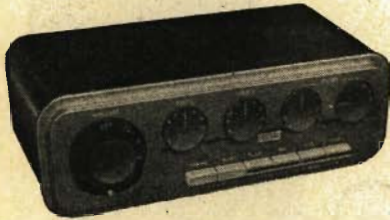


TECHNICAL REPORTS

Quad 22 Control Unit and Quad II Amplifier.

Price: Control Unit, £25; Amplifier, £22 10s. 0d. (additional adaptor units 15s. each—all types). The Acoustical Manufacturing Company Limited, Huntingdon, Hunts.



Makers' specification: Control Unit—QUAD 22.

Frequency Response:

Cancel position: Radio and Tape inputs 20-20,000 c/s ± 0.5 db.

Cancel position: Microphone inputs 20-20,000 c/s ± 2.0 db.

Cancel position: Gramophone inputs 20-20,000 c/s ± 1.0 db for the four characteristics provided.

Bass Treble and filter controls within ± 1.5 db of published curves (given in booklet free from the makers).

Input Sensitivity (at 1,000 c/s for 1.4 v r.m.s. output):

Radio: 70 mV at 100,000 ohms input impedance.

Tape: 70 mV at 100,000 ohms input impedance.

Microphone: 1.5 mV at 100,000 ohms input impedance.

Pickup: Depending on adaptor unit; basic sensitivity 400 mV before compensation.

Distortion (for 1.4 v output):

Controls at level, any input 0.02%.

Least favourable arrangement of controls, less than 0.1%.

Noise and Hum: Better than -70 db.

Output: To power amplifier 1.4 v—maximum cable extension 20 ft. at 30 pf per foot. To tape recorder—0.25 v—maximum load 500 K Ω and 200 pf.

Crosstalk: Better than 40 db. 20-20,000 c/s.

Balance: With any setting of controls better than ± 1 db (balance control provides up to 9 db unbalance either way).

Power Supply: Requires 330 v at 4 ma and 6.3 v at 1.1 A (plus current taken from tuner supply sockets).

Values: 2 x EF86 29 or (276267), 2 x ECC83 (12AX7).

Dimensions: 7" D x 10½" W x 3½" H (including plugs).

Finish: Front panel: Die-cast stove finished silver fawn.

Knobs: solid turned metal finished matt brown.

Chassis: Steel cadmium plated.

Cover: Stoved steel grey.

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



QUAD II Power Amplifier:

Power Output: 15 watts from 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: At 12 watts—total 3rd and higher less than 0.1% at 700 c/s. High order alone less than 0.03% at 700 c/s. Valve mismatching up to 25% (introducing 2nd harmonic) not to cause distortion exceeding 0.18%.

Total at 50 c/s not to exceed 0.25%.

Input: 1.4 v for 15 watts. Load 1.5 megohms in parallel with 10 pf.

Hum and Noise: -80 db referred to 15 watts.

Output Impedance: 15 and 7 ohms (1.5 ohm effective for 15 ohm output).

Power Supplies: 200-250 v 40-80 c/s (alternative model 95-125 v) at 90 watts. Spare power 330 volts at 40 ma. 6.3 v. 4a.

Values: 2 x EF86 (Z729 or 6267) 2 x KT66 (or 6L6G matched), 1 x GZ32 (54KU or 5V4G).

Weight: 18½ lbs.

Dimensions: 13" D x 4½" W x 6½" H (plus plugs).

Finish: All windings impregnated in compound filled cases. All metal work rust proofed and stoved steel grey. Suitable for use under all climatic conditions.

Since its appearance in the autumn of 1953 over 20,000 Quad II amplifiers have been produced. In this time only very minor alterations have been made, a tribute to the advanced thinking that went into the original design: for now, almost six years later, it has not been surpassed in style, appearance, flexibility or performance and might well have continued substantially unchanged had it not been for the birth some 18 months back of a slightly premature, but now quite healthy baby called stereo. In these intervening months my colleagues and I have been asked dozens of times, "What are Quad doing about stereo?" and although little scraps of rumour came from Huntingdon, any direct enquiry was met with evasion, followed by a list of questions regarding the ideal in a stereo system. From this semi-public opinion poll the fertile brains of Peter Walker and his team has evolved the beautiful Quad 22 control unit, which is before me as I write. The wisdom of their policy will soon become obvious, for this is a unit without rival today. In describing it, I hope that the many readers who are familiar with the Quad II will bear with me when I discuss features of which they are aware. On the other hand strangers to the Quad must forgive comparisons with its predecessor.

