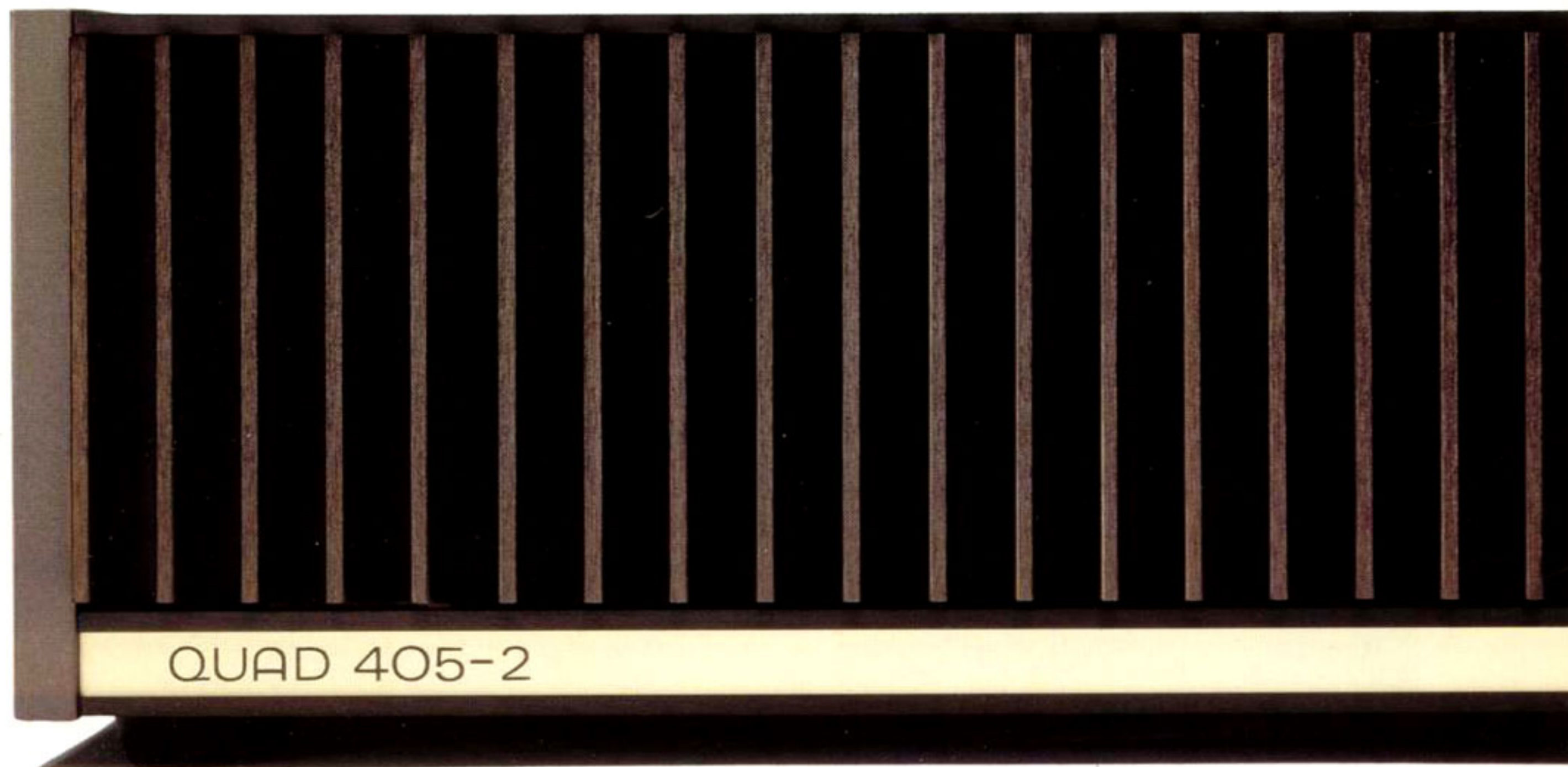




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The QUAD 405-2



More than 60,000 Quad 405 current dumping amplifiers are in use around the world providing the "closest approach to the original sound" in the homes of serious music listeners, in recording and broadcasting studios and for sound reinforcement where quality is of prime importance.

The Quad 405-2 exploits improvements in component technology to provide more VA into a wider variety of loads than the original Quad 405 without compromising performance and reliability.

