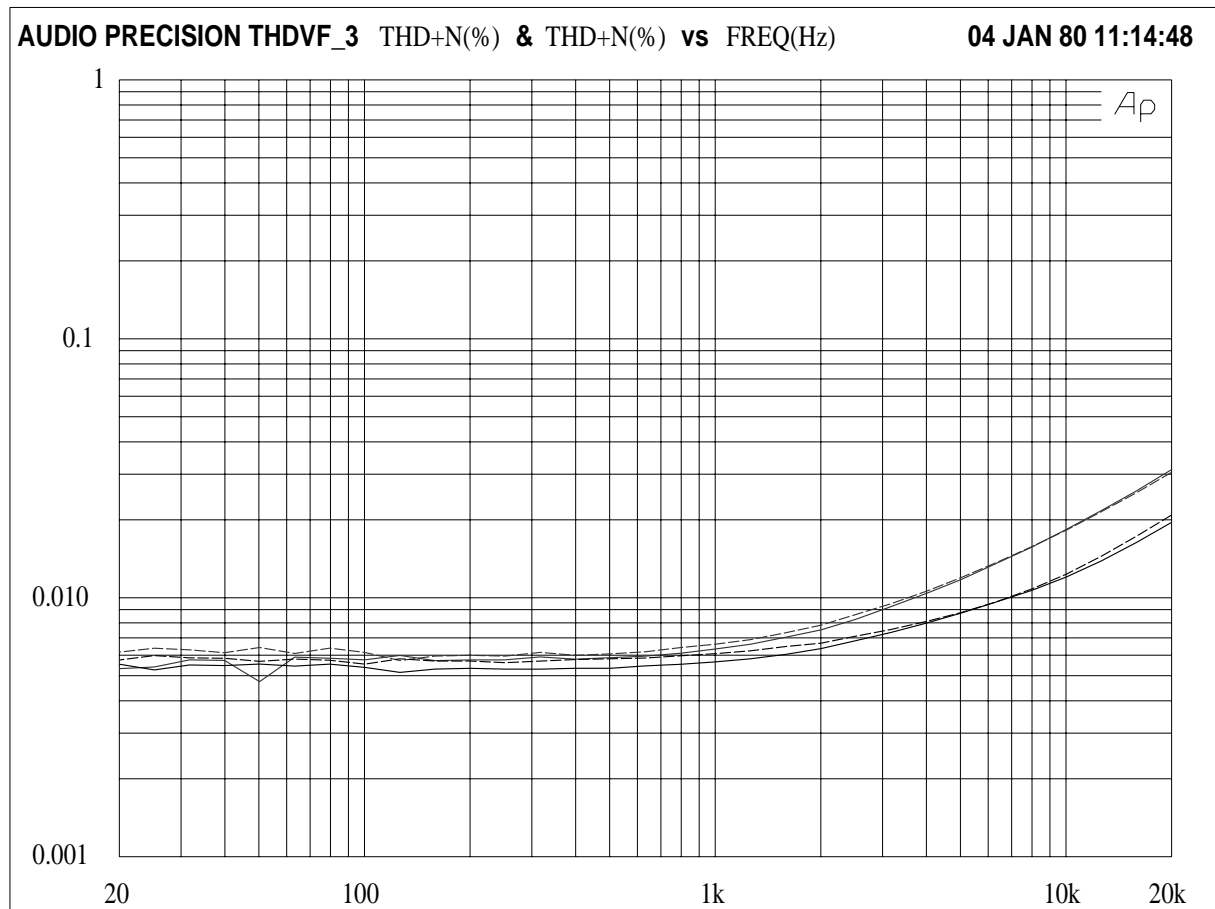
DIM test signal is 3.15 kHz square wave filtered to 100 kHz bandwidth + 15 kHz sine.

**Dynamic intermodulation distortion v. output level, 4Ω load.**



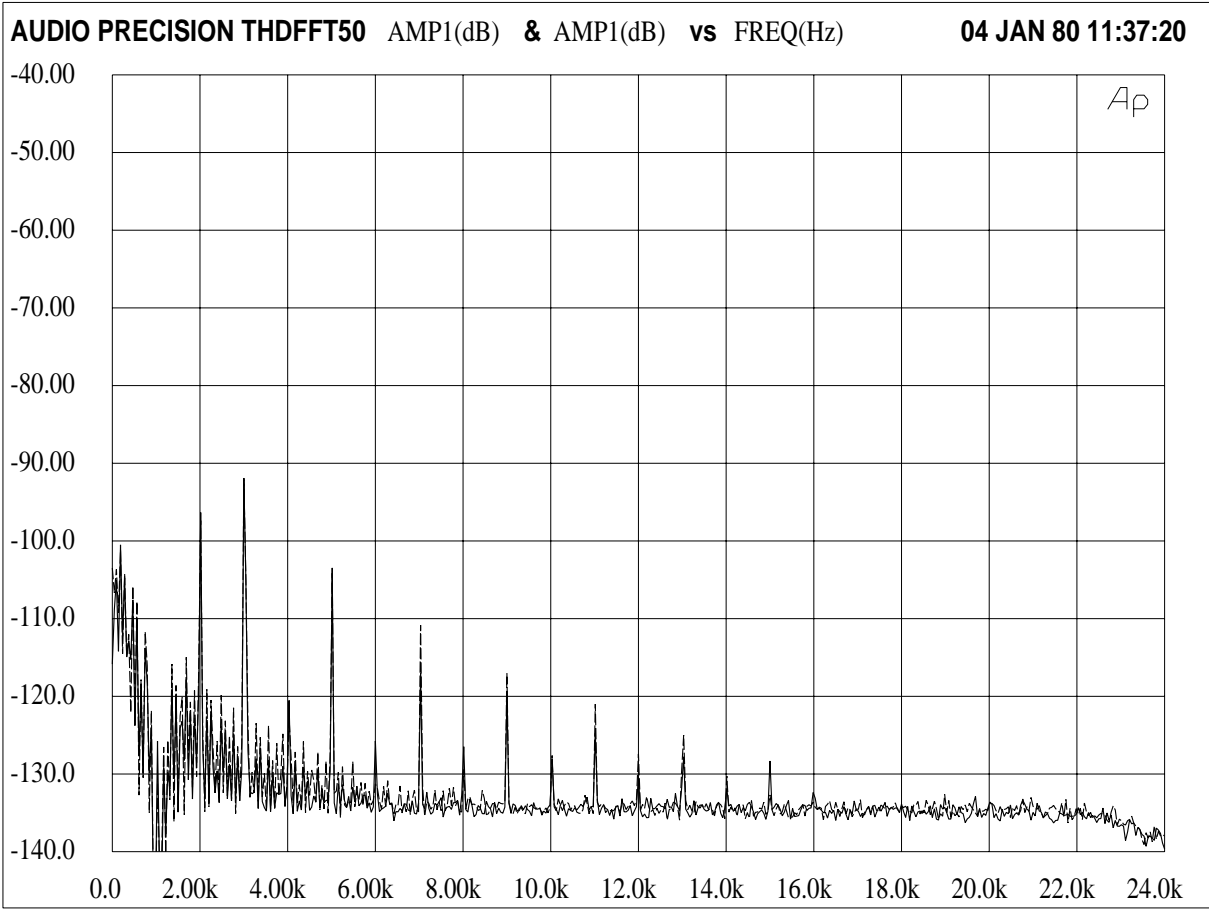
DIM test signal is 3.15 KHz square wave filtered to 100 KHz bandwidth + 15 KHz sine.

### THD+N v. frequency at half power into 8Ω and 4Ω loads.

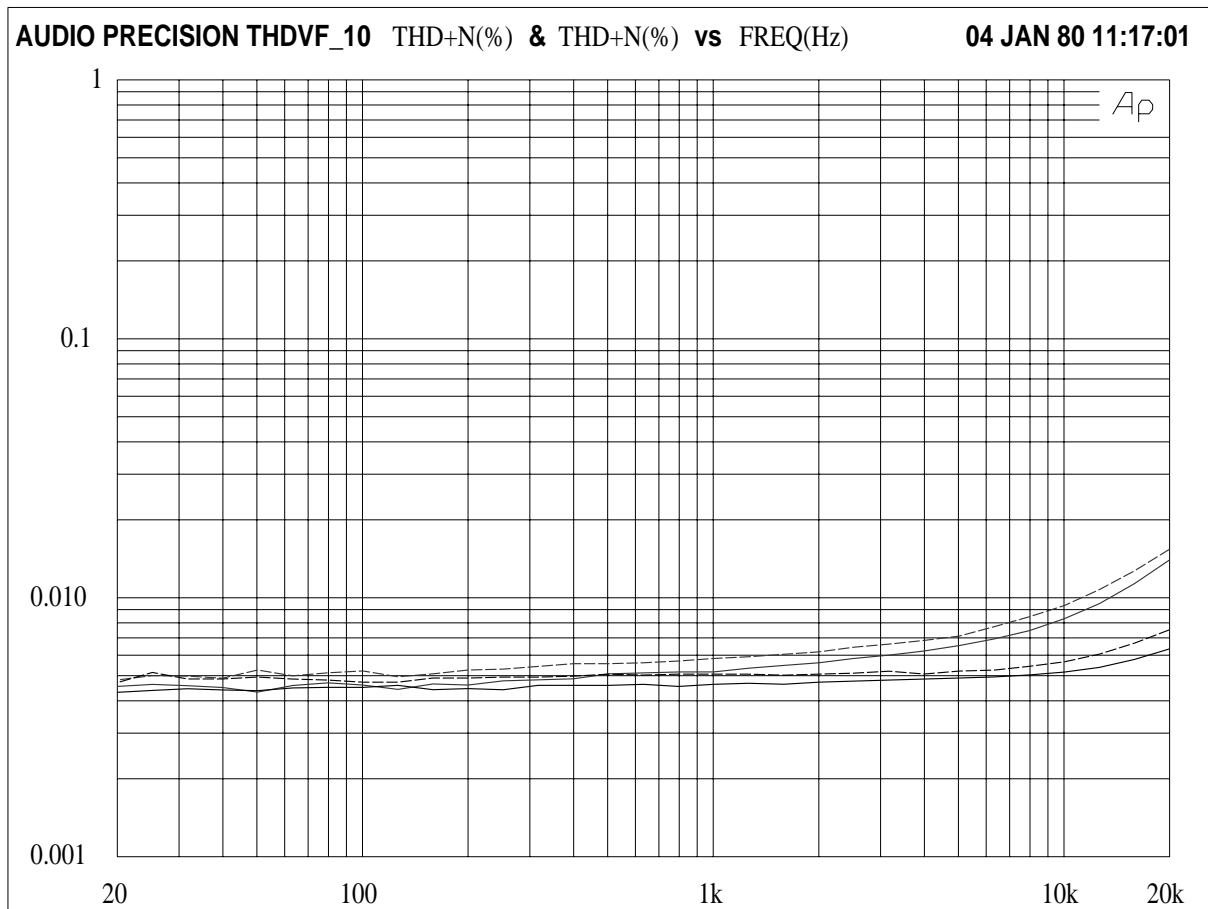


The measurement was made at a power level 3 dB below clipping.  
Measurement bandwidth is >500 kHz.  
The upper curve pair are with a 4 Ω load.