Let me start by stating the basic duties of the Quad 22. They are: to select as required the input from Radio, Microphone, Disc or Tape, either single channel or stereo: to match and compensate them in the most efficient way: to amplify them to the desired degree: to allow the user to apply such corrections as will benefit the reproduced sounds and then to pass them without loss to the power amplifier. In addition a separate pair of outlets is provided to feed a recorder with whatever programme is being reproduced at the time. Lastly, if only one power amplifier is used, all features except stereo must remain operative.

On the front of the unit, as before, are six push buttons. The engraving above the buttons indicates the common uses and from left to right they are: 1 Stereo; 2 Mono; 3 Radio; 4 Mic; 5 Disc; 6 Tape. The last four are distinguished by a red line running through them as their function is to decide the input, whereas the two on the left decide the service. Below the row of buttons are engraved the less used combinations of the nineteen provided.

With the Stereo button pressed, three inputs become available, Radio, Tape and Disc. (There are alternatives to the tape position which I shall discuss later.)

With the Mono button pressed there are added, a second radio input, a microphone input and three alternative disc playback characteristics (apart from the Standard International LP which is always brought in by the Disc button alone). These are obtained by depressing more than one button as indicated on a list provided.

If both left buttons are pressed, all the listed Mono facilities are passed to both amplifiers. Incidentally, the second amplifier has its power switched by the operation of the buttons so that it is not energised if only Mono is in use. Similarly HT is only fed to such radio tuners as are brought into use.

As before, the large knob on the left turns on the entire equipment and controls volume in both channels. In a slot beneath it appears a second scale with a small white finger button. This is the balance control, varying the relative strength of the signals passed to the two power amplifiers. It should normally be central and each of three divisions either side is a change of approximately 3 db.

The first pair of small knobs are the bass and treble tone controls—less needed these days with better programme sources and improved loudspeakers. The arrangement is a clever one using networks in both signal and feedback paths to give symmetrical boost and cut circuits. The bass control is arranged to operate at very low frequencies near the level position and to move progressively up the musical scale towards the extremes. Similarly the treble control maintains correct balance of harmonics whilst varying the brilliance—an elegant arrangement giving the best subjective result I have experienced.

The right-hand pair of knobs control the variable slope filter and still incorporate the unique Quad arrangement, although are not identical circuitwise with their predecessors. Their purpose is to temper the response of the equipment to that of the programme material which is being reproduced. With modern wide range speakers I regard them as indispensable, for while having little effect on the brilliance of the treble (as they operate in the harmonic range musically), their value in removing the "edginess" of some records and broadcasts, their ability to correct over-sibilance and to counter tape hiss is undoubted. The slope control is continuously variable from zero to 25 db per octave, a feature not known to me in any other equipment. A choice of three frequencies at half octave intervals of 5, 7 and 10 kc/s is provided on the filter switch, together with a Cancel position which by-passes bass, treble and filter circuits. Thus the operator is presented for an instantaneous comparison with a level response, so that he can be sure he has done the right thing. It also enables "Granny" to use the equipment without difficulty as it becomes virtually a one-knob device. Again a unique feature.

Having described the front controls, now let us go back stage and consider the various connections. There are, of course, a lot of them, but one of the design considerations has obviously been to make the operation simple, even if this involves some initial complication of connection, which, after all, only has to be done once. Incidentally, all connections are now at the rear, a blessing to those with somewhat inaccessible installation space.

Looked at from the rear, on the left are three pickup sockets; two are a stereo pair and the third for a separate mono pickup if required. Below them is a nine-pin adaptor. The purpose of this is to match the pickup(s) to the input circuit and the way in which this is done is both ingenious and valuable in ensuring the best result. Most people know that correct matching is important, but very few amplifier designs have sufficient flexibility to achieve the optimum, with the components that are built into them. Quad puts the flexibility into the adaptor unit, leaving the amplifier unchanged—briefly as follows. The pickup is fed to the input stage which has a negative feedback loop over it. The adaptor contains the pickup load resistor and adjusts the feedback to suit that load; in addition it adjusts the stage gain to suit the particular pickup and applies compensation if it is of a type other than constant velocity. Thus in addition to accurate compensation and load a worth while improvement in signal to noise ratio can be achieved—without technical knowledge or ability on the part of the user beyond reading the type number and inserting the adaptor. A major stumbling block neatly removed! With the Quad 22 there are two types of pickup adaptor available. Those with a single letter designation are so made that a single stereo pickup is used and its outputs are combined in the Mono position, i.e. one pickup is used for all types of record. Adaptors with two letters enable a separate pickup to be used for mono discs and the two pickups need not be of similar type.