The Quad 405-2 will produce perceptibly higher sound pressure levels from the majority of loudspeakers than the original Quad 405, which will be of significant benefit with the increased dynamic range of modern programme sources.

The 405-2 uses "current dumping," a Quad invention based on feedforward error correction which eliminates many of the problems traditionally associated with transistor amplifiers.

"Feedforward error correction" was first proposed by Harold Black in 1928, in which a derived error signal is added to the output signal of an amplifier in exactly the right amount to cancel the distortion produced by the amplifier. While it is relatively easy to add error current to signal current without interaction, as in Black's invention, it is very much more difficult to do so in voltage terms. Loudspeakers require a stiff source and so 'feedforward' has found no

successful application in audio amplifiers.

What Quad has done – not quite as easy as it sounds – is to produce a current controlled amplifier, apply a special type of feedforward current error correction and then apply overall voltage feedback to convert the whole to a voltage amplifier. There is in effect, both a low powered very high quality amplifier and a high powered heavy duty amplifier, the current dumpers. The low power amplifier controls the loudspeakers at all times, calling upon the high power section to provide most of the muscle. The small amplifier which carries the error signal is so arranged that provided the large power transistors get within the target area of the required output current, it will fill in the remainder accurately and completely.

The quality is solely dependent upon the performance of the low powered high quality amplifier together with four passive components. When correctly designed, all distortion in the output stage is reduced to zero.

With this technique it is possible to produce an amplifier of very high performance without using carefully matched relatively fragile output devices. There are no crossover biasing problems, no alignment or adjustment is required to obtain optimum performance and nothing can go out of alignment during life. In the event of component failure, replacement can be effected and performance restored without realignment.