**FFT of 1 kHz 50 W output into 8Ω.**



### THD+N v. frequency at 1/10<sup>th</sup> power into 8Ω and 4Ω loads.

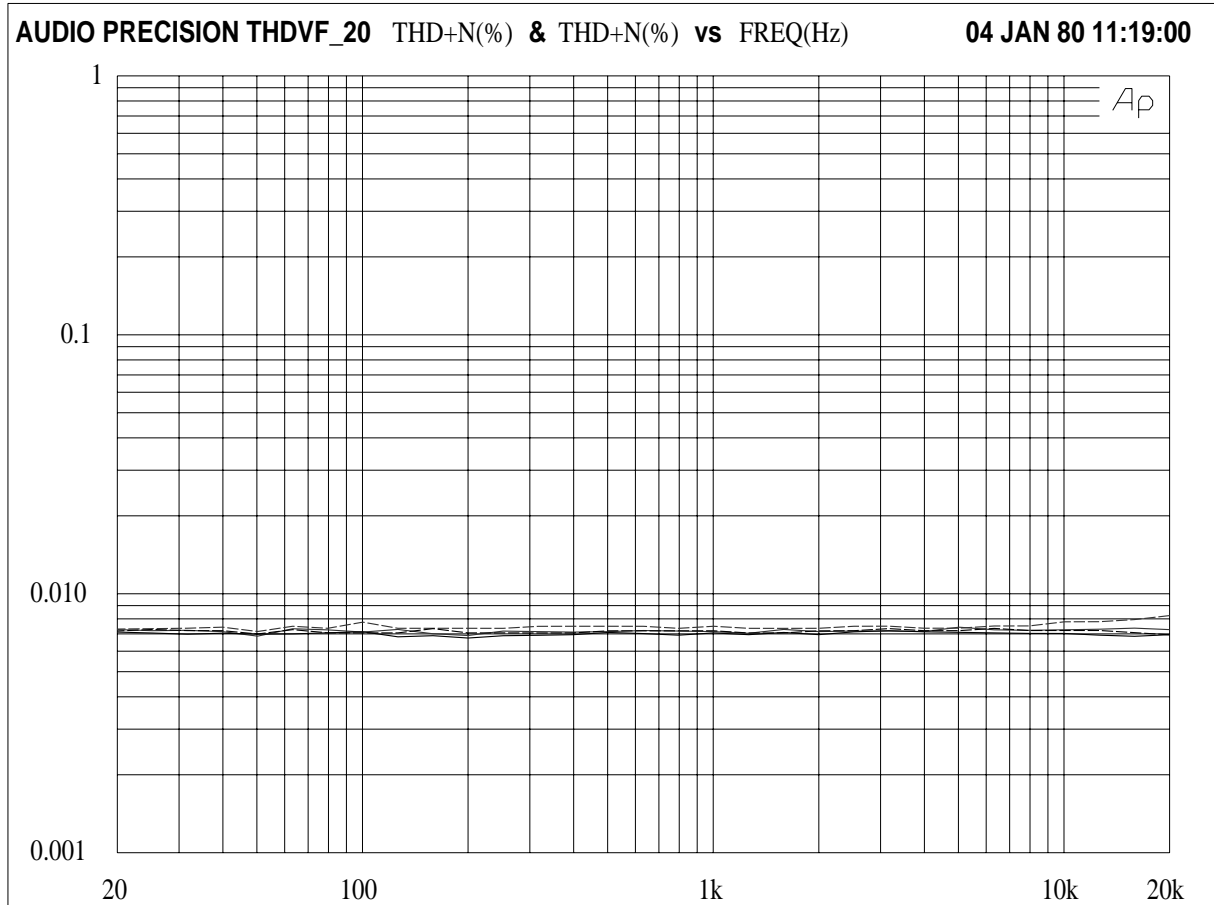


The measurement was made at a power level 10 dB below clipping.

Measurement bandwidth is >500 kHz.

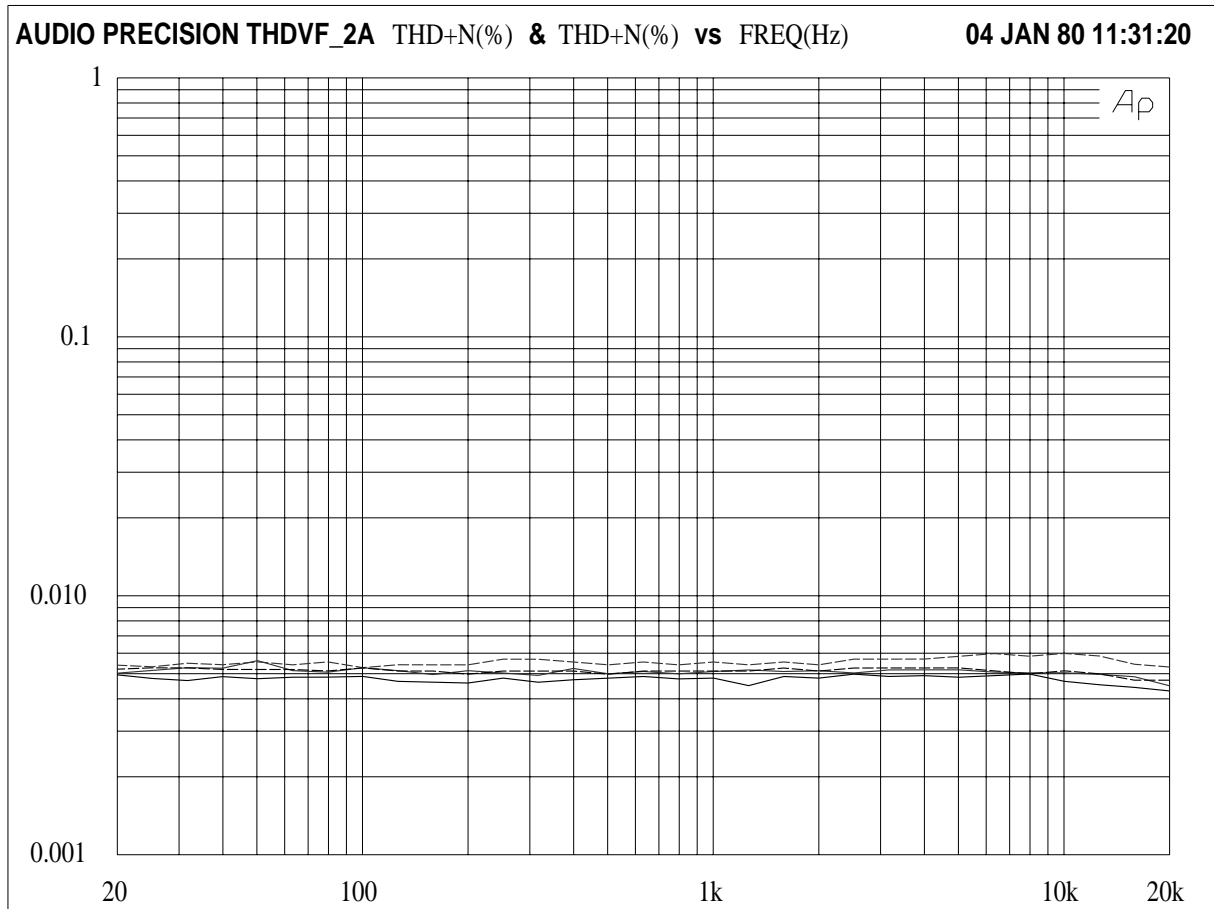
The upper curve pair are with a 4 Ω load.

### THD+N v. frequency at 1/100<sup>th</sup> power into 8Ω and 4Ω loads.



The measurement was made at a power level 20 dB below clipping.  
Measurement bandwidth is >500 kHz.  
The upper curve pair are with a 4 Ω load.

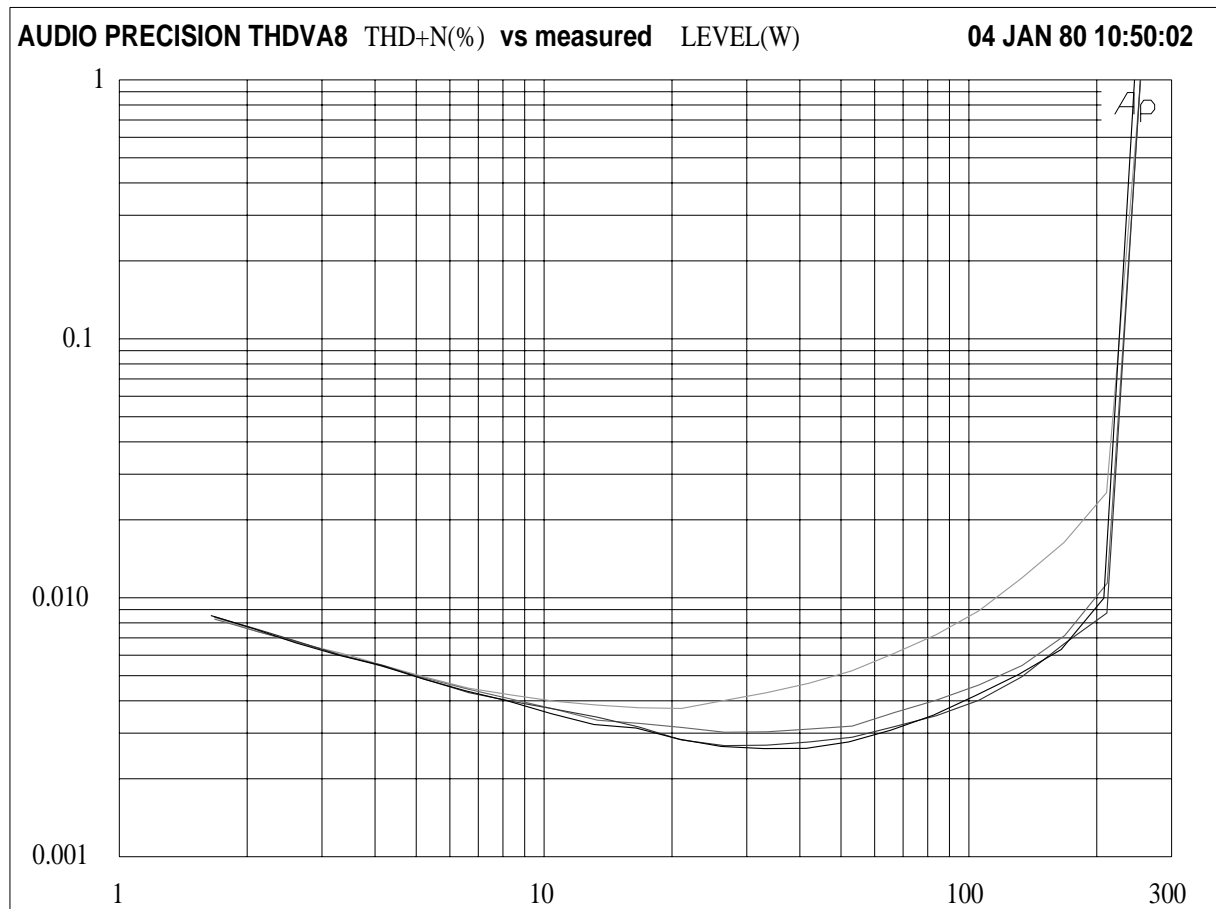
**THD+N v. frequency at 1/100<sup>th</sup> power into 8Ω and 4Ω loads with lower measurement bandwidth.**



The measurement was made at a power level 20 dB below clipping with a 30 kHz measurement bandwidth.

