

405-2 Current Dumping
Amplifier
Instruction Book

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.

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Quad is a registered trade mark

Packing

The amplifier is supplied with an input lead, mains connector, four speaker connectors, two voltage limiting shorting links, and a spare mains fuse. 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 Acoustical Manufacturing Co. Ltd. A brief note should be enclosed giving your name and address plus the reason for returning it. Circuit diagrams and service data for this Quad product are available from the manufacturer or distributor on request.

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.

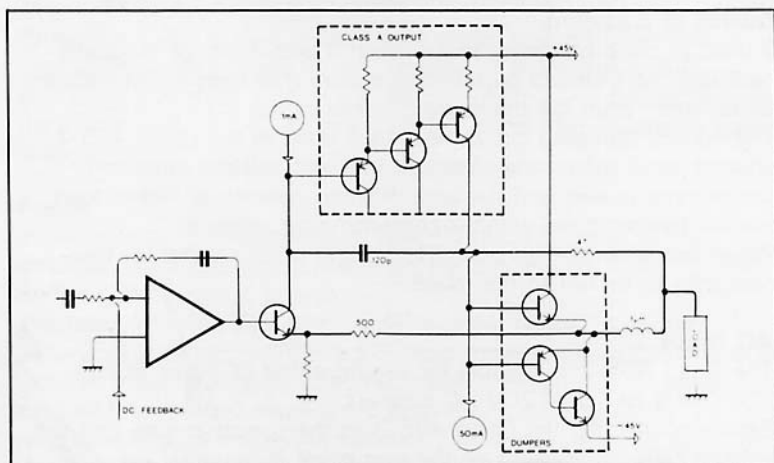


Description

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 type is less restrictive.



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

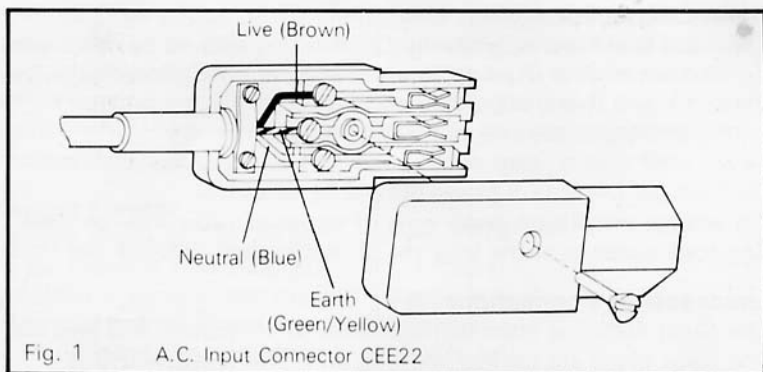
The 405-2 is fitted with a new Quad-designed protection circuit. This is a load-sensitive, time-dependent current limiter which overcomes the problems associated with conventional "load-line" circuits. The amplifier will deliver an instantaneous maximum current of 8.5A into any load. If the load is too 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.

AC Input

The Quad 405-2 is suitable for use on either 50Hz or 60Hz, 200-240V or 100-120V AC supplies. Before connecting the Quad 405-2 to the supply ensure that the voltage selector, located on the rear panel is correctly set. Voltages of up to 10% above or below the indicated range do not affect performance. AC mains input is via a standard three pin Euro plug supplied with the unit which should be wired in accordance with the internationally agreed code, Green/Yellow earth, Brown live and Blue neutral, see Fig. 1.



Earthing (Grounding)

The Quad 405-2 should be connected to earth, either via the signal lead or the AC mains lead but not both. When used with a Quad 33 or Quad 34 which is itself connected to earth via a 3 conductor AC mains lead, the Quad 405-2 is earthed via the signal lead and a two conductor AC mains lead is used. The Quad 44 is double insulated. Signal and AC mains earths are not interconnected. The Quad 405-2 should be connected to one of the 44's switched AC outlets via a 3 conductor AC mains cable. The correct interconnecting cables are supplied with Quad control units. When the Quad 405-2 is used with signal sources other than a Quad control unit check to see whether or not signal and AC earths are common. If they are then the 405-2 will be earthed via the signal lead. If they are not then a 3 conductor AC mains lead is required.

