



405-2 CURRENT DUMPING AMPLIFIER

INSTRUCTION BOOK

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QUAD

QUAD 405 2

Current Dumping Amplifier

INSTRUCTION BOOK

The Quad 405-2 is capable of very high output levels. Read this book thoroughly before connecting your loudspeakers.

CONTENTS

	<i>Page Number</i>
Packing.....	2
Service.....	2
Guarantee.....	2
Description.....	3
Installation.....	4
AC Input.....	4
Earthing (Grounding).....	5
Fuses.....	5
Input connection.....	6
Loudspeaker connection.....	6
Loudspeaker protection.....	6
Output Limiter.....	7
Quad electrostatic loudspeaker.....	7
Loudspeaker phasing.....	7
Headphones.....	8
Additional loudspeakers.....	8
Specification.....	19-11

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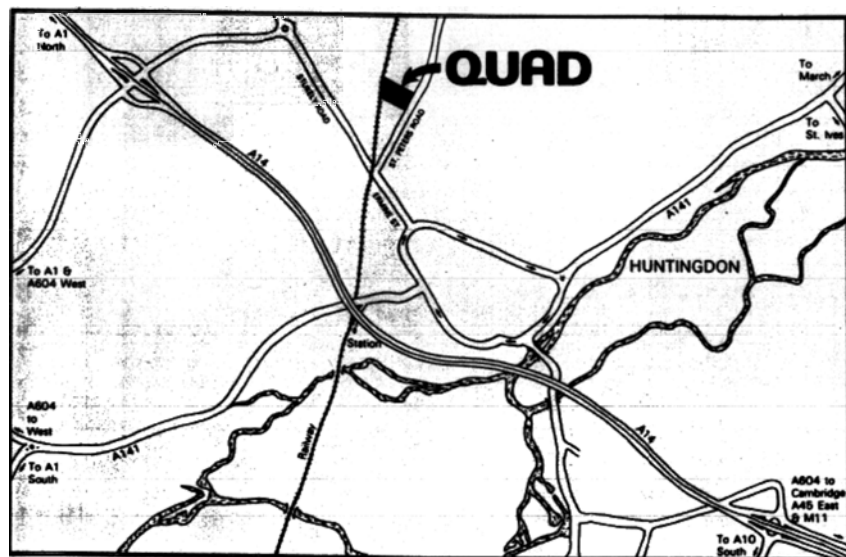
Packing

The amplifier is supplied with a signal lead, mains lead, four speaker connectors and two voltage limiting shorting links. The packing material comprises a two part expanded polystyrene shell and a cardboard carton and should be retained for re-use in case the unit has to be returned at any time.

Service

If servicing is required the amplifier should be returned to the supplier, to the agent for the country of purchase or to the Quad Electroacoustics Ltd. A Brief note should be enclosed giving your name and address plus the reason for returning it. Quad offers same-day service from Monday to Friday except for bank holidays. The map below shows where to find us. Please call 0480 52561 to make an appointment.

Circuit diagrams and service data for this Quad product are available from the manufacturer or distributor for a small charge.



Guarantee

This amplifier is guaranteed against any defect in material and workmanship for a period of twelve months from the date of purchase.

Within this period we undertake to supply replacement parts free of charge provided that failure was not occasioned by misuse, accident or negligence. Labour and carriage costs are not covered unless by local agreement.