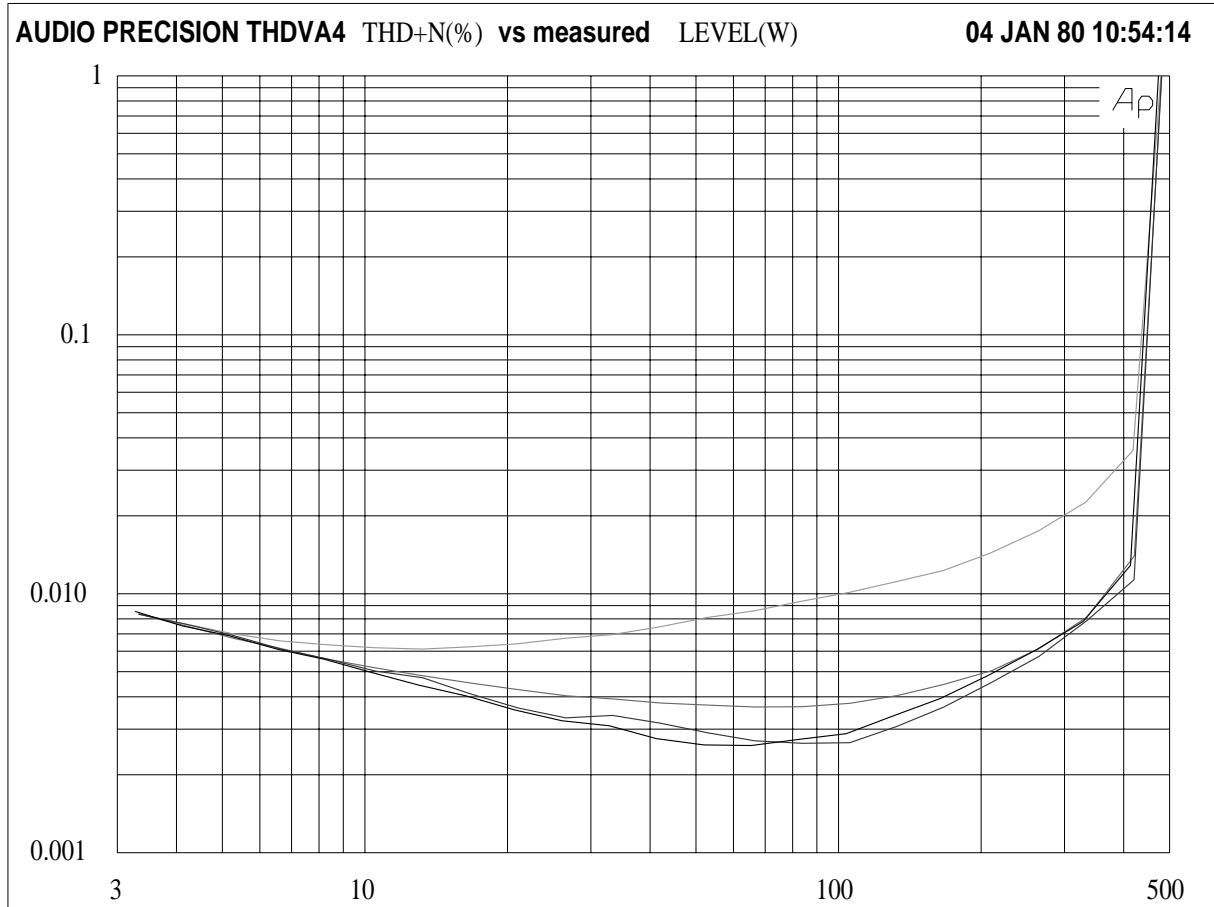
The upper curve pair are with a 4 Ω load.

### THD+N v. output power at 10 Hz, 100 Hz, 1 kHz and 10 kHz. 8Ω load.



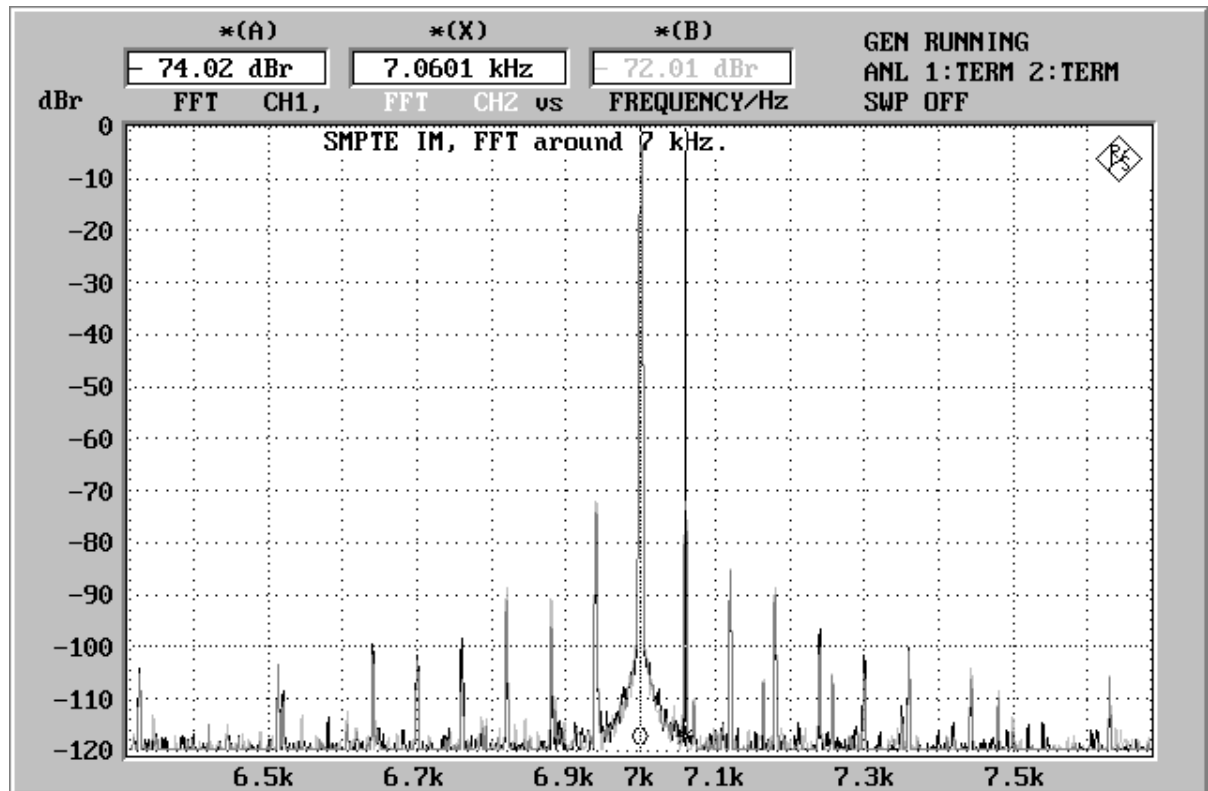
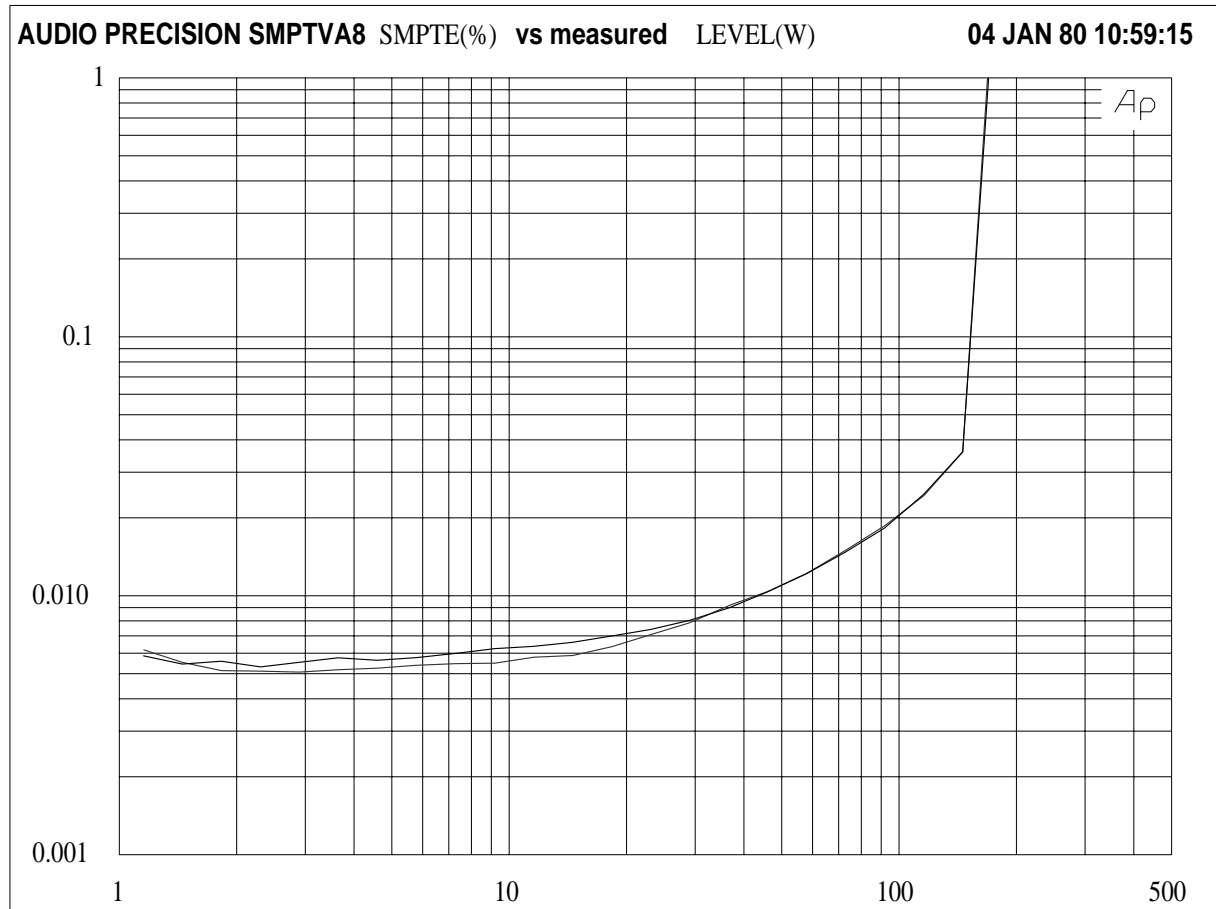
Measurement bandwidth is 80 kHz.  
The darkest curve is the lowest frequency.  
Only one channel was driven.

