



**QUAD 22  
CONTROL  
UNIT**



**QUAD II  
POWER  
AMPLIFIER**

[www.valve-radio.co.uk](http://www.valve-radio.co.uk)

**QUAD 22  
CONTROL  
UNIT**

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**QUAD II  
POWER  
AMPLIFIER**

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**QUAD**

For the closest approach to the original sound

**ACOUSTICAL MANUFACTURING COMPANY LTD  
HUNTINGDON, ENGLAND**

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**T**HE objective associated with the name QUAD is the closest approach to the original sound—not as an end in itself, but that the enjoyment and appreciation of music may be unimpeded.

The QUAD 22 Control Unit presents further development towards this objective. It incorporates refinements in design, greater flexibility of input and provides facilities for both mono and stereo reproduction.



## QUAD 22 CONTROL UNIT



The QUAD 22 Control Unit is designed to operate from Discs, Radio, Tape and Microphone, mono or stereo. Its function is to select any input or service required; to match that input correctly; to amplify it; to apply such corrections as are desirable and to pass the resultant signals to the power amplifiers and hence to the loudspeakers. A separate pair of outputs are suitably derived

to provide facilities for recording on tape any programme currently being reproduced, either mono or stereo.

The unit is designed to operate with two QUAD II power amplifiers and two loudspeakers. It may, however, be used with a single QUAD II power amplifier and single loudspeaker in which case of course the stereo facilities will become inoperative.



### BASS AND TREBLE CONTROLS

Compensation for the environment in which the equipment is used.

### FILTER SLOPE

Adjusting the filter characteristic for the finest quality inherent in the programme.

### ON/OFF, VOLUME AND BALANCE CONTROL



### FILTER SWITCH

Setting the filtering range.

**PUSH•BUTTONS** to select service required: stereo or mono on one or two loudspeakers

**PUSH•BUTTONS** to select programme required and to provide correct record equalisation.







When the single MON button is depressed, so that only one loudspeaker is required, the mains supply is automatically disconnected from the second power amplifier. Similarly the HT supplies to the various tuners are only made alive when the appropriate service is required.



## BASS, TREBLE & FILTER

The treble and bass controls are designed to obtain correct musical balance to suit the environment in which the equipment is used(1). The correct use of these controls is a function of the loudspeaker(s). With a high grade loudspeaker and good programme source, these controls should be at or near level.

The remaining two controls adjust the equipment to suit the useful range of the particular programme material available(2) and thus to reproduce the highest quality inherent in that programme. The use of this control is again dependent upon the loudspeaker used. With the highest grade loudspeaker these controls become an essential requirement and they are designed with this application in mind.

A cancel position is fitted on the filter switch control. In this position, bass,

## VOLUME CONTROL · BALANCE · ON/OFF

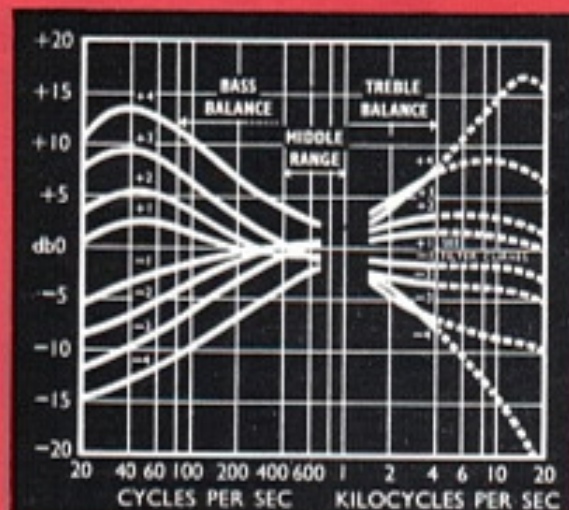
The large knob on the left of the panel provides volume adjustment and this is combined with the On/Off switch for the complete equipment. The QUAD nameplate is illuminated when the equipment is switched on.

Slotted immediately beneath the volume control is the balance control. This adjusts the relative volume level to the two loudspeakers. With proper control in record manufacture this control should require little attention after being set for any installation.

treble, and filter controls are automatically by-passed to give a level response. Thus a switched reference standard is provided for comparison with control settings found by aural assessment.

Full instructions for the proper use of these controls are supplied with each equipment.

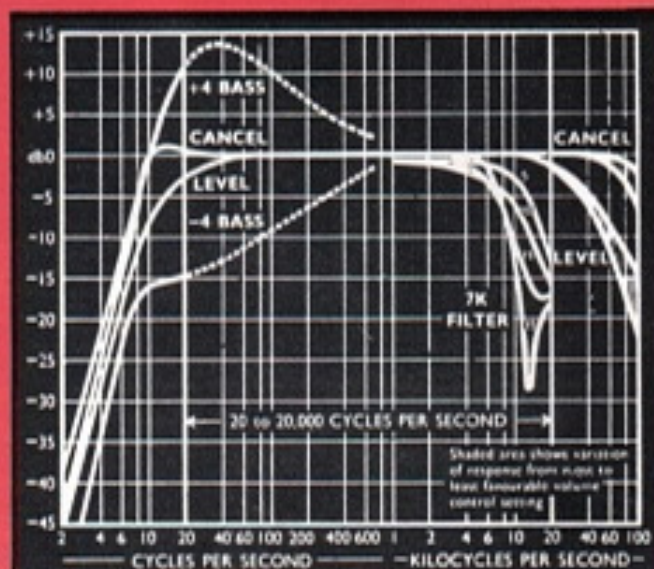
- (1) Bass and treble control is effected in two frequency discriminating networks of identical impedance, one in the signal chain and one in a feedback chain. Boosts and cuts are therefore symmetrical. The bass control varies both slope and turnover. The treble operates midway between variable step and variable slope in order to facilitate adjustment of musical brilliance while maintaining natural harmonic balance.
- (2) The filter is of the "m" derived type with "m" = 0.85. The filter may be switched in half octave steps and the slope is continuously variable from zero. This arrangement gives the widest frequency range for minimum distortion from nearly all programme sources. The calibration gives the approximate attenuation over the first octave rather than a theoretical final slope, thus producing a more linear scale and a closer match to the subjective effect.