Fuses

In addition to the mains supply fuse on the rear panel of the amplifier, each channel is protected by two internal fuses, located on the printed circuit boards. The main fuse is a 2.5 amp surge-resisting (2.5AT) type for 200–250 volt supplies while a 5 amp surge-resisting (5AT) fuse is required when operating with 100–125 volt supplies. In either case all four internal fuses are 4 amp quick blowing (4AF). To reach the internal fuses 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

The input lead supplied with the Quad 405-2 should be used with signal sources other than a Quad control unit. The phono plugs are marked L and R and should be connected to the appropriate output sockets of the pre-amplifier or mixer.

When used with a Quad control unit, the standard four-pin Din/four-pin Din lead supplied should be used.

For remote installation larger runs of screened cable may be used. The total capacity of the lead should not exceed 2000pF per channel.

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 8). 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

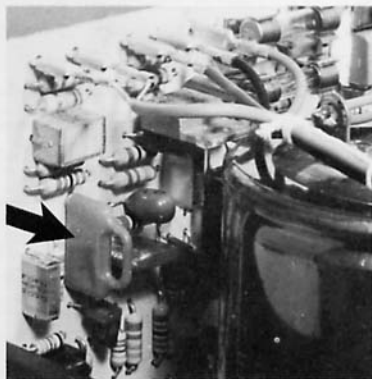
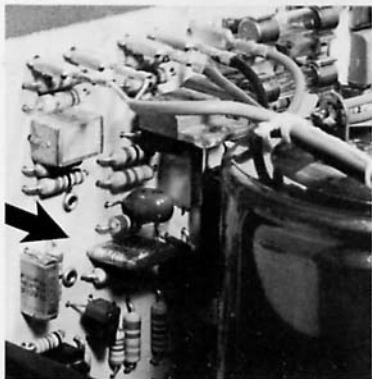
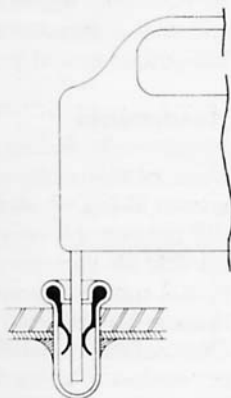
The loudspeaker manufacturer usually states a maximum recommended amplifier power for his loudspeaker. If this figure is below 100W (into 8Ω) then the limiter facilities provided with the amplifier should be fitted. Failure to do so may cause damage to the loudspeaker and infringe its guarantee.

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 one of the 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 (except for ESL-63)

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.

Note:

Quad electrostatic 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 9), 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.

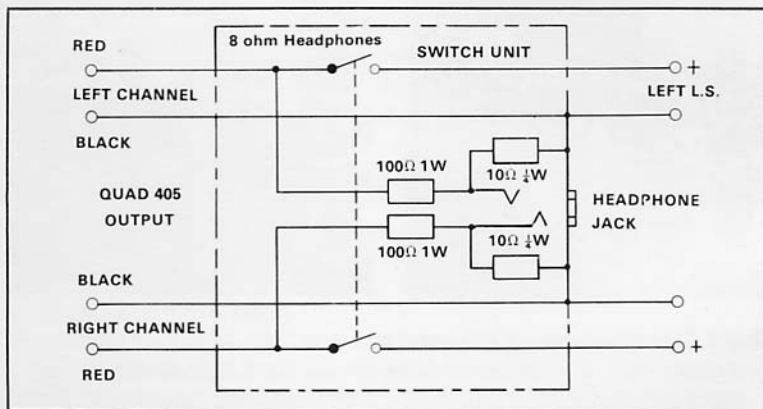


Fig. i

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.

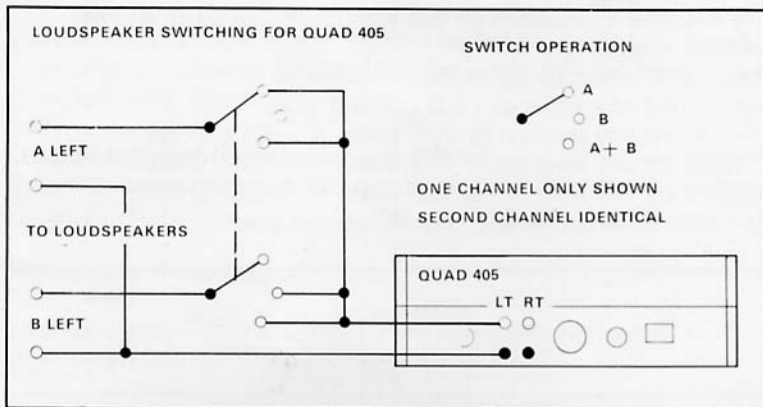


Fig. ii

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.