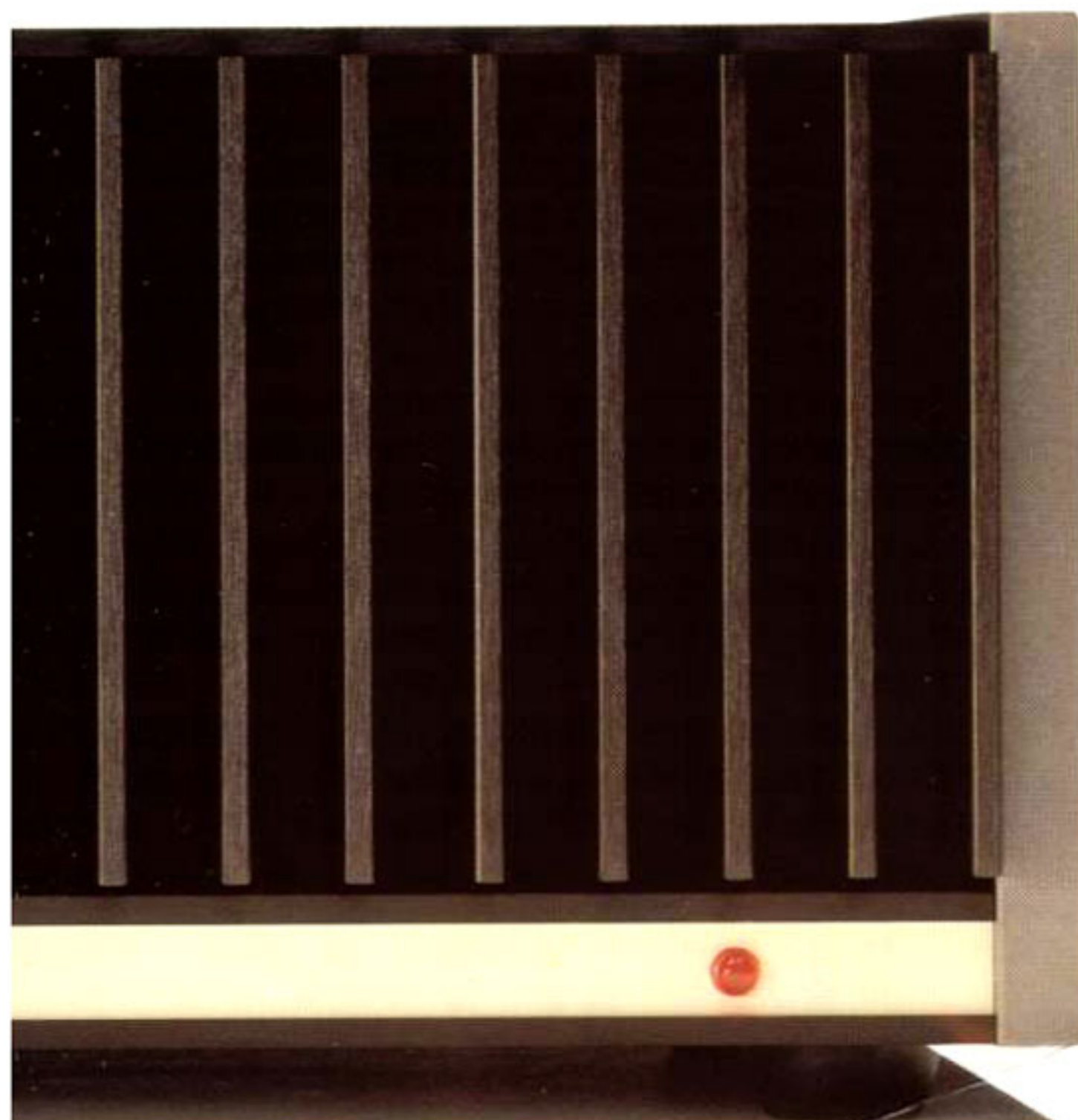


QUAD 405-2



The external design continues the Quad tradition of practical simplicity which has won prizes and world-wide acclaim on previous models. A combination of castings and extrusions is used to produce a unit which is strong and pleasing both to the eye and the touch.

The internal appearance is unmistakably Quad and reflects concern with economy of manufacture and ease of service.



"Current Dumping" was originally presented as a paper to the AES 50th Convention. Since then a number of technical articles and papers have appeared which confirm the inherent advantages of current dumping over conventional class B techniques.

The Quad 405-2 is fitted with a new Quad-designed protection circuit. This is a load-sensitive, time-dependent current limiter which overcomes the problems associated with conventional "load-line" circuits. The amplifier will deliver an instantaneous maximum current of 8.5A into any load. If the load is too reactive, or of a resistance substantially below 4Ω , the current limit is smoothly and progressively reduced to a value which enables the output transistors to remain within their safe operating area. In the extreme case of a short circuit this value is 3.1A. When the signal level falls or the short circuit is removed the current limit gradually returns to its initial level. This enables the amplifier to deliver high peak currents into almost any load when handling a normal music programme, while fully protecting the output devices from sustained overloads into short circuit or purely reactive loads. Shorting both outputs simultaneously on signal for an extended period (minutes) is not protected.

The Quad 405-2 is normally used with a Quad control unit, but other signal sources can be readily accommodated. Since the amplifier has no controls it may be mounted out of sight in a well ventilated cupboard.

Great care has been taken to ensure that the high power output of the 405-2 does not increase the risk of damage to the loudspeaker. Although direct coupled, the d.c. offset voltage is confined to negligible values even under gross overload. A fixed high pass filter is incorporated to prevent spurious subsonic signals from reaching the loudspeaker.

In the unlikely event of component failure causing offset, the output to the loudspeakers is instantaneously interrupted by a clamp circuit.

Not all loudspeakers can safely accept the full power output of the Quad 405-2, and the amplifier is provided with a power limiter which is fitted internally for use in such cases.

The Quad 405 has won both a Design Council Award 1976 and The Queen's Award for Technological Achievement 1978.

THE QUAD 405-2

SPECIFICATION

Measurements apply to either channel, with or without the other channel operating.

Power Output

The amplifier is intended for use with loudspeakers of 4-16 Ω nominal impedance.

Power and distortion for various frequencies.

Continuous sine wave into 8 Ω resistive load.

100Hz any level up to 100 watts <0.01% Dtot

1,000Hz any level up to 100 watts <0.01% Dtot

10,000Hz any level up to 100 watts <0.05% Dtot

For any other impedances and frequencies see graphs.

Notes:

1. The curves show maximum short term and long term power output into resistive loads. Performance into reactive loads depends upon the impedance and phase angle of the load and the immediate past history of the signal. In practice with loudspeaker loads and music programme, power output approximates to the peak power curve.
2. With the additional power limiter inserted the maximum output voltage is limited to 20V $\pm$ 10% (50 watts 8 Ω), all other performance figures unchanged.

