

# QUAD

## 405







The external design continues the Quad tradition of practical simplicity which has won prizes and world-wide acclaim on previous models. A combination of mouldings 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.



# Quad 405

The Quad 405 "current dumping" amplifier is designed primarily for use in high quality domestic installations with loudspeakers of less than normal efficiency, but is equally suitable for professional use.

The Quad 405 uses a current dumping output circuit, a Quad invention which eliminates many of the problems associated with transistor amplifiers.

The basis of current dumping is 'feed forward error correction' 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 'feed forward' 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 feed forward 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 is so arranged – it carries the error signal – 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 result is that 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.

The advantages of this technique are that 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.

For further details see "Current Dumping Audio Amplifier" by P. J. Walker and M. P. Albinson presented to the 50th convention of A.E.S.

The Quad 405 is normally used with the 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 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 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, and the amplifier is provided with a power limiter which is fitted internally for use in such cases. The Quad electrostatic loudspeaker can be used safely with the power limiter in.

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

Note: Quad electrostatic loudspeakers prior to serial no. 16800 must be modified for use with the Quad 405 amplifier.



# Quad 405

## Quad 405 Specification

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

**Power Output.** The amplifier is intended for use with loudspeakers or 4-16 $\Omega$  nominal impedance. Power and distortion for various frequencies. Continuous sine wave in 8 $\Omega$  resistive load.

100Hz any level up to 100 watts <0.01 % Dtot  
1 kHz any level up to 100 watts <0.01 % Dtot  
10 kHz any level up to 100 watts <0.05 % Dtot

For other impedances and frequencies see graphs.

Notes: In addition to the performance into a resistive load R, the amplifier will maintain full voltage within the same distortion rating into a load  $R \pm jX$  where X is any value from zero to infinity.

With the additional power limiter inserted the maximum output Voltage is limited to 20V rms  $\pm 10\%$  (50 watts 8 $\Omega$ ) all other performance figures unchanged.

**Output Internal Impedance and Offset.** 3.3 $\mu$ H in series with 0.03 $\Omega$   
Offset <7mV.

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

**Signal Input Level.** 0.5V rms  $\pm 0.5$  dB for 100 watts into 8 $\Omega$ . Amplifier loads input by 20k $\Omega$  in parallel with 50pF.

**Signal Input Slew Rate Limit.** 0.1 V/ $\mu$ S. Provided the rate of change of input voltage does not exceed this figure and the amplifier is not driven into clipping, then the total of all distortions appearing in the audio range (20-20 kHz) 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 $\Omega$ ) 80dB at 100Hz. 70dB at 1kHz. 60dB at 10kHz.

**Hum and Noise.** (input loaded 1k $\Omega$ ) 'A' weighted -95dB ref full power Unweighted (15.7kHz measurement bandwidth) -90dB ref full power.

