HI-FI CHOICE

AMPLIFIERS

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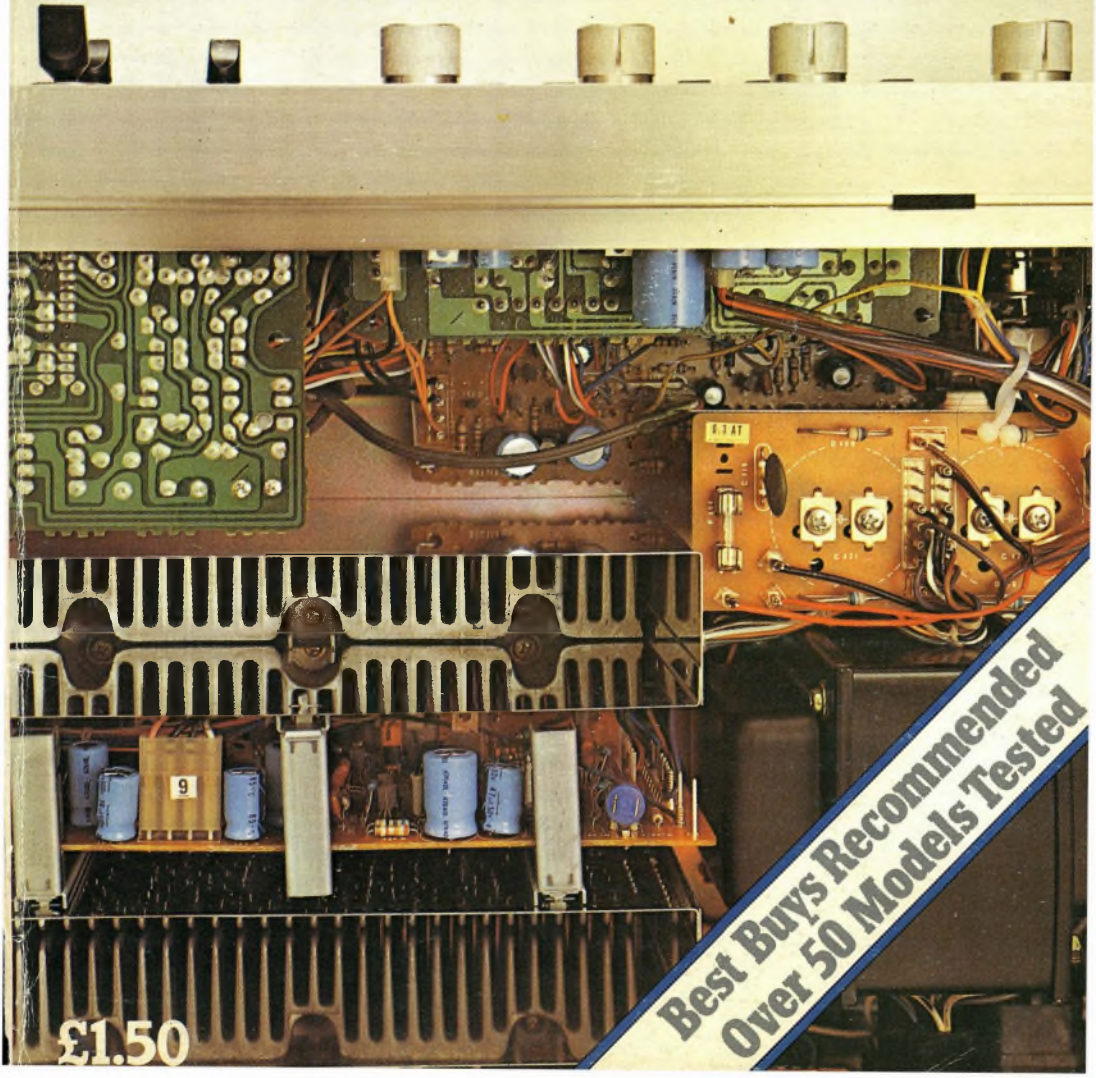

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SANSUI INTEGRATED STEREO AMPLIFIERS

HI-FI ENGINEERING AT ITS BEST

AU 7900

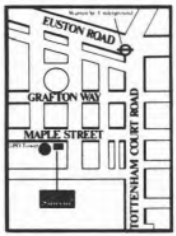
This integrated stereo amplifier delivers a powerful 75 Watts (each channel driven into 4 and 8 ohms from 20 to 20,000 Hz). It is the perfect choice for those music lovers demanding texture, range and dynamics - the most important factors in high fidelity music reproduction. Wide range of controls give complete versatility without tonal deterioration.

Beneath its sophisticated design are very sophisticated electronics - electronics ensuring the capture of the subtlest nuance in perfect tonal quality.

The AU 4900 and AU 5900 offer 35 and 45 Watts respectively, both with the same Sansui high quality.

If you are in the London area, drop into our Showroom for a full demonstration. It's just next to the G.P.O. tower. Or if you are out of town, see a qualified Sansui dealer.
(Closed Monday)

AU 7900	
Continuous power into 4 and 8 ohm - from 20 to 20,000 Hz	75W x 2
THD and IM distortion overall (AUX to speaker terminals) - at rated power output	Less than 0.1%
Damping factor at 8 ohm	Approx 80
Maximum phono input capacity (at 1000 Hz 0.1% total harmonic distortion)	250mV RMS
RIAA curve deviation (phono) 30 to 15000 Hz	±0.3dB



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Hi-Fi Choice No 6: Amplifiers by Hugh Ford

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Determined to enhance their now-established reputation as specialist makers of high-calibre loudspeakers, Castle have just built another.

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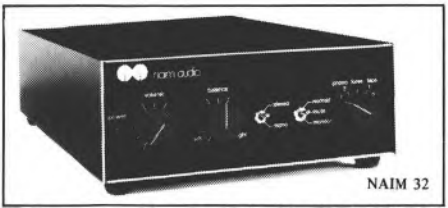
WHY GUILDFORD HI-FI HAS A NUMBER OF PROBLEMS

SALESMEN	Sales personnel at this establishment have a disconcerting habit of treating the customer as though they were human-beings and capable of rational actions. On occasion they have recommended equipment when it was not in sock and have even recommended that customers listen to the equipment in their own homes prior to purchase.
LOCATION	This shop is unwisely located more than twenty miles from Tottenham Court Road out in the wilds of Surrey. Customers are even allowed to park within walking distance which is unfortunate since the customer is not completely exhausted upon entering the shop and might not purchase the first item that is thrust at him.
PRICES	Prices at this shop tend to be higher than those of well-known discounters. They try to justify this devious practice by offering generous trade-in allowances, hire-purchase facilities, delivery, installation, home-demonstrations and an extravagent guarantee.
BRAND-NAMES	There is a genuine dearth of reassuring, well-known, household brand names at this establishment. Instead they make the iconoclastic and highly improbable claim that many other smaller, less touted manufacturers make equipment that actually sounds better, costs less, lasts longer and represents better value for money than the well known brands.
TECHNOLOGY	This is going to be hard to believe but this shop actually stocks valve equipment. Everyone knows that valves have been dead for the past ten years, and no wonder! They are bulky, noisy, hot and they wear out. Their specifications are inferior to solid-state designs and to top it all they cost more than transistors. But these guys say that although this is true, Valve equipment still sounds superior and they intend to cater to people who care about listening to accurate music reproduction rather than those who are interested in mere technological innovations. To show that they mean business they now stock such outlandish brands as dB Systems, Paragon, Futtermans and Lux valve equipment and they threaten to bring in even more esoteric gear in the future.

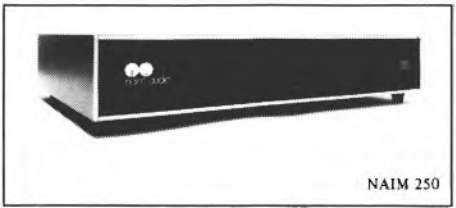
GUILDFORD HI-FI

270 HIGH ST, GUILDFORD, SURREY Tel. 71534

the music maker



NAIM 32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The RS61 5US Stereo Cassette Deck.

Sound enthusiasts will love its many features. For example, the famous Dolby system, A DC motor to keep wow & flutter down to 0.10%, and a tough, durable tapehead.

There is also a convenient timer recording/playback facility and the front panel controls make it ideal for bookshelf installation.

If the RS61 5US sounds desirable, the price of £129.95 will make it sound irresistible.

The SB4500 Linear Phase Speaker.

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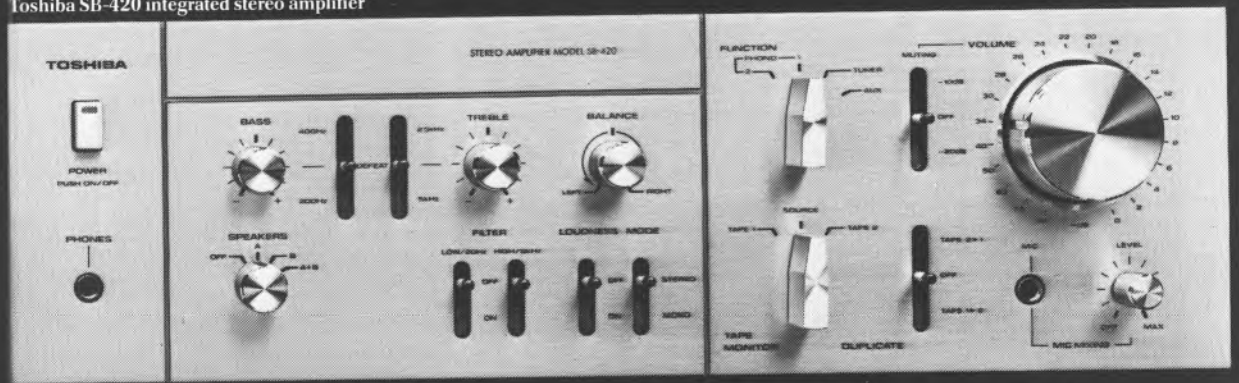
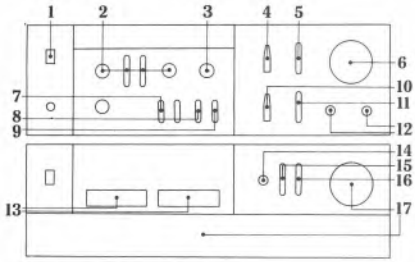
On the face of it, Toshiba has a lot of explaining to do.

Toshiba SB-420 integrated stereo amplifier



Toshiba ST-420 FM/AM stereo tuner



SB-420 INTEGRATED AMPLIFIER

1. Power Switch
It has a built-in white-light indicator so that you know when power is ON.

2. Tone Controls
There are two turnover frequencies over which the bass and treble controls operate (BASS, 200Hz, 400Hz, TREBLE, 2.5 kHz, 5 kHz). There is also a TONE DEFEAT switch for each of these controls.

3. Balance Control
Adjusts volume balance of left and right loudspeakers.

4. Function Switch
You can select between turntable 1 or 2, tuner, or auxiliary.

5. Muting Level
This reduces the volume level by 10 dB or 20 dB while you, say, answer the 'phone. The volume control is not disturbed.

6. Volume Control
A new type of precision control with 22 click-stop positions, combined with advanced resistor design, results in a logarithmic change in sound output level to match the response of the human ear. Hence the direct calibration in decibels.

By placing the volume control in the input signal path, large signal peaks are attenuated, preventing pre-amplifier overload.

7. Low and High filters
Low-filter, filters out subsonic noise below 20 Hz which in extreme cases could damage loudspeaker drive units. The high filter operates above 8 kHz to reduce surface noise from records.

8. Loudness Control
A compensation to low and high frequencies, owing to the fact that the human ear does not hear all frequencies equally at different sound levels.

9. Stereo/Mono Switch

10. Tape Monitor Switch
You can select tape deck 1 or 2, and monitor with a 3-head tape deck.

11. Tape Duplicate Switch
Two tape decks can be connected to the SB-420; you can dub from 1 to 2 or 2 to 1 with the amplifier on or off. Also the duplicate switch allows recording from one tape deck to another, and at the same time it is possible to listen to a radio broadcast or play records.

12. Microphone input with level control
Full mixing facilities and output terminals. You can record the total mix if required.

ST-420 TUNER

13. Signal and Tuning Meters
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15. Air Check Level
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16. Function Switch
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Each edition of Hi-Fi Choice is intended to be the most comprehensive guide to a particular part of the hi-fi chain, whether it be cassette decks, loudspeakers, turntables or in this instance, amplifiers. For anybody, from the first time buyer to the professional user of audio, Hi-Fi choice is invaluable. It can serve as anything from a buyers guide to a survey of the current state of the art. It fulfills whatever purpose you require.

Should you wish to know which of the amplifiers reviewed are the models we can confidentially recommend, you need do no more than read the chapters entitled 'best buys' and 'conclusions' and look at the 'overall comparison chart' at the end of the book. However, nobody need have any difficulty in discovering how such decisions have been reached. Although the reviews are written in a technical manner, a little time spent in reading the non-technical introduction that follows will not only explain the meaning and significance of the language used, but also the importance of each parameter measured and discussed. So for those of you who are new to hi-fi technology, just turn the page and read on. In addition, a more technical introduction explains the test methods employed and how they were carried out.

Please note that the prices quoted in this survey are typical retail prices including VAT, based upon a dealer survey, carried out shortly before going to press. They should only be regarded as an indication and are likely to change at any time.

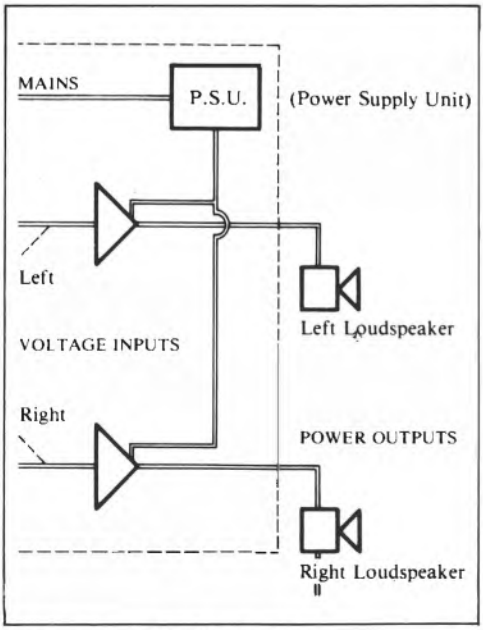
Finally, the author would like to acknowledge the fruitfull discussions with many colleagues, too numerous to mention, who have contributed to the success of this project and to the editor for many hours of persistent hard work. Especial thanks go to Allen Dawe for burning much midnight oil at the test bench.

Test equipment used by H F Engineering for the reviews.
Advance type OFS2B Off Air Frequency Standard.
Ampex type ATR-100 Professional Audio Recorder.
Bruel & Kjaer type 1013 Beat Frequency Oscillator.
Bruel & Kjaer type 1612 Band Pass Filter Set.
Bruel & Kjaer type 1901 Tracking Frequency Multiplier.
Bruel & Kjaer type 1902 Distortion Control Unit.
Bruel & Kjaer type 2010 Heterodyne Analyser.
Bruel & Kjaer type 2305 Level Recorder.
Bruel & Kjaer type 2426 Autoranging Electronic Voltmeter.
Bruel & Kjaer type 2606 Measuring Amplifier.
Bruel & Kjaer type 4409 Response Test Unit.
Bruel & Kjaer type 4440 Gating System.
Dale Load Resistors.
Data Precision type 3500 Autoranging Digital Multimeter.
Dolby type Cat 98 C.C.I.R. weighting Network.
Farnell Modular Pulse Generating System.
Fluke type 8110A Digital Multimeter.
Hewlett Packard type HP35 Calculator.
Hewlett Packard Type 3580A Spectrum Analyser.
Marconi type TF2161 Monitored Attenuator.
S.E. Laboratories type SM202 Timer/Counter.
Servomex Type AC2 Voltage Stabiliser.
Sennheiser type RV55 Voltmeter.
Sound Technology type 1700A Distorion Measurement System.
Spendor types BC1 & BC III Louspeakers.
Technics type SL110 Direct Drive Turntable.
Tektronix type 31 Programmanle Calculator.
Tektronix type 152 Calculator Interface.
Tektronix type 153 Calculator Interface.
Tektronix type C59 Oscilloscope Camera.
Tektronix type DM501 Digital Multimeters.
Wayne Kerr type B221 Universal Bridge.
Of local manufacture by H F Engineering.
Amplifier switching Comparitor.
Dummy Phono Load Unit.
Master Loudspeaker Load Unit.
R.I.A.A. Inverse Correction Unit.
Signal Distribution Units.

By definition, an audio amplifier is a device which enlarges or amplifies sound. A simple amplifier receives a voltage representing sound and enlarges it to a suitable level for driving a loudspeaker. Such a simple amplifier has one set of input and one set of output terminals, and in an ideal world, the output voltage will be identical in shape and or form to the input voltage. The function of an amplifier is to transfer and amplify the sound signal from an input source, either tape or pick-up cartridge or the like, to the output source, either loudspeakers or headphones, with as little distortion and alteration as possible. This may sound a simple operation, but as with any electronic product, all sorts of problems are encountered on the way.

What is a power amplifier? (See Fig 1)
A power amplifier is close to the simple amplifier in that it accepts a voltage and enlarges it to drive a loudspeaker. However, a loudspeaker needs power in order to emit an audible sound. To create this sound energy, the power amplifier must supply not only the voltage but also the necessary current. The resulting power is measured in Watts.

Virtually all modern amplifiers are designed for stereo sound reproduction, so there are two separate amplifiers in a single package for driving two loudspeakers, both of which usually are supplied by the same direct current power.



1 How a power amplifier works

The maximum power output capability of a power amplifier is limited by three main factors: the maximum output voltage capability, the maximum output current capability and the internal heat generated. The amplifier manufacturer takes these limits into consideration when he specifies loudspeaker load impedance, which should be observed. Impedance is the resistance the loudspeaker offers to the amplifier's output.

What is a pre-amplifier?
The pre-amplifier has a number of functions. Primarily, it amplifies very small voltage inputs from such devices as pick-up cartridges or microphones to a suitable voltage for feeding to the power amplifier.

In addition, the pre-amplifier has facilities for switching between various input signal sources such as radio tuners, turntables, tape recorders, cassette players etc. Further features include treble and bass tone controls and the volume control, and depending how much money you are paying, various filters for reducing hiss or rumble from records. A few models also incorporate a socket for connecting headphones and some other facilities.

What is an integrated amplifier?
This term describes a single package which contains a power amplifier and a pre-amplifier. In addition to the facilities described, an integrated amplifier sometimes also offers the ability to switch between various loudspeakers, and has a connecting socket for headphones.