Correct compensation and gain will automatically be provided for each and the push buttons will select the appropriate pickup. There are, of course, a very large number of possible adaptors and the number will grow. Dealers will keep the common types, but a list is provided and the control unit arrives with the standard adaptor, suitable for low output, medium impedance pickups, in a small box with a tie-on label. If a different type is required the label is filled in and posted and the standard will be replaced with the desired type by return. I understand this exchange service is being organised on a world-wide basis.

The next pair of sockets are the tape input and below them a seven-pin socket for a tape adaptor. Here the one supplied will nearly always be used, as with it the inputs will accept the output from a tape pre-amplifier channel, either mono or stereo. An alternative plug is available, raising the gain of these inputs for stereo microphone, or special plugs can be made for any source which future requirements may demand, right up to the basic sensitivity of 400 micro v. which the unit possesses. N.B.—A plug for direct connection to tape head(s) can only be supplied where the unit is to become part of a professionally built machine, as the makers consider the compromises (e.g. unknown head impedance and lead length) are considerable. I think this a wise decision.

Adjacent to the tape input sockets are a further pair providing output for recording—unaffected by the setting of volume, tone or filters.

Three radio inputs and power supply sockets are provided and here again there is great flexibility. Radio 1 and 2 could be, say, A.M. and F.M., available separately or coupled as a stereo pair. Alternatively the third input will form a pair with radio 1 or can become the second outlet from a multiplex adaptor if this system of broadcasting is adopted.

The last input socket is a high gain mono microphone input. Other items at the rear are the two cables to the power amplifiers, the mains input socket and the earth terminal.

Installing all these connections is greatly aided by a very simple device. Everything relating to the first channel, which is the one in operation when the Mono button is pressed, is coloured yellow, and that for the second channel, brought in on Stereo or Mono 2, blue. Services available on one channel only are black. These colours are followed consistently from the input sockets, through all the internal wiring and out to the power amplifier leads.

The unit is invisibly fixed in a cabinet by removing the cover (two bolts), passing it through a cut-out (template provided) and refixing the cover.

Internally the construction is seen to be of the highest standard and remarkably uncluttered for such an intricate and compact piece of apparatus. Above deck is a large sub-assembly, consisting of the tone and filter controls and their associated components: all can be removed with a few disconnections if ever required. The underside is dominated by the push-button switch, which is beautifully made with twin latching mechanisms and a substantial side mounted mains switch for the second amplifier. Tracing the operation is greatly assisted by the colour coded wiring with its yellow and blue tracers and sleeves and by the open nature of the construction. High stability, low noise resistors are freely used and (apart from the leads out to the power amplifiers) there is a complete absence of screened wires with their possible attendant loss at high frequencies. Their avoidance by good layout and the notable absence of that modern "fix it" the self-threading screw always mark Acoustical products. The die-cast panel and solid machined

knobs, so arranged that no parallax error in reading is possible are as before.

As there are so many variables, I do not propose to list the results of the tests made on the Quad 22 because, although several hours have been spent on them and all the main possible combinations have been investigated, in no case have the figures given in the specification been inaccurate; indeed in a few respects my unit (a production model out of the first hundred) is better than spec. There are no unnecessary controls such as channel and phase reversing switches, it being taken for granted that these things are covered by correct installation in the first instance, and so this must be one of the simplest and most straightforward stereo control units from the users' point of view. With its great adaptability and foresighted design it is certainly not likely to be excelled in the foreseeable future and at the cost of £25 against £19 10s. for the single-channel predecessor it must certainly be rated in the words of the Consumer Reports a "best buy".

The power amplifier is not appreciably changed from the original (reviewed in the September 1954 issue), but there have been minor improvements. Briefly the output valves are worked well below their maximum ratings in a form of ultra-linear circuit with part of the load in the cathodes. Under these conditions they behave before the application of overall feedback as the equivalent push-pull triode circuit, but with less than half the distortion and much greater efficiency. To make this possible the output transformer is complex with fourteen sections, but it can be quite small. Less H.T. smoothing is required, but the signal balance is more critical. This is satisfied by a novel see-saw, high gain phase splitter of considerable ingenuity. Overall feedback completes this stable and economical circuit. The complete amplifier has fewer components than average and is below the size and cost of contemporary amplifiers of this power. Needless to say the components and construction are impeccable and there is remarkably little stray field from the mains transformer to induce hum into sensitive pickups, etc.