**THD+N v. output power at 10 Hz, 100 Hz, 1 kHz and 10 kHz. 4Ω load.**



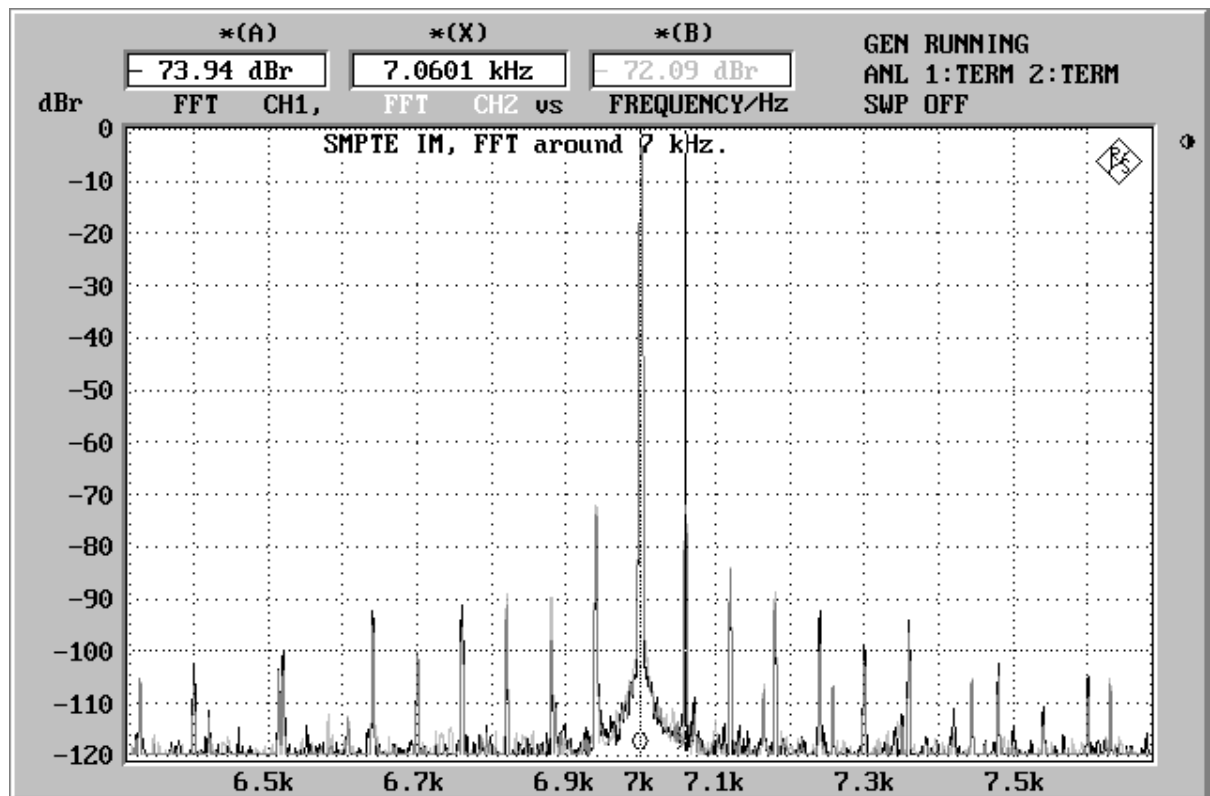
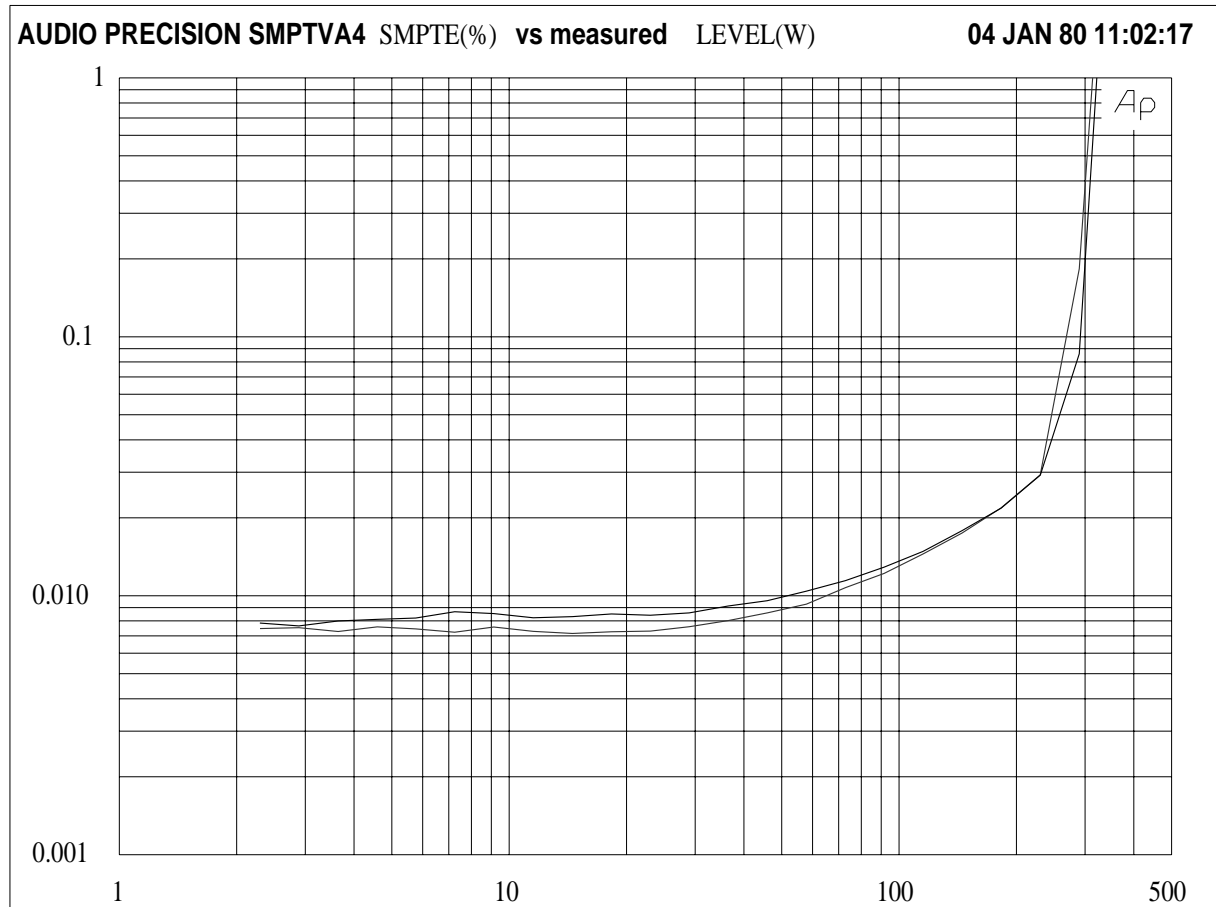
Measurement bandwidth is 80 kHz.  
The darkest curve is the lowest frequency.  
Only one channel was driven.

# SMPTE Intermodulation Distortion v. output power 8 Ω load.



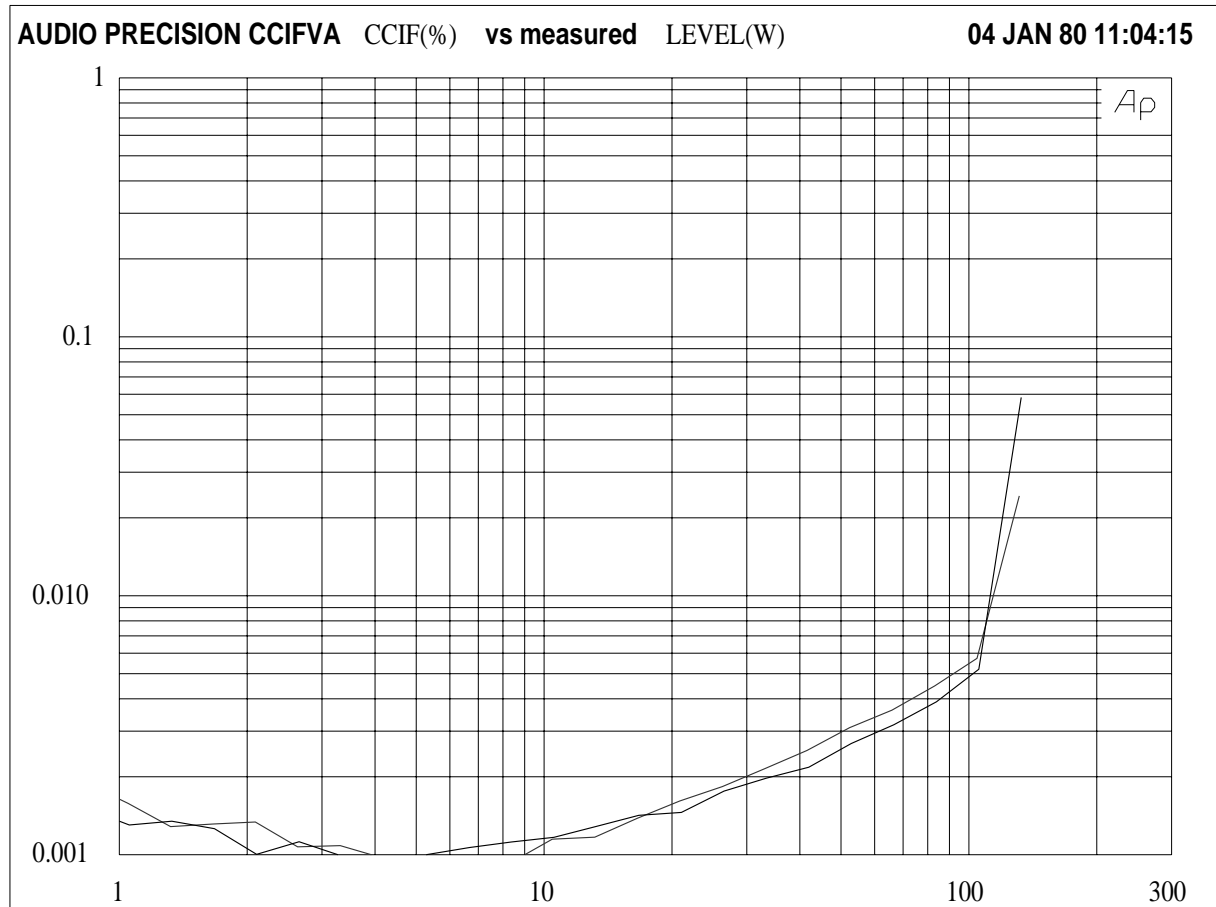
FFT taken with 100W into 8Ω.

# SMPTE Intermodulation Distortion v. output power 4 Ω load.

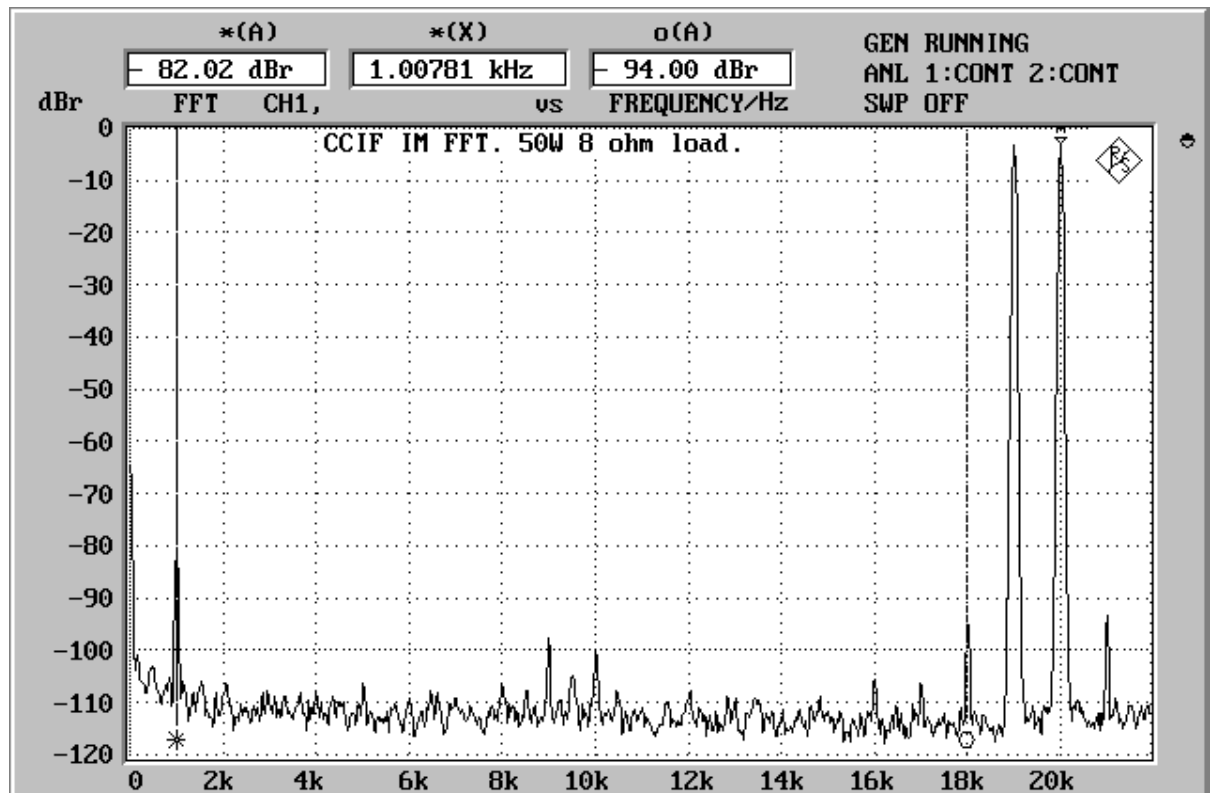


FFT taken with 200W into 4Ω.