What is the advantage of separate power and pre-amplifiers?
It used to be true that the best quality amplifiers were to be found as separate power and pre-amplifiers, but many modern 'integrated amplifiers' now offer an excellent sound performance, so you are not likely to benefit by buying separate units.

One practical advantage of 'separates' is that the pre-amplifier can be located remote from the power amplifier, and because pre-amplifiers are generally much smaller than 'integrated amplifiers' you can have a neater installation. And, if you want facilities for switching between sets of loudspeakers or headphone monitoring, when they are not provided in separate monitors, you can easily buy or make a suitable adaptor box.

Another advantage is that you can upgrade your hi-fi system by replacing either the power or pre-amplifier which can cost less than replacing an integrated amplifier of equivalent performance.

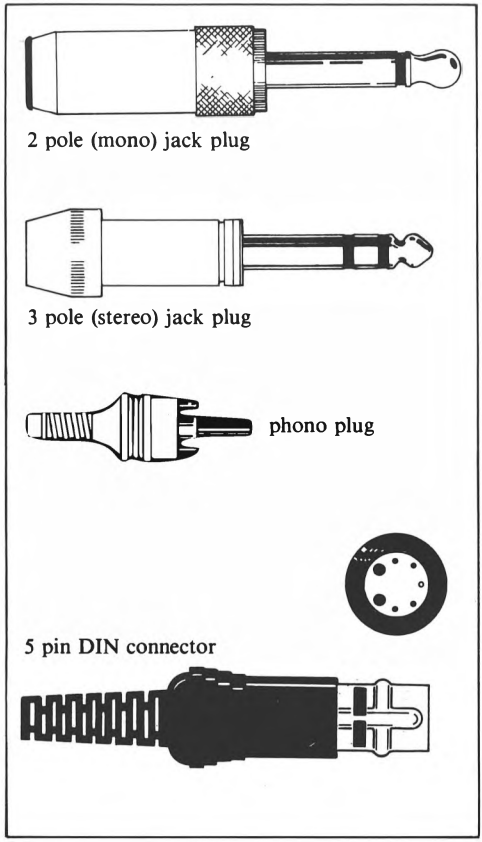
What are all the inputs for at the back of an integrated amplifier?
At first sight the multitude of connections may be quite baffling, but once the overall system has been grasped, the connections fall into small groups which are logically simple.

The connectors themselves (see Fig 2), so far as inputs and low power (not loudspeaker) outputs are concerned, are of three types which are readily available as either connectors or ready made leads. Adaptor leads are readily available to convert one type of connector to another.

Most American and Japanese audio equipment is provided with single pin connectors, called 'phono plugs', which normally come in pairs for connecting stereophonic equipment.

In complete contrast to the phono plug there is the 'DIN' standard series of connectors which are widely used in Europe and which appear frequently on Japanese equipment for connecting tape recorders. So far as stereophonic equipment is concerned you are only likely to meet two of the DIN series of connectors, the two pin loudspeaker plug and the five pin 180° signal connector.

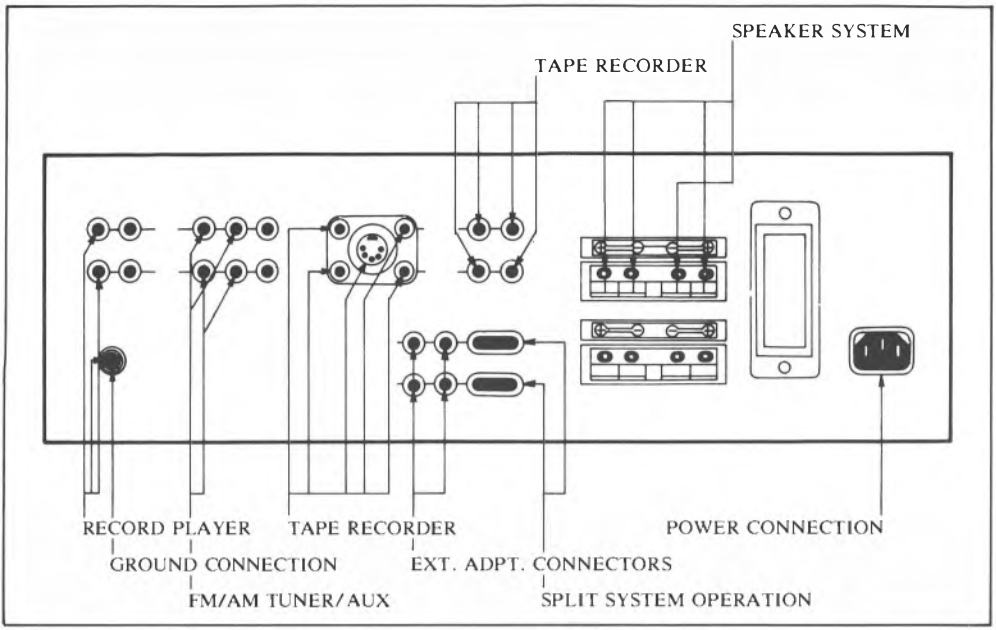
The third type of connector which you may meet is the quarter inch diameter jack plug which is often used as a headphone or a microphone connector, and comes in either a two pole mono version or a three pole stereo version.



2 Various types of connecting plugs

Headphone and microphone connectors are likely to be found on the front panel of amplifiers, with the puzzling collection of DIN and phono connectors at the rear of the amplifier. This collection of rear panel connectors is best understood from the block diagram of a typical amplifier (see Fig 3).

The two record player inputs are low level inputs for magnetic pick-up cartridges which require special treatment known as 'equalisation' as a result of the techniques



3 The rear panel connections of a typical integrated amplifier

used for recording discs, so these inputs cannot be used for other purposes. Some amplifiers have a control on the front panel for switching between two-pick-up systems.

The 'tuner' and 'auxiliary' inputs accept a much higher voltage than the pick-up inputs. Such high level inputs are often identical, with the desired input being selected by a 'source switch' which feeds the amplifier.

These high level inputs can be fed from radio tuners, tape replay sources, or any other high level signal source. These inputs cannot be used directly with pick-ups or normal mircophones as these do not give out a large enough signal to drive the amplifier.

How should I connect the amplifier inputs?

It's very important to use the right sort of wire and good connections for the input leads, if you don't you will end up with hum and crackles and maybe intermittent faults. Always keep the connections as short as possible, as long leads are often the cause of hum pick-up and they can also be the cause of loss of high frequencies. Unless you are good at soldering and enjoy fiddly jobs it's far better to buy ready made input leads from your local hi-fi dealer stockist.

If you insist on making your own input leads you must use low capacity and individually screened wire, be very careful when stripping the insulation as it's easy to make small accidental cuts which lead to shorts and also be careful not to burn the insulation with the soldering iron.

What about amplifier outputs?

The output to feed tape recorders has already been mentioned and just as a reminder this output may be available at both phono sockets and at the DIN connector. However the voltage at the output will normally be different so that the DIN connector should only be used to feed other DIN compatible connectors.

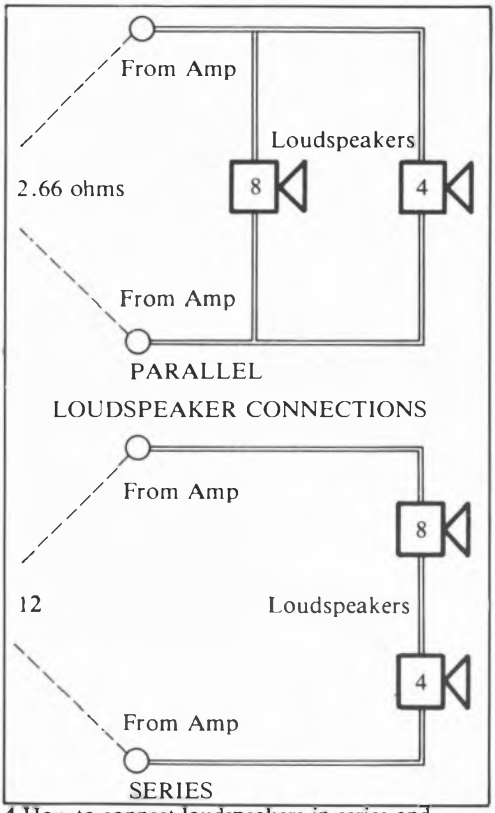
In the instance of integrated amplifiers, the only other outputs will be the loudspeaker outputs and may be the headphone output, but where separate pre-amplifiers and power amplifiers are used the pre-amplifier will have

an output connection for feeding the signal to the power amplifier.

How many loudspeakers can I use with an amplifier?

This depends upon both the amplifier and the loudspeakers. The amplifier should be presented with the loudspeaker load for which it has been designed so that it remains efficient and doesn't have to work too hard.

The minimum load that may be imposed on the amplifier is stated in the manufacturers specification. Normally this is either 4 or 8 ohms. Likewise, the loudspeaker manufacturer specifies the impedence of his loudspeakers which will usually be 4 or 8 ohms. If you are driving one loudspeaker from each amplifier channel the loudspeaker's impedance must be equal to or greater than the amplifier's minimum recommended load. With transistorised amplifiers it doesn't matter if the loudspeaker impedance is too high as it won't damage anything, but you will loose some output power.



4 How to connect loudspeakers in series and parallel

If you wish to drive more than one loudspeaker from each amplifier channel you must make sure that the combined impedance of the loudspeakers is not less than the amplifier manufacturers' specified minimum load. To do this you must understand how to work out the value of impedances or resistances in series and parallel.

When resistances are connected in series (like joining pieces of string) the total resistance is the sum of the individual resistances, so a 4 ohm and an 8 ohm loudspeaker in series will represent 12 ohms to the amplifiers. If the loudspeakers are connected in parallel like a ladder the problem is more complicated and you'll probably need at least a pencil and paper to do the sums (see Fig. 4).

If we call the combined resistance R, and the individual resistances R1, R2 etc. the formula to use is as follows:—

$$\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} \text{ etc}$$

In the example in the figure this works out as follows:—

$$\frac{1}{R} = \frac{1}{8} + \frac{1}{4}$$

Multiplying both sides by 8:—

$$\frac{8}{R} = \frac{1}{4} + \frac{2}{1} = 3$$

Multiplying both sides by R:—

$$8 = 3R \text{ so } R = \frac{8}{3} = 2.66 \text{ ohms}$$

You may conclude that if you wish to drive a 4 ohm and an 8 ohm loudspeaker from a channel of an amplifier which is designed to drive a minimum load of 8 ohms you must operate them in series, because the combined impedance when in parallel is far too low.

Provided that you follow these instructions you can drive as many loudspeakers as you like from a single amplifier, but the output

power will of course be shared between the loudspeakers and you will get less sound per speaker as you add more loudspeakers.

How do I connect extra loudspeakers?
Many amplifiers have speaker selector switches which allow you to select either or both of two sets of loudspeakers, with extra loudspeaker connections being provided at the back of the amplifier.

Provided that you use loudspeakers with an impedance not less than the minimum rated impedance of the amplifier you can use either set of loudspeakers, but you must not use both sets at the same time unless you take further precautions.

If you want to use both sets of loudspeakers at the same time, the impedance of the two loudspeakers connected to each channel in parallel must be greater than the minimum rated impedance that the amplifier can drive. For instance, if you use two sets of 8 ohm loudspeakers their impedance in parallel is 4 ohms, and many amplifiers have a minimum rated load of 4 ohms, so all is well using both sets of loudspeakers at the same time.

On the other hand, if you use two sets of 4 ohm loudspeakers, their impedance in parallel is 2 ohms and it is pretty unlikely that your amplifier will be rated for driving into such a small load; so you can only use one set of loudspeakers at a time.

What sort of wire should be used for loudspeaker leads?
Ordinary twin 'figure of eight' lighting flex is quite suitable for low power amplifiers if the loudspeaker leads are not too long, but as a general guide you should use the heaviest twin cable reasonably available. If the cable is either too thin or too long its resistance will be significant and this will have two adverse effects, you will loose power output and you will upset the effective damping of the loudspeaker.

If you really do have to join loudspeaker leads use a proper connector or a soldered joint, but do make sure that joints are properly insulated as some amplifiers will start to smoke if their outputs are shorted!

Which way round should I connect loudspeakers and what is 'phasing'?
It doesn't actually matter which way round you connect the pairs of wires from each loudspeaker provided that both loudspeakers of a stereo pair are connected the same way. An amplifier's loudspeaker output terminals are often marked with the symbols + and — and a loudspeaker's terminals marked similarly or one of the terminals marked with a coloured dot, so if you make sure that for instance the coloured dot leads to the amplifier's + terminals with both loudspeakers all will be well.

If you have made the right connections the 'phasing' will be correct so that both loudspeakers will be working together with their cones moving in the same direction with monophonic sound. But, if the connections are wrong the loudspeaker cones will work in opposite directions and the 'phasing' will be incorrect.

It's easy to check the phasing, just set the amplifier for monophonic operation or reproduce monophonic material and listen to the reproduced sound. If the lower notes appear to be in a well defined position between the two loudspeakers all is well, if the location of the sound is not well defined the phasing is incorrect and you should reverse the leads to one loudspeaker only.

What are the controls for on the front panel?
Many modern amplifiers have a lot of knobs on the front panel, and whilst the function of some of them is really obvious the function and purpose of others may be quite obscure. The first lesson with any piece of equipment is to read the manufacturers' instruction book, but all too many people fail to do this and as a consequence do not get the best out of their equipment.

The function of the power on/off switch and the volume control is pretty fundamental and whilst several source selector switches may be fitted their only purpose is to select the desired signal source to be fed to the amplifier.

What does the balance control do, and what is it used for?
The balance control functions as a secondary volume control, but altering the balance control in one direction will increase the

volume of say the left channel and decrease the volume of the right channel, moving the control in the opposite direction will have the inverse effect. Some balance controls will completely cut off each channel in the extreme positions, whilst others will have a relatively minor effect.

The purpose of the balance control is to move the stereo sound image between the two loudspeakers. With mono reproduction the sound image should be mid-way between the loudspeakers and this condition will only be achieved if both loudspeakers have the same sound output; if the sound location is correct for mono reproduction it should then produce the correct stereo image.

As a result of differences in efficiency between loudspeakers, the two channels of pick-up cartridges and other parts of the sound reproduction chain, the sound image location will be incorrect if both amplifier channels have identical amplifications. The balance control is used to compensate for these differences in efficiency, and also defects in original stereo recordings in the form of poor balance between the two channels. It follows that you may need to adjust the balance control quite frequently if you are sensitive to correct stereo sound location.

What about tone controls, why are they necessary?

Integrated amplifiers or pre-amplifiers always have at least two tone controls, one for the treble and one for the bass: in some cases further tone controls may be found, such as a 'presence' — that is, mid-band — control. These allow you to increase or decrease the amount of treble bass or presence you require.

In an ideal world these controls would be unnecessary, as both high and low frequencies would be reproduced with equal efficiency, but in reality this is not the case. The sound quality of a loudspeaker depends on a variety of ingredients such as their positioning, the furnishing and size of the listening room and even where you sit has a substantial effect.

Tone controls are used to compensate for these deficiencies, and of course to make the final sound suit your personal tastes.

What are filters, and what are they used for?

Filters which are often on/off switches are rather like tone controls, but they don't affect the sound at mid frequencies. You may find something called a scratch filter, or low pass filter, and a rumble, or high pass filter.

The scratch or low pass filter is used to cut high frequencies which are often associated with scratch on records or noise from tape. Ideally this filter should be variable in frequency and rate of cut, but this feature is not very common.

A rumble or high pass filter is intended for reducing rumble from turntables or discs and works by attenuating the low frequencies. Ideally such a filter should operate about 20Hz and have a rapidly increasing attentuation with decreasing frequency.

Some amplifiers have a loudness control, what is this?

The characteristics of the human ear are such that the effective sensitivity to high and low frequencies in relation to mid frequencies varies according to the sound level. It follows that if you listen to music at lower than natural reproduction levels the apparent intensity of the treble and bass will be upset in relation to the middle frequencies.

A loudness control is a device which attempts to compensate for this effect by boosting the treble and bass at low listening levels, but some loudness controls only affect either the treble or the bass. With some amplifiers the amount of boost varies according to the volume control setting, but even then the amount of boost is unlikely to be correct because the actual listening level depends upon the listening conditions, loudspeakers and programme source.

In short the loudness control does little that cannot be done with the tone controls which will also require adjustment at low listening levels, even if the loudness control is used.

Amplifier specifications often give several power ratings, why?

This is an area of great confusion, deception, and technical dispute. Clearly the higher the power rating for an amplifier, the more money it would seem to be worth, so advertising copy writers like to put in the highest number for the amplifier power. This is the area of deception when the power measurement conditions are not specified.

Taking a typical amplifier from this Hi-Fi Choice selection its power output could be quoted as 40W, 55W, 57W or 78W into 4 ohms, depending how you measure the power output!

The 40W is the continuous sinewave power with both channels driven, the 55W is the amplifier's capability on a short burst of sinewave signal. Both these are legitimate measurements and this is the area of technical dispute, as whilst it can be argued that the continuous power capability matters, it can also be argued that the peak capability matters.

For instance, the continuous power may be related to a sustained note on an organ and the peak capability to a crash on the cymbals. It may therefore be fairly said that both types of power measurement are valid, but how long a burst is desirable for the measurement of the peak capability is another matter. Furthermore, any specification must state if both channels or a single channel are driven, as this can make a quite large difference to both types of measurement.

The extraordinary 56W and 78W ratings are derived by multiplying the 40W continuous rating and the 55W burst rating by the magic number 1.414 which provides the peak instantaneous power.

To understand this you need to know something about what power is and how it is measured. If you plug an electric fire into the socket of the mains it will be fed with 240 volt alternating current and reach a certain temperature; if you feed the same fire from batteries (which are direct current) you will again need 240 volts to reach the same temperature.

However if you could measure the voltage you fed to the fire from the mains, using a meter which indicated instantaneous voltage, you would find that the voltage varied from zero to 240 x 1.414 = 339 volts at the peaks.

In this case 339 volts is known as the peak voltage and 240 volts as the root mean square (abbreviated rms) voltage. This sounds rather complicated, but power is proportional to the square of the voltage, so we have to consider the squares of the instantaneous voltages to find the power if the voltage varies with time, such as with alternating voltages.

With the public electricity supply, or a pure musical tone, both of which are sinewaves, the relation between the peak and the root mean square voltages happens to give the magic figure 1.414. It follows that multiplying the continuous amplifier power by 1.414 gives a nice big figure for the power rating which could be called peak instantaneous power, but it's really a big deception.

A further method of specifying output power capability produces yet another figure called 'music power' to the IHF standard. This rating can be derived by one of two methods both of which assume short term performance as opposed to the reproduction of sustained notes, so the figures produced will again be greater than the continuous sinewave power capability of the amplifier.