The almost complete agreement between the test figures and those in the spec. show the close control inherent in the design. The overload characteristic in particular is commendable, 25 watts being available at quite low distortion over a wide part of the pass band.

Frequency response: ± 0.2 db, 15-50,000 c/s.

Power/Frequency response (for commencement of grid current):

Frequency c/s	20	25	30	40	50	100	10k	15k	20k	50k
Power (watts)	12	15	16	20	21	22	21	17	15	

Stability: Under no conditions could oscillation be provoked and a square wave was accurately reproduced without overshoot or ringing until large reactive loads were applied.

For interest the gain of an elderly Quad which has been in constant use for some years was compared with the new. It was within 1 db and therefore quite suitable as one of a stereo pair. Of course the control unit can be used with almost any combination of main amplifiers by those with sufficient technical knowledge and it is sold separately.

So there it is, for a total outlay of £70 one of the finest stereo amplifiers available, certainly the most flexible and quite literally a pleasure to use.

A British product of the very highest class and obviously destined to be a landmark in the Audio World. G.E.H.

Grundig TK25 Tape Recorder. Price: 62 gns. (excluding m/c). Grundig Ltd., 39/41 New Oxford Street, London, W.C.1.



Makers' Specification:

Tape Speeds: $3\frac{1}{2}$ i.p.s. and $1\frac{1}{2}$ i.p.s.
Recording Sense: Top Track (International Standard).
Frequency Response: $3\frac{1}{2}$ i.p.s.: 60—15,000 c/s ± 3 db.
 $1\frac{1}{2}$ i.p.s.: 60—8,000 c/s ± 3 db.
Signal/Noise: Better than 45 db.
Wow and Flutter: Better than $\pm 0.25\%$ at $3\frac{1}{2}$ i.p.s.
Erase Damping: Better than 60 db.
HF Bias: 78 Kc/s.
Amplifier Output: 2.5 watts.
Inputs: Microphone (1.5 mv at 500 k), Diode (5 mv at 250 k), Radio (75 mv at 1 m.g.).
Output: Ext. Speaker (5 ohms), High Impedance (1,000 mv at 5 k).
Recording Level Meter: Magic Eye.
Controls: Selector Switch—Recording, Playback, Fast wind, Rewind, Stop, Temporary Stop; Record button; Volume Control—rewinding and playback; Volume Control—internal speaker; Tone Control on playback; Speaker, On-Off; Speed change button.
Spool Size: $5\frac{1}{2}$ "
Weight: 20 lbs.

In our issue for September 1958 I reviewed the single speed TK20 recorder and gave it high marks, both for ease of operation and performance.

This TK25 model might possibly be described as an improved TK20, for its appearance and size and mode of operation are similar.

But the differences are appreciable. The performance is just as much an improvement as the TK35 was on the TK30, and the addition of a $1\frac{1}{2}$ i.p.s. playing facility is a valuable one for those who have a special need for speech recording. The light weight, coupled with the ability to use $3\frac{1}{2}$ in. spools (1,200 ft. long play) instead of only 5 in. spools (850 ft. long play) makes the model particularly suitable for this purpose; and the frequency response even at $1\frac{1}{2}$ i.p.s. (which gives a 4-hour playing time per $5\frac{1}{2}$ in. spool on LP tape) is adequate for entirely realistic speech recording. The fact that a little "wow" is detectable at this speed is of no moment for speech recording.

The frequency response measurements that we made confirm the good impression that our listening tests had created. Here are our figures, which represent the combined effect of recording and playback:

c/s	40	60	110	200	500	1k
$3\frac{1}{2}$ db	-8	-3	-3	-1	0	0
$1\frac{1}{2}$ db	-8	-7	-1	+0.5	0	0
c/s	2k	4k	6k	8k	10k	
$3\frac{1}{2}$ db	+0.5	+0.5	+1	+0.5	0	
$1\frac{1}{2}$ db	0	-2	-3	3	-	
c/s	12k	14k	16k	18k		
$3\frac{1}{2}$ db	-0.5	-2	-5	-10		
$1\frac{1}{2}$ db	-	-	-	-		

It will be seen that the specification is fully borne out, and that, as is now commonplace with the current Grundig models, the frequency response is at least as good as was attainable at twice the tape speed as recently as two years ago. P.W.

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