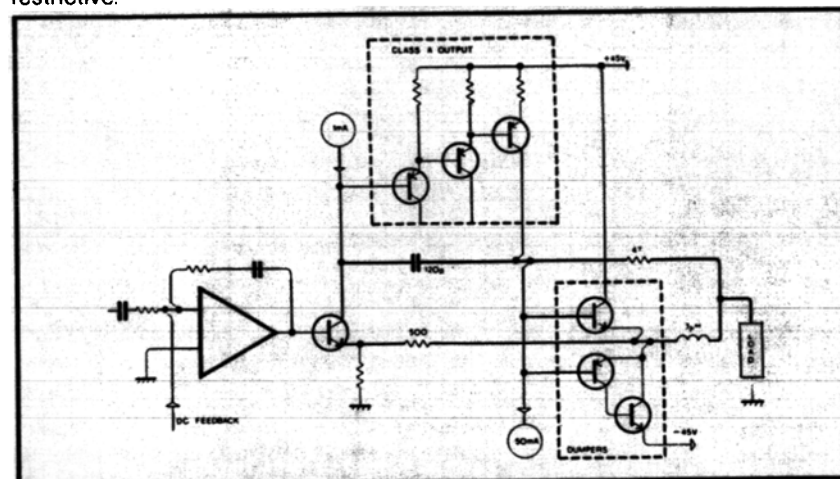
Within the U.K. the guarantee offered with this equipment does not limit the consumer's existing statutory rights. A separate guarantee card is not supplied with your Quad unit. Your guarantee begins on the day on which you take delivery.

Description

Description
The Quad 405-2 is a two channel power amplifier primarily intended for use in high quality sound reproducing systems. The amplifier is usually used with a Quad control unit though other signal sources can readily be accommodated.

The amplifier uses a current dumping output circuit, a Quad invention which eliminates many of the problems associated with transistor amplifiers, and covered by patents in several countries. In a current dumping amplifier there is in effect both a low powered very high quality amplifier and a high powered heavy duty amplifier. 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 an error signal – that provided the larger power transistors (the dumpers) get within the target area of the required output current it will fill in the remainder accurately and completely. The reproduced quality is *solely* dependent on the small amplifier which because of its low power can be made very good indeed.

Problems of crossover, crossover distortion, quiescent current adjustment, thermal tracking, transistor matching, all disappear. There are no internal adjustments or alignments and the choice of power transistor types is less restrictive.



Simplified Schematic of 405-2 Amplifier showing Class A, Dumpers and Bridge Components.

The 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.

INSTALLATION

The Quad 405-2 carries no controls and may be mounted out of sight in a cabinet or any other convenient location.

The Quad 405-2 is provided with a substantial heat sink, and must always be adequately ventilated, particularly if positioned in a cabinet or cupboard.

If used in close proximity to the control unit, tuner or magnetic cartridge, care should be taken to ensure that hum is not induced by radiation from the mains transformer of the 405-2.

The current dumping circuit technique used in the Quad 405-2 enables extra robust transistors to be used without impairing programme quality and the amplifier can operate at higher than normal temperatures without compromising reliability.

When operated at high power levels it is quite normal for the heatsinks to be hot to the touch.

A.C. Mains Supply

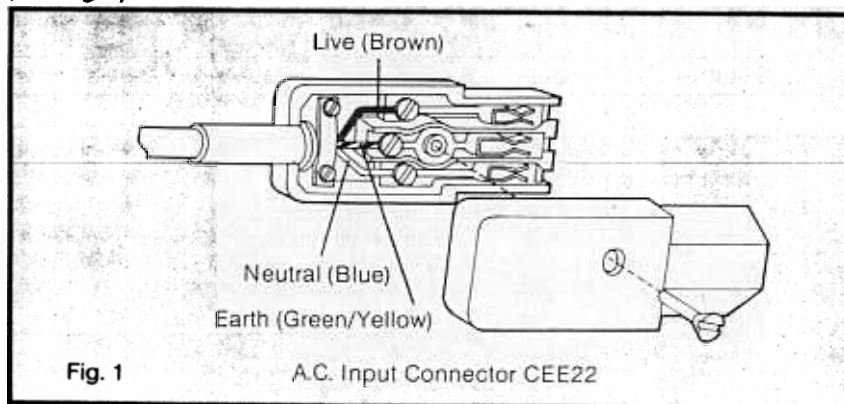
This amplifier is designed to operate on one range of A.C. mains voltage only, 50 or 60 Hz, viz: 110v (covering 100-110) 220v (covering 200-220)

120v (covering 110-120) 240v (covering 220-240)

BEFORE CONNECTING THE AMPLIFIER TO THE A.C. SUPPLY CHECK THAT THE VOLTAGE MARKED ON THE BACK OF THE AMPLIFIER CORRESPONDS WITH THAT OF THE A.C. SUPPLY.