Curves showing (left) effect of Bass and Treble Controls and (below) extended frequency response and effect of the 7K Filter.

A multi-element low frequency filter rapidly attenuates the sub-audio frequencies without encroachment into the useful range making a switchable roll-off superfluous.

The high frequency filter curve shapes are accurately maintained and the figures adjacent to the curves are the approximate dial settings. The 5K and 10K filters provide similar curves one half octave up or down.

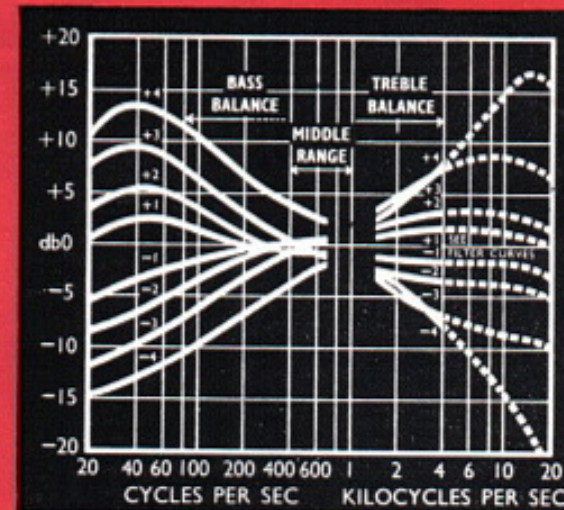




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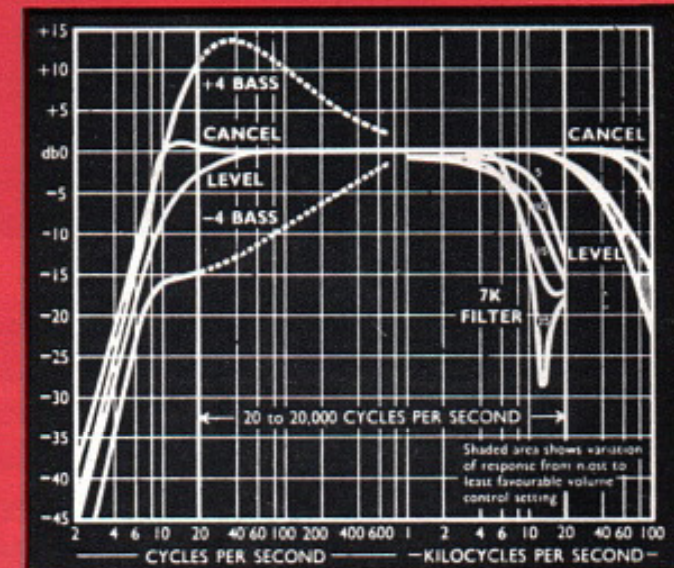
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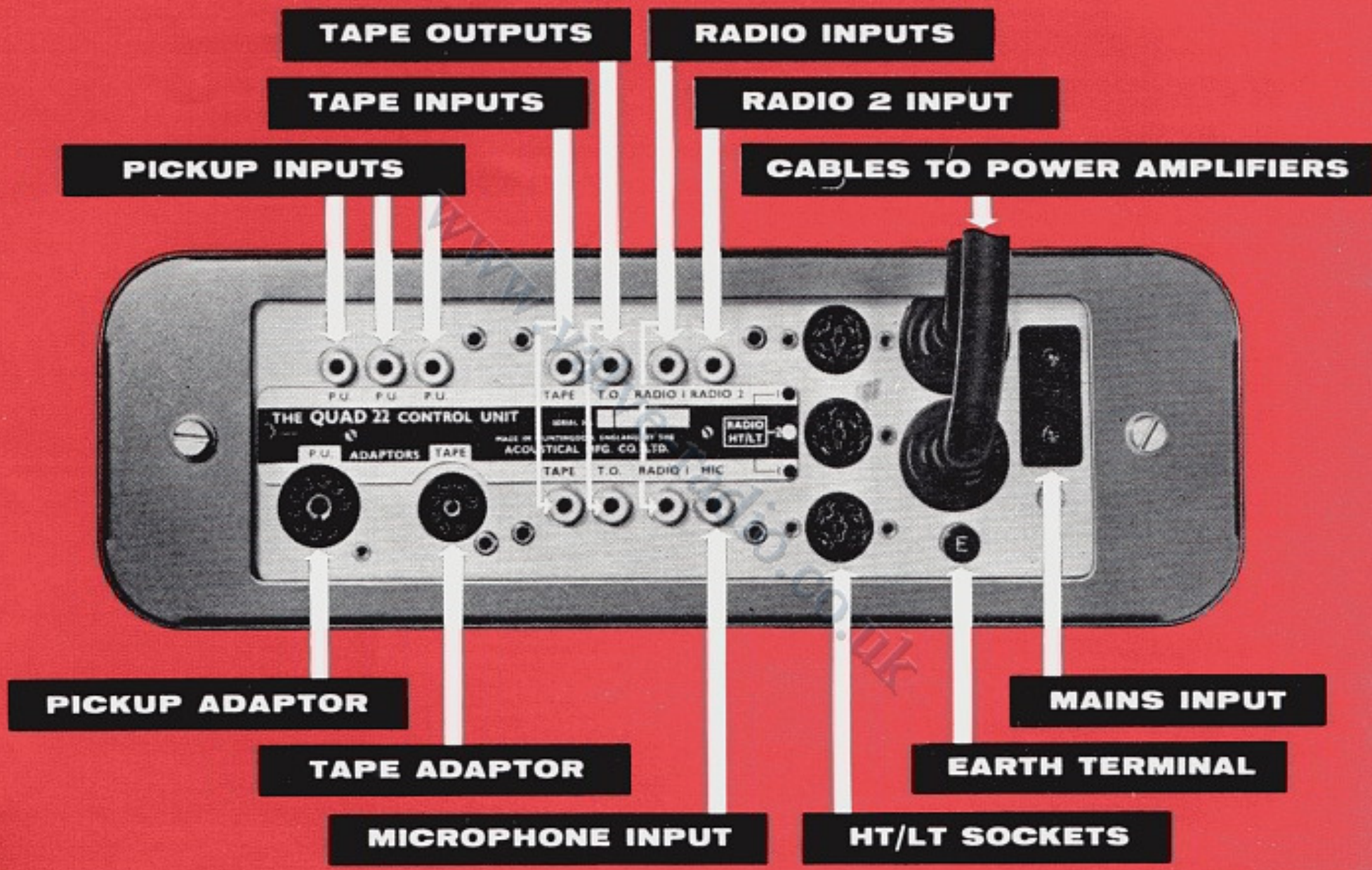
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## PICK-UP INPUT