**CCIF difference intermodulation distortion v. output power 8 Ω load.**

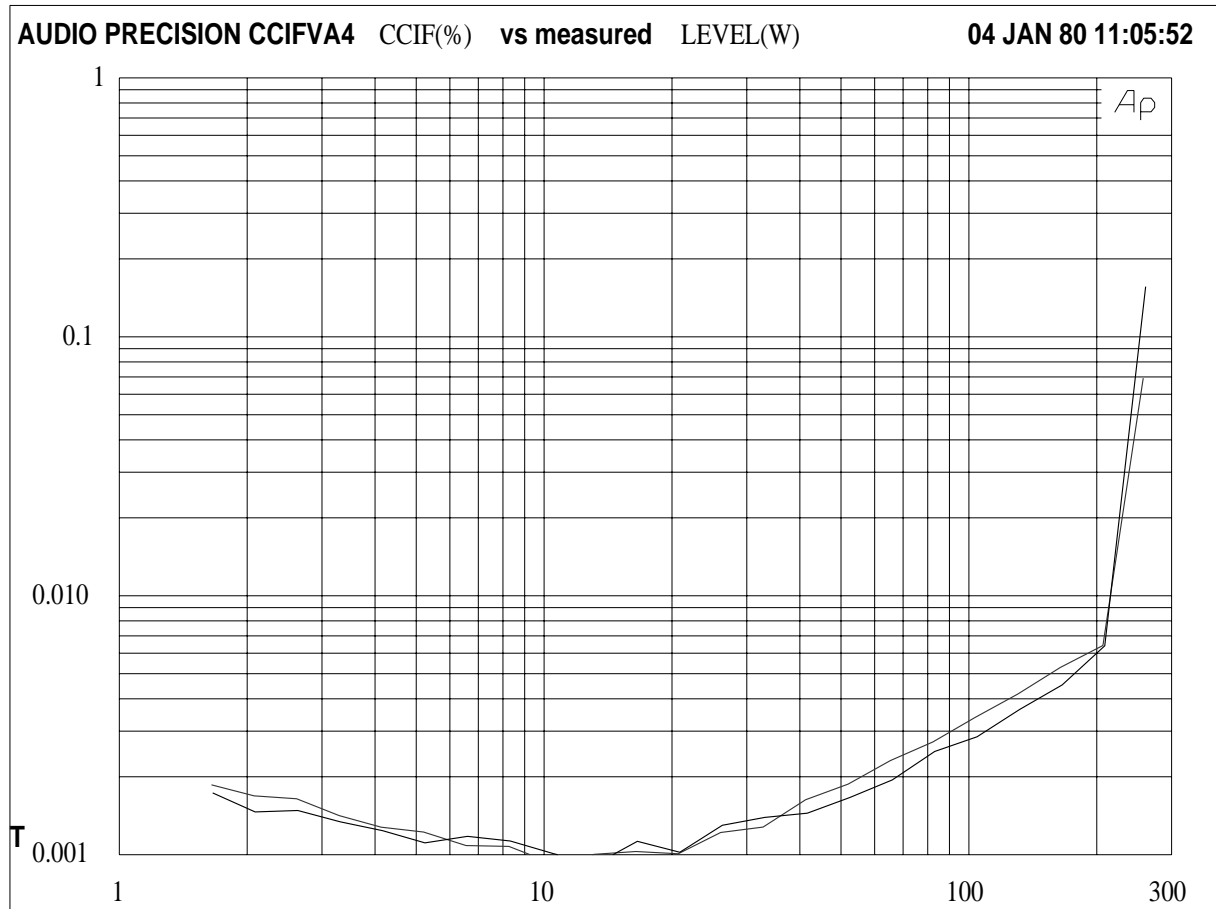


Test signal was 19 kHz + 20 kHz.

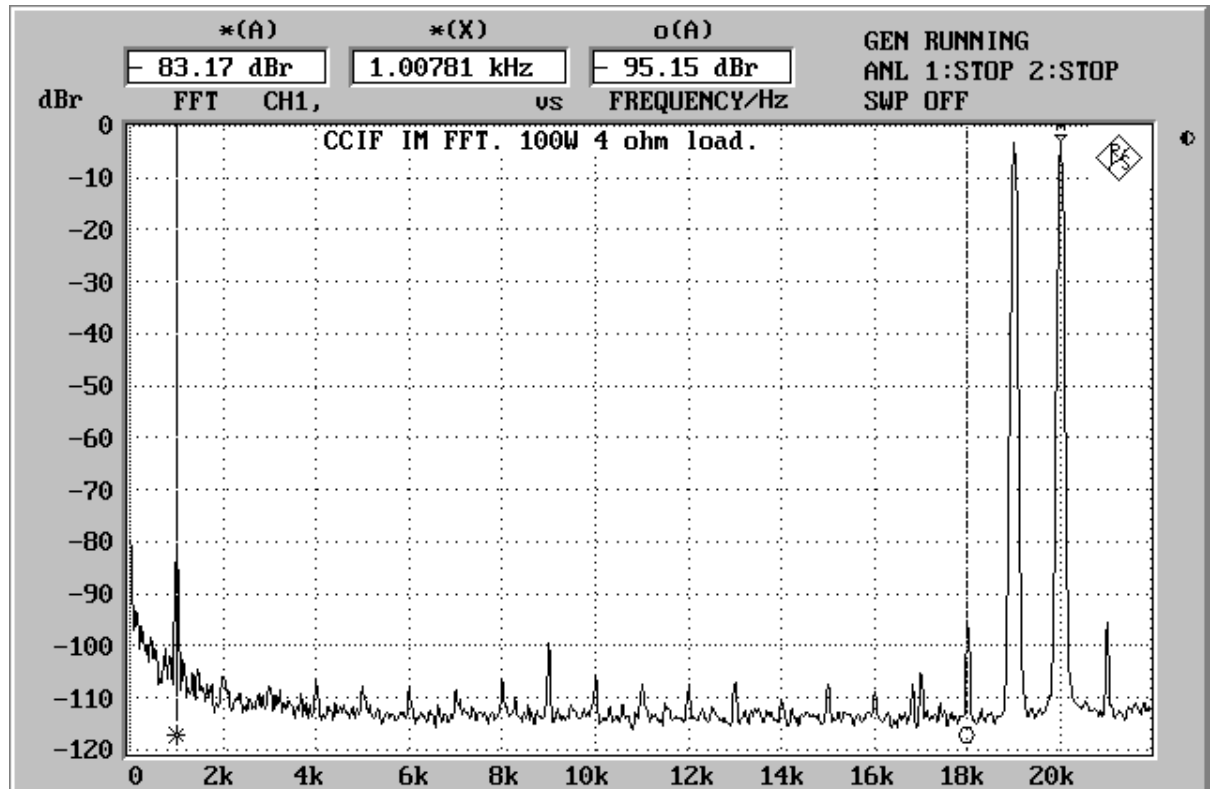


FFT of CCIF output signal at 50W into 8Ω.

**CCIF difference intermodulation distortion v. output power 4 Ω load.**

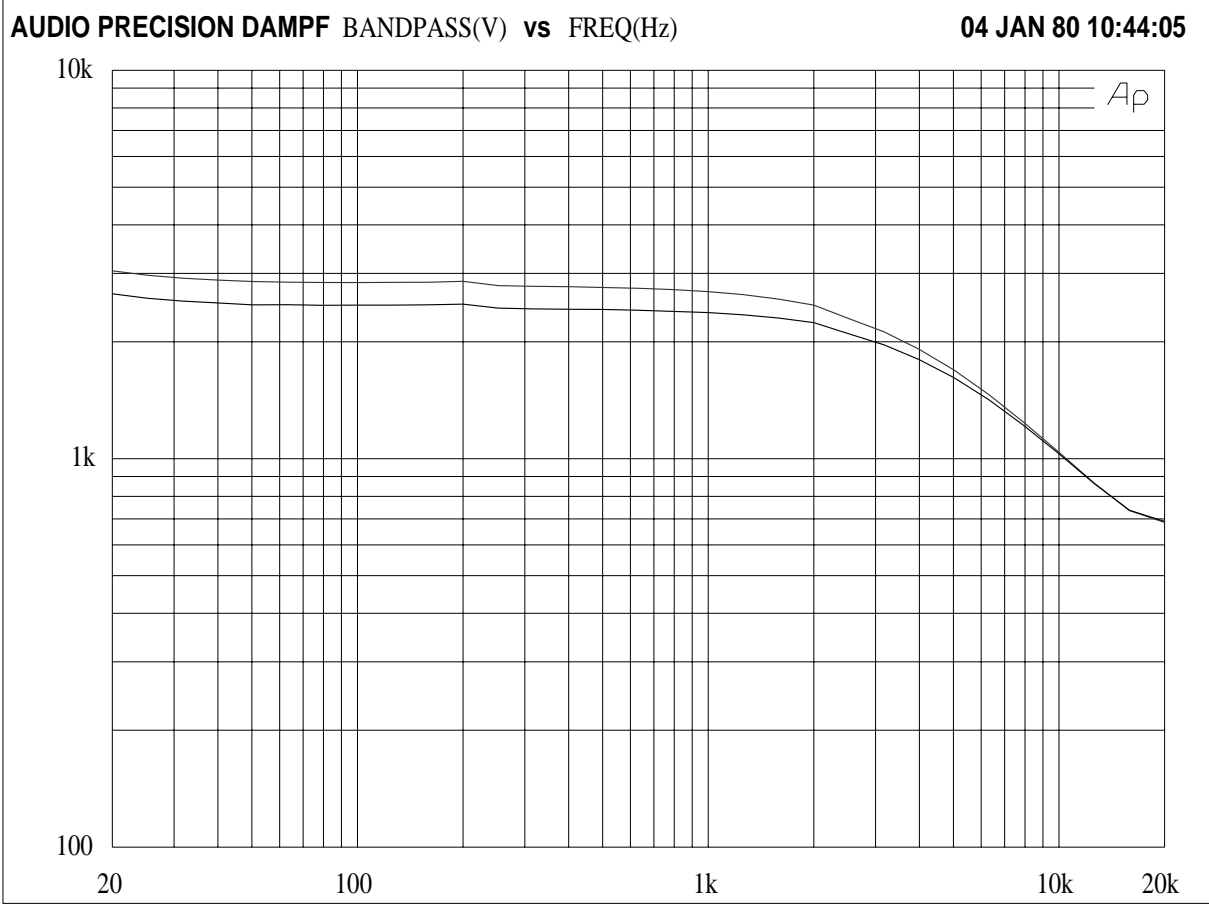


Test signal was 19 kHz + 20 kHz.