The amplifier can be changed from one voltage range to another by a qualified technician.

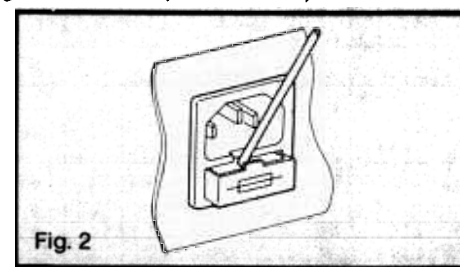
The A.C. mains input is via a standard 3-pin Euro connector supplied with the amplifier which should be wired in accordance with the international code (see Fig. 1).



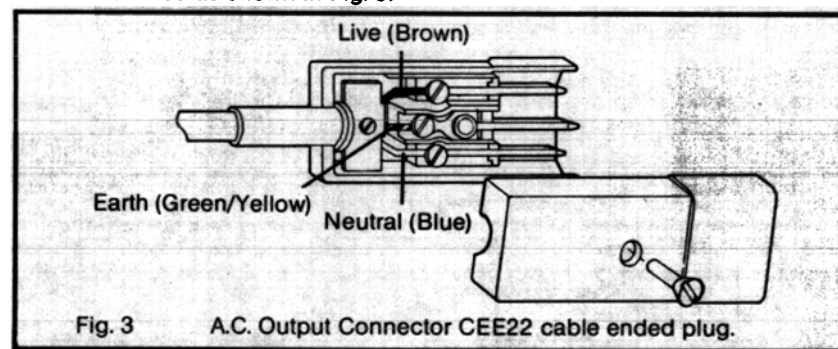
The A.C. supply will normally be drawn from the A.C. supply outlet on the rear of the Quad control unit. A suitable lead is supplied with the amplifier. The switch on the amplifier may be left permanently in the ON position, and both amplifier and pre-amplifier then switched on and off at the pre-amplifier.

A surge-resisting fuse (2.5 amp for 220/240V, 5 amp for 110/120V) housed in the mains input receptacle in the rear panel provides the usual protection. To obtain access to the fuse, unplug the mains supply and use a small screwdriver to lever open the drawer carrying the fuse. (see Fig. 2).

If a replacement fuse has to be fitted, make sure that it is of the correct type. The marking will be 2.5AT (5AT for 110v).



An unswitched A.C. outlet supplies appropriate additional equipment up to a maximum current of 4 amps. The shrouded plug used with this outlet and should be wired as shown in Fig. 3.



Earthing (Grounding)

A 3-core A.C. mains lead should be used to earth the amplifier whether its supply is taken direct from the wall socket or, more usually, the A.C. outlet of a Quad control unit or other similar source.

Fuses

In addition to the mains supply fuse on the rear panel of the amplifier, each channel is protected by two internal 4 amp quick blowing (4AF) fuses, located on the printed circuit boards.

To reach them it is necessary to remove the top cover of the amplifier, by undoing the two retaining screws and sliding the cover about 10 mm, (0.5"), backwards before lifting it clear. Withdraw the mains plug before removing the cover.

The indicator lamp on the amplifier is powered from the +50 volt supply. If the indicator lamp is on, the main fuse must be intact, but illumination of the indicator lamp does not imply that the internal fuses are intact.

Input Connections

Signal input is via phono sockets, clearly marked L (left) and R (right).

If the amplifier is used with a Quad 33/34/44 control unit with a DIN output socket, you will need a 4-pin-DIN-to-2-phono-plugs lead. This may be obtained from QUAD, or your dealer by quoting part number QD4FP1A.

Loudspeaker Connections

The Quad 405-2 is fitted with standard 4mm sockets and two red and black plugs are packed with the unit. The Quad 405-2 is unconditionally stable and may be used with any type of speaker cable. For optimum performance it is necessary to ensure that the impedance of the cable is small relative to the impedance of the load.