## THE REAR PANEL

The gramophone input consists of three inputs and an adaptor unit. Two of these inputs form the stereo pair and the third input is for use with a separate monaural pickup. There are two ranges of adaptor units. One range is designated by a single letter and when one of this range is employed, monaural reproduction is automatically taken from the lateral output of the stereo pickup. Thus one pickup is used for all types of record. The second range of adaptors is designated by two letters and when one of these is employed the input for monaural records is automatically taken from the separate input provided.

Correct matching for a pickup is very important, and this entails the adjustment of several parameters for proper operation. The adaptor unit carries out this function in a unique manner so that correct operating conditions are ensured(3). The range of adaptor units provides separately for the stereo and monaural inputs, so that when two pickups are used they may be of entirely different types.

A list showing the appropriate unit for various pickups is published and this is revised from time to time as new pickups become commercially available. An adaptor is supplied with each control unit and an exchange service is available in most Countries throughout the World.

- (3) *The pickup input is fed to the first stage over which parallel feedback is applied. The adaptor unit in applying the correct load for the pickup also adjusts the impedance of the feedback circuit to suit that load. In this way noise is virtually that of the thermal noise in the pickup load impedance alone. It will be seen that, particularly with pickups requiring medium and low impedance loads, the signal to noise can be improved several dB over that of fixed high impedance parallel feedback of equivalent gain. The limit is reached with a load of 12 Kiloohms, the noise with any load impedance below this value being that of the equivalent noise of a 12 Kiloohms resistance at the input. The adaptor also adjusts the total stage gain together with the type of compensation required when pickups of other than constant velocity types are employed.*



## PICK-UP INPUT

## THE REAR PANEL

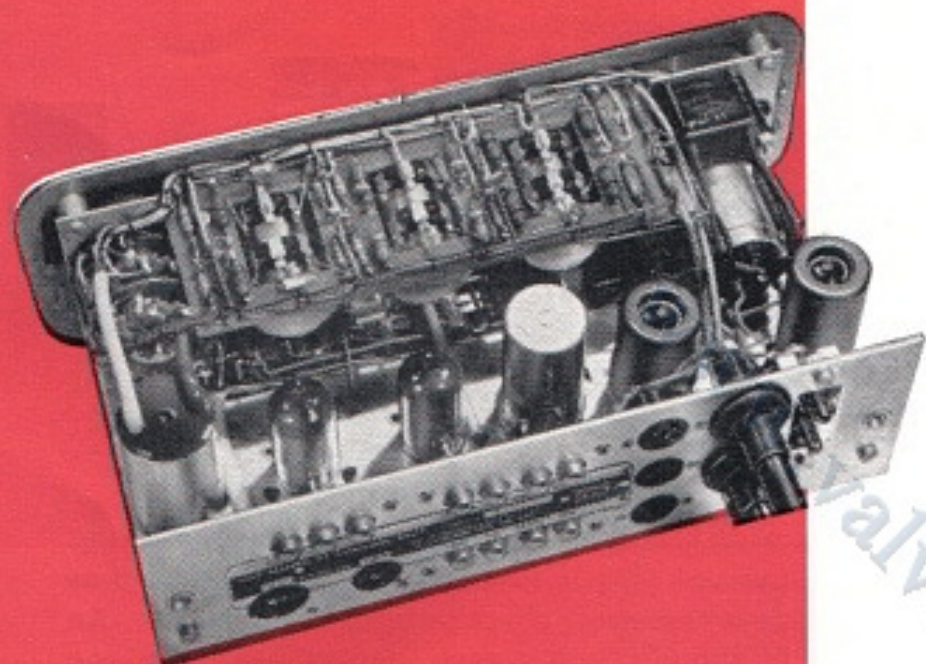
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## RADIO INPUTS

Three radio inputs are provided together with three HT and LT supplies. Two of these—Radio 1 and Radio 2—provide alternative radio inputs available monaurally. The third input forms a stereo pair with Radio 1, either from a separate receiver or multiplex unit. It is possible to connect Radio 1 and Radio 2 so that they automatically couple as a stereo pair in the rare case where this may be required.