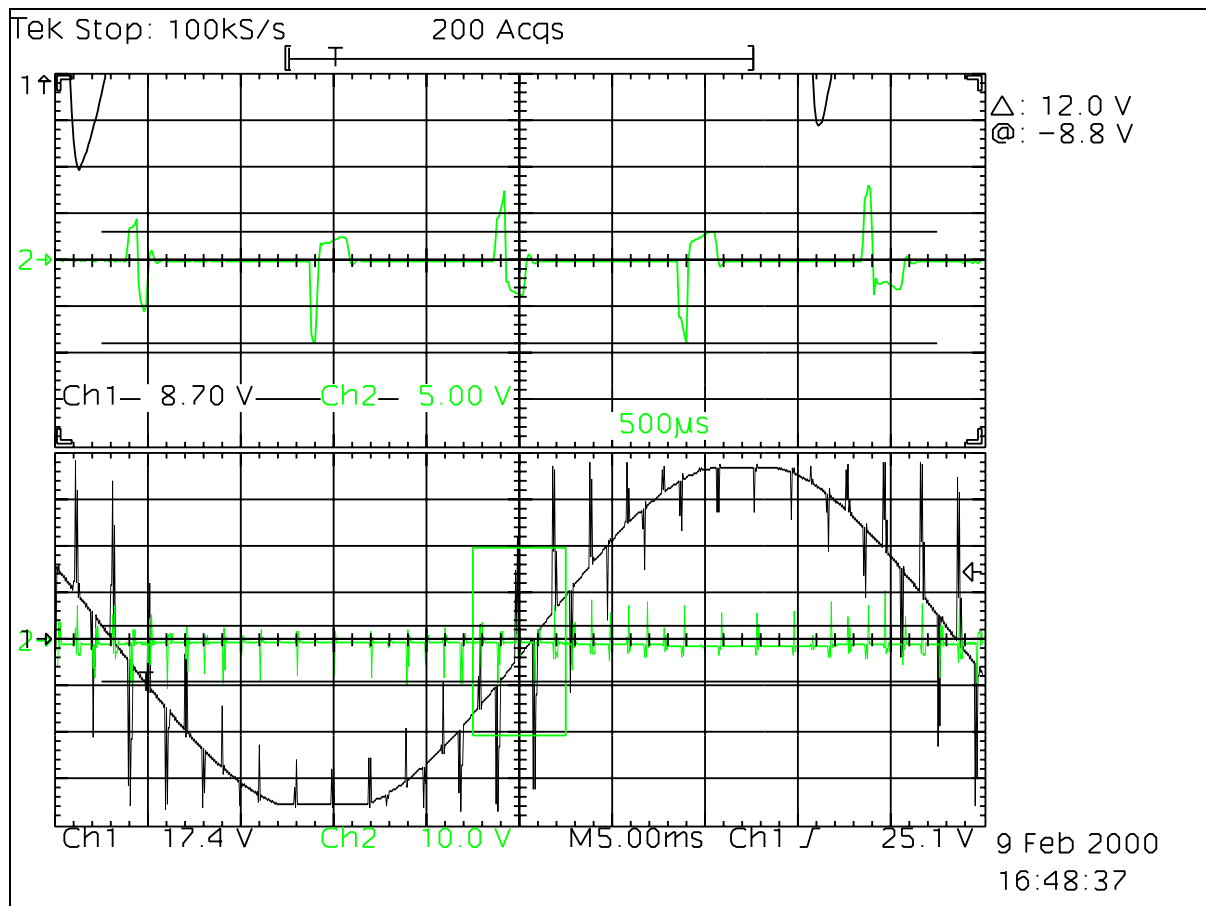


FFT of CCIF output signal at 100W into 4Ω.

**Output damping factor v. frequency.**



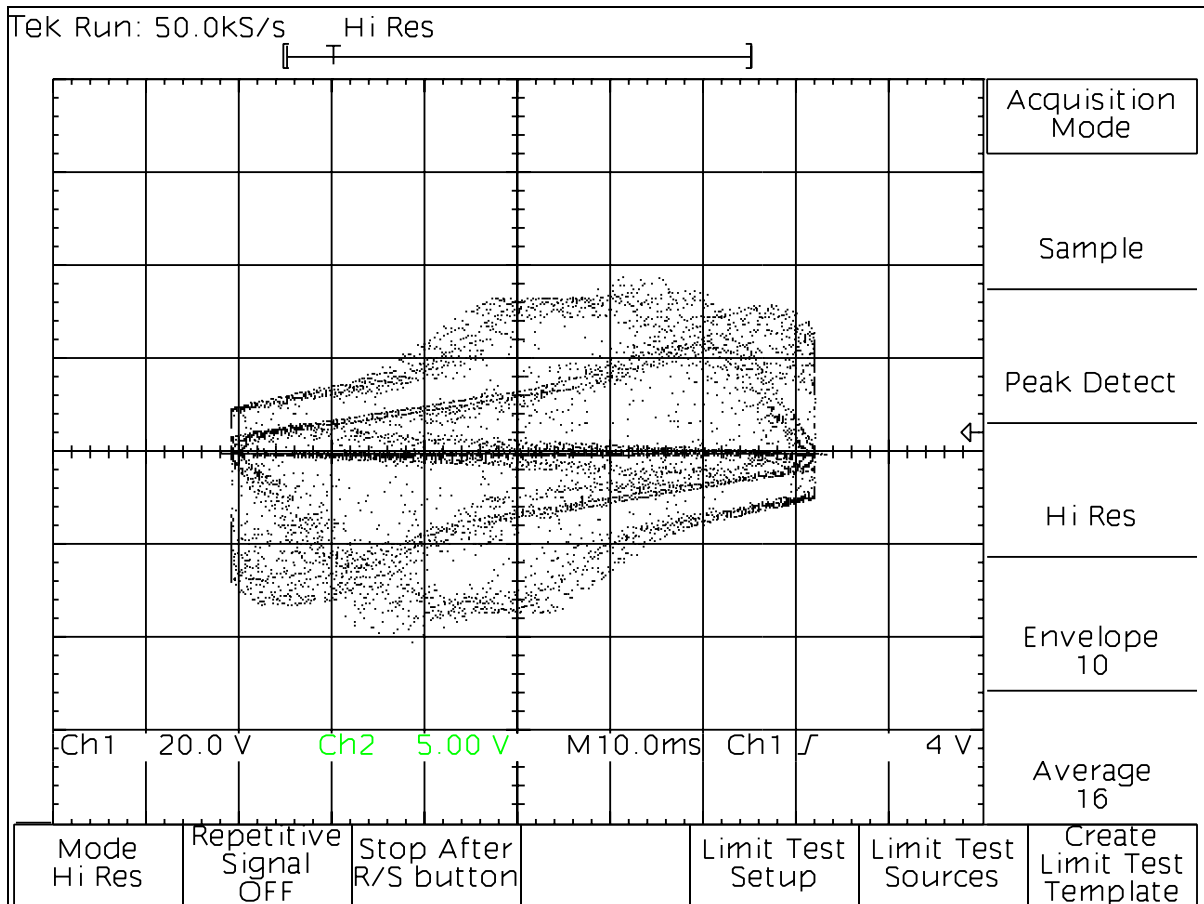
## Baxendale signal voltage and current v. time.



This test is described in the AES Journal vol.36 1988 No.1/2.

The test is a technique for displaying the current and voltage output capability of amplifiers. The test signal is shown above as a low frequency sine wave with alternate positive and negative pulses. The load of  $40 \mu\text{F}$  in series with  $0.1 \Omega$  presents a high impedance to the low frequency sine wave but a very low impedance to the pulses. The output voltage of the amplifier is measured on one channel of the oscilloscope. The voltage across the  $0.1 \Omega$  resistor is measured with the other channel of the oscilloscope and is proportional to  $1/10^{\text{th}}$  of the current through the load. The original article states a  $1 \Omega$  resistor but this would limit the measured current to the voltage supply rails in the amplifier. The test amplifier is observed to exceed this limit so a  $0.1 \Omega$  resistor was used.

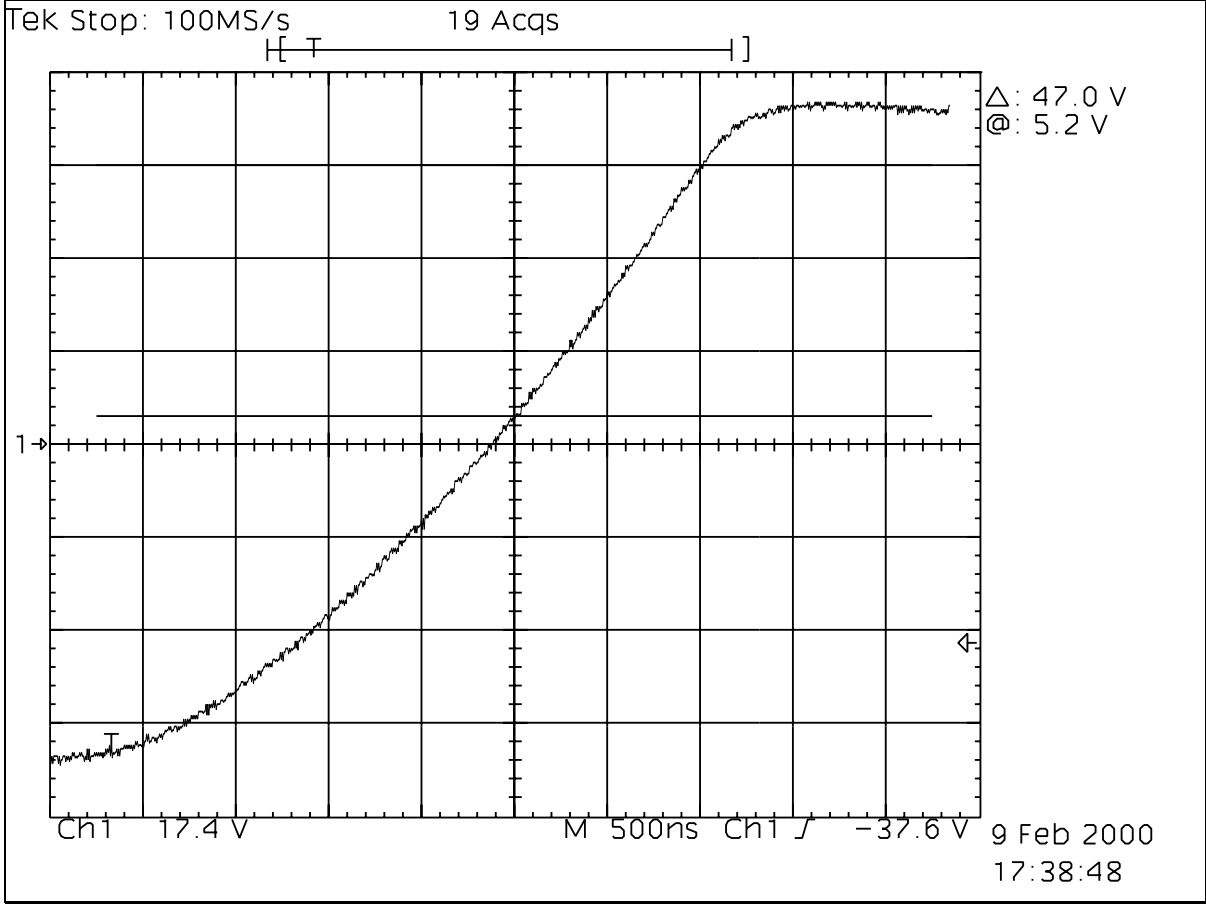
## Baxendale XY plot with high resolution sampling.



- Horizontal (X) axis is output voltage, 20 V / division
- Vertical (Y) axis is output current. 5 A / division
- Load is 40  $\mu$ F in series with 0.1  $\Omega$ .