Each loudspeaker should be connected to its appropriate amplifier output so that the two pairs of wires are connected in the same way, to ensure that the speakers operate in phase. The output terminals are colour-coded to facilitate this.

Should there be any doubt the phasing can be checked later experimentally. (See Page 7). Where one loudspeaker only is used for mono, either channel may be used and the terminals of the other channel left vacant. A dummy load resistor is not required.

In cases where loudspeakers, such as the electrostatic loudspeaker, also require an energising supply, the instructions provided with the loudspeaker should be followed.

Each loudspeaker should be capable of handling the full output of the amplifier, or the protection facility described below should be used. The outputs of the 405-2 can be connected in series or in parallel to produce a single channel power amplifier for special applications. A separate data sheet is available on request. Do not attempt to connect the red output terminals together.

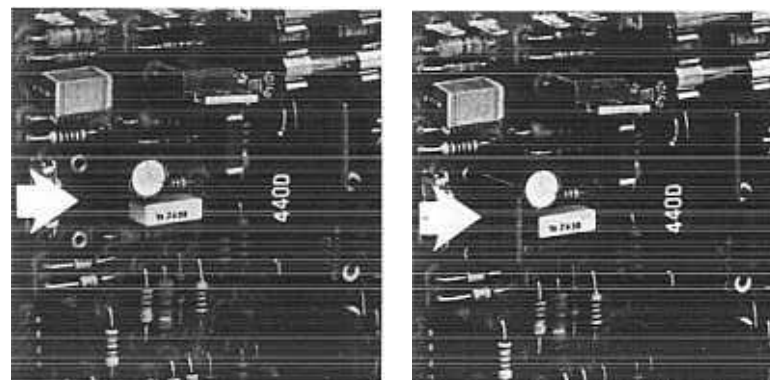
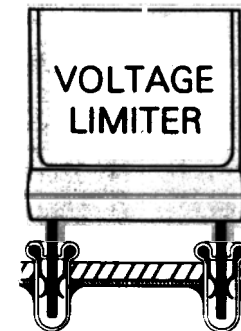
Loudspeaker Protection

The loudspeaker manufacturer usually states a maximum recommended amplifier power for his loudspeaker. If this figure is below 100W (into 8 Ω) then the limiter facilities provided with the amplifier should be fitted. Failure to do so may cause damage to the loudspeaker and infringe its guarantee.

Maximum safe power for most loudspeakers is time and frequency dependent and so is difficult to define precisely for a music signal. Some manufacturers will permit their loudspeakers to be used with amplifiers exceeding the quoted handling capacity provided certain precautions are observed. This can sometimes be advantageous in enabling short duration high level peaks to be handled without overload. The advice of the loudspeaker manufacturer or his agent should always be obtained before embarking on such a procedure. Each channel of the amplifier incorporates a DC sensing circuit which cuts off signal to the loudspeakers in the event of component failure which would otherwise be likely to damage the loudspeakers.

Output Limiter

To limit the output to 20 volts rms insert the two shorting links supplied, in the sockets provided in each of the amplifier boards, as illustrated below. These sockets are spring loaded (see diagram) and the links should be pushed firmly home but not soldered. First withdraw the mains plug and then remove the top cover by undoing its two retaining screws, sliding the cover about 10 mm (0.5") backwards and lifting it clear. The adhesive label provided should be stuck on to the amplifier to indicate that the limiters have been fitted.



Quad Electrostatic Loudspeaker (Old Model)

The Quad 405-2 amplifier should always have the voltage limiters in place when driving a single Quad electrostatic loudspeaker on each channel. When two such speakers are used on each channel (stacked pairs) they should be connected in parallel with the limiters in circuit.

Loudspeakers prior to serial number 16800 (March 1966) need slight modification before being used with the Quad 405-2 unless they have already been modified for use with the Quad 303.