## TAPE INPUT & OUTPUT

Tape input and tape output are provided, available for monaural or stereo. The tape inputs (playback) are interconnected via an adaptor unit which is normally arranged so that the input is taken from a properly corrected tape pre-amplifier channel, this being the





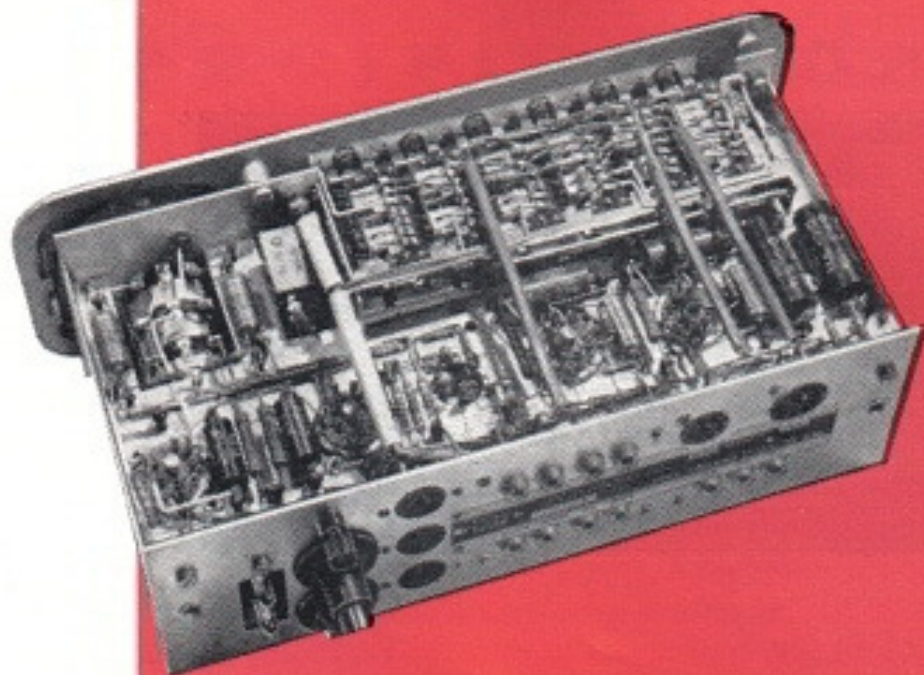
recommended procedure for professional standards. Alternative adaptor units make it possible to convert this pair of inputs for direct connection to suitable replay tapeheads (TAPE H units) or for stereo microphone use (MIC N unit) or to provide for any other input configuration which future requirements may demand (4).

The tape output (for recording) feeds signals selected by the push-buttons to the record amplifier of a tape machine. Gramophone signals are suitably equalised and amplified to the correct level, otherwise this output is unaffected by any of the controls, and recordings may thus be made of a programme without affecting normal listening.

## MICROPHONE

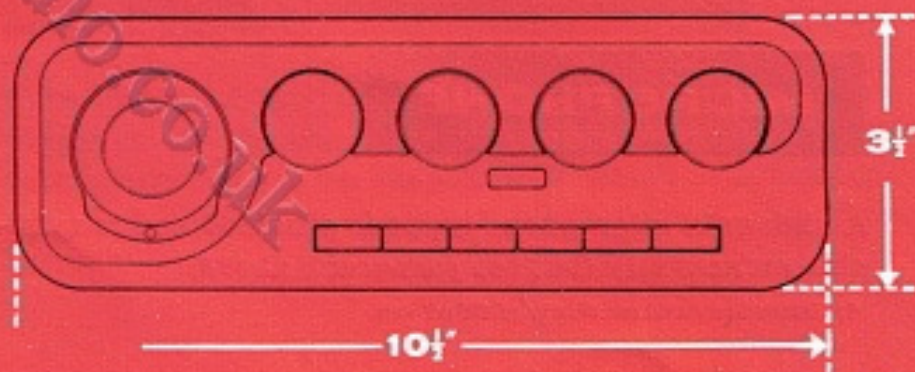
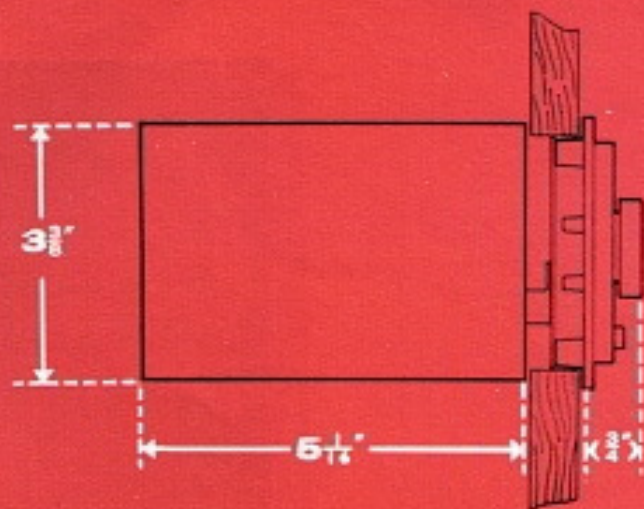
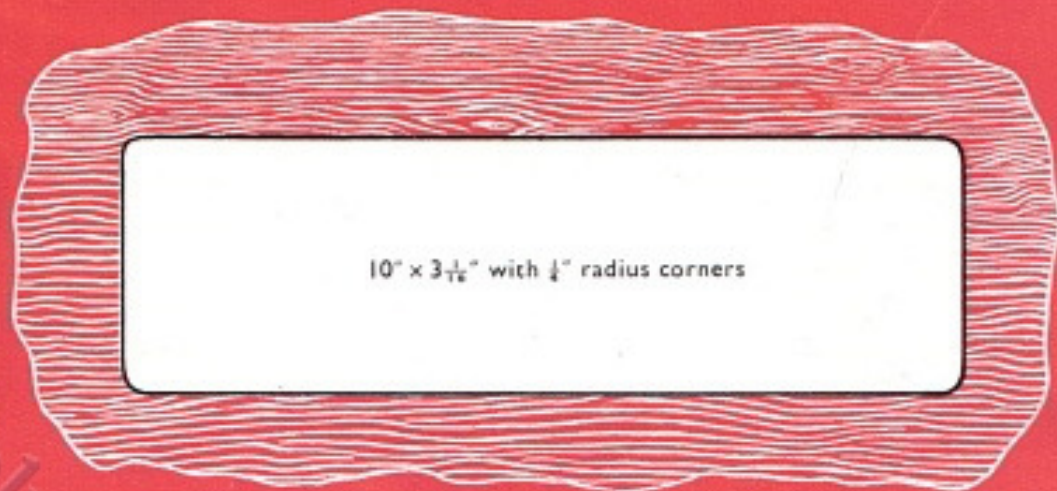
A high gain microphone input is provided and is available monaurally (but see paragraph above).