So how powerful should an amplifier be?

There is no simple answer to this. It depends on the efficiency of your loudspeakers. 1W into one loudspeaker can give the same amount of sound as 10W into another loudspeaker.

In general, most good loudspeakers are rather inefficient and will require about 30W power per channel to deliver reasonable listening levels in an average living room, but by reasonable listening levels we mean the sort of levels associated with the original live sounds, and you may be quite happy with less power depending upon your tastes and your particular loudspeakers.

You may well be tempted to buy an amplifier with plenty of power in reserve, but be warned, it is all too easy to permanently damage your loudspeakers if you exceed the loudspeaker manufacturers' power rating. The tweeters in loudspeakers are particularly easily damaged and just a fraction of a second of that high power flute may be enough! Similarly a good blast of mains hum while you are changing amplifier connections may well be the end of the woofer if you use too powerful an amplifier.

How important is frequency response?

Frequency is measured in cycles per second which are nowadays called Hertz after the physicist Herr Heinrich Hertz, and abbreviated Hz for cycles per second or kHz

(kilohertz) for thousands of cycles per second.

Middle C on the piano has a frequency of 256Hz, the lowest organ note about 16Hz for a 64 foot pipe and the highest musical note of interest is probably the 18,000Hz partial of the cymbal.

So far as the human hearing ability is concerned at the low frequency end we can all sense very low frequencies either by hearing or feeling vibrations, the noises which we don't hear being called infrasonic. At the high frequency end our hearing ability varies enormously with age.

Young babies can hear up to 20,000Hz, but by the age of 20 years the average limit is 16,000Hz, falling to 14,000Hz at 40. However it appears that the loss of high frequency hearing ability with age is not the whole story, as in spite of not actually being able to hear these high frequencies it has been shown that they still contribute to the subjective effects of music.

It is therefore fair to say that we are interested in all frequencies up to 20,000Hz, but at the low frequency end the physics of sound reproduction limit the ability of any loudspeaker to reproduce low frequencies in the average sized room. This is because the wavelength of the reproduced sound approaches the largest dimensions of the listening room, which in practice means that notes below around 40Hz cannot be reproduced in even fairly large listening rooms.

Basically, we are interested in the frequency response from 40Hz up to 20kHz and ideally, the performance of an amplifier should be constant over this range. Because the ear does not function in a linear manner when sensing the intensity of a sound, this is always measured in logarithmic units called decibels (abbreviated dB), and the frequency response of a piece of audio equipment is specified as plus or minus (±) so many decibels over a given frequency range. Thus the performance of an amplifier so far as frequency response is concerned might be specified as '±2dB from 15Hz to 30kHz' and such a statement would normally mean that the frequency response with respect to a zero point at 1kHz does not depart by more than 2dB above or below the performance at 1kHz over the frequency range 15Hz to 30kHz.

So far as the audibility of deviations in frequency response are concerned, this partly depends on how rapid the change is, and in which part of the audible range the change occurs. However it is fair to say that even highly trained ears are very hard put to hear a total deviation of 2dB in the audible range.

In practical terms the frequency response of amplifiers is far flatter than that of other parts of the system, and the operation of the tone controls will be necessary to produce the closest overall system frequency response; therefore, an amplifier which is within say ±1dB from 40Hz to 20kHz is certainly as close to the ideal as is necessary in practical use.

Reading amplifier specifications will show you that many amplifiers have specifications which extend well below 20Hz and above 20kHz, and therefore at first sight appear to be better amplifiers. However this is not the case, and the extended frequency response can be the cause of a number of evils.

A frequency response flat up to 120kHz (which is not unknown!) is fine for entertaining bats and dolphins, and may even attract moths to your tweeter, but it's also ideal for amplifying unwanted signals which contribute to noise and apparent distortion. Similarly an extended frequency response to very low frequencies will play havoc with your loudspeakers when you accidently drop your pick-up onto a disc and will be good for amplifying turntable rumble, but it certainly will not contribute to the reproduced music.

Contrary to the impressions given by many advertisements the ideal amplifier will have a flat frequency response from say 40Hz to 20kHz and will have inbuilt filters which intentionally roll off the frequency response fairly rapidly below 20Hz and above 25 or 30kHz.

What is distortion in an amplifier?

A perfect amplifier has been described as a straight wire with amplification, in other words you get out exactly what you put in, but an amplified version of it. Practical amplifiers are unfortunately not like that, they always add to the original input in two respects.

Firstly the practical amplifier adds a certain amount of hiss (called noise) which we will

talk about later, and secondly the amplifier adds other unwanted signals which vary with the intensity and frequency of the input signal — this addition is called distortion, and there are several types of distortion.

The type of distortion most often talked about is called harmonic distortion and is the result of the amplifier adding small amounts of harmonics to the signal being amplified. A single pure tone is called the fundamental, and harmonics are multiples of the frequency of the fundamental. For example the frequency of middle C on the piano is 256Hz, its second harmonic is at 2 x 256 = 512Hz, its third harmonic at 3 x 256 = 768Hz, its fourth harmonic at 4 x 256 = 1024Hz and so on.

Whilst all musical instruments generate harmonics themselves these are mainly even numbered harmonics, and the addition of odd numbered harmonics is particularly objectionable, the higher the number of the harmonic the more unpleasant the effect.

Harmonic distortion measurements on amplifiers are usually performed by feeding a pure tone (often at 1kHz) to the amplifier and then examining the output of the amplifier for the presence of harmonics at various power output levels. The result may be expressed in two ways, either as individual harmonic distortion which relates to the level of an individual order of harmonic, or as total harmonic distortion which relates the sum of the harmonics to the total output. In either case the distortion is expressed as a percentage of the level of the fundamental output.

However, other forms of distortion are of more interest partly because they relate to the unwanted generation of non-harmonic frequencies in amplifiers. This is called intermodulation distortion. Such non harmonic frequencies are subjectively far more objectionable than the harmonics which themselves are present in music anyway.

Also, the test technique involved is more pertinent to the practical uses of an amplifier. In real life, the amplifier reproduces speech and music, which consists of a multitude of simultaneous tones. So, to gain an indication of what non-harmonic frequencies will be generated, *two* pure tones are simultaneously applied to the amplifier. Two tones can be arranged to have a constant frequency difference but be continuously altered in frequency while the distortion is plotted on a graphic recorder in relation to frequency.

This 'swept intermodulation distortion' measurement technique is a powerful tool which can be used to measure extremely small amounts of distortion at both high and low amplifier power outputs in any part of the audio frequency spectrum, and also outside the spectrum.

It is in this area at high frequencies that the different frequency measurement technique gives a correlation with another much talked about form of distortion called 'transient intermodulation distortion'. Transient intermodulation distortion, TIM for short, is an effect that occurs in some designs of amplifier whereby the amplifier saturates itself when transient sounds are applied and as a result goes into distortion.

The final form of distortion which deserves a mention is called crossover distortion, but there is no standard form of measurement. In many amplifiers, the output stages which provide the power to drive the loudspeakers use separate transistors, or sets of transistors, to drive the output either positive or negative direction. Crossover distortion occurs in the area when the output voltage is around zero volts and one transistor, or set of transistors, is taking over from the other transistor or set of transistors.

The form of crossover distortion may be examined on an oscilloscope, and will often appear as a sharp spike which in effect consists of a series of high order harmonics. As crossover distortion is independent of the output level within reason this form of distortion is particularly objectionable at low listening levels.

What about hiss and noise? What is 'weighted noise'?

The background hiss which is always present in amplifiers, tape recorders and all electronic devices is technically called noise. Noise is generated by the random movement of electrons and is therefore completely random in nature and has an infinite frequency spectrum, furthermore its voltage depends upon the absolute temperature (which is the temperature in Centigrade plus 273°).

Thus, unless the temperature is absolute zero (—273°C) noise will always be present to some degree. In audio equipment the problem is to keep the audible noise well below the quietest sounds which are being reproduced so that the noise will not be heard, and this is where the measurement of 'weighted noise' is of concern.

The characteristics of the human ear are such that it is more sensitive to noise at some frequencies than at others, so in order to measure the subjective influence of noise it is necessary to modify the frequency response of noise measuring instruments to compensate for the varying sensitivity of the ear.

This modification of frequency response is called noise weighting because it makes noise at some frequencies carry more weight in the measurement than noise at other frequencies. Unfortunately there is more than one noise weighting in common use and you will certainly see figures for 'A weighted' noise, but now the 'A weighting' is being slowly replaced by a new curve known as 'CCIR weighting' which gives a better correlation with the subjective effects of noise.

You will also see figures for unweighted noise which is noise measured by an instrument with a flat frequency response, but these figures do not mean much unless the frequency band over which the measurement was made is specified.

A further complication with all noise measurements is created by the type of meter used for the measurement; there are meters which measure peak values, root mean square values or average values — these all give different readings with noise.

Unfortunately it is not possible to convert the measured noise by one method to the measured noise by another method, so you must always compare measurements which have been made by identical methods and with identical types of metres.

Noise is conventionally specified as a signal-to-noise ratio at the loudspeaker terminals, so that it relates the maximum output power to the maximum noise. Thus a more powerful amplifier with the same signal-to-noise ratio as a less powerful amplifier will sound more noisy, and this may well be annoying when listening with headphones.

Because the noise at the output depends upon the amount of amplification the signal-to-noise ratio will depend upon the sensitivity of the selected input, so pick-up inputs are always more noisy than high level inputs.

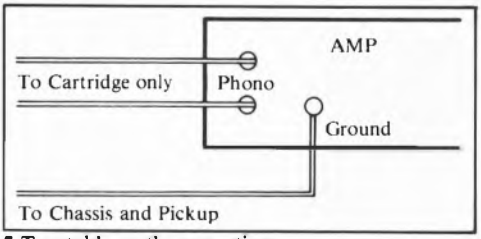
Hum can be a problem, is this part of noise?

Mains hum is generated by the mains in the amplifier leaking into the audio circuits and takes the form of the 50Hz (in America 60Hz) fundamental frequency of the mains power and the harmonics at 100Hz, 150Hz, 200Hz, 250Hz and higher. Discrete tones such as these are far more subjectively objectionable than random noise of the same voltage, and whilst they are measured during noise measurement it will not show their real nuisance value. Even worse, weighted noise measurements vastly reduce the effect of low frequency tones in the measured noise.

How can hum from pick-ups and turntables be avoided?

The primary source of mains hum trouble is caused by 'hum loops' being formed in the pick-up connections and it is fairly easy to deal with this problem in most instances.

The solution to the problem is to separate the earth wiring of the signal leads from the pick-up arm and the chassis of the turntable,



5 Turntable earth connections

such that the signal wiring is connected to the pick-up cartridge alone. If the turntable is no longer earthed by its mains lead a separate earth wire should then be run from the turntable chassis to the amplifier chassis (see Fig 5).

Other turntable hum problems arise from the pick-up cartridge being affected by the leakage from the turntable's motor; in this instance the hum will vary with the position of the pick-up over the turntable and there is

unfortunately little to be done about this complaint except to buy a new turntable or a pick-up cartridge which is less hum sensitive.

Is it possible to use old loudspeakers with a new amplifier?
Yes you can, provided that you choose the right amplifier. Find out the impedance of your loudspeakers. If they are 8 ohm loudspeakers there is no matching problem with any amplifier, but some amplifiers are not suitable for driving 4 ohm loudspeakers. If your loudspeakers have an impedance of more than 8 ohms you can use them with any amplifier, but you're unlikely to get the full power out of the amplifier.

Power handling is of course another potential problem, and if you listen to loud programme material you should make sure that your old loudspeakers are rated to accept the full power of the new amplifier.

Finally, don't forget that you may have to fit a new type of plug to your loudspeaker leads so they can fit the new amplifier — if it has DIN type loudspeaker sockets this will mean a simple soldering job.

What about an old record player, is this OK with any new amplifier?
Depending upon what type of pick-up cartridge you have this can be a problem. If you are using a magnetic cartridge, this is suitable for feeding the 'phono' input of almost any amplifier — just check that the amplifier's input sensitivity is less than 5 millivolts and that it is RIAA equalised — it almost certainly will be.

Ceramic pick-up cartridges are a rather different story. Some are designed for feeding a magnetic pick-up input like the one that's just been mentioned, but some others like to work into a high impedance amplifier input and also give out too high a voltage for a magnetic cartridge input.

Other cartridges like moving magnet cartridges are another problem, as they only produce a very small voltage compared with magnetic cartridges, and only very few amplifiers are designed to use them. However, it may be possible to use them with a magnetic cartridge input if you use a special transformer.

If your record player is fitted with phono plugs and your new amplifier has a DIN input socket for the 'phono' input you can easily buy a short adaptor lead and vice versa.

How about radio tuners, will they work with any amplifier?
It is unusual for this to be a problem area, but you should check that the output voltage from your tuner is greater than the amplifier's input sensitivity for its tuner input, and that the input clipping point of the amplifier is for safety twice the tuner's output voltage.

Most amplifiers have a tuner input impedance of at least 40,000 ohms which is unlikely to be too low for any tuner, but to be safe it's wise to make sure that the tuner's recommended load is exceeded by the amplifier's input impedance.

You may of course need adaptors from DIN connectors to phono connectors, or vice versa, but these are easily bought.

Will magnetic tape equipment always match amplifiers?
In short, no, you may have problems. Strictly if both the amplifier and the tape equipment have DIN connectors they should work together without trouble as they should comply with the DIN standard 45511. But, there is some equipment about that has DIN tape connectors that do not comply with the DIN Standard.

If both the amplifier and the tape equipment have phono sockets all is likely to be well, but you should make sure that your tape gives out more voltage than the amplifier's tape input sensitivity and not so much that the amplifier's input will overload. Similarly you should check that the amplifier matches the tape recorder's input, but this isn't always so easy, as the amplifier's output to tape normally depends upon the input voltage that is applied to the amplifier from the programme source.

As we've said you are not particularly likely to have problems when the amplifier and tape use phono sockets, but it's best to enquire about this when you decide which amplifier you want to have.

This is particularly true if you want to connect one device having phono plugs to

another having DIN connectors; such interconnections often require special adaptor leads which contain resistors.

What about electrical safety?

We all know that the mains electricity can be lethal, but bear in mind that some high power amplifiers can deliver potentially lethal voltages to loudspeakers so take care of loudspeaker leads and connections as you should mains leads.

All three wire mains connections must of course be fitted with a three pin plug including the earth connection which is most important, and where 13A flat pin plugs are used, the correct fuse value must be fitted to the plug in lieu of the 13A fuse which is normally supplied.

If it is necessary to increase the length of mains wiring do not use a taped joint, but use a properly made extension lead with a socket on one end and a correctly fused plug on the other end. Never route any wiring under carpets or in places where it could be trapped or cut by furniture.

Any fuses in amplifiers or other equipment must be replaced when necessary with the correct type and fuse rating, the latter including not only the current carrying capacity but also the acting speed of the fuse which is usually either fast or slow blow which is indicated by the letter T. If you change the mains operating voltage of equipment it is normal to have to change the current rating of the mains fuse, the correct value being indicated either on the amplifier or in the instruction manual.

A further very important matter is that any electronic equipment must have adequate circulation of air so that it doesn't overheat, so don't enclose all your audio equipment in a sealed cabinet or you are certain to suffer from overheating problems at best, or a very expensive bonfire at worst!

But, please remember to switch off mains power before making any connections or investigations!

The individual reviews in this book quote a lot of figures what do they all mean?

The testing programme for the amplifiers included subjective listening tests which naturally provide subjective comments where appropriate, and also provide an opportunity to assess the operational features of amplifiers.

Such operational features include any problems such as noisy controls, switch-on transients, and the general ergonomics of the amplifiers' layouts. Attention was also given to the general standard of construction and access to various parts for servicing, including inspection of the amplifiers for any obvious shortcomings so far as electrical safety is concerned.

These procedures lead mainly to subjective impressions, so it is essential to supplement these with factual data which will provide a direct comparison between the various products.

The intention of the measurements which are tabulated is to give a reasonably thorough insight into each amplifier's performance, and to enable you to make direct comparisons which are usually impossible from the manufacturers' published specifications because of the different measurement techniques used by different manufacturers.

It must of course be emphasised that the quoted measurements and impressions are in general based on a single sample of each product, and there is therefore no certainty that other samples will have the same performances. Some manufacturers took the trouble to check their submitted samples before despatch to the laboratory, others submitted 'off the shelf' samples, and a few samples had been in use at exhibitions.

What do you mean by hum modulation?

Some amplifiers generate more mains hum when they are working hard, compared with when they are only driving at low powers. Obviously this is yet another form of distortion which will interfere with the quality of the reproduced sound.

What we did was to drive both channels of the amplifiers at the manufacturers' rated power into 8 ohms, and then look at the level of the 50, 100 and 150Hz mains hum in the amplifier's output. The figures in the tables show the amount of change in the hum level when the amplifier is driven in relation to the

hum level when the amplifier is idle with no input signal.

Damping factor — what's this about?
The damping factor (see glossary) is the ratio between the amplifier's output impedance, and in this case a load of 8 ohms. We measured this at the two frequencies of 60Hz and 1kHz. We think that any amplifier with a damping factor greater than 40 in relation to 8 ohms (which is the same as 20 in relation to 4 ohms) should be satisfactory with any loudspeakers so far as damping factor itself is concerned.

In any practical installation the resistance of the loudspeaker leads reduces the effective damping factor so far as the loudspeaker is concerned, and we guess that increasing the damping factor of an amplifier above 40 in relation to 8 ohms cannot make any difference to most practical installations.

What is the DC offset and why bother about it?
Most modern amplifiers do not have a capacitor in series with the loudspeaker and the headphone outputs. The DC offset is any undesirable inbalance in the direct current conditions within the amplifier appears at the loudspeaker and headphone outputs.

The result of this is that the direct current will displace the loudspeaker's cone, or parts within the headphone, and it is considered that such displacements can lead to distortion. It follows that the lower the DC offset is, the better.

What is crosstalk, and what does it mean?
Crosstalk is a form of breakthrough between the left and right channels of an amplifier, and we measured this at 100Hz, 1kHz and 10kHz. The crosstalk at 1kHz is potentially the most objectionable, but you shouldn't be troubled if the crosstalk is greater than —40dB below the wanted channel at 1kHz.

How about the effect of the loudness control?
We have already said that loudness controls are really completely unscientific and unnecessary, but as they exist on many amplifiers we've told you what they do. Some loudness controls just boost the bass, so we've measured this boost at 100Hz. Others boost both the bass and the treble, so we've measured the treble boost at 10kHz.

This was all done with the volume control set to —30dB which we have assumed to be a typical quiet listening position, and some loudness controls vary their effect depending upon the volume control setting.