Loudspeaker Phasing

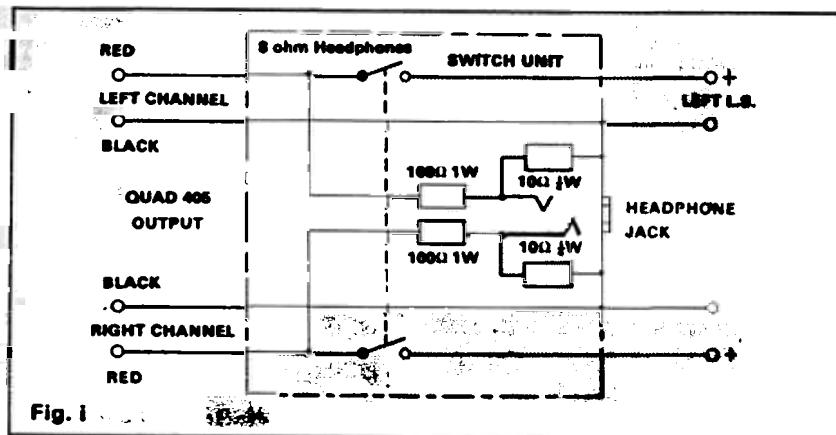
If there is any doubt about the way in which the loudspeakers are connected (see Page 6), their phasing may now be checked by playing a mono disc over both channels, when the sound should appear to emanate from a point midway between them. If this is indefinite the connections to either of the loudspeakers, but not both, should be reversed. Correctly connected the loudspeakers will give a definite centre sound source accompanied by a more full-bodied sound in the tenor and bass registers.

Headphones

Headphones should be connected to the Quad 405-2 outputs in place of the loudspeakers and a typical wiring arrangement is shown in Fig. (i). Any of the headphone switch units on the market will provide the necessary switching and many of them also provide for incorporating the resistors which adjust the signal level to suit most magnetic headphones. The Quad 405-2 does not require dummy load resistors.

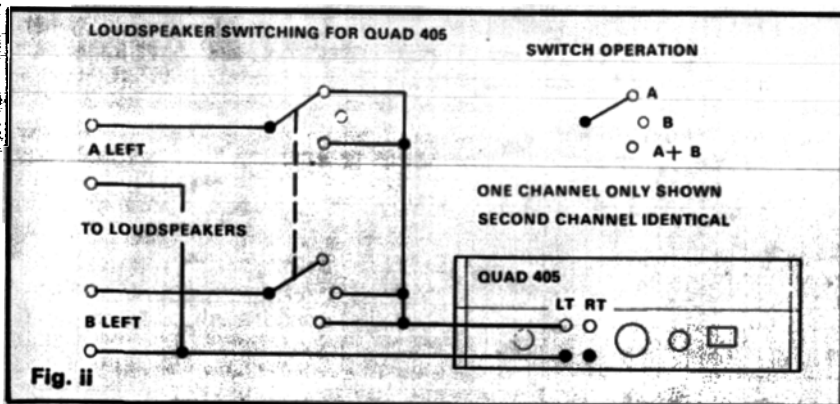
Electrostatic or other types requiring a high level input should be connected in accordance with manufacturers' instructions.

The loudspeaker return leads (which may be commoned if necessary) must be taken to the black sockets and never to chassis or earth.



Additional Loudspeakers

Fig. (ii) shows the switching arrangements if more than one pair of loudspeakers is to be used. The switch may be either of the rotary type or one of the proprietary switch boxes which are readily available.



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 4-16Ω nominal impedance.

Power and distortion for various frequencies.