4) Down to a basic sensitivity of  $400 \mu V$  rms.





The Control unit may be fitted to cabinet panels of any thickness from  $\frac{1}{8}$ " to  $\frac{3}{4}$ ". The cut-out required is shown on the right. The cover is removed and the unit inserted from the front when it will locate automatically. The cover is refitted from the rear and will grip the unit firmly in position.



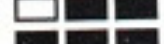
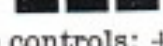




# SPECIFICATION

## FREQUENCY RESPONSE

Cancel position: Radio and Tape inputs: 20-20,000 c/s  $\pm$  0.5 dB.  
" " Microphone: 20-20,000 c/s  $\pm$  2 dB.  
" " Gramophone Maintained over 20-20,000 c/s within  $\pm$  1dB of the following characteristics:

	3180 $\mu$ S	318 $\mu$ S	75 $\mu$ S.
	3180 $\mu$ S	318 $\mu$ S	100 $\mu$ S.
	3180 $\mu$ S	450 $\mu$ S	50 $\mu$ S.
	—	450 $\mu$ S	25 $\mu$ S.

Bass and treble controls:  $\pm$  1.5 dB of published curves.  
Filter frequencies: 5 Kc/s, 7 Kc/s, 10 Kc/s.  
Filter slope: See curves.

## INPUT SENSITIVITY (at 1 Kc/s for 1.4 Vrms output)

Radio:	70 mVrms,	load impedance	100,000 ohms.
Tape:	70 mVrms,	" "	100,000 ohms.
Microphone:	1.5 mVrms,	" "	100,000 ohms.
Pick-up:	Depending upon adaptor unit. Basic sensitivity prior to compensation 400 $\mu$ Vrms.		

## DISTORTION (1.4 Vrms output):

All controls level: Any input: 0.02%.  
Least favourable arrangement of controls: less than 0.1%.

## NOISE

Total hum and noise: Better than -70 dB.  
Noise: -80 dB or where applicable, the equivalent noise of the pick-up load impedance at the input.

## OUTPUT

Control unit to power amplifier: 1.4 Vrms.  
Maximum cable extension of signal lead only: 20 feet at 30 pF per foot. (L.T. leads should not be extended unless diameter is also increased).  
Tape outputs: Peak signal approx. 0.25 Vrms.  
Maximum loading 500,000 ohms and 200 pF.

## INTERCHANNEL SPECIFICATION

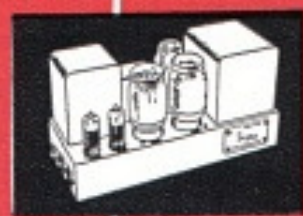
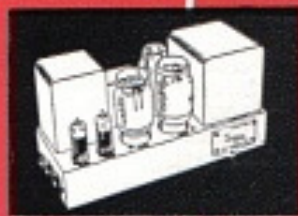
Cross talk: Better than 40 dB 20-20,000 c/s.  
Gain stability: With any volume setting and tone controls level: Less than 1 dB between channels.  
With any volume setting and tone controls varied: Less than 2dB between channels.  
Balance control: Provides up to 9 dB unbalance either way.

## POWER SUPPLY

The unit takes its power from the power amplifier as follows:—  
330 V 4 mA. } Plus current taken by tuner units.  
6.3 V 1.1 A. }  
Maximum power available from tuner sockets:  
330 V 35 mA each tuner.  
Rad. 1 and Rad. 2: 6.3 V 3 A total.  
Rad. 1 (2nd channel): 6.3 V 3 A.  
The heater supply is C.T. to chassis.

*continued overleaf*





### VALVES

2x EF86

2x ECC83

### MECHANICAL

Front panel: Die cast, stove finished silver fawn.

Knobs: Matt brown.

Chassis: Steel: Cadmium plated.

Cover: Steel: Stoved steel grey.

The complete unit is electrically and mechanically suitable for use in all climatic conditions.



*.. For the closest  
approach to  
the original sound*



## QUAD II POWER AMPLIFIER

One or two QUAD II power amplifiers may be used with the QUAD 22 control unit depending upon whether single channel mono only or two channel mono and/or stereo reproduction is required.

The function of the power amplifier is that of amplifying the output from a control unit or other source with the highest possible standard of accuracy. The unexcelled quality of reproduction provided by the QUAD II is recognised