Output Internal Impedance and Offset

3.3 μ H in series with 0.03 Ω

Offset 7mV max.

Frequency Response

Ref. 1kHz Low frequency -1dB at 20Hz. Filter attenuation as curve. High frequency -0.5dB 20kHz -3dB 50kHz.

Signal Input Level

0.5V rms $\pm$ 0.5dB for 100 watts into 8 Ω . Amplifier loads the input by 20k Ω in parallel with 220pF.

Signal Input Slew Rate Limit

0.1V/ μ S. Provided the rate of change of input voltages does not exceed this figure which is about ten times the maximum slew rate on a gramophone record and the amplifier is not driven into clipping, then the total of all distortions appearing in the audio range (20-20,000Hz) due to transient or repetitive waveforms with frequency components inside or outside the audio range will be at least 80dB below full rated power. If the major portion of the input energy is wanted signal then -80dB (0.01%) represents the maximum possible distortion on programme.

Signal Input Overload

Instantaneous recovery up to +20dB overload.

Crosstalk

(Input loaded by 1k Ω) 80dB at 100Hz

70dB at 1kHz

60dB at 10kHz.

Hum and Noise

'A' weighted -96dB ref full power

Unweighted -93dB ref full power

(15.7kHz measurement bandwidth).

Protection

The Quad 405-2 is suitable for use under the most arduous music conditions and is electrically protected by current limiters; 8.5 amperes peak current into any load reducing to 3.1 amperes steady state into a short circuit. Shorting both outputs simultaneously for an extended period will result in overheating and eventual breakdown.

Stability

Unconditionally stable with any load and any signal.