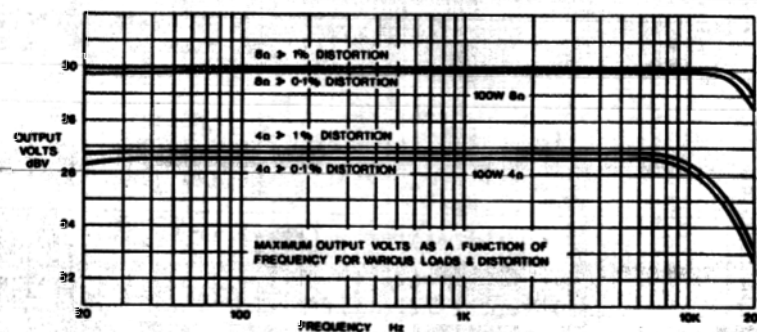
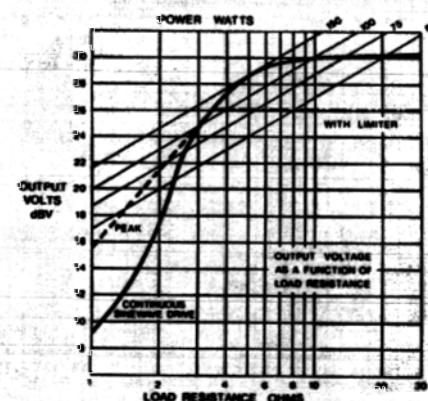
Continuous sine wave into 8Ω resistive load.

100 Hz any level up to 100 watts < 0.01% D tot

1000 Hz any level up to 100 watts < 0.01% D tot

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

For 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 8Ω), all other performance figures unchanged.

Output Internal Impedance and Offset

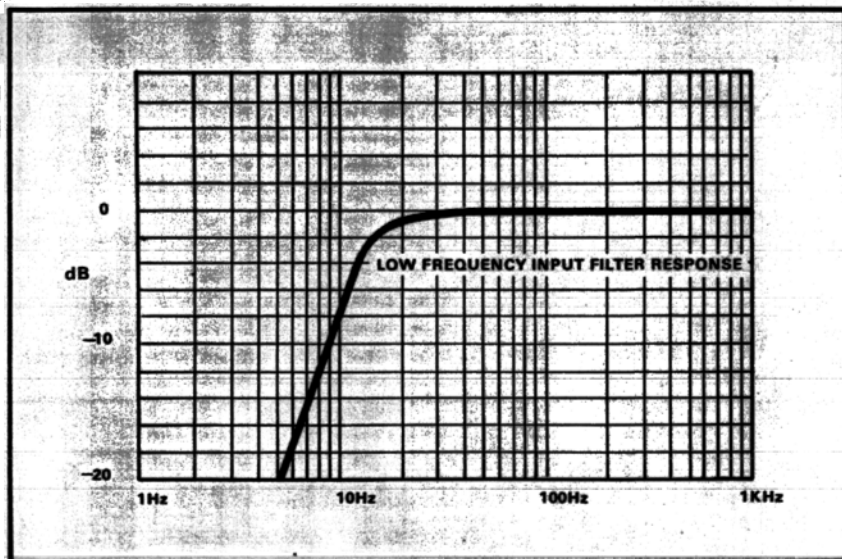
$3.3\mu H$ in series with 0.03Ω
Offset $< 7mV$.

Frequency Response

Ref. 1 kHz

Low frequency $-1dB$ at 20 Hz. Filter attenuation as curve.

High frequency $-0.5dB$ 20 kHz $-3dB$ 50 kHz.

**Signal Input Level**

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

Signal Input Slew Rate Limit

$0.1V/\mu S$.

Provided the rate of change of input voltages does not exceed this figure and the amplifier is not driven into clipping, then the total of all distortions appearing in the audio range (20-20,000 Hz) 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.

Signal Input Overload

Instantaneous recovery up to $+20dB$ overload.

Crosstalk

(Input loaded by $1k\Omega$)
 $80dB$ @ 100 Hz
 $70dB$ @ 1 kHz
 $60dB$ @ 10 kHz.

Hum and Noise

'A' weighted $-96dB$ ref full power

Unweighted $-93dB$ ref full power (15.7 kHz 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, 220 or 240V.

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

Dimensions

Height 115 mm (4.5")
Width 340.5 mm (13.4")
Depth 195 mm (7.7")
allow an extra 38 mm (1.5") for plug and socket.

Weight

9 Kg. (20 lbs.)