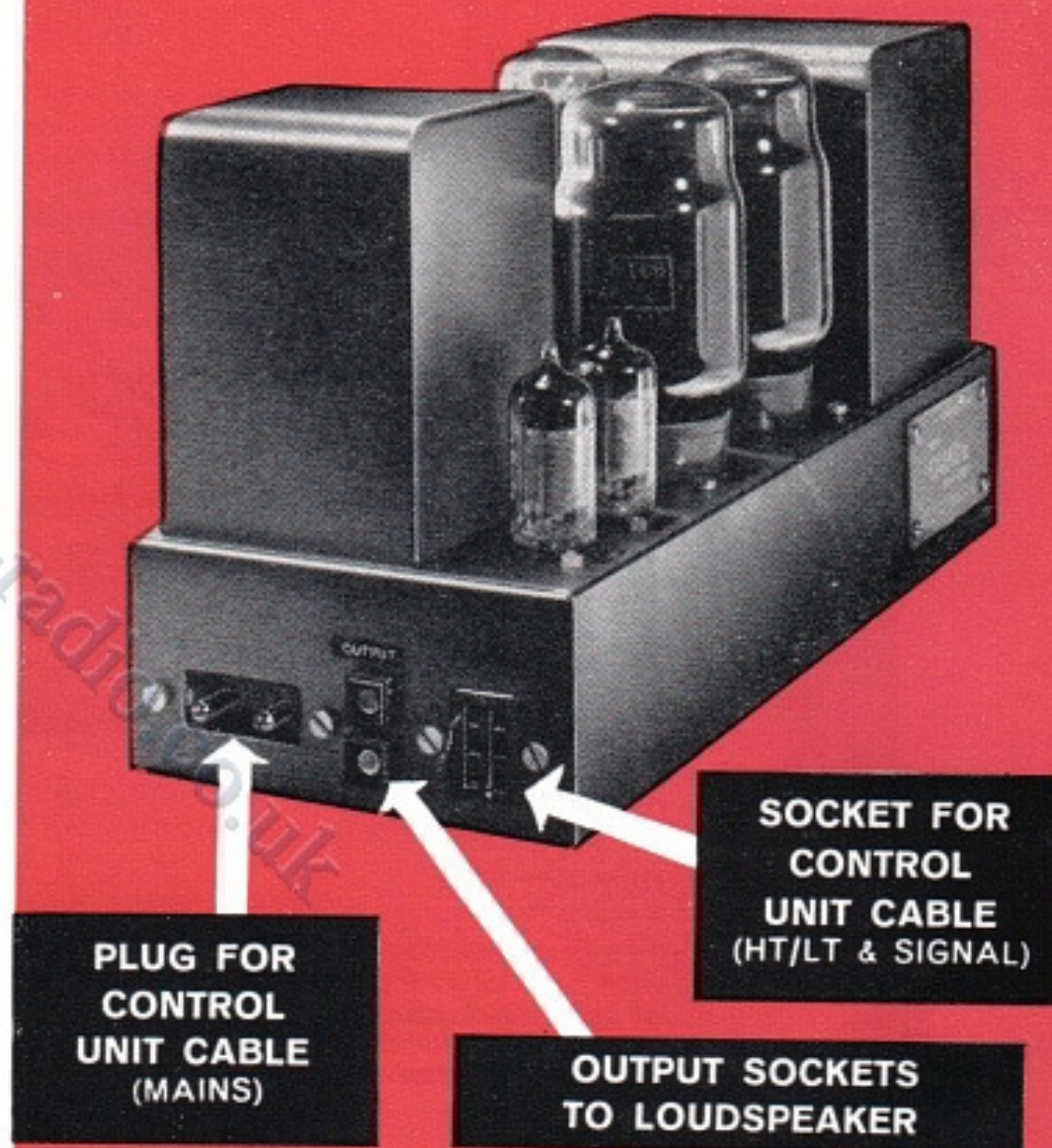


throughout the world and several features contribute to maintain this standard through many years of service with the minimum of attention. Stability and hence performance are entirely independent of load or signal conditions. It is thus suitable for use with any loudspeaker configuration, the quality of reproduction being solely that imposed by the limitations of the loudspeaker selected (and of course that of the programme input).

The performance specification is fully maintained with random valve replacements from standard commercially tested valves without matching or alignment of any kind.

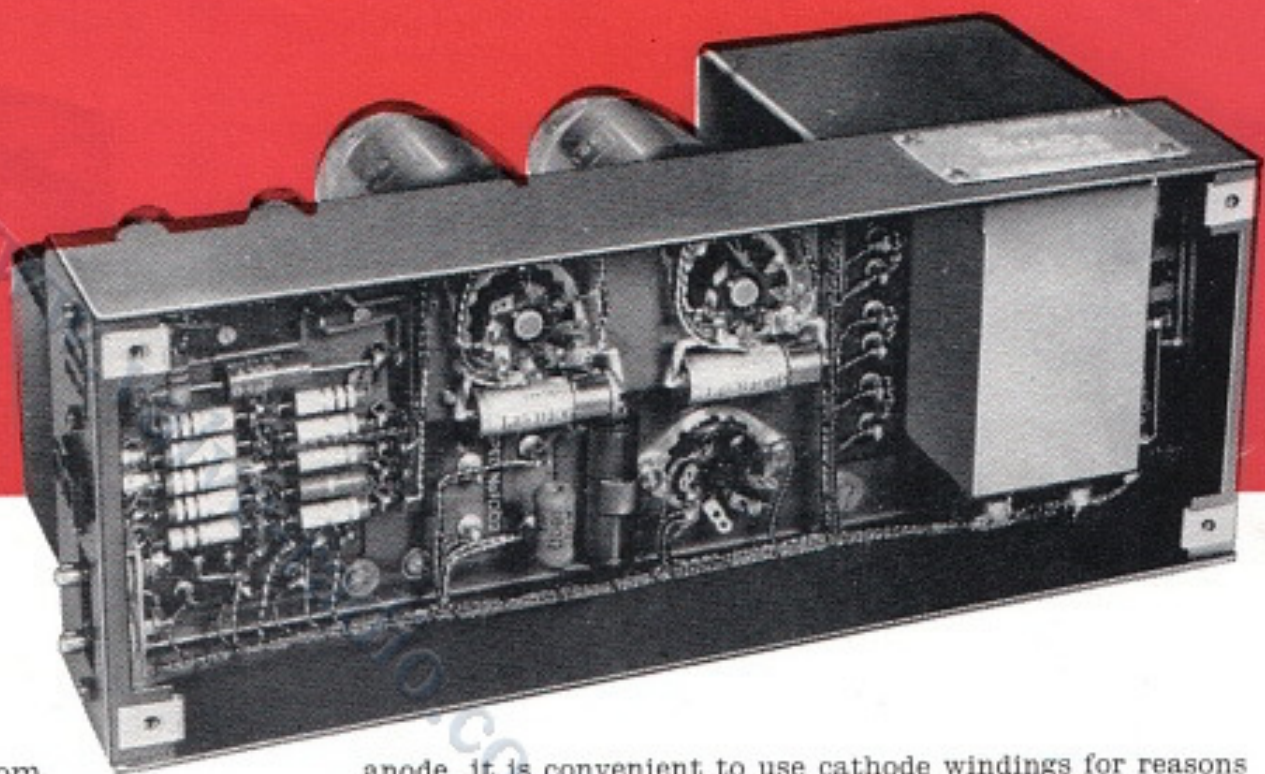
Although high power output valves are used these are not operated at their maximum power. The designed power output is selected to be adequate for all home music listening with low sensitivity loudspeakers.