What about frequency response?
Every amplifier input was measured for frequency response to the amplifier's loudspeaker terminals over the range 20Hz to 20kHz with the tone controls in their centre position or switched out of action.

We plotted the frequency response on a chart, and the table shows the worst deviation over this frequency range. You won't be worried about deviations less than 0.5dB, but anything over 1dB could be noticeable.

Several figures are quoted for power output; what's this about?
With all amplifiers we have checked the maximum power that they can deliver into 8 ohm loads with a continuous sinewave. This test at a frequency of 1kHz is the conventional way of specifying amplifier power, and the test has been done with single channels driven and with both channels driven.

Differences between the single and both channel figures are an indication of the capabilities of the amplifier's internal power supplies, because the amplifier requires more power from its internal supplies when both channels are driven. If the internal power supplies are not capable of providing enough power the amplifier's output power capability will drop when both channels are driven.

Where the amplifier manufacturers have specified that their products are suitable for 4 ohm loudspeakers, the same items have been checked with a 4 ohm load.

What about 'Burst Output'?
Another indication of the capability of the amplifier's internal power supplies is its ability to deliver a higher power than its continuous power output for a short time — this capability of course relates to the reproduction of peaks of loudness in music.

We checked this capability by applying a 'burst' of tone to the amplifiers for a duration

of ten-thousandths of a second, every one tenth of a second. This was always checked into an 8 ohm load, and also checked into a 4 ohm load when the amplifier manufacturer said that 4 ohm loudspeakers could be used.

Why was the power output checked into half the rated load?

We regard this as a very important test because loudspeakers do not behave like a resistor and have an impedance which is constant with frequency. All loudspeakers vary their impedance with frequency, and the rated impedance is measured at a fixed mid-frequency.

There are several loudspeakers which show very wide impedance variation with frequency, to the extent of having half their rated impedance at some frequencies, and this is why we checked amplifier performance into half the manufacturers' rated loads.

What does all this about power output mean to me?

You already know that the amount of power you need depends upon the type of loudspeakers which you have, and also on the size and acoustics of your listening room. But, when you are thinking about amplifier power, do remember that if you double the amplifier power you won't hear much difference.

Once you have decided about how much amplifier power you want, look for an amplifier which gives at least this amount of power into the load which corresponds to the impedance of your loudspeakers or the combined impedance of your sets of loudspeakers if you use more than one set.

Then make sure that the 'burst power output' into the same load is equal to or greater than the continuous power output, and also that the power output into half the load which your loudspeakers will present is not less than the continuous power output. (If you are using an 8 ohm load this will be the power into 4 ohms).

How about 'power bandwidth', what does this mean?

All the powers which we have talked about so far have been measured at the mid-frequency of 1kHz, which together with 400Hz is the common frequency for making such measurements. However, you are of course interested in what happens at other frequencies which appear in music and speech.

The power bandwidth is the range of frequencies over which the amplifier will deliver more than half the manufacturers' rated power without significant harmonic distortion. The tables show you the power and load used, and the range of frequencies over which the amplifier delivered this power with less than 0.1% total harmonic distortion.

If this range extends from below 40Hz to above 20kHz we do not feel that there is anything to worry about; but, you will see that some amplifiers fall far short of this requirement, and also that there are wild differences between the left and right channels of some amplifiers — such amplifiers are best avoided.

The point is that music consists of a very wide range of frequencies, and some instruments such as cymbals have a great deal of energy at high frequencies. You must have enough power available at high frequencies to reproduce these sounds without excessive distortion. There have been many arguments about the distribution of energy in the frequency spectrum, but many people feel that you should have equal power available at all audio frequencies for the reproduction of musical instruments. Electronic music is another story, and this type of music is often even more demanding!

How about total harmonic distortion?

We measured total harmonic distortion at the low level of power output of only 1 watt, and at frequencies of 1kHz and of 10kHz. The resulting figures represent total harmonic distortion and noise, which it is admitted is not a particularly meaningful figure unless it is greater than say 0.1% which means trouble!

However, whilst making the measurements we looked at the type of distortion, and anything untoward in the nature of the distortion is mentioned in the reviews.

The importance of this is that much listening time is spent at low output levels, and contrary to popular belief distortion at such levels is often far more important than distortion at high output levels.

What the tables mean: IM distortion; noise ratings

What's all this about 'IM Distortion'?
Intermodulation distortion results from the amplifier producing sum and difference frequencies when two discrete tones are simultaneously fed to the amplifier. Such sum and difference products are subjectively most objectionable, and the application of more than one tone to the amplifier is more akin to real life than single tones which seldom occur in music.

What we did was to apply two simultaneous tones separated by 70Hz, and to sweep these tones continuously from 200Hz + 70Hz right up to 200,000Hz + 200,070Hz whilst plotting the size of the intermodulation products.

At half the amplifier's rated power output we measured the difference frequency produced at 70Hz which is indicated in the tables as 'DF2' and also the frequency produced at twice the frequency of one of the tones minus the frequency of the other tone — this is shown as 'DF3'.

These unwanted frequencies are shown in the tables in terms of decibels below one of the wanted tones, at 1kHz and 10kHz within the audio frequency band, and also at 100kHz which of course cannot be heard by humans. The reason for quoting figures at 100kHz is that the intermodulation performance at such high frequencies gives an indication of the other form of distortion known as 'Transient Intermodulation Distortion'.

The tests at half rated output power show large differences between amplifiers, but we also tested at 1W output using both the auxiliary input and the phono input, but only looked at the difference frequency DF3 generated by the amplifier for these tests.

What does 'noise referred to input' mean?
Most amplifier specifications talk about 'signal-to-noise' ratio, but this isn't actually very helpful because it relates the amplifier's maximum output to the background hiss from an input at the maximum volume setting — this just isn't how you use an amplifier.

What we have done is to calculate the noise voltage which would be required to give the amplifier's measured output noise if the amplifier were perfectly noiseless. You can compare amplifiers directly this way without bothering about output power, and the larger the figure the better.

Two types of noises are mentioned, the first figure is the CCIR Weighted Noise which is weighted to give correlation with its subjective effect, the second figure is unweighted but filtered to include frequencies only from 22Hz up to 22kHz.

The point is that the first figure effectively excludes mains hum which is included in the second figure.

Because different parts of the amplifier are used for high level inputs such as auxiliary, tuner and tape, as opposed to low level inputs such as phono and microphone, the noise for the high and low level inputs is different.

If you want to know the maximum signal-to-noise ratio you can obtain with a particular amplifier which is not the manufacturer's signal-to-noise ratio, take the figures from the tables and relate them to the input voltage which you will apply to the amplifier. For instance, if you will feed 1 volt to the auxiliary input of an amplifier which has noise tabulated as —97dBV (97 decibels below 1 volt) the potential signal-to-noise ratio is 97dB.

If you are going to apply 100mV instead of 1 volt, this is 20 decibels below 1 volt and the signal to noise potential will become —97dBV + (—20dBV) = 77dB.

In practical use the actual signal-to-noise ratio at the amplifier's output depends not only on the input noise, but also on the noise generated in the output parts of the amplifier. Unfortunately with almost all amplifiers this varies with the setting of the volume control, and it's often at its worst at the most used volume settings.

What about the noise power at zero volume?
There's nothing more annoying than the loudspeaker burbling away in the corner without any music, and it's the output noise power at zero volume setting which tells you how much hiss and hum comes out of the amplifier when the volume is turned down to zero.

Because we do not know what loudspeakers you will be using, we can't tell you how much noise will come out of them at zero volume, but any output power greater than 0.1μW may be apparent in a quiet room.

Even more important, the noise power output at zero volume may be most annoying when using headphones, because they are normally far more sensitive than loudspeakers and are usually fed from the amplifier's loudspeaker terminals via a resistor. You may find that only 0.01μW output power may be annoying with headphones.

You may well ask why are we interested in the noise power at zero volume, but this is the minimum output and all other conditions will be worse.

What about noise at the worst case volume setting?

With many amplifiers as you increase the volume control setting without any input signal the noise in the output will first increase to a maximum, and then decrease again as maximum volume setting is reached.

All too often the worst case volume setting coincides with a normal volume setting for listening! All that we've said about the noise power at zero volume setting applies, particularly for headphone listening.

What is dynamic range?

The dynamic range or signal-to-noise ratio often quoted by manufacturers, is the relation between the maximum output power which the amplifier can manage without excessive distortion, and the amplifier noise at maximum volume setting.

For this purpose we've taken the auxiliary input channels and the CCIR weighted noise, and related this to the power output into 8 ohms — this has been worked out in decibels, and the larger the number the better.

What do the input impedances mean?

The amplifier's input impedances are an indication of how much load the amplifier puts on devices which feed it with audio signals, such as tuners, tape recorders and pick-up cartridges. If the input impedance is too low, the amplifier will load the input device and will reduce the input signal as well as quite probably producing distortion.

The input impedance often varies with the amplifier's volume setting, so we have indicated this as well as showing two different parts of the input impedance — the resistive part in ohms, and the capacitive part in picofarads (abbreviated pF).

If this capacitive part is too large, you may lose high frequencies, and we prefer to see this below 150pF for all inputs. So far as the high level inputs are concerned, if the resistive part is above 20,000 ohms you're unlikely to have matching problems so far as impedance itself is concerned.

Phono inputs should have a resistive component of about 47k ohms for most pick-up cartridges, but some amplifiers offer a choice of resistive component. Different pick-up cartridges prefer different capacitive loads and probably an amplifier with a capacitive input component of around 120pF or less is the best compromise, for one can always add more capacitive loading but never make it lower.

Where a microphone input is fitted this was always found to be intended for dynamic microphones, and should therefore present a load in excess of 50,000 ohms for many types of domestic microphone. But this isn't a hard and fast rule, as the optimum impedance depends upon the type of microphone to be used.

How about input sensitivity and clipping points?

The input sensitivity shows the minimum voltage that you must feed to each amplifier input to achieve the full potential power output, whilst the input clipping point shows the maximum voltage which each input can accept without excessive distortion.

So far as the high level inputs are concerned, it is preferable to feed them with a signal about ten times their sensitivity or less, provided that this doesn't reach the input clipping point.

You must of course check that your tape recorder, tuner etc. give an output voltage in this region, or you'll not get the best out of your amplifier.

The phono input is a special case because the output from magnetic cartridges is fairly standard and in the region of 1 to 1.5mV per centimetre per second of recorded velocity, and pick-up cartridges of this type are by far the most common nowadays. A phono input sensitivity less than 5mV will almost certainly

be adequate, but it is most important that the input clipping point should be at least 100mV to cope with the very high recorded velocities and also with scratches and other recorded effects.

We've dealt with input voltages, what about output voltages?

The figures which we have shown for output voltages relate to the amplifier being operated at maximum volume control setting and being driven at full power. Consequently the headphone output voltage is the maximum which can be encountered, and the tape and DIN output voltages are likely to be the lowest encountered.

Because of wide variations between types of headphones, we can't tell you how well any particular headphones will work with a particular amplifier, but armed with the output voltage and impedance and data on headphones this is all the information that you need.

With most amplifiers the tape output and the DIN outputs are before the volume control, and therefore unaffected by the volume setting. The output voltage therefore depends on how many volts you feed to the amplifier, and the voltage in the tables is the output when the amplifier is fed by the voltage shown in the table for input sensitivities. If you double this voltage you will get twice the output, and so on.

With many amplifiers the tape output is fed straight from the input to the amplifier, so the output impedance varies according to the signal source. However the DIN output is normally an attenuated version of the tape output and its output impedance is constant.

This DIN output should conform to the requirements of the German DIN Standard 45511 which permits an output voltage of between 0.1mV and 2mV per thousand ohms of impedance. Thus, if the output impedance was 50,000 ohms, the output voltage should be between 5mV and 100mV to feed other equipment which conforms to the DIN Standard.

What about the pen chart recordings — how much do they tell?

There's a great deal of information in the two pen chart recordings — they tell you about the frequency response of both channels, filters, tone controls and the accuracy of the frequency response of the phono input as well as the accuracy of the balance between the channels under all these conditions.

The vertical scale of the pen chart recordings is in decibels and covers a full scale range of 50dB with each division representing 1dB. The horizontal scale shows the frequency, the first chart covering from 2Hz to 200kHz, and the second chart from 20Hz to 20kHz which is effectively the audio frequency range.

If you look at the first chart (see Fig 6) the top line is the overall frequency response of the amplifier at a power level of 1W into 8 ohms. In the sample here the line is straight from 10Hz up to 50kHz, showing that the amplifier's frequency response is within 0.5dB over this range.

You will see that this line droops below 10Hz and above 50kHz, and has dropped by three vertical divisions at just below 3Hz and just above 100kHz — these are the points where the overall frequency response has fallen by 3dB.

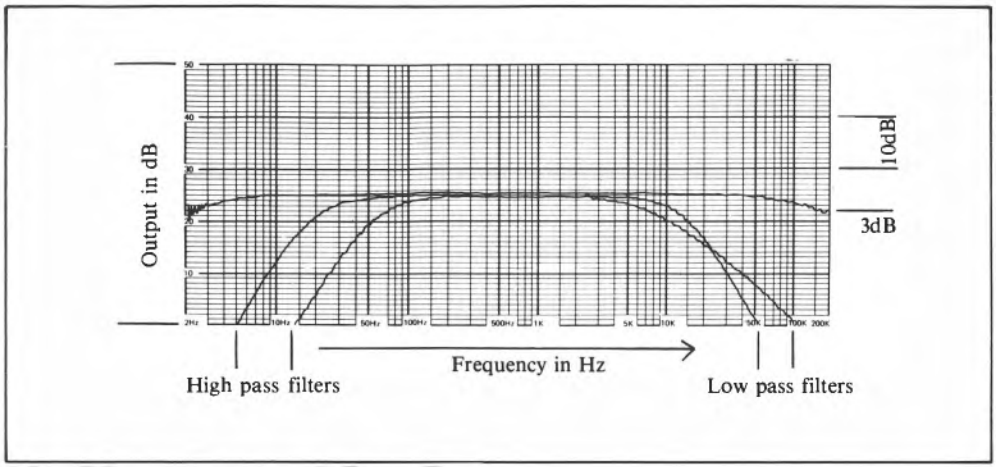
If you look at the lines to the left of the pen chart recording these show the performance of the two high pass filters which were fitted to this amplifier. You can see that they attenuate the output by 3dB at either 25Hz or 70Hz, and that they are of equal slope.

To the right of the pen recording you can see that two low pass filters are fitted to the sample amplifier, with —3dB points at 7kHz and just over 10kHz. These two filters have different slopes. The 7kHz filter works at only 6dB/octave, whilst the 10kHz filter works at 12dB per octave.

Both these filters introduced a small difference between the two channels, to the extent of a zigzag in the curves of about one vertical division which is equivalent to 1dB — a minor matter.

This amplifier is a good amplifier with four filters, some amplifiers have none; some amplifiers show poor balance between the two channels, some have none too flat a frequency response — all the information is in this pen recording!

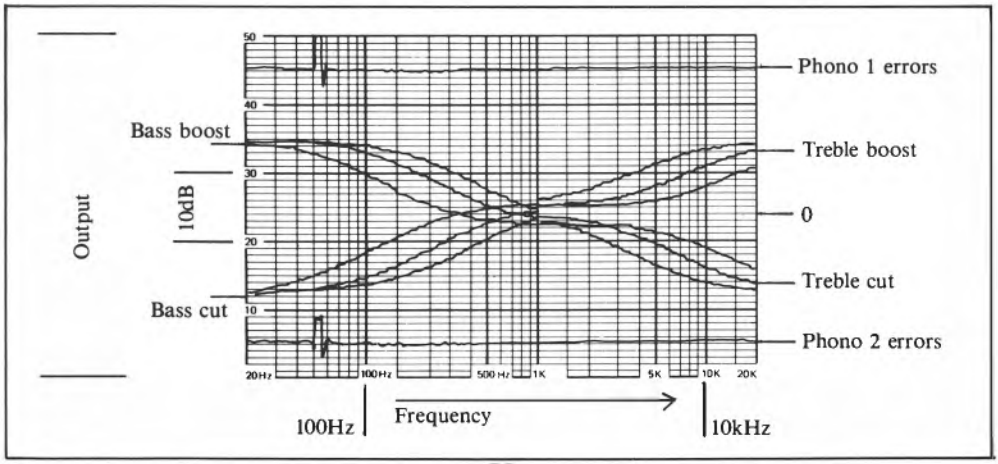
The second short pen chart recording (see



6 Overall frequency response and effect on filters

Fig 7) has the same vertical scale, but the frequency scale only goes from 20Hz to 20kHz. Like the first pen recording the difference between the two channels is shown in the same way as a zigzag in the lines, but this time the plot shows the performance of the tone controls and the errors (if any) in the RIAA correction to the phono input or outputs.

With all magnetic pick-up cartridges there is a special frequency response correction required because of the method by which the records are made, and it is this correction which is called RIAA equalisation, and which boosts low frequencies and cuts high frequencies by an internationally standardised amount. This standardised amount of 'equalisation' was checked for all phono inputs, and the top line in the plot shows the errors in the correction for both left and right amplifier channels; where two phono inputs are fitted, a second plot has been made at the



7 The effect of tone controls and the accuracy of RIAA equalisation

bottom of the frequency response plot.

Turning now to the tone controls, the line at the vertical centre of the frequency response plot shows the frequency response of the two amplifier channels from the auxiliary input to the loudspeaker output with the tone controls at their mechanical centre position — which should of course provide a flat frequency response. The remaining lines show the maximum and minimum treble and bass boost available, but in the case of the sample amplifier the treble and bass controls were more complex than normal, and that's why there are three different lines for bass and treble cut and boost.

In this instance the amplifier had three switchable turnover frequencies for the treble and bass controls, and that's why there are three sets of tone control characteristics shown.

The performance of tone controls is often specified in terms of bass cut and boost at 100Hz, and treble cut and boost at 10kHz. If you look at the performance of the sample amplifier you can see that the bass control allows either ±5dB, ±9dB or ±10.5dB compensation at 100Hz in the bass region, or ±4.5dB, ±7.5dB or ±9.5dB compensation in the treble at 10kHz.

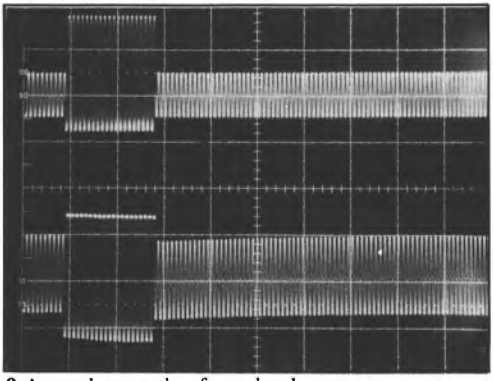
These are in fact very versatile tone controls, and unusual in their complexity, and you'll find the other amplifier much simpler to understand — but it's often better to start with the most complicated problems, it's then easy to understand the simple ones.