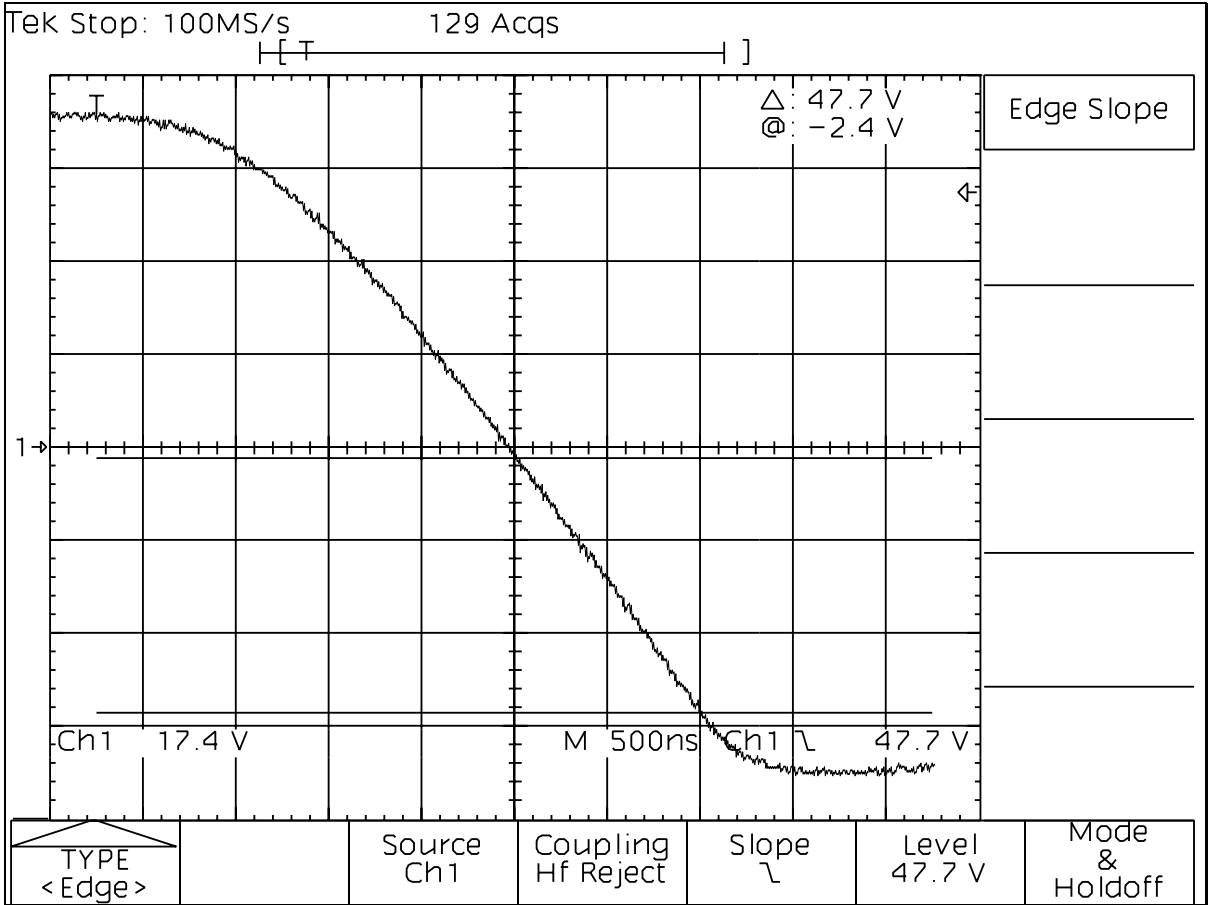
This trace is obtained when using a downsampling technique and shows the loci of the positive pulse current and its corresponding negative return current together with the negative pulse currents and its corresponding positive return current. Some of the peak information is lost due to the undersampling but the trends are displayed much better. The upper portion of the plot shows two areas that overlap. One has a sort of 'car' form while the other is more like a long clown shoe. The car shape represents the positive current capacity. The rotated negative 'car' image represents the negative current capacity. The clown shoe shapes show the extent of the return current from the load and is generally proportional to the output impedance of the amplifier.

**Output voltage positive flank slew rate.**



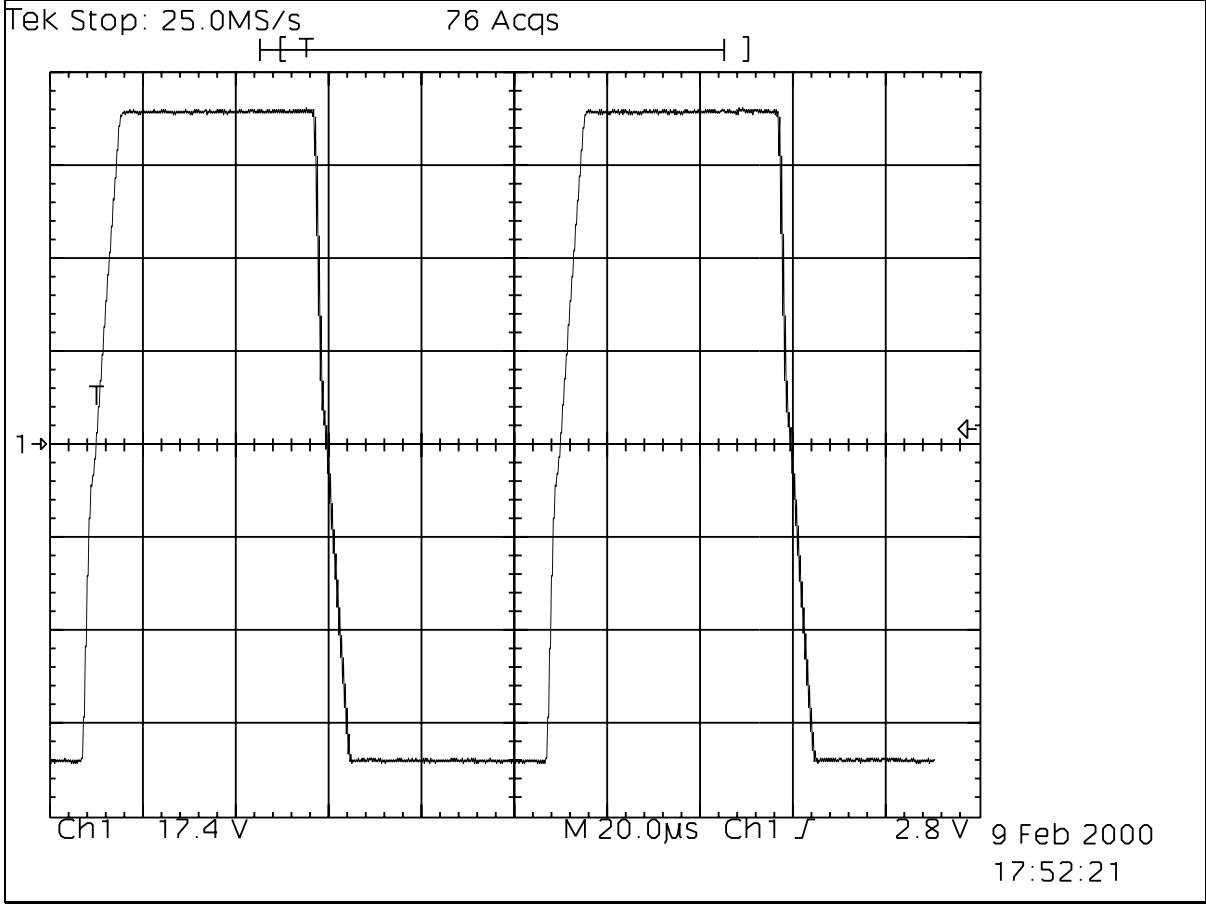
The slew rate is limited by the input signal filtering. The highest gradient shown here gives a slew rate of approximately  $47 \text{ V}/\mu\text{s}$ .

**Output voltage negative flank slew rate.**

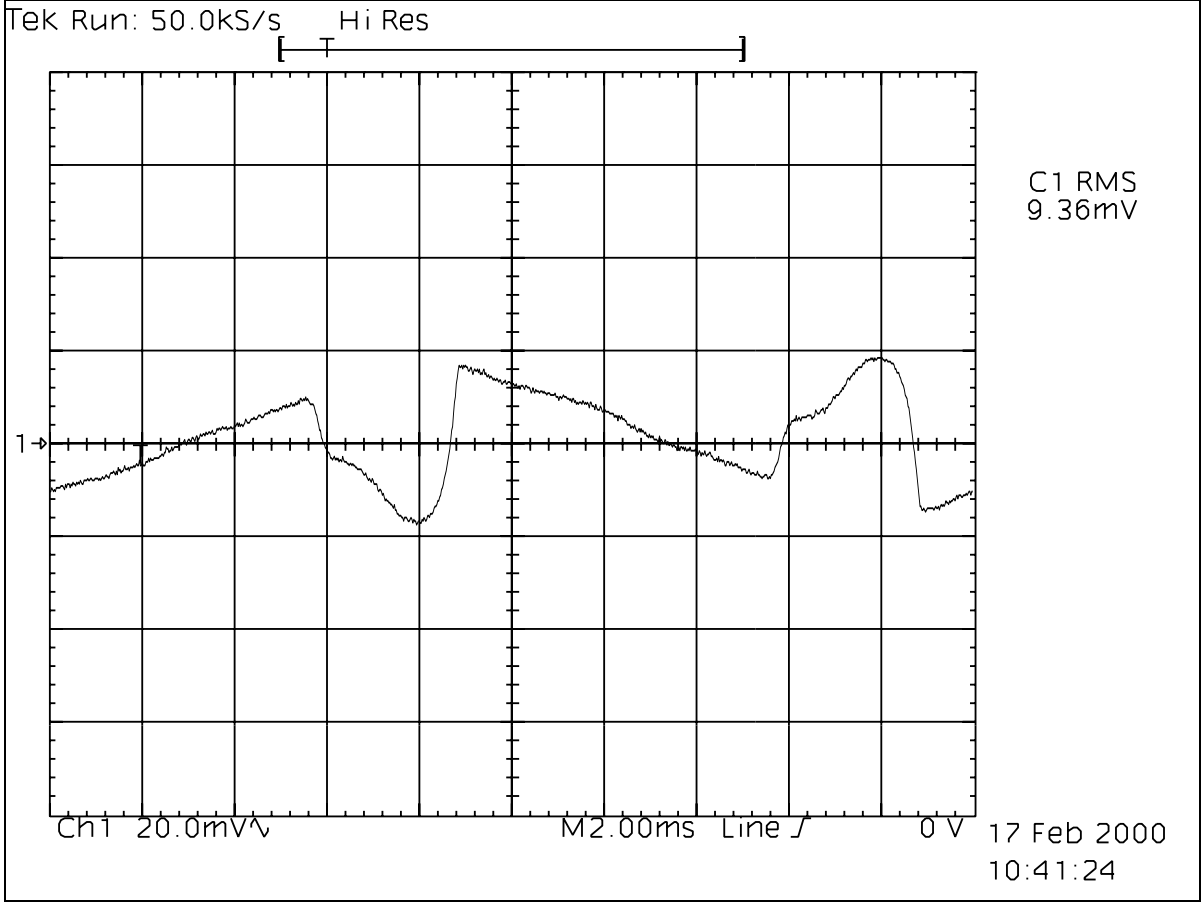


The slew rate is limited by the input signal filtering. The highest gradient shown here gives a slew rate of approximately 47 V/μs.