Power Input

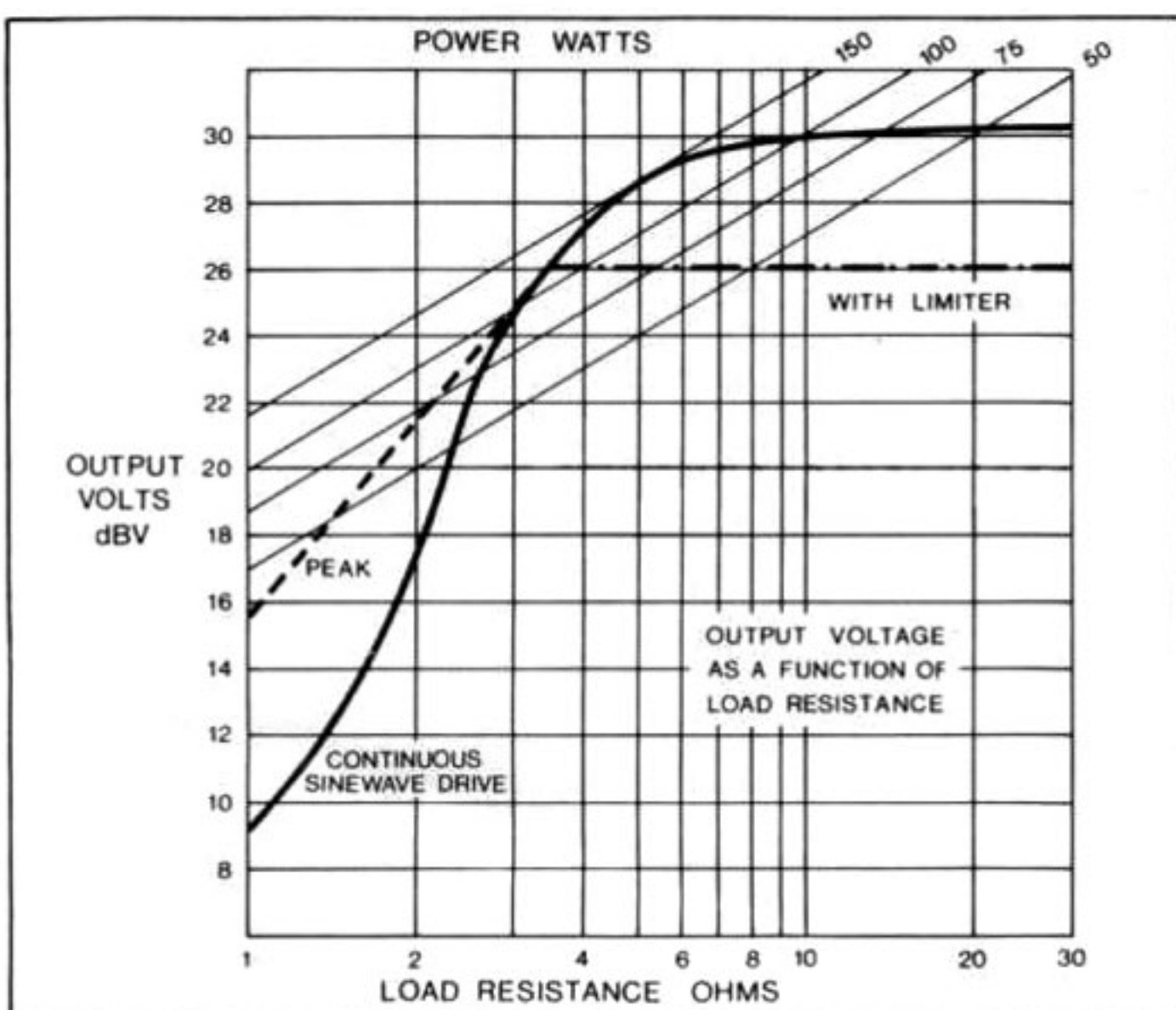
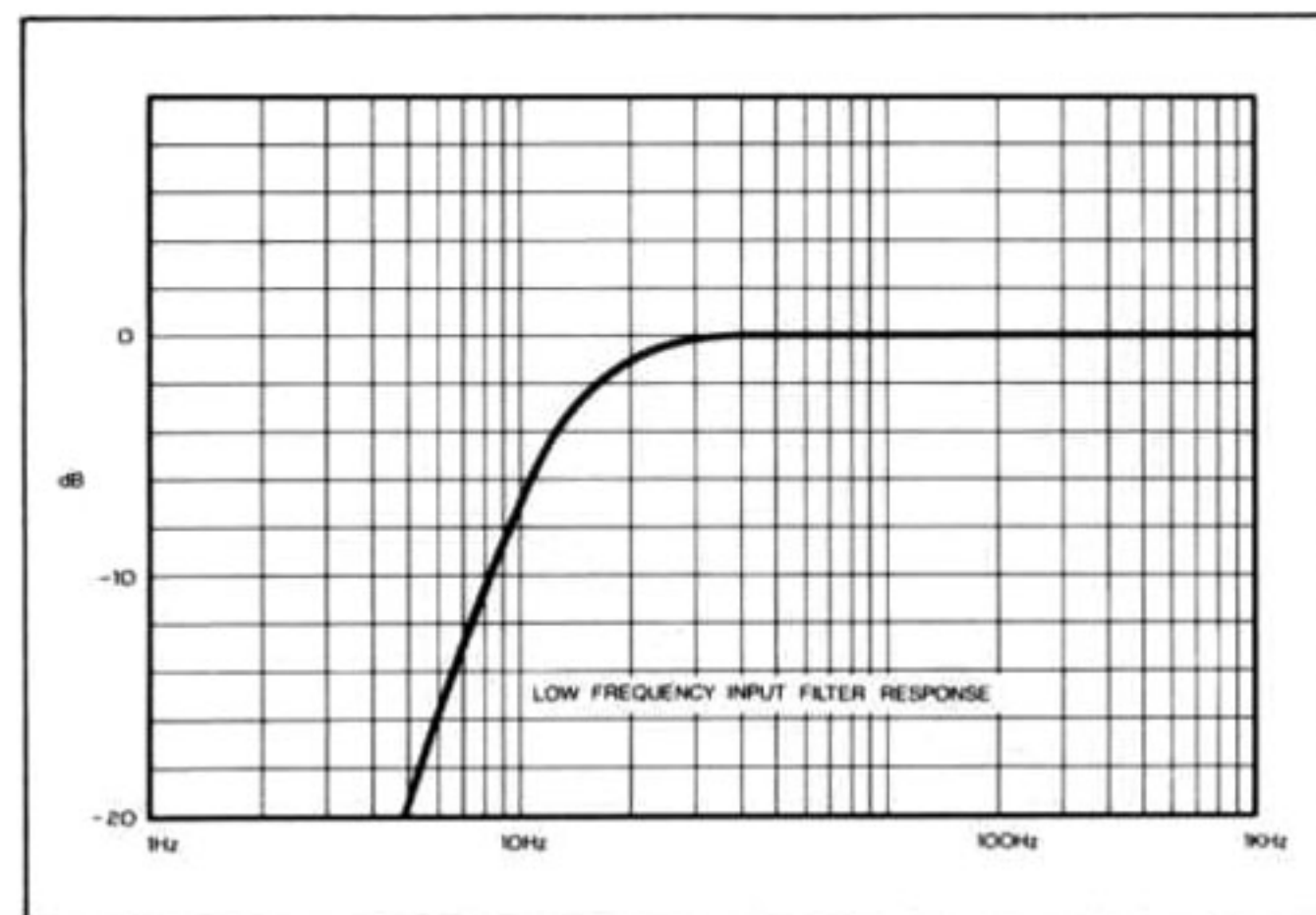
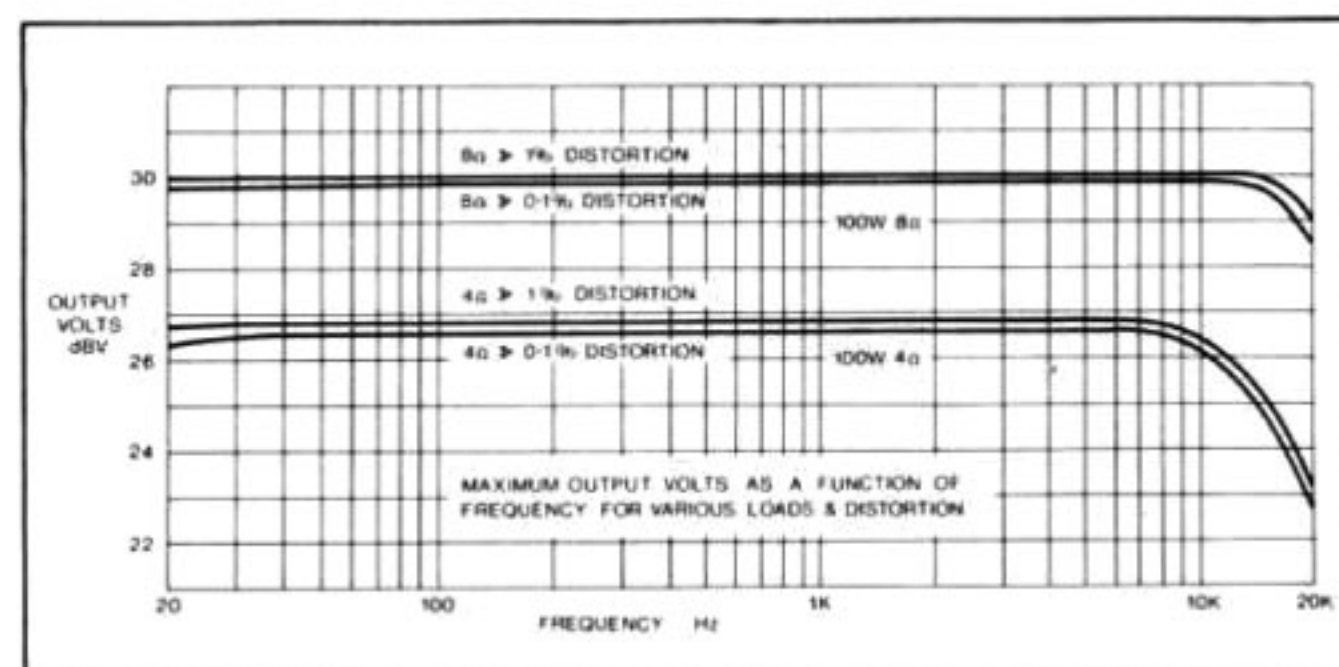
110-120-130V, 220-230-240V

50-60Hz, 30-350 watts depending on signal level.

Dimensions

Height 115mm (4.5") Width 340.5mm (13.4")

Depth 195mm (7.7") allow an extra 38mm (1.5") for plug and socket. Weight 9Kg (20lbs).



The Acoustical Manufacturing Co. Ltd.,
Huntingdon, Cambs., PE18 7DB.
Telephone: (0480) 52561

QUAD 
for the closest approach
to the original sound