What about the photograph of the overload performance — it's rather complicated?

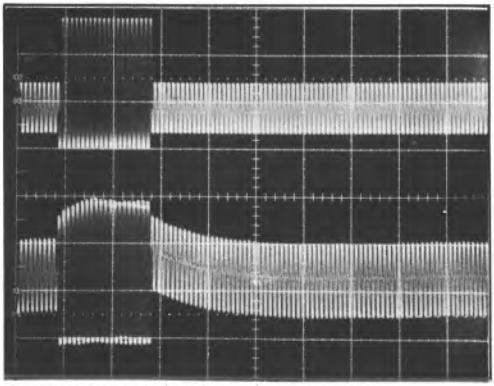
Yes, it's quite true, this is rather complicated to interpret. What we've done is to run the amplifier continuously at half power with a sinewave, and then suddenly apply an assymetrical burst of sinewave to drive the amplifier well into overload — the sort of thing which might happen on a crescendo when you're driving the amplifier a bit hard.

What you don't want is serious distortion after the overload, and we're trying to show you what's likely to happen with each amplifier. The top part of the photograph show the signal which is fed to the input of each amplifier, and the bottom part shows what happens at the output of each amplifier. If you look at the first photograph (see Fig 8) you'll see that the amplifiers output is similar to its input, with the exception that the top of the input signal is clipped in relative height. After the overload the lower level signal is virtually unaffected, but drifts slightly upwards — this is a good amplifier.

If you examine the other photograph (see Fig 9) you'll see that the burst of overload is most peculiar in comparison with the input signal at the top of the photograph — the bottom of the burst is clipped and the top completely distorted. Furthermore the output after the burst of overload takes a vertical offset and slowly recovers — this is not such a good amplifier.



8 A good example of overload recovery performance



9 A poor example of overload recovery performance

Why were sinewaves used for all these measurements?
Sinewaves happen to be very convenient because any waveform can be analysed into a fundamental sinewave and its harmonics — this process is called Fourier Analysis, but this is quite complicated mathematics.

However, all speech and music can be analysed into sinewaves, and that's why they are so convenient a measuring tool.

How do I decide which amplifier is best?
To help you with this decision we've suggested recommended amplifiers and 'best buys', but you can of course look through the individual reviews and make your own choice based on the measured data and the opinions expressed. There are of course many possible measurements which have not been quoted, and many measurements which have been made are not included — quite simply there's a limit to the reasonable space allocated to each amplifier, and many readers would be bored with more complex figures.

I want to know how the measurements were made?
The next section of this introduction deals with this in some detail. But, be warned, it takes a lot of very expensive test equipment to give accurate measurements.

For instance, if you try to measure power output with a meter which is accurate to ±3% you may end up with a 12% error in the power output, let alone other errors which can be introduced by mains voltage variations and load resistor accuracy.

The lesson here is, if you are a do-it-yourself enthusiast, be very careful before you tell a manufacturer that he is wrong. On the other hand, many manufacturers publish the most meaningless specifications, and we're throughly in favour of challenging these.

So far you've learnt about the basic meaning of the terms used to specify amplifier performance, and very briefly about the measurement methods used to compile the tables in this book.

This section of the book is concerned with full details of the measurement methods used, and of the equipment used to make the measurements. However, it is generally accepted that measurements do not tell the full story about an amplifier's performance, so it is necessary that listening tests should form part of each amplifier review.

The original material for listening tests was recorded on an Ampex type ATR-100 professional recorder at a tape speed of 30 inches per second, with some material originating on a Nagra IV recorder at 15 inches per second. Live recordings of individual instruments (piano and flute) and male and female speech were used, in addition to music from direct cut discs.These were: Carl Orff; Carmina Burana (Deutsche Gramaphon 139362); Fantastic Sound of Tsugarn Jyamisen (EMI Toshiba LF 95005). Mcabe Symphony (Elegy) 1965 Opus 40 (Pye TPLS 13005); The LA4 Parane: Pour une enfante défunte (East Wind EW 10003).

As expected, the outcome of listening tests was that there were substantial differences between some amplifiers, and only more subtle differences between others. Because the type of loudspeaker used for the tests is bound to have a considerable influence, many of the tests were done using Spendor type BC III loudspeakers which are known to present a particularly awkward load.

Each product was compared with a reference — the Quad 33 and one of the Quad 405s — by switching the loudspeakers between amplifiers which were fed with identical programme material and adjusted for identical gain. Further tests were conducted to assess the effects of the tone controls, filters and other forms of equaliser.

Careful note was taken of the performance of each control and its ease of operation, as for instance, some balance controls were far too coarse in operation about the centre point setting. Other effects such as switching transients which could cause damage to loudspeakers were assessed by listening, as measurements upon such defects are not very meaningful, and such measurements would not be easy to interpret.

In addition to the listening part of the evaluation, each amplifier was examined both internally and externally for the overall standard of construction, with particular reference to the electrical safety and general standard of wiring and assembly. Over the last few years, these aspects of amplifier design seem to have substantially improved.

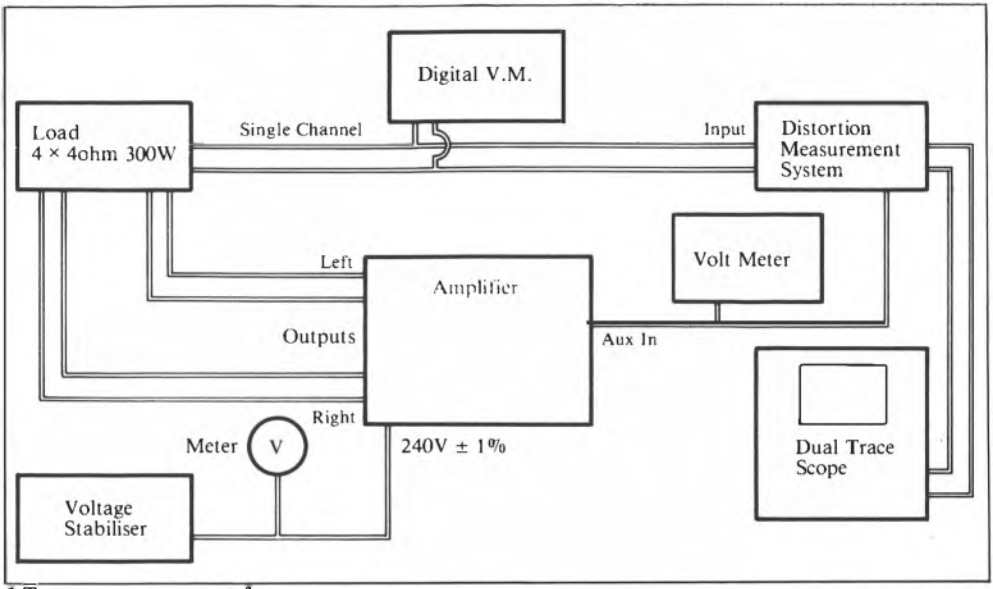
Clearly the electrical safety side has had to improve as a result of the recent Common Market regulations known as the 'Low Voltage Directive', and maybe this has led to more attention being paid to assembly standards. However, automated production techniques have also done much to improve assembly standards, and the wire wrap joint is rapidly replacing hand soldering which has often left much to be desired in the past.

Another improvement which has become common is the replacement of rotary potentiometer volume controls with switched attenuators, thus getting rid of matching problems between channels. Equally important, the same has been done with tone controls in some of the better amplifiers, but we have to report some 'cheating' in this area. Some manufacturers are just fitting detent mechanisms to potentiometers, so you have the feel of a switched mechanism with the evils of potentiometers remaining.

Measurement Conditions

Because very few amplifiers have stabilised power supplies, the incoming mains voltage can have a substantial effect upon the amplifiers' power capabilities. Therefore all tests involving power output were conducted using a voltage stabiliser the output of which was held within 1% of 240V. This was continuously monitored on an expanded scale voltmeter which itself had been specially calibrated.

The ambient room temperature was held close to 21°C which was considered as being



1 Test gear arrangement for power measurements

typical of a living room, and when under test, each amplifier was placed in free air on the bench.

Resistive loading was used for all tests, with the overall load accuracy including connecting leads being within 0.5% of the required nominal load. The load used for high power testing comprised a load box of local manufacture, this consisting of four 300W 4 ohm metal clad resistors mounted on a heavy alloy heatsink which itself was air blast cooled. These resistors could be patched in series or parallel to form any desired load.

Power Outputs

The testgear arrangement used for power measurements is shown in Fig 1. The auxiliary inputs of the amplifier under test were fed from the low distortion oscillator in a Sound Technology type 1700A Distortion Measurement System, the output level of which was monitored with a Bruel & Kjaer type 2426 Autoranging Electronic Voltmeter.

The amplifier's output was loaded and fed to an A.C. Digital Voltmeter and to the balanced input of the Sound Technology Distortion Measurement System. The Fluke type 8110A Digital Voltmeter was accurate to better than 0.25%, having been calibrated against our more accurate Data Precision DP3500 meter which is generally within 0.1% on A.C. Voltage.

The Distortion Measurement System offers two oscilloscope outputs which were fed to a dual trace oscilloscope. This provided a display of the unaltered amplifier output, and also of noise and distortion by rejecting the fundamental input frequency.

All amplifiers were tested for output clipping into 8 ohms at 1 kHz using this arrangement of testgear, the distortion output of the Distortion Measurement System providing a very accurate indication of the onset of clipping.

This measurement was done for both amplifier channels, with and without the other channel driven to clipping point. The difference in drive capability with single or both channels driven gives an indication of the capacity of the amplifier's power supplies.

Where amplifiers were rated by the manufacturers for working into either 4 ohms or 8 ohms, the tests were repeated with 4 ohm loads, but in any case each amplifier was

tested for its clipping point into half the manufacturers' minimum rated load with a single channel driven. The reasoning behind this test being that wild variations in loudspeaker impedance are common, with several well known loudspeakers having impedance which falls to around half the nominal impedance. Thus, it is clearly a good thing if amplifiers are capable of operating into half the nominal load, but in practice it is unlikely that both channels will be required to give large outputs simultaneously into such a load, so the test was done with a single channel driven.

This leads to the peak power output capabilities of amplifiers, and each amplifier was tested for its output clipping point at 1 kHz into its rated loads using a tone burst of 10ms duration every 100ms. This burst was derived from a Bruel & Kjaer type 1013 Oscillator which fed a Bruel & Kjaer type 4440 Gating System which generated the toneburst starting and stopping at the zero voltage point of the sinewave input.

The output of the gating system was fed via a Marconi type TF2161 attenuator to the amplifier's input, in lieu of the Distortion Measurement System's oscillator. As the amplifier's output then consisted of tonebursts the output voltage could not be measured using conventioanl meters, and to cope with this the Bruel & Kjaer type 2426 Autoranging which has a very fast peak reading capability was used to measure the amplifier's output voltage.

Not only does the burst output power give an indication of the peak practical output power of each channel, but the difference between the burst capability and the steady state capability gives an indication of how 'hard' the amplifier clips on music.

Power Bandwidth

For the measurement of power bandwidth we used the testgear arrangement shown in Fig 1 but at high frequencies the Distortion Measurement System was used to measure output power instead of the digital voltmeter, as its accuracy falls off.

The amplifier under test was driven to half the manufacturers' rated power with a single channel running, and the total harmonic distortion measured. The frequency of the input signal was then decreased until the point was found where the total harmonic distortion increased to 0.1% and the frequency noted. Frequency was then increased keeping the output power constant at half the manufacturers' rated power, and the 0.1% total harmonic distortion point found and the frequency again noted.

These two frequencies represent the power bandwidth for 0.1% total harmonic distortion, but it will be noted that in many instances, the amplifier's lower limit was not reached at 10Hz and lower frequencies have not been tried. This is because the performance at lower frequencies is not of significance, and the same may be said of performance above 20kHz so far as power bandwidth is concerned. However, the high frequency performance is indicative of the maximum slewing rate, which ties up with transient intermodulation distortion and other distortion phenomena.

Returning to power bandwidth itself, this aspect of an amplifier's performance is very important in terms of the reproduction of music, and whilst the energy spectrum of music is not necessarily flat with respect to frequency it is highly desirable that an amplifier should be capable of reproducing high levels at frequencies up to 15 or 20kHz.

There are two common misconceptions in this area. Firstly, that the fundamental of a musical instrument contains more energy than the harmonics, which is only true for some instruments. Secondly, that because pre-emphasis is used in tape and disc recording this reduces the relative energy of the high frequencies; the point here is that pre-emphasis does reduce the relative energy at high recorded levels only, but that at lower recorded levels the high frequency energy can be greater than the mid or low-frequency energy.

Total Harmonic Distortion

The total harmonic distortion and noise at 1W output at a frequency of 1kHz and 10kHz was measured for each amplifier working into its manufacturers' rated loads. This measurement, like the power bandwidth, was done using the Sound Technology Distortion

Measurement System which has a distortion residual in the order of only 0.002%.

It will probably come as a surprise to some readers that the total harmonic distortion was only measured at 1W output, but this is for a good reason. Because of the ease and low cost of measuring total harmonic distortion by means of a rejection filter which only removes the fundamental it has become a popular measurement. But, it has been shown that the CCIF difference tone method of distortion measurement is a far better method and we have used this at both high and low output levels.

On the other hand the total harmonic method gives some figure of merit at low output levels, in that it includes harmonics, noise and any other unwanted 'rubbish' in an amplifier's output. Furthermore it gives a visual indication of crossover distortion as seen on the oscilloscope, and we took note of this in terms of 'noise', 'harmonic', 'spikes' or 'harmonic and spikes' as seen on the oscilloscope. Any predominant features in this distortion are mentioned in the individual amplifier reviews.

Intermodulation Distortion

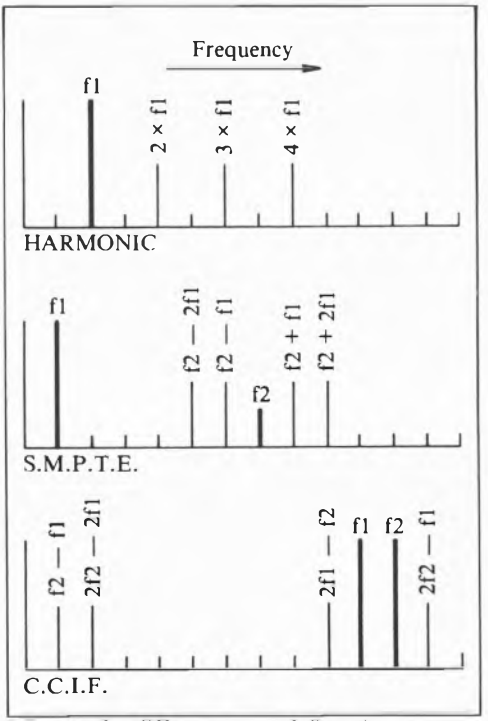
There are two distinctly different methods in use for the measurement of intermodulation distortion, the SMPTE Method and the CCIF Twin-tone method. The latter has been used in the amplifier reviews. With the SMPTE Method two fixed frequency tones, typically at 50Hz and 7kHz are applied to the amplifier simultaneously and with a voltage ratio of 4:1 with the low frequency tone being the larger.

If, as a result of non-linearities in an amplifier, the low frequency tone modulates the high frequency tone and a number of extra discrete tones will be generated about the 7kHz tone, and these are called 'sidebands'. Such sidebands will appear at 7kHz ± 50Hz, 7kHz ± 100Hz. 7kHz ± 150Hz etcetera.

Whilst these sidebands can of course be analysed by means of a spectrum analyser, far simpler and cheaper instruments are available for this measurement and certainly it is in many ways a more useful measurement than total harmonic distortion and less affected by amplifier noise. However, the use of a high frequency and a low frequency is in some ways restrictive and many engineers feel that the CCIF Twin-tone method is the most meaningful.

Like the SMPTE Method this uses two simultaneous tones, but in this instance they are of equal amplitude and close in frequency. Non-linearity in an amplifier will generate different frequencies which are located at the difference in frequency between the two tones, the difference in frequency between each tone and its harmonics etc.

Figure 2 shows this distortion spectrum,



2 Spectra for different types of distortion

together with the distortion spectra of the SMPTE Method and harmonic distortion, with f1 and f2 representing the twin tones in the SMPTE and the CCIF Methods of intermodulation measurement. One of the big advantages of the CCIF Method is that provided that a narrow band spectrum analyser is used it is possible to make distortion measurements at very low amplifier

power levels without noise interfering with the measurements, and futhermore, if the two tones are close in frequency it is possible to investigate the performance at high frequencies where the frequency response rolls off.

The technique used for the review measurements is known as swept intermodulation distortion measurement, and is shown as a system block diagram in Fig 4. The Bruel & Kjaer Type 2010 Heterodyne Analyser in conjunction with the type 1902 Distortion Control Unit generates the two tones which were set to be 70Hz apart from each other. When the Bruel & Kjaer Level Recorder is started the tones are continuously swept in frequency from 200Hz to 200kHz with the constant 70Hz separation in frequency being maintained.

At the same time, the Distortion Control Unit tunes the analyser section of the Heterodyne Analyser to either the different frequency f1-f2 or to 2f2-f1, the former being indicated as DF2 and the latter DF3 in the review tables. At the same time the output of the Heterodyne Analyser which was set for a 3.16Hz bandwidth is plotted by the level recorder which was arranged to give a distortion readout from —80dB to —30dB below the level of a single applied tone.

In all cases, the amplifier's output was loaded with 1% 250W non-inductive load resistors and for convenience, the output was fed via a Bruel & Kjaer Response Test Unit to the output measuring instruments. These comprised the Heterodyne Analyser, a Data Precision type DP3500 Digital Voltmeter for accurate level setting and a Sennheiser type RV55 analog voltmeter which also fed an oscilloscope.

Each amplifier was tested for both mentioned intermodulation products at half the manufacturer's rated power output when fed at the auxiliary input, and also at 1W output for the simple difference tone f1-f2 when fed at the auxiliary input and at the phono input via an inverse RIAA equaliser which theoretically should produce a constant output voltage.

The resulting plots were corrected for frequency response errors, and the intermodulation performance at 1kHz, 10kHz and 100kHz noted in the review tables.

Hum Modulation

Whilst this is not a conventional measurement, it does indicate another form of distortion which is present in many amplifiers. What in practice happens is that the unwanted mains hum in the amplifier's output varies in level according to the power output at the time, thus, when the amplifier is working hard more hum appears in its output.