**Output voltage overload recovery oscillogram.**

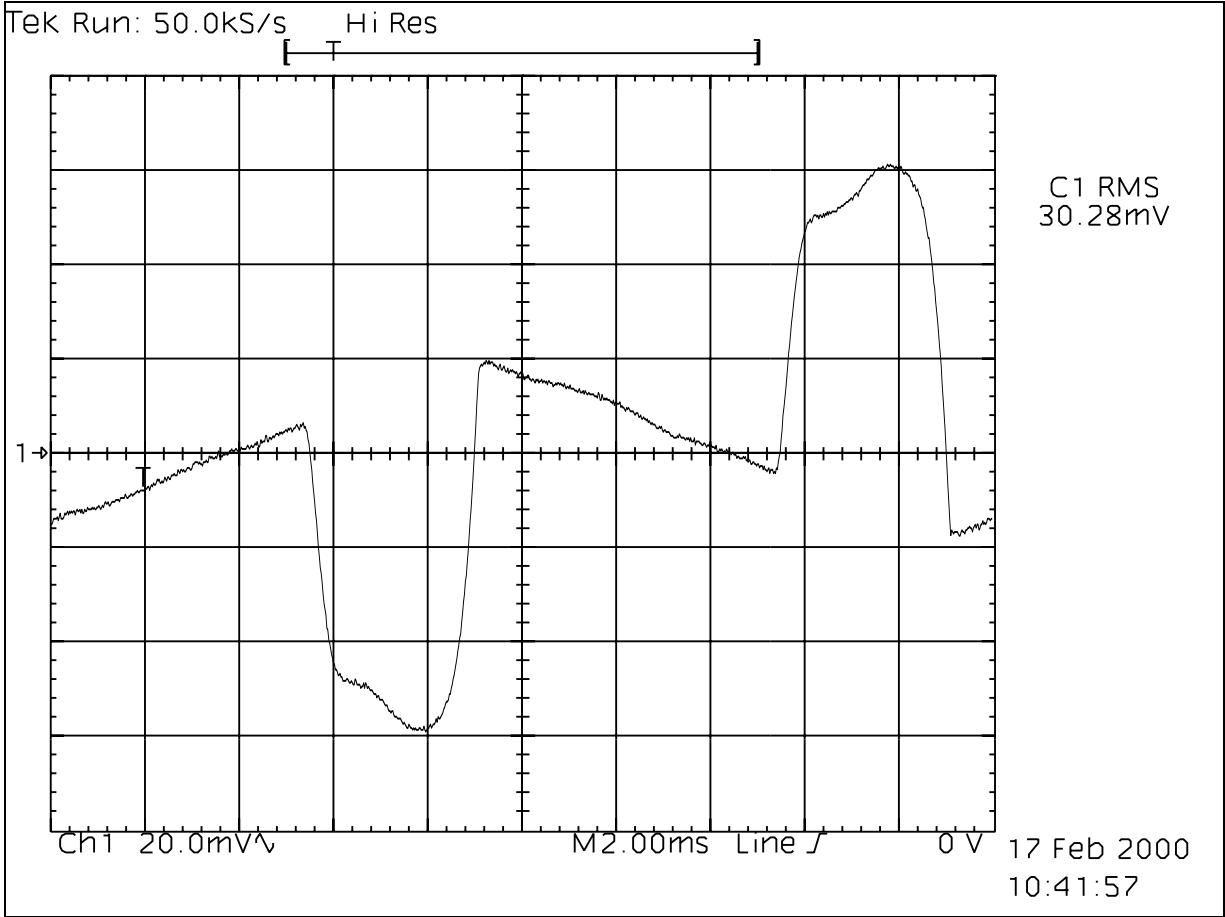


**Mains current drain, quiescent.**



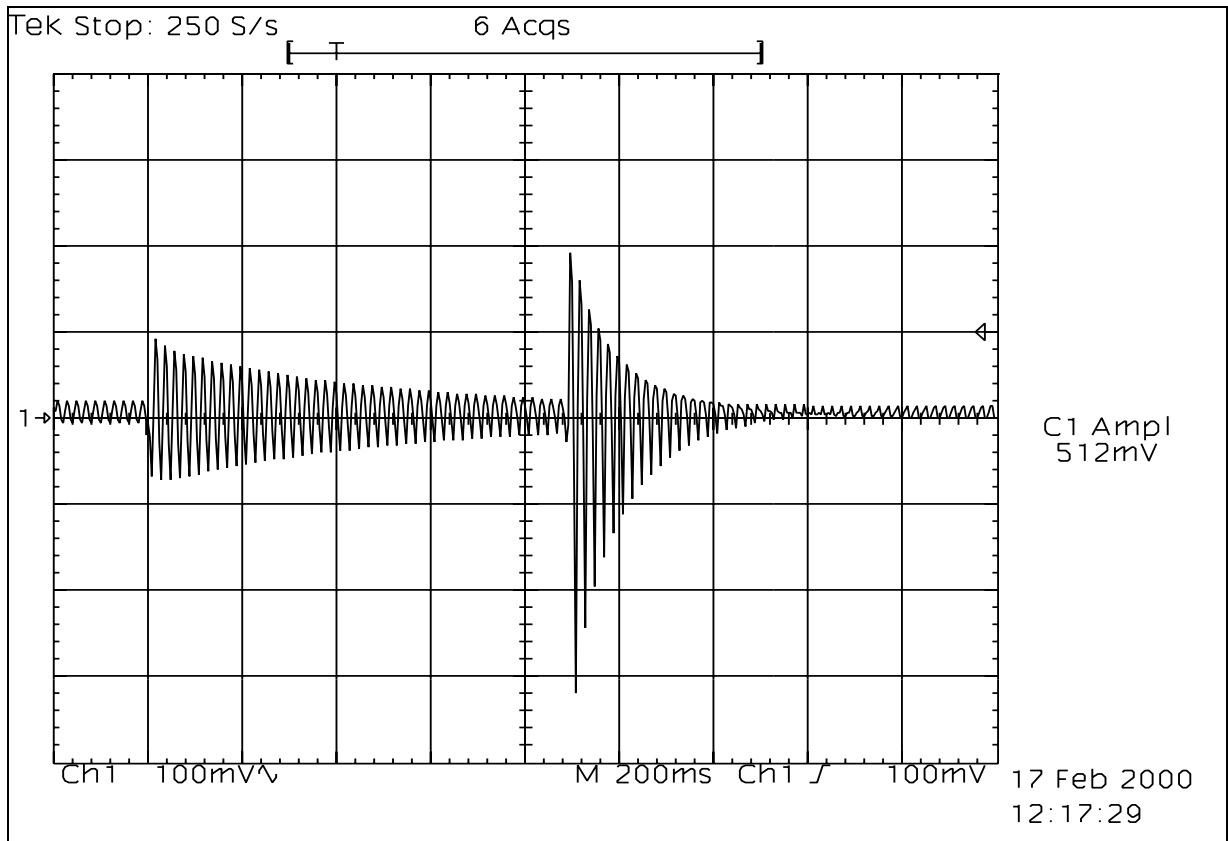
Vertical scale is 2A /division.  
The RMS value calculated from the trace is 0.9A

**Mains current drain, full power into an 8Ω load.**

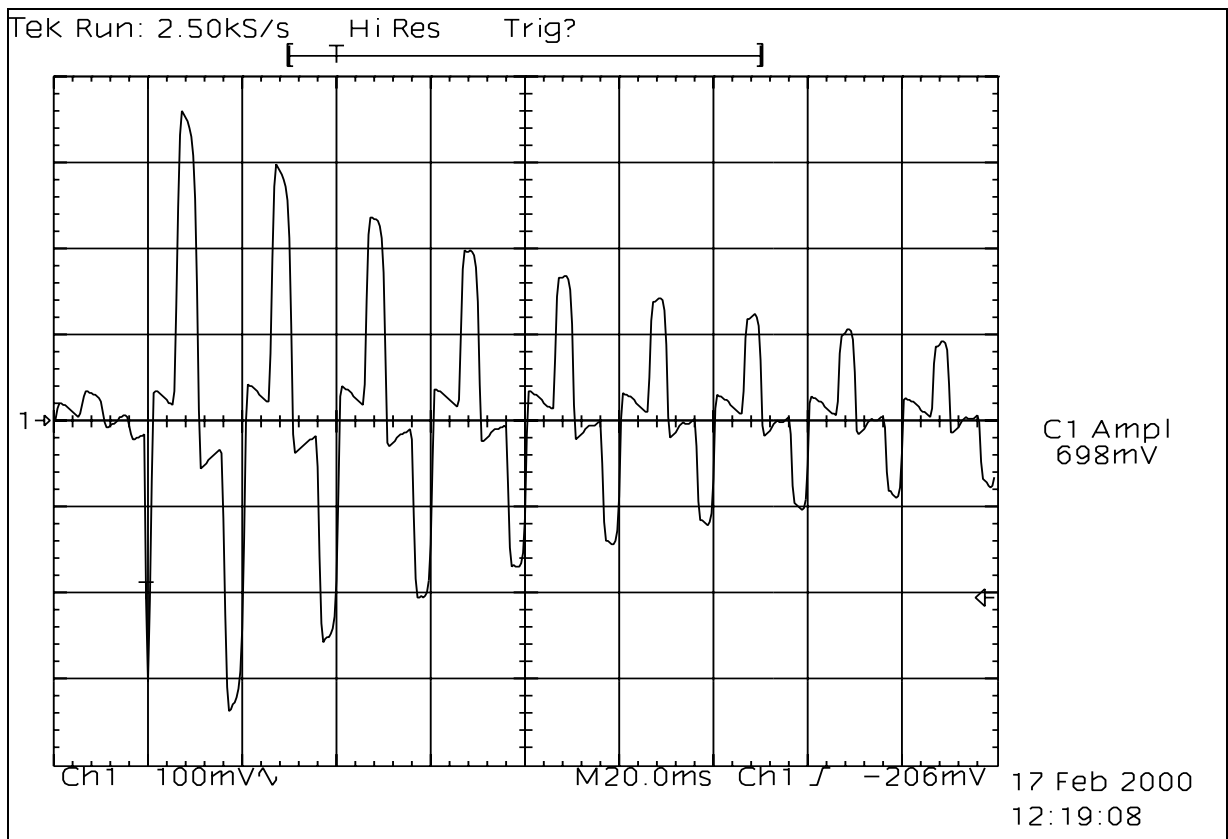


Vertical scale is 2A /division.  
The RMS value calculated from the trace is 3.0 A

### Mains inrush current when switched on.

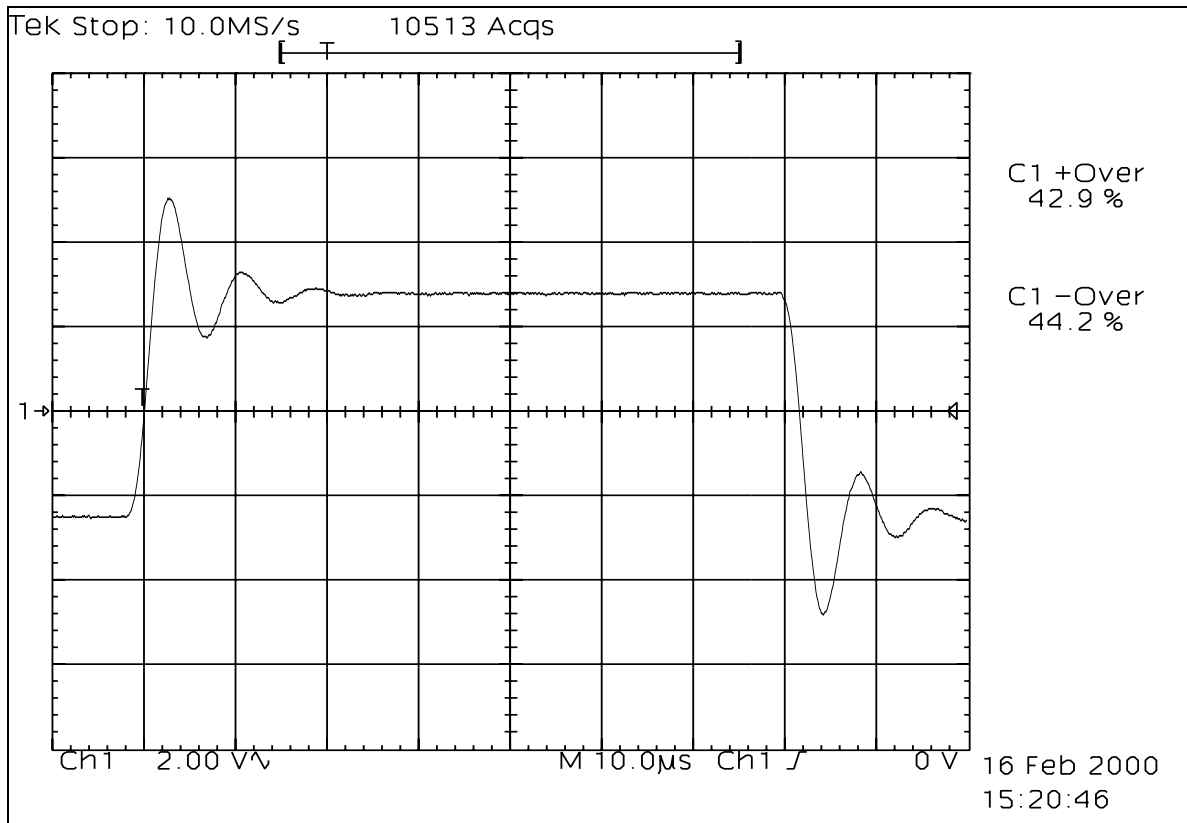


Vertical scale is 10A /division.



Vertical scale is 10A /division.

**Square wave response with and without 2.2  $\mu$ F, in parallel with 8  $\Omega$ .**



Overshoot is caused by the series combination of the low output impedance of the amplifier, the series output inductor and the load capacitance.