The amplifier is suitable for use in all climatic conditions and is available for operation from all AC mains supplies.





## CIRCUIT DESCRIPTION



The QUAD II power amplifier differs from contemporary practice both in the output stage and in the penultimate stage.

### THE OUTPUT STAGE

The basic principles utilised in the output stage design have been treated elsewhere\* and need only brief reference here. It has been shown that by proportioning the influence of screen and anode currents on the load, a series of operating conditions may be obtained offering low distortion and high efficiency. Since cathode current is common to screen and

anode, it is convenient to use cathode windings for reasons which have also been explained\*.

The output stage as used in the QUAD II appears before feedback is applied as the equivalent push-pull triode circuit as far as amplification and effective output impedance are concerned but with less than half the distortion and an increase of 40% in efficiency over the equivalent triode circuit. The screen and anode circuits are more favourably arranged for efficient smoothing, a factor which is reflected in the overall size of the equipment.

\*Wireless World. Sept., 1952.



The output transformer employs five windings sub-divided into fourteen sections coupled so that the output stage phase shift is extremely small within the range where the overall feedback loop gain exceeds unity. The small size of the output transformer resulting from optimum choice of flux and material should be noted.

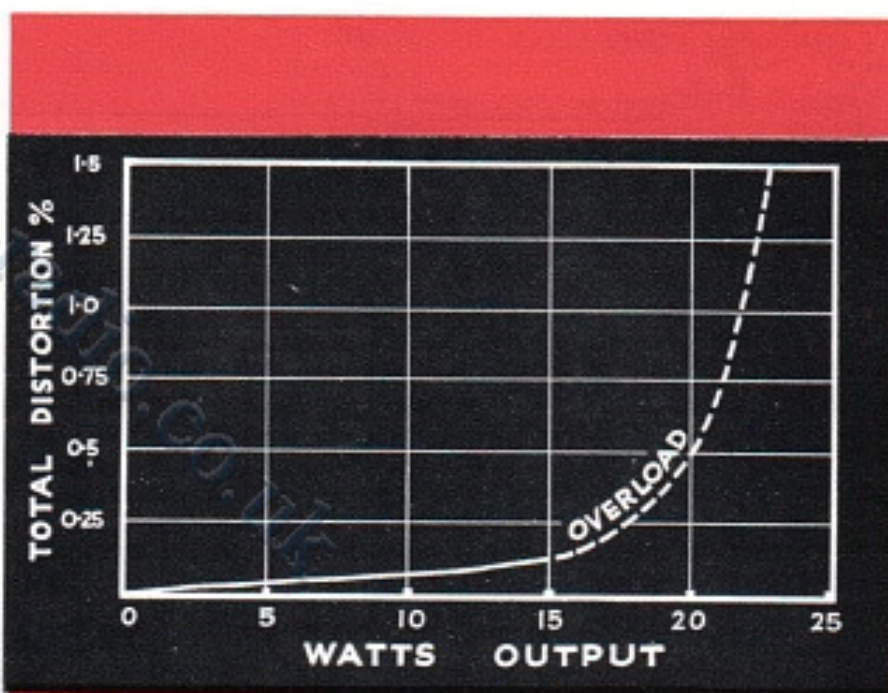
### THE PENULTIMATE STAGE

Full benefit can only be obtained from this output circuit if the feed is accurately balanced throughout the frequency range, since it is some three times more sensitive to unbalance than conventional operation. A high stage gain is desirable and some form of see-saw circuit is called for. Such circuits, however, are unsymmetrical in relation to the HT supply. In the QUAD II, two EF.86 valves are used, each feeding one output valve. The second EF.86 is fed from the first but with a signal 6 dB lower than would be required for balance. The EF.86's are then coupled through their screens and cathodes so that they are always approaching balance. This arrangement is inherently stable, satisfies symmetry requirements and the balance error is automatically maintained through see-saw action. The output valve grid returns are applied to a fixed signal point in phase with one and out of phase with the other, the small signal so applied being equal to the small resultant balance error previously mentioned. In this way, the complete phase change centres around balance and provided the anode load resistors are of equal value, any error due to valve mismatch will be small.

### FEEDBACK AND LINEARITY

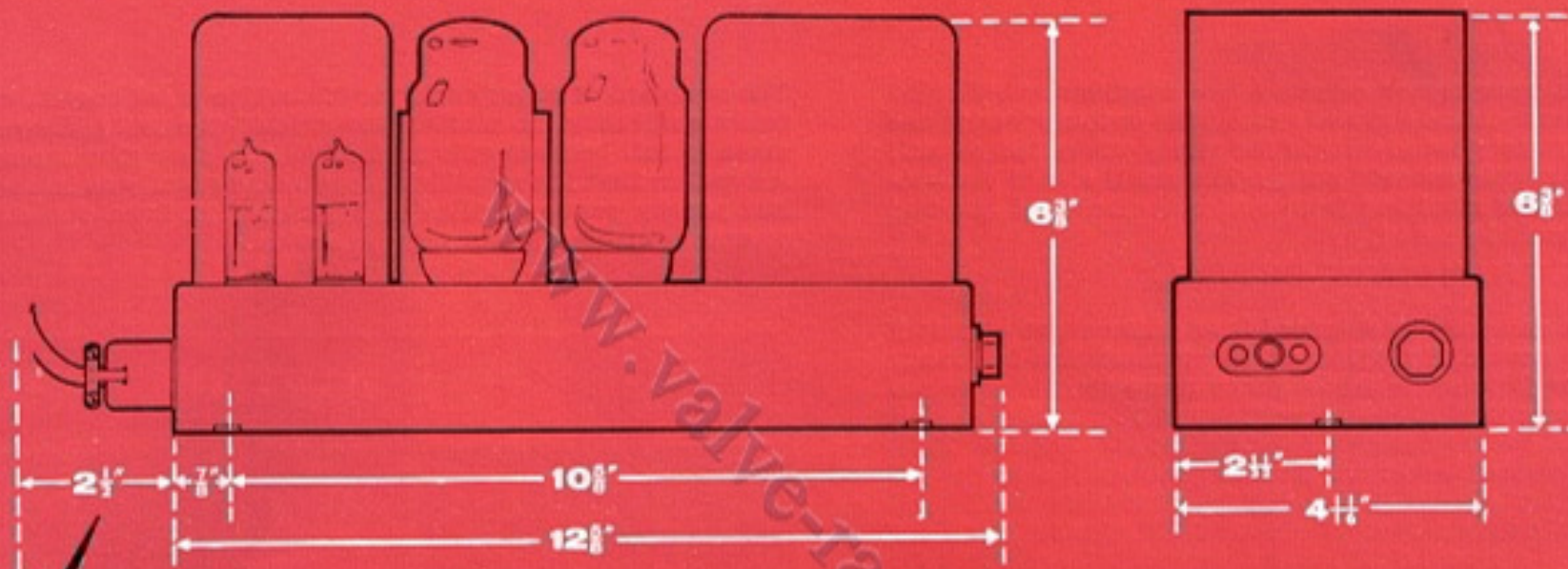
The overall feedback is an integral part of the amplifier design and cannot be considered separately.