A similar testgear arrangement to that shown in Fig 3 was used for this measurement, but the 1902 Distortion Control Unit was replaced with a Bruel & Kjaer Type 1901 Tracking Frequency Multiplier which was used to tune the Heterodyne Analyser to 50, 100 or 150Hz.

The amplifier under test was set to deliver its rated output from both channels into 8 ohms at 1kHz, and the hum content of the output was noted with the Heterodyne Analyser. The input signal was then removed and the hum content of the output again noted.

The differences in the hum level at 50, 100 and 150Hz were then taken, and these are the hum modulation figures quoted in the review tables.

Damping Factor

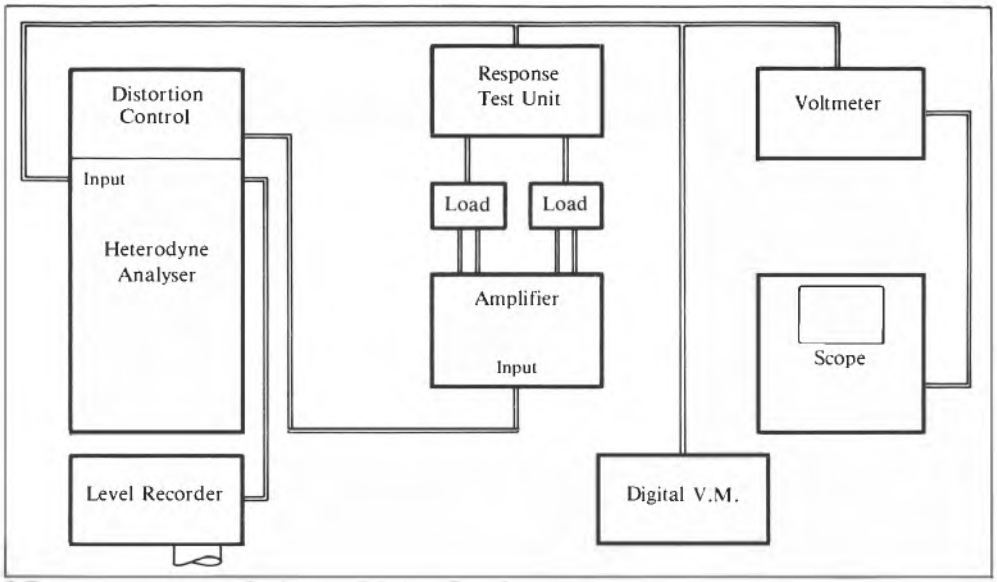
Whilst there are several methods of measuring damping factor, not all of which give the same result, the method used was that according to British Standard 3860:1965.

The amplifier was set to deliver one quarter of its rated power into 8 ohms at the appropriate frequency, the output being measured by a Tektronix type DM501 Digital Multimeter which was connected on-line to a Tektronix type 31 Programmable Calculator. The 8 ohm load was then removed and the calculator worked out the damping factor as no load voltage divided by difference between on load and no load voltage.

This is but one of the many routine tasks for which the on-line calculator system was used, others included noise calculations and impedance measurements.

DC Offsets

It is common for direct coupled outputs to be



3 Test gear arrangement for intermodulation distortion measurements

used in solid state amplifiers, and this leads to any unbalance in the output stages appearing at the loudspeaker terminals and the headphone jack. Such DC may affect loudspeakers and headphones, so it was measured with the amplifier loaded into 8 ohms, furthermore other outputs were checked to see that there was no DC offset, as it could affect tape recorders or other peripheral devices.

Noise

Unfortunately, there are a very great variety of methods of both measuring and specifying noise performance of amplifiers, and for the purposes of the amplifier reviews it was necessary to standardise on measurement methods which are hopefully most meaningful.

To start with. it was decided that both a weighted and an unweighted measurement should be included, as weighted measurements always tend to greatly reduce the apparent effect of mains hum. The popularity of the CCIR Weighting over recent years, and its good correlation with the subjective effects of noise, made this weighting a clear choice. However, confusion exists about the use of this weighting, as one may take the zero gain point at 1kHz, 2kHz or elsewhere.

Whilst it does tend to give a figure which is 'bad' at first sight, we have taken the zero gain frequency at 1kHz, and we have measured the noise with a true rms meter. Likewise we again used a true rms meter for the measurement of unweighted noise, but in this instance we restricted the noise measurement bandwidth from 22.5Hz to 22.5kHz using a Bruel & Kjaer Type 2606 Measuring Amplifier in conjunction with a Bruel & Kjaer Type 1612 Filter Set to check the influence of mains hum products on the measurement.

So much for the testgear; how should the results be expressed? Many specifications just give a signal to noise ratio in terms of the relation between an amplifier's rated power output and the noise associated with a particular input at maximum volume setting.

Unfortunately, this tells but part of the noise story, for as you wind down the volume setting the signal reduces but the noise frequently increases and down goes the dynamic range. Furthermore, the signal-to-noise ratio tells us nothing about the noise

performance of the amplifier's input stages.

To overcome the latter objection to signal-to-noise specifications we measured the noise at the amplifier's output at maximum gain and then referred the noise to the input in terms of an effective input noise voltage, simply by compensating for the gain associated with the input being tested. Thus, if you know what input voltage you will apply, you can work out the maximum possible signal-to-noise ratio by relating this to the noise referred to the input which is tabulated in terms of CCIR weighted and unweighted noise.

The signal-to-noise ratio, or dynamic range, at the output is another story because it depends upon the setting of the volume control. We have therefore measured to output noise at zero volume setting in terms of the output noise power into 8 ohms — this tells you how much background noise you will get at zero volume setting, and some amplifiers are very poor and give an objectionable hiss with even inefficient loudspeakers — let alone headphones.

The other background noise figure of interest is the worst case noise at the amplifier's output. This was measured by setting the amplifier to use the auxiliary input which was shorted, and then altering the volume control whilst observing the output noise voltage and finding the worst noise condition. Almost all amplifiers gave this worst condition at the most normal volume settings for practical use!

Again this output noise voltage has been tabulated as output noise power, for unless we know the input signal amplitude a figure for signal-to-noise ratio is meaningless.

The final noise related figure in the review tables is the dynamic range referred to an 8 ohm load and the auxiliary input. This figure is the maximum possible dynamic range, in that it relates the power output at clipping into 8 ohms at 1kHz to the maximum volume setting noise associated with the auxiliary input when shorted.

In the case of all high level inputs such as the auxiliary, tuner and tape inputs the noise has been measured with the input shorted. It is felt that this is justified because most input sources should have a low output impedance such that their output impedance will make negligible contribution to noise. However, low level inputs such as the phono and microphone inputs are another story.

In the instance of phono inputs it was felt appropriate to load the input with a typical pick-up cartridge. A Shure type M75 cartridge was mounted in a diecast alloy box which itself was screened with Telcon 'Telshield'. The output of the cartridge was then fed to phono plugs via a lead which had a capacitance of 120pF between its core and its shield.

This contraption was used for all phono noise measurements, with the additional use of a short phono socket to DIN plug converter lead when necessary. This converter lead had a capacitance of 37pF which is rather high, but on the other hand typical of such leads which are in common use.

Microphone inputs were measured for noise performance with a resistive load of 200 ohms ±1% included within a jack plug, but the performance of many amplifiers was such that this load probably made an insignificant contribution to the measured noise performance.

Input Impedances

Whilst the input impedance of phono inputs was unaffected by the setting of the amplifier's volume control, that of high level inputs may show alarming excursions with volume setting. These effects were measured using a Wayne Kerr Type B221 bridge which operates at 1,592Hz, and note was taken of both the resistive and capacitive components of the input impedance.

Bearing in mind that a shunt capacity of 250pF represents about 42,000 ohms at 15kHz it will be seen that with some amplifiers there is a substantial risk of the input capacitance affecting the frequency response with many input devices; furthermore, it is felt that wide input impedance variations are also highly undesirable.

In the case of phono inputs, there was again a wild variation in shunt capacitance, and in the now more common cases where the phono loading was variable we measured all the available input configurations.

Input Sensitivity and Clipping Point
Input sensitivities were always measured at 1kHz using an oscillator which had a low output impedance, but in spite of this, the input voltage was always checked with a Bruel & Kjaer Type 2426 Autoranging Electronic Voltmeter.

The tabulated input sensitivities represent the rms input voltage at 1kHz required to give the amplifier manufacturers' rated power output into 8 ohms with a single channel driven at maximum gain settings. Whilst the figures are the average of the two channels, any wild variations in sensitivity will be apparent in the text of the reviews.

Having determined the input sensitivity, the input voltage was increased and the amplifier's gain reduced until the point at which input waveform clipping occurred, or serious distortion was apparent — this input voltage is tabulated as the clipping point, but the maximum level applied to the high level inputs was restricted to 20V rms as higher levels are unlikely to be met.

Output Impedances and Voltages
The amplifiers were set to deliver their rated output into 8 ohms at 1kHz with maximum gain settings, and the open circuit output voltage measured at the headphone, tape and DIN record/playback outputs when fitted.

The output impedance was then measured by noting the voltage drop when the outputs were loaded with a resistor, the resistance being 100 ohms for headphone outputs (typical of many headphones) and 10,000 ohms for tape and DIN connectors.

In order to comply with the DIN standard 45 511 the output voltage should be in the range 0.1mV to 2mV per thousand ohms impedance of the load, but sadly some amplifiers still do not meet this requirement.

Crosstalk
Crosstalk between the amplifier's channels was measured using the Bruel & Kjaer Heterodyne Analyser in the selective mode in order to effectively eliminate the possible noise contribution.

Both amplifier channels were set to maximum gain and the auxiliary inputs fed with an input level which gave 1W output into 8 ohm loads, the input to one channel was then shortened and the leakage from the driven channel plotted with the Bruel & Kjaer Type 2305 Level Recorder over the frequency range 20Hz to 20kHz and crosstalk level range of between —80dB and —30dB below 1W output.

The results have been tabulated at the spot frequencies of 100Hz 1kHz and 10kHz which gives a good indication of the amplifier's performance in this respect. Whilst low frequency crosstalk may increase at high power outputs, it was considered a fairer comparison between amplifier to examine this parameter at the low level of 1W output as the results should not be at all power output sensitive at this level.

Frequency Response, Filters, Tone Controls etc.
The frequency response of all inputs was measured at each amplifier's output at 1W output at 1kHz into 8 ohms over the frequency range 20Hz to 20kHz, and in addition, the overall frequency response from the auxiliary input to the output was measured over the frequency range 2Hz to 200kHz. A plot of this together with the frequency response of any high pass or low pass filters is shown in each amplifier review, and this plot also shows any imbalance between the amplifier's channels as the input to the plotting system was switched between the channels every one second — the result of any unbalance being a zigzag in the plot.

The second plot in each amplifier review shows the response from the auxiliary input to the output with the tone controls in their mechanical centre positions, and with the treble and bass controls at their extreme positions together with the effect of any switched choice of turnover frequencies. Also shown shown in the frequency response of the phono inputs as found by inserting an inverse RIAA equalisation before the amplifier's input. As with the first plot, the effects of any imbalance between channels appears as a zigzag in the plot.

Additional types of tone control were examined in the same way and comments appear in the individual reviews where these are fitted, but the performance at 100Hz and

10kHz of the common loudness control which boosts bass and possibly treble is tabulated in the individual reviews.

Whilst examining the performance of tone controls etc., a careful watch was kept to ensure that the amplifier did not run into severe distortion, and if this did occur due to the excessive boost of some controls this is mentioned in the text and the frequency response plot made at a lower output level.

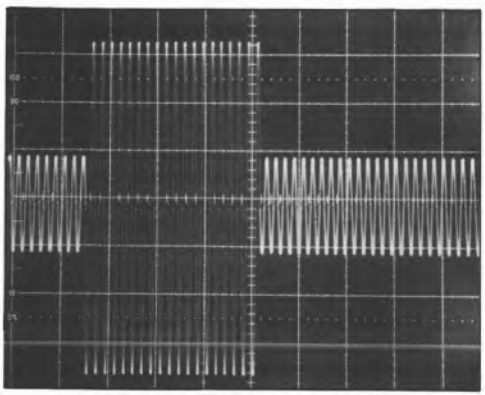
Overload Recovery

When some amplifiers are driven into heavy overload by an assymmetrical waveform they tend to block and to give a sustained DC offset at the output, which could damage loudspeakers at the worst and will lead to severe distortion at the best.

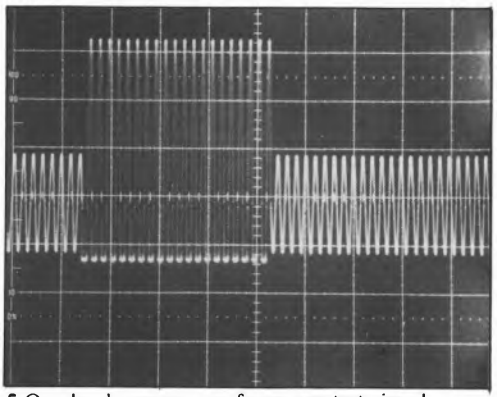
This aspect of the amplifiers' performances was investigated by applying a special toneburst which was derived from a Farnell Modular Pulse Generating System in conjunction with a special toneburst unit of local manufacture.

The pulse generating system was used to provide a 20ms wide pulse every 100ms, which itself was used to drive the toneburst unit. This unit in addition to a conventional toneburst commencing and ending at the zero crossing point, provides a continuous sinewave output at a variable threshold level; thus a continuous sinewave can be 'bursted' to a higher level.

Such a waveform is shown in Fig 4 but this is a symmetrical waveform, so this waveform was clipped by means of a diode to produce an assymmetrical burst of 1kHz as shown in Fig 5.



4 A typical tone burst



5 Overload recovery performance test signal

For the amplifier tests, the continuous threshold level was set to half the amplifier's rated power output into 8 ohms, with the burst amplitude 10dB higher, so that the amplifier was driven 7dB into overload. The results are shown in the oscillograms with each review, and as will be seen there is a substantial difference between amplifiers, some giving almost perfect reproduction of the input toneburst, and others entering severe longterm distortion.

Accuphase E 202

Pyser Ltd., Fircroft Way, Edenbridge, Kent. 0732 71 41111.

Ranking amongst the most powerful and the most expensive of the amplifiers the Accuphase E 202 has many sensible features. To start with, the overall frequency response is flat where it needs to be and rolls off at a sensible point, in addition to which a steep low pass filter and high pass filter can be switched into circuit. Whilst the high pass filter operates at 30Hz which is a good choice, the low pass filter operating at 6kHz is aimed at too low a frequency for the optimum.

In addition to these filters, there is a subsonic filter associated with the disc input which provides 6dB attenuation at 10Hz, but this is really an unnecessary addition to the existing high pass filter. The rotary switch type treble and bass controls operate in 2dB steps at 10kHz and 100Hz and are limited to ±10dB which is all that is necessary. The balance between channels was to all intents and purposes unaffected by any controls other than the balance control which is of the full range type.

On the input end there are two auxiliary and two phono inputs, plus a tuner input. Whilst one phono input is of fixed sensitivity and impedance, the other has variable sensitivity and switched impedance selection. In addition to the basic inputs, provision is made for two tape recorders with switched tape monitoring or tape dubbing from one recorder to the other. Front panel stereo jack connectors duplicate the rear panel phono connectors for one tape unit — a useful feature.

A further rear panel feature is that the pre-amplifier and power amplifier can be switch separated, thus providing an interface for equalisers and such at a voltage level of 450mV for rated output. Three sets of loudspeakers can be connected to the amplifier, with front panel switch selection of any individual loudspeaker, or speaker A and one other, with an off position for headphone listening via the front panel stereo jack socket.

As with many amplifiers, a mode switch is provided. This allows normal stereo, reversed channels, mono, or either difference signal in the form of the wanted channel less the sum of left and right.

The final obvious feature of this amplifier is two illuminated meters which are scaled like VU meters and which work in conjunction with a range switch. Like the meters fitted to almost all other amplifiers this is a feature which is of little practical use, as the meters are far too slow to indicate transients and to give any guidance about overload conditions. This was verified by listening tests where transients clipped hard at between —10 and —15dB meter indication on the 0dB range.

An unusual control on the rear panel is a damping factor control which has three positions giving damping factors of 66, 6 or 1. The effect of this selection on the reproduction of a double bass was dramatic, with all but the high damping factor giving exceedingly boomy reproduction.

Listening tests were impressive with a good transient attack, but as expected from the measurements, the low pass filter had a dramatic effect.

Examination of the performance figures

shows that the amplifier behaves well into 4 or 8 ohm loads, but certainly takes exception to 2 ohms, it is therefore recommended that it should not be used with 4 ohm loudspeakers

Input and output voltages were sensible, and the associated impedances and clipping levels were satisfactory.

Overall, this is a good practical amplifier with plenty of power and a sensible performance, but at rather a high price.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 64*
D C offset at loudspeaker and headphones L/R 8/4mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —80/—67/—46dB
Loudness control effect ref 1kHz 100Hz/10kHz . +7/+0dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 0.5dB

Power performance

Power output into 8Ω both L/R 128W
Power output into 8Ω single L/R 142W
Power output into 4Ω both L/R 185/186W
Power output into 4Ω single L/R 215/216W
Burst output into 8Ω single L/R 144W
Burst output into 4Ω single L/R 231W
Power output into half rated load L/R 2Ω 19/16W
Power bandwidth ref 8Ω 50W L/R ..... 10Hz to 68/63kHz
Power bandwidth ref 70 W L/R ..... 10Hz to 61/54kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.05%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.07/0.06%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —71/75/62dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —>80/>80/71dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/>80dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/72dB

Noise performance

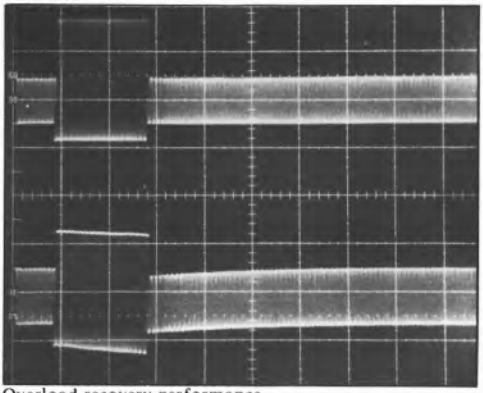
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 101/106.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 113/115dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.10/0.03μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.63/0.20μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 87.5dB

Inputs and outputs

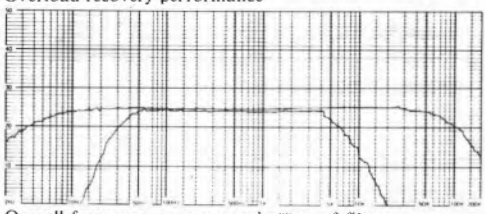
Input impedance on aux/tuner/tape 155/148K 210pF
Input impedance on phono 49k 15pF
Input impedance on mic ..... —pF
Input senstivity and clipping point at 1kHz
aux/tuner/tape 160mV 20V
Input senstivity and clipping point at 1kHz
phono 2.8mV 420mV*
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone ..... 28 V 810Ω
Output voltage and impedance for rated output —
tape 160mV 5000Ω
Output voltage and impedance for rated output —
DIN ..... —kΩ

Typical selling price including VAT £580.00

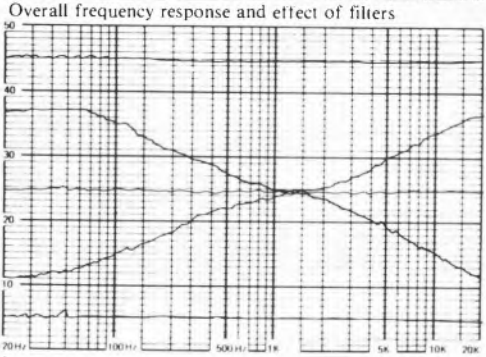
*See text



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

BEST BUY

Akai AM-2600

Rank Audio Products Ltd., PO Box 70, Great West Rd., Brentford, Middlesex. 01-568 9222.