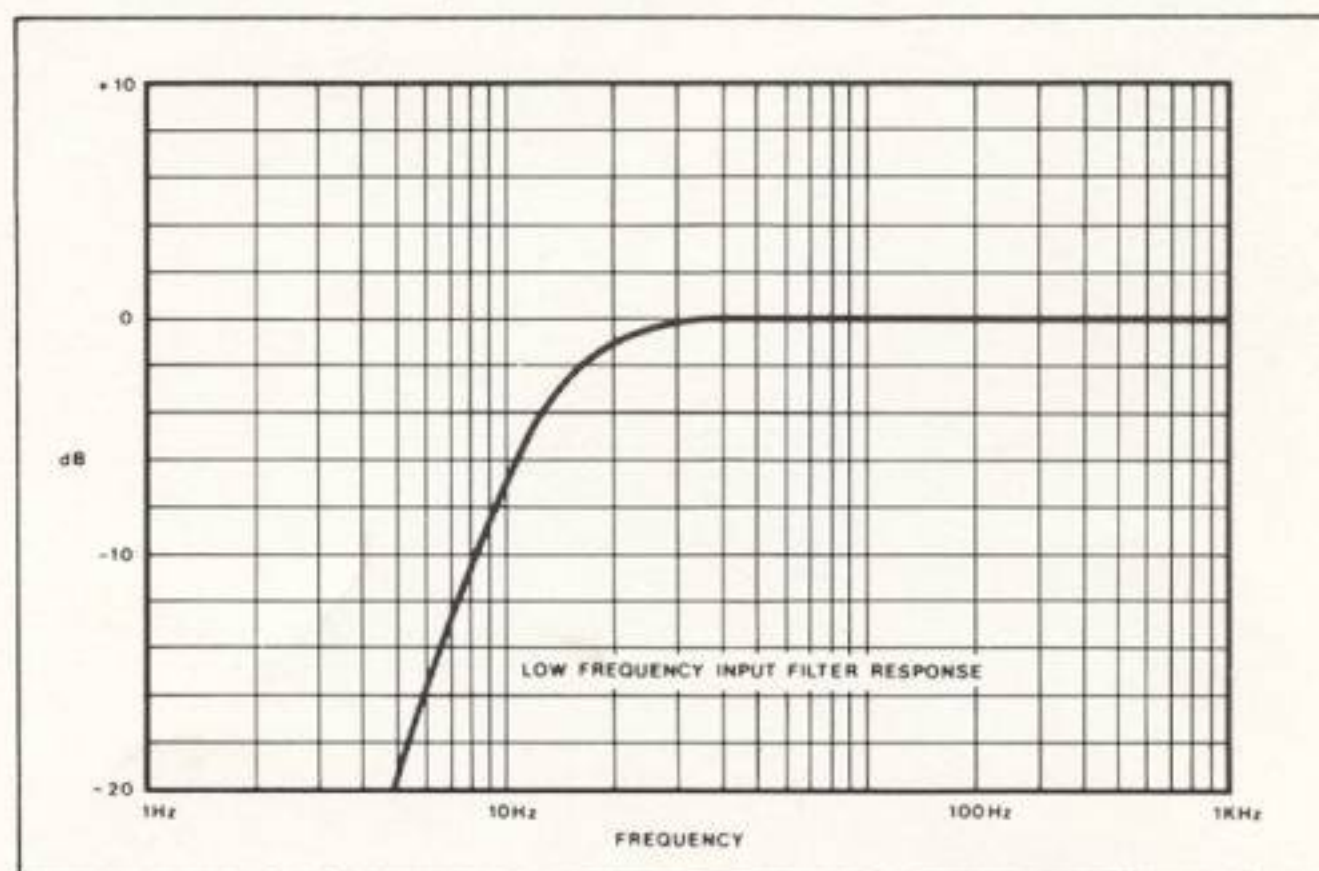
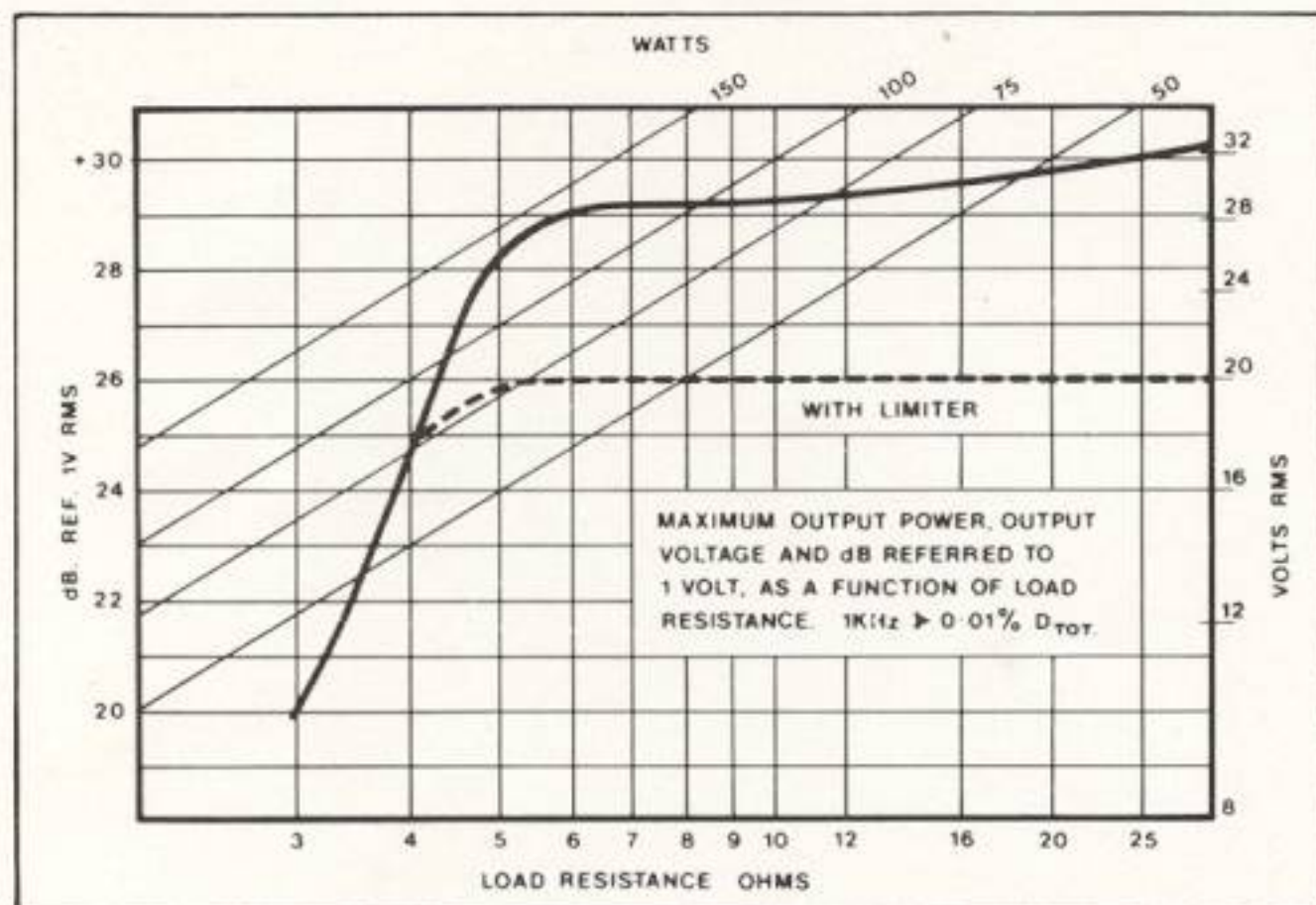
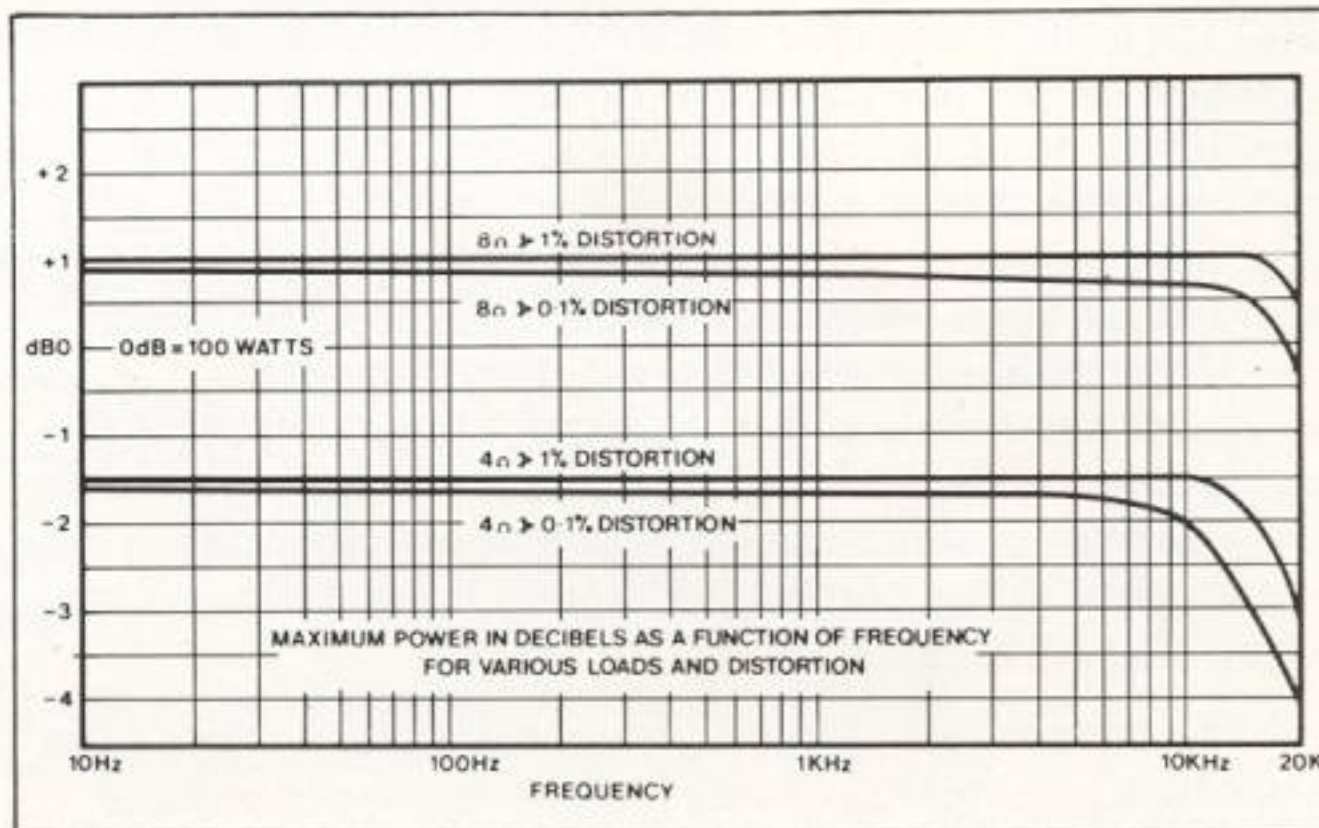
**Protection.** The amplifier is suitable for use under the most arduous music conditions and is electrically protected by current limiters; 7 amps in phase current at peak voltage and 3½ amps at zero voltage. Shorting both outputs simultaneously on signal for an extended period (minutes) is not protected.

**Stability.** Unconditionally stable with any load and any signal.

**Power Input.** 110-130V or 220-240V. 50-60Hz, 30-350 watts depending on signal level.

**Weight.** 9 Kg.

**Dimensions.** Width 340.5mm Height 115mm Depth 195mm (plus 38 mm for connectors)



**QUAD** for the closest approach to the original sound

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