The standard of pass figures for distortion is, of course, well below audibility, no matter how refined the test. They are given in full because only in this way do they give a proper indication that the amplifier is operating exactly as intended and not by part cancellation of distortion from one stage to another by fortunate valve selection.



Linearity and overload of the QUAD II power amplifier.





to allow for  
insertion  
of plug

The QUAD II Power amplifier dimensions are given above. In fitting in a cabinet,  $2\frac{1}{2}$ " at each end should be allowed for easy access to the fuse and input and output leads. It may be fixed in position by means of the two tapped holds in the baseplate.



Figures for response, distortion, sensitivity and background are the pass figures on final test.

## SPECIFICATION

### POWER OUTPUT

15 watts throughout the range 20-20,000 c/s.

### FREQUENCY RESPONSE

Within 0.2 dB 20-20,000 c/s.

Within 0.5 dB 10-50,000 c/s.

### DISTORTION (measured at 12 watts output)

Total 3rd and higher order: less than 0.1% at 700 c/s.

Higher order alone: less than 0.03% at 700 c/s.

Valve mismatching up to 25% (introducing 2nd harmonic) not to cause distortion to exceed 0.18%. Total distortion at 50 c/s not to exceed 0.25%.

### INPUT

Sensitivity: 1.4 Vrms for 15 watts output.

Load imposed on input: 1.5 Megohms in parallel with 10 pF.

### BACKGROUND

80 dB referred to 15 watts.

### OUTPUT IMPEDANCES 15 ohm and 7 ohm.

Effective output resistance: 1.5 ohm for 15 ohm output.

### POWER SUPPLIES

INPUT: 200-250 V. AC single phase (or 95-125 V. AC)  
40-80 c/s.

90 watts consumption (excluding control unit, tuners, etc.).

HT AND LT supplies available for external equipment:

330 V. 40 mA.

6.3 V. 4 A. (heater C.T. to chassis).

VALVES 2 x EF.86, 2 x KT.66, 1 x GZ.32.

WEIGHT 18½ lbs. (8.3 Kg).

DIMENSIONS 13" x 4½" x 6½". See drawing.

MECHANICAL All windings impregnated and housed in compound filled casings. All metal work fully rust-proof processed and stoved steel grey. Metal work, rust-proofing, finishing, transformer winding, tropicalisation, assembly and tests, all carried out under constant supervision by our AID approved inspection section. The equipment is suitable for use under all climatic conditions.



## **SPECIAL APPLICATIONS**

The reliability and consistent performance of the QUAD II power amplifier has led to its wide use in professional, industrial, and scientific applications. The unconditional stability allows any number of units to be connected in parallel without interaction. The flexibility of multiple unit operation is of value where increased power is required, and where it is necessary to retain the excellent characteristics of a single QUAD II power amplifier.

## **NON-STANDARD VERSIONS**

The QUAD II power amplifier can be supplied with certain variations, for example:

- (a) Input to bridge 600 ohm lines at zero level and fitted with gain control.  
For use as recording, broadcast, or television sound monitor amplifier.
- (b) Fitted with single multi-way Tuchel plug for all external connections.  
For use in rack mounted broadcast applications.
- (c) 50/100 Volt line output. For use in local programme distribution or warning systems.
- (d) 115/230 Volt output. For use as artificial mains supply to drive small synchronous motors from quartz crystal controlled or variable frequency sources.

Such non-standard amplifiers are only available in quantity to special order.



## Guarantee

*This instrument is guaranteed against any defect in material or workmanship for a period of twelve calendar months from the date of purchase.*

*Within this period we undertake to supply replacements free of charge for any parts excepting valves (which are covered by makers' guarantee of three months) which may prove on examination to be defective provided that such defectiveness is not the result of misuse (including use with unsuitable ancillary equipment), accident or negligence, and further that the instrument was purchased at the proper retail price prevailing in the country of purchase.*

*Any set requiring service under this guarantee should be taken to the supplier through whom it was purchased, or, in case of difficulty, it should be carefully packed and consigned, carriage paid to the main distributor for the country of purchase quoting the date of purchase. It must not be sent to any other agent or distributor except by special arrangement.*

*This guarantee is valid only when the guarantee card is properly filled in and returned for registration as directed within ten days of purchase, and does not cover labour or carriage costs involved in any repair under the guarantee.*



**ACOUSTICAL MANUFACTURING CO. LIMITED**

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[www.e-radio.co.uk](http://www.e-radio.co.uk)  
**QUAD**

**FOR THE CLOSEST APPROACH TO THE ORIGINAL SOUND**