This amplifier, which does not have an excess of knobs, has practical controls which function in a proper manner. In addition to two tape inputs which can be used for either tape monitoring or dubbing from one recorder to the other, the amplifier has switch selection of either of two phono inputs, a tuner input and an auxiliary input. In all cases, the sensitivities and impedances are sensible, and one phono input has rear panel switch selection of impedance from 32k to 47k to 86k ohms. However this switch was not well shielded and could be a source of hum pick-up. With the exception of the DIN tape connector all connections are through phono sockets.

On the output end, there is provision for headphones and two sets of loudspeakers, with switch selection of speakers 'off' or either or both sets on. Whilst the amplifier can drive quite a lot of power into 2 ohms, it is felt inadvisable to use two sets of 4 ohm loudspeakers in parallel.

Switchable high pass and low pass filters are provided, each with two turnover frequencies, and as is to be seen from the plot these filters have well chosen frequencies which do not produce excessive effects. The same applies to the tone controls which are smooth in operation and do not introduce significant unbalance between the channels.

It should however be noted that the phono inputs suffer from a frequency sensitive unbalance and a deviation from the ideal RIAA equalisation of about 1dB which is worse than any other input.

Subjective testing showed that this amplifier sounded clean and had good transient performance with the front panel level meters having fast response which can be useful. It is, however, hard to see the point of the meter sensitivity switch which allows full scale meter deflection of either 3W or the normal 80W. The worst case noise with volume control setting was subjectively irritating, particularly when listening with headphones, and as it occurred at about the 3 pm setting of the volume control (with another bad point lower down) it could not necessarily be avoided by use of the 'mute' switch which introduced either 15dB or 30dB extra attenuation.

The volume control itself was of the stepped type with adequately small steps and a large easy-to-handle knob concentric with the balance control, the latter being of the full range type whereby either channel could be completely faded out.

As with many cheaper amplifiers the stepped volume and tone controls are in fact potentiometers with detent mechanisms, but in the case of this amplifier the potentiometer law was such that the steps between detents are well graduated.

On the input noise front, this amplifier was unusually quiet on the high level inputs, but the poor noise performance of the volume control could lose this advantage and also spoil the good performance of the phono input which is about average.

Whilst the external appearance of the amplifier is neat and tidy, the internal standards leave something to be desired with

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rather untidy wiring and ordinary printed circuit boards. Unfortunately, these do not identify the components which would make servicing that much easier.

For those who like loudness controls, the one on this amplifier really bangs out the bass with an enormous boost of 8dB at 100Hz associated with a mere 4dB boost at 10kHz.

Input senstivity and clipping point at 1kHz
phono 2.8mV 175mV
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output — headphone 22V 220Ω
Output voltage and impedance for rated output — tape . . . . . 135mV VARLΩ
Output voltage and impedance for rated output — DIN 26mV 32kΩ

Typical selling price including VAT £199.00

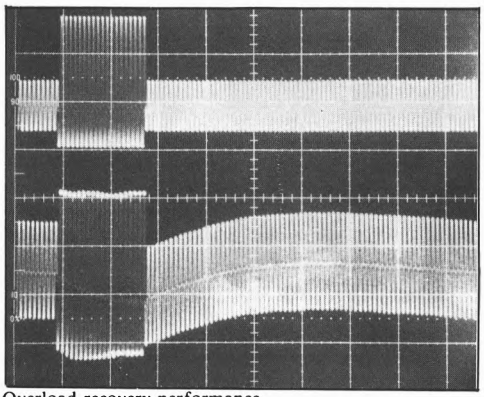
General Data
Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 75
D C offset at loudspeaker and headphones L/R 8/4mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —80/—73/—49dB
Loudness control effect ref 1kHz 100Hz/10kHz . +8/+4dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner . . . . . —dB

Power performance
Power output into 8Ω both L/R 74W
Power output into 8Ω single L/R 84/83W
Power output into 4Ω both L/R 94W
Power output into 4Ω single L/R 114W
Burst output into 8Ω single L/R 86W
Burst output into 4Ω single L/R 113W
Power output into half rated load L/R 2Ω 77/63W
Power bandwidth 8Ω 30W L/R . . . . . 10Hz to 46/43kHz
Power bandwidth 4Ω 32½W L/R . . . . . 10Hz to 39/36kHz

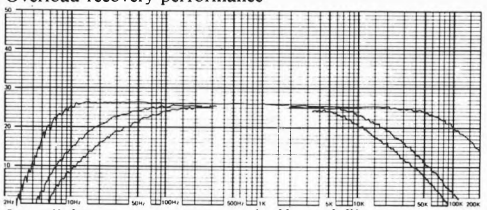
Distortion
Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.04%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —78/78/48dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —78/78/49dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —>80/>80/>80dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —>80/>80/>80dB

Noise performance
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 104/109dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 115/120dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.13/0.03μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.38/0.13μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 88dB

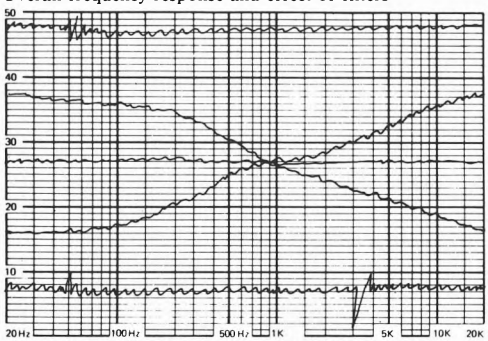
Inputs and outputs
Input impedance on aux/tuner/tape 62/55k 100pF
Input impedance on phono 43/100pF
Input impedance on mic . . . . . —pF
Input senstivity and clipping point at 1kHz
aux/tuner/tape 135mV 20V



Overload recovery performance



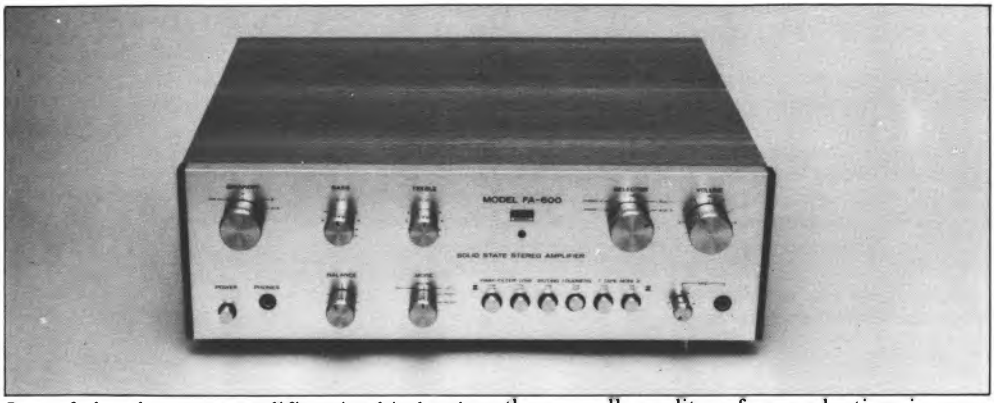
Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Alpha FA-600

Highgate Acoustics, 38 Jamestown Road, London NW1. 01-267 4936.



One of the cheapest amplifiers in this book, the Alpha FA-600 offers quite good facilities, but as will be seen, these are at the expense of the performance which leaves much to be desired.

With the exception of two sets of phono sockets for the pre-amplifier output and main amplifier input connections which are phono sockets, all audio connectors are of the DIN type including speaker connections for two pairs of loudspeakers. A four position switch on the alloy front panel selects either 'speakers off' or either or both pairs of loudspeakers, and the amplifier is quite happy to drive into 4 ohms, which means that two pairs of 8 ohm loudspeakers may be used.

In all positions of this selector switch the headphone jack connector is operative, but it was found that the residual amplifier noise had an adverse effect on headphone listening in spite of the use of the 'muting' facility which added to the range of the volume control by 10dB. A further source of trouble when listening with headphones or at low volume levels was that balance between channels was poor at low volume settings, and the same comment applies to the loudness control and to certain positions of the bass tone control.

Both tone controls operated in steps, and it was found that at some settings the steps were too large, with up to 4dB being recorded at 100Hz and 10kHz and appropriately more at extreme frequencies.

Even more unsatisfactory were the high pass and low pass filters, and these are such that the overall quality of reproduction is more akin to a telephone than hi-fi with both filters inserted — the reason for this being apparent from the frequency response plot which shows —3dB points at 200Hz and 3kHz with 6dB per octave attenuation in the case of both filters.

Noise from the high level inputs was decidedly in the poorer range, but the performance of the phono input was acceptable, as was the microphone input which has its own volume control for talking over other inputs.

The power bandwidth ranked amongst the worst measured in this book, with one channel only performing up to 2.2kHz, and the intermodulation distortion in all forms was decidedly poor. In addition, the overload recovery gave most unpleasant subjective effects. In fact, listening tests led to further complaints with a general feeling of poor presence and 'cramped' high frequency performance. In addition, the crosstalk between wanted and unwanted inputs was poor and the stereo image gave an impression of poor definition, probably due to the fairly wide frequency response differences between the two channels and general poor balance between channels.

Further comments arose from the fact that the manufacturer stated that the auxiliary mains power outputs were disconnected when they were only blanked-off, and the mains cable was exceptionally and inconveniently short.

Internal examination showed that both

soldering and wiring were not particularly tidy, and there was no component identification at all — hardly an aid to servicing.

In summary, this amplifier offers quite a lot of connections and knobs, but the performance is a severe disappointment in many ways.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0/16/0dB
Damping factor ref 8Ω at 1 kHz 55
D C offset at loudspeaker and headphones L/R 0mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —34dB
Loudness control effect ref 1kHz 100Hz/10kHz . +8/+3dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 2dB

Power performance

Power output into 8Ω both L/R 23/22W
Power output into 8Ω single L/R 29/28W
Power output into 4Ω both L/R . . . . . —W
Power output into 4Ω single L/R . . . . . —W
Burst output into 8Ω single L/R 35/32W
Burst output into 4Ω single L/R . . . . . —W
Power output into half rated load L/R 4Ω 38W
Power bandwidth 8Ω 16W L/R. . . . . 23Hz to 2.2/3kHz
Power bandwidth 4Ω —W L/R. . . . . —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.2/0.5%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz . . . . . —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —48/47/55dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —57/76/66dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —78/71/66dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —70/75/48dB

Noise performance

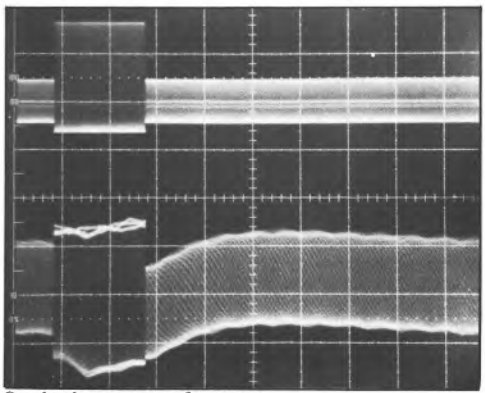
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 89/82dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 113/119dBV
Noise ref to input — average L/R CCIR/22kHz
Mic 110/117dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.20/0.16μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.20/0.16μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 74dB

Inputs and outputs

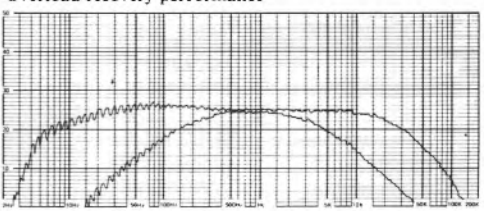
Input impedance on aux/tuner/tape 44/39k 170pF
Input impedance on phono 59k 500pF
Input impedance on mic 44k 300pF
Input senstivity and clipping point at 1kHz
aux/tuner/tape . . . . . 185mV>20V
Input senstivity and clipping point at 1kHz
phono 2.6mV 85mV
Input sensitivity and clipping point at 1kHz mic 3.1mV 20V
Output voltage and impedance for rated output —
headphone 16V 660Ω
Output voltage and impedance for rated output —
tape . . . . . —Ω
Output voltage and impedance for rated output —
DIN 32mV 79kΩ

Typical selling price including VAT £100.00

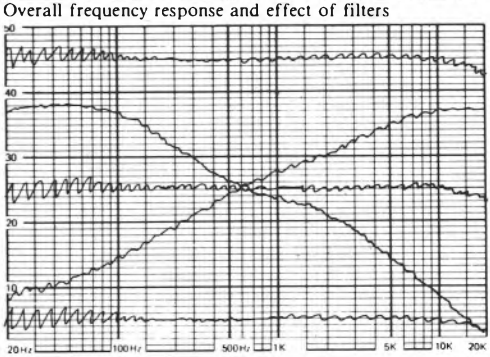
*See text



Overload recovery performance



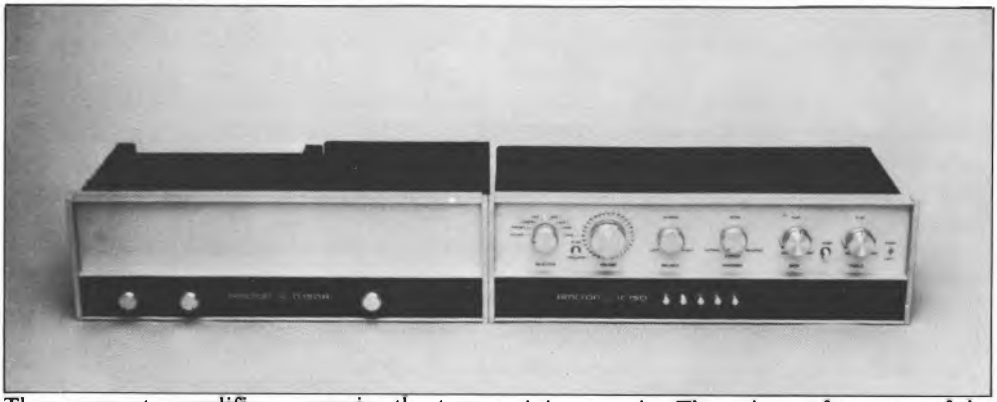
Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Amcron IC150A and D150A

Macinnes Laboratories Ltd., Macinnes House, Carlton Pk. Ind. Est. Saxmundham, Suffolk. 0728 2262.



These separate amplifiers comprise the type IC150A pre-amplifier and the DC150A power amplifier. The latter is a twin channel power amplifier rated at 80W into 8 ohms requiring a 1.2V input signal for the rated output. The only front panel controls are the on/off switch and a potentiometer gain control for each channel, the rear of the amplifier having a mono/stereo switch which provides for mono operation when the amplifier is rated at 160W into 16 ohms.

Leads are provided for connecting the single pole jack inputs of the power amplifier to the phono socket outputs of the IC150A pre-amplifier which has two sets of output sockets.

The pre-amplifier caters for two magnetic phono cartridge inputs, plus three auxiliary inputs and a tuner input in addition to which there are connections for two tape units. Any of these sources can be selected by a single rotary switch, in addition to which there are two tape monitoring push-buttons.

Crosstalk between the input sources was virtually non-existant, but that occurring when monitoring tape might be noticeable. All the high level inputs had a good sensitivity and overload margin, but the input impedance varied over a wide range and was rather on the low side at 26k ohms which only occurred at the maximum volume setting.

Two rear panel controls affect the sensitivity of the phono inputs which could be varied over the range 0.34mV to 3.8mV with an excellent overload margin which varied from 35mV at maximum gain to 380mV at minimum gain. The noise performance of the phono inputs was outstandingly good, and that of the high level inputs to a high standard. However, the output noise at the worst volume setting was on the high side.

No headphone monitoring is provided on the power amplifier, but the pre-amplifier has a 'monitor' jack socket which was suitable for driving high impedance headphones. The power output capability was fine for 8 ohm loudspeakers, but it will be noted from the adjacent table that the output capability of the two channels varied widely when working into 4 ohms. However, this is probably due to the internal protection circuits being correctly set to limit the output current into half the rated load.

The power bandwidth and the harmonic distortion performance were excellent as was the intermodulation distortion at audio frequencies, but this rose abruptly above the audio frequency band, as a result of the speed at which the power amplifier can operate being intentionally limited.

High pass and low pass filters are inserted by push-buttons, and whilst the characteristics of the high pass filter were sensible for domestic use, it was found that the low pass filter was subjectively far too severe in its action, and could do with being arranged at a higher frequency.

Treble and bass tone controls are in the form of coaxial potentiometers, each potentiometer having identically sized knobs. It was found that these were fiddly to use, and that the tracking was not very good such that

it was not easy to preserve the proper amplifier balance when using the tone controls.