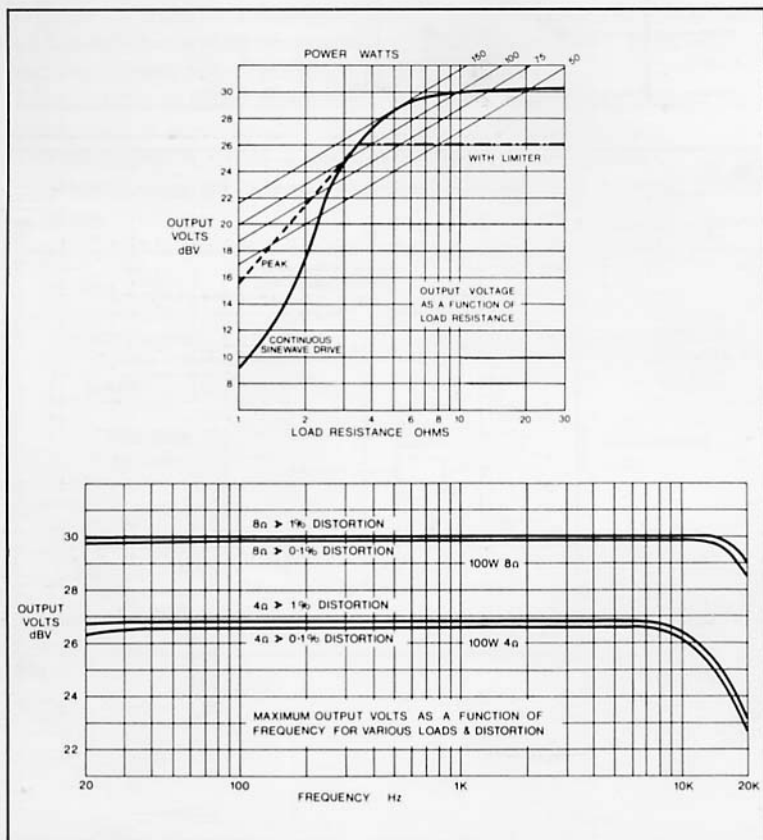
Continuous sine wave into 8 Ω resistive load.

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.



Signal Input Slew Rate Limit

0.1V/ μ 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 on programme.

Signal Input Overload

Instantaneous recovery up to +20dB overload.

Crosstalk

(Input loaded by 1k Ω) 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

110–120–130V, 220–230–240V

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.)

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

$3.3\mu\text{H}$ in series with 0.03Ω

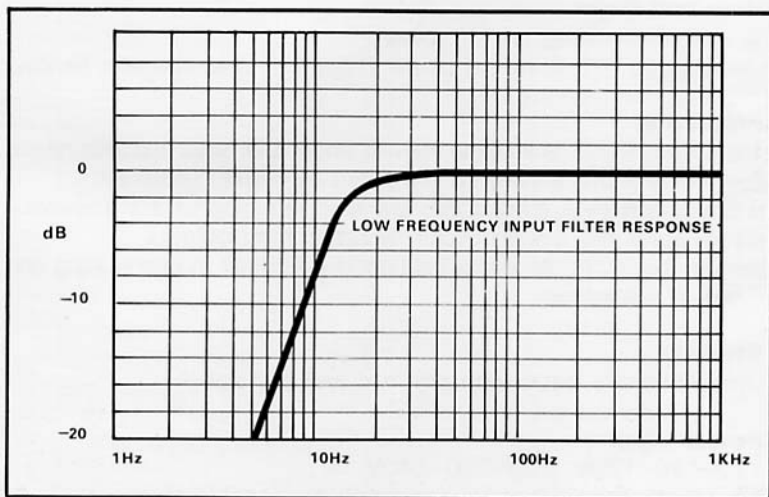
Offset $< 7\text{mV}$.

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