The subjective effects of amplifier overload were unusually smooth, and in other respects there were no complaints about the performance. However, the amplifiers use the now barred flat pin plugs, and the mains lead was not labelled with the correct colour coding for fitting plugs.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz ..... >400
D C offset at loudspeaker and headphones L/R
..... 4/11 & 0mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz..... —>80/—74/—57dB
Loudness control effect ref 1kHz 100Hz/10kHz . +2/+0dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner..... 0.5dB

Power performance

Power output into 8Ω both L/R 102W
Power output into 8Ω single L/R 105/110W
Power output into 4Ω both L/R..... —W
Power output into 4Ω single L/R ..... —W
Burst output into 8Ω single L/R 107/110W
Burst output into 4Ω single L/R..... —W
Power output into half rated load L/R 2Ω 80/180W
Power bandwidth 8Ω 40W L/R ..... <10Hz to 40/38kHz
Power bandwidth 4Ω W L/R ..... —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.02/0.03%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz ..... —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz..... —>80/>80/30dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz..... —>80/>80/30dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/72dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/60dB

Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape..... 106.5/109.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 116/119.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz..... 0.13/0.10μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz..... 0.31/0. 16μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR..... 89dB

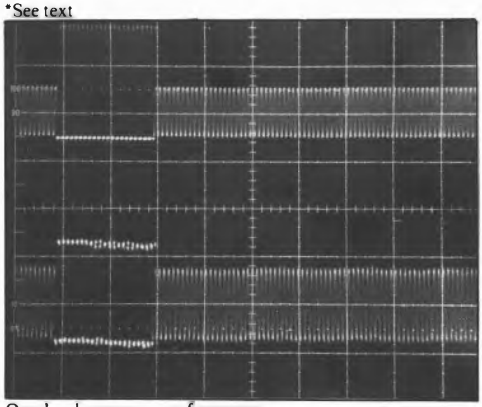
Inputs and outputs

Input impedance on aux/tuner/tape
..... 104/26K 72;70;78pF
Input impedance on phono 51k 250pF
Input impedance on mic .....

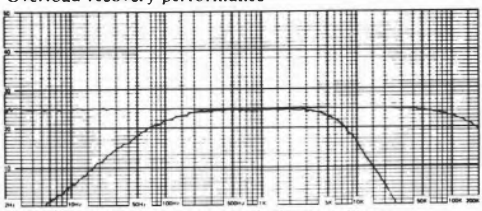
Input sensitivity and clipping point at 1kHz
aux/tuner/tape..... 115mV 20V
Input sensitivity and clipping point at 1kHz
phono..... 0.34mV 35mV*
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone 1.2V 2700Ω
Output voltage and impedance for rated output —
tape..... 115mV VAR1Ω
Output voltage and impedance for rated output —
DIN ..... —kΩ

Typical selling price including VAT £920.00

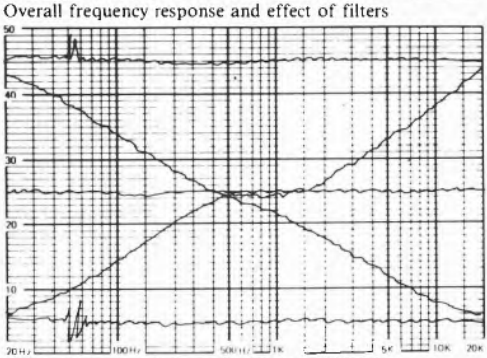
*See text



Overload recovery performance



Overall frequency response and effect of filters

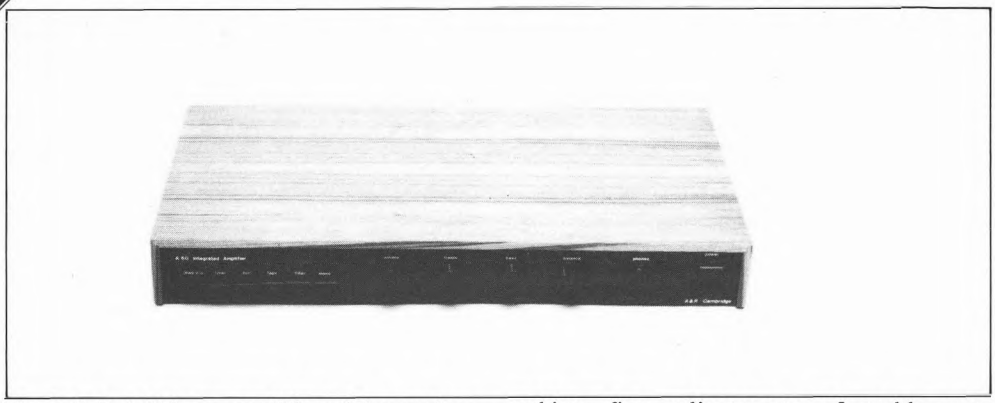


Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

A&R A60

A & R (Cambridge), French's Mill, French's Road, Cambridge. 0223 54507.



The A & R A60 is an amplifier of the modern 'slim line' design with a black front panel and a teak cabinet. All input and output connections are in the form of DIN connectors, there being a single pick-up input, and tuner input and an auxiliary input, all of which are selected by interlocking pushbuttons on the front panel. In addition, there is a tape input/output which is available as a tape monitor by means of another front panel switch. Whilst this utilises a DIN connector, the amplifier's output voltage and impedance do not comply with the DIN Standard 45 511 and the amplfier is therefore not DIN compatible.

The loudspeaker outputs which are properly rated for 8 ohm loudspeakers and above are in the form of two position DIN connectors. In one position the front panel headphone jack mutes the loudspeakers when a plug is inserted, and in the other position the loudspeakers remain connected.

Two further front panel pushbuttons provide for monophonic operation and for a low pass filter which was subjectively very good in operation with its turnover frequency at 8kHz and 12dB per octave attenuation. Whilst no high pass filter is fitted, the amplifier rolls off in the bass below 20Hz, and even better, the disc input rolls off rapidly below 50Hz to reduce rumble and other unwanted low frequency effects.

Both the treble and the bass controls have a very wide range, more than is necessary, and it was found that the treble control was very coarse in action about its centre setting, making fine adjustments of treble very difficult.

Another grouse hinged on the volume control. Whilst the balance between channels was very good at high volume settings, severe stereo image shifts occurred at low volume settings as a result of more than 6dB unbalance between channels at —50dB setting on the volume control.

The power output capability was excellent for use with 8 ohm loudspeakers, but the capability into half the rated load of 4 ohms was limited by fuses within the amplifier when testing. However, this is extremely unlikely to have any effect with normal programme material.

Noise under all conditions was about average and all forms of distortion were low, including the overload recovery characteristics which sounded clean without any blocking of the amplifier.

Listening tests gave the impression of a bright and clean high frequency performance, but possibly a tendency to give a slightly 'soggy' bass. However, the overall performance was very good with the exception of the volume and treble tone control defects already mentioned.

The balance control was of a good law around the centre position, giving full muting of either loudspeaker at the extreme positions, and the headphone output gave a sensible level for the popular types of headphones. No transients of significance were produced by any controls or by the initial on or off switching.

RECOMMENDED

Finally, it must be said that the standard of construction was beyond reproach, with a very tidy printed circuit board having full and clear component identifications to aid servicing.

Overall, this is potentially a very good amplifier, but the manufacturer must pay attention to the volume and tone controls, and also make it quite clear that the tape connector is not DIN compatible.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0/8/0dB
Damping factor ref 8Ω at 1 kHz 49
D C offset at loudspeaker and headphones L/R . . . 24/37 & 9/15mV
Crosstalk at 1W output 100Hz/1kHz/10kHz . . . . . —43/—42/—39dB
Loudness control effect ref 1kHz 100Hz/10kHz . . . . . —dB
Frequency response deviation from 20Hz to 20kHz aux/tape/tuner 1.0dB

Power performance

Power output into 8Ω both L/R 34/35W
Power output into 8Ω single L/R 41/42W
Power output into 4Ω both L/R . . . . . —W
Power output into 4Ω single L/R . . . . . —W
Burst output into 8Ω single L/R 45/44W
Burst output into 4Ω single L/R . . . . . —W
Power output into half rated load L/R 4Ω 47/46W
Power bandwidth 8Ω 15W L/R . . . . . 11Hz to 36/53kHz
Power bandwidth —W L/R . . . . . —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.02/0.04%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz . . . . . —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —>80/80/54dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —75/72/61dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —>80/>80/>80dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —>80/>80/68dB

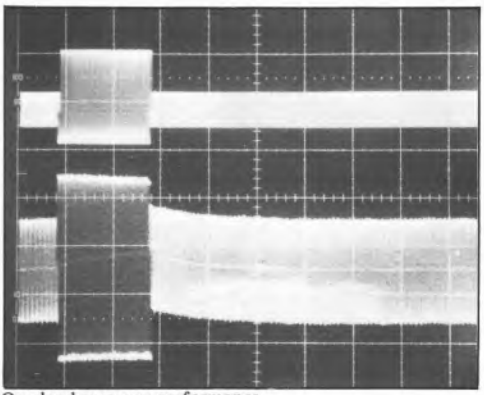
Noise performance

Noise ref to input — average L/R CCIR/22kHz aux/tuner/tape 111/108.5dBV
Noise ref to input — average L/R CCIR/22kHz Phono 112/118dBV
Noise ref to input — average L/R CCIR/22kHz Mic . . . . . —dBV
Output noise power at zero volume (8Ω) CCIR/22kHz 0.016/0.02μW
Worst case volume setting auxiliary input (8Ω) CCIR/22kHz 0.20/6.13μW
Burst dynamic range aux input ref 8Ω worst channel CCIR 94.5dB

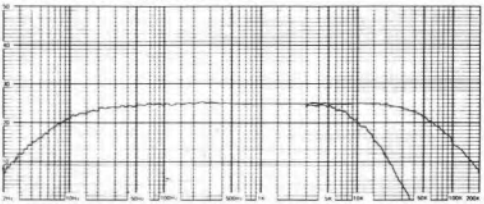
Inputs and outputs

Input impedance on aux/tuner/tape . . . . . 100/82 tape—47/43k 100k 80pF
Input impedance on phono 50k 25pF
Input impedance on mic . . . . . —pF
Input senstivity and clipping point at 1kHz aux/tuner/tape 130mV 20V
Input senstivity and clipping point at 1kHz phono 3.5mV 200mV
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output — headphone 8.8V 130Ω
Output voltage and impedance for rated output — tape 120mV 5300Ω
Output voltage and impedance for rated output — DIN . . . . . —kΩ

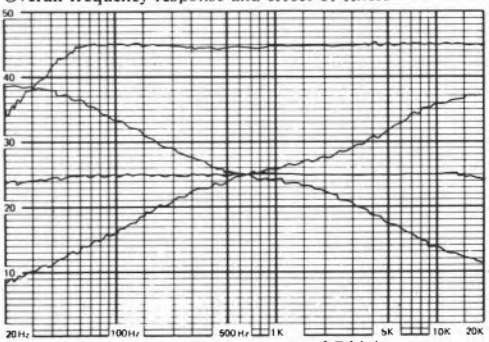
Typical selling price including VAT £125.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Armstrong 621

Armstrong Audio Ltd., Warlters Roads, London N7. 01-607 3213.

This amplifier was of a particularly neat design, being compact and having a reasonable number of practical facilities all of which were far better designed than those on other amplifiers costing far more.

To start with the filters, there is a 12dB per octave high pass filter with a —3dB point around 30Hz — just what is wanted to get rid of the rumble and other low frequency defects in the cheaper range of turntables with which this amplifier is likely to be used. On the high frequency end, there are two low pass filters which can be switched to either 6dB per octave or 12dB per octave slope, and which can have their turnover frequency switched to either about 4kHz or 8kHz.

These filters and other functions are operated by interlocked piano key type switches which are positive in action and clearly identified, the other functions including a mono/stereo switch, tape monitoring, loudness, power on/off and switching either of the two loudspeaker sets on or off.

Unlike most loudness controls, the one on this amplifier introduces 20dB attenuation at 1kHz whilst boosting the bass and treble, rather than relying upon the setting of the volume control — thus, the range of the volume control is increased and it must be mentioned that neither the loudness control nor any other controls introduced significant changes in balance between the amplifier channels.

The balance control itself is of the full range type with a smooth performance, and whilst the tone controls are fairly dramatic at the extreme settings no difficulty was experienced in their practical use.

All signal connectors are of the DIN type, with two pairs of DIN loudspeaker connectors and separate five-pin DIN connectors for tuner, auxiliary, disc and tape; the output signals from the latter not being DIN compatible, but suitable for most other types of tape transport, particularly in view of the fact that the tape output level can be varied by means of two potentiometers underneath the amplifier.

There is also a disc input sensitivity control which gives a sensitivity of either 2.9mV or 5.8mV, and this is decidedly necessary in view of the rather small overload margin on the disc inputs.

Whilst it may be noted from the tables that the overall frequency response appears not to be particularly flat, this is due to the intentional low frequency roll off which is a good thing, and the frequency response in the normal audible range is in fact very good.

So far as noise is concerned, this amplifier is quite good, particularly the noise at the output at lower volume settings. However, trouble was experienced from hum pick-up from external devices and it is felt that the manufacturer should fit hum screening in the top and bottom of the cabinet to overcome this defect.

Whilst the even order intermodulation distortion was not particularly good, this is the lesser of the evils and the subjective performance was generally good with no

troubles in handling overloads. However, the high frequencies sometimes sounded a little muddled, probably as a result of the rather poor power bandwidth.

Some thumps were present on switching the power, but it is not thought that these present a practical problem, as neither did the effect of the volume control being noisy after switching the source selector.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0/13/0dB
Damping factor ref 8Ω at 1 kHz 51
D C offset at loudspeaker and headphones L/R 0mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —52/—73/—37dB
Loudness control effect ref 1kHz 100Hz/10kHz
. . . . . +10/+4.4dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 2dB

Power performance

Power output into 8Ω both L/R 53W
Power output into 8Ω single L/R 62W
Power output into 4Ω both L/R . . . . . —W
Power output into 4Ω single L/R . . . . . —W
Burst output into 8Ω single L/R 68W
Burst output into 4Ω single L/R . . . . . —W
Power output into half rated load L/R 2Ω 90/87W
Power bandwidth 8Ω 20W L/R . . . 30/38Hz to 3.4/3.8kHz
Power bandwidth 4Ω —W L/R . . . . . —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03/0.10%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz . . . . . —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —68/68/50dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —80/72/60dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —>80/>80/66dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —>80/78/66dB

Noise performance

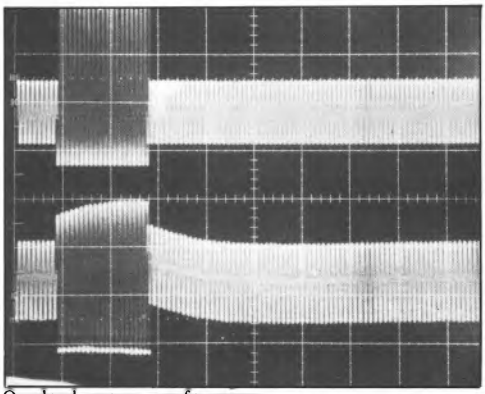
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 93/91dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 112.5/114dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.015/0.02μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.015/0.02μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 77.5dB

Inputs and outputs

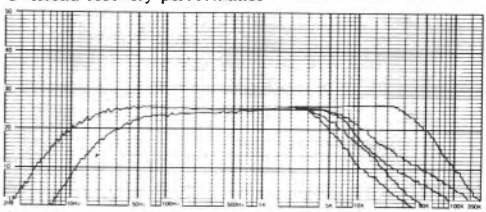
Input impedance on aux/tuner/tape 43/43k 55pF
Input impedance on phono 47k 280pF
Input impedance on mic . . . . . —pF
Input senstivity and clipping point at 1kHz
aux/tuner/tape 120mV 3.8V
Input sensitivity and clipping point at 1kHz
phono 2.9mV 90mV*
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output —
headphone 9V 135Ω
Output voltage and impedance for rated output —
tape 330mV 195Ω
Output voltage and impedance for rated output —
DIN . . . . . —kΩ

Typical selling price including VAT £130.00

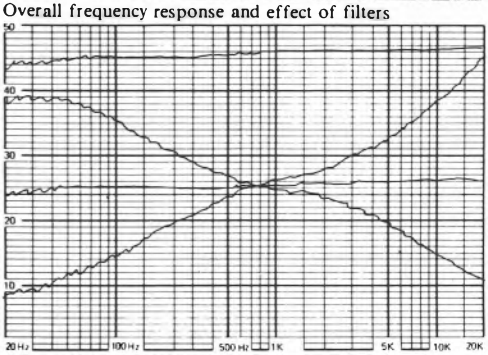
*See text



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Audiotronics LA-4040

Laskys Ltd., Audiotronic House, The Hyde, Hendon, London NW9. 01-200 0444.

This amplifier, whilst lying at the lower end of the cheaper price range, offers all the necessary basic facilities including switch selection of two auxiliary inputs, two phono inputs and a tuner. In addition, there are connections for two tape decks together with a dubbing facility for dubbing from tape 1 to tape 2 only.

With the exception of a DIN compatible connections for tape 1 in addition to the phono connections, the inputs and outputs are phono connectors having sensible levels and impedances. A front panel jack socket is provided for headphones and screw terminals on the rear for loudspeakers connections to two pairs of loudspeakers which are fed via a front panel switch which allows selection of either or both loudspeaker pairs in addition to an 'off' position for headphone listening.

A further front panel jack is provided as a microphone input and has its own volume control so that talkover is possible. However, the microphone input is not switched, and if you forget to turn down the microphone volume you would have noise added to the amplifier's output.

Another slight peculiarity is that the microphone is a mono connection, but it is not affected by the balance control so you can't centre the microphone input. The balance control itself is of the full range type and was found to be rather coarse in action around the centre position, so you have to be careful to achieve the proper stereo image position.

The treble and bass tone controls were generally satisfactory and adjustment was no problem with a good law and no significant unbalance between channels over the full range, but it was disappointing to note a 1.5dB unbalance in the pick-up inputs, one of which has switch selection of two impedances.

In addition to the tone controls, there is the usual loudness control which introduces an enormous bass boost and some treble boost, but of more interest are the low and high filters. The high pass filter had a well chosen turnover frequency of 100Hz with an attenuation of 12dB per octave which is close to the ideal for this class of amplifier, whilst the low pass filter had its —3dB point around 6kHz again with 12dB per octave attenuation — perhaps the frequency is a little low, but it makes good sense.

Other than the on/off switch the only remaining front panel control is a 'muting' switch which introduced an extra 20dB attenuation which is handy for headphone listening. Additional features at the rear of the amplifier include phono sockets to gain access to the pre-amplifier output and main amplifier input which can be separated by a slide switch, and a mono output socket.

The external appearance and finsh of the amplifier were good, but internally the construction is pretty basic with rather untidy wiring and mediocre soldering. There was also some rather untidy taped insulation at the mains switch and the mains fuseholder.

Whilst noise in all forms and distortion was not of the highest standards, the subjective testing did not reveal any important shortcomings other than at high power levels

when the lack of power bandwidth became apparent. General checking for noisy controls or serious switch clicks only showed that a relatively small switch-on thump sometimes occurred and that the source selector switch produced mild click at maximum volume — nothing serious here.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0/18/0dB
Damping factor ref 8Ω at 1 kHz 32
D C offset at loudspeaker and headphones L/R . . 30/32mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —38/—68/—37dB
Loudness control effect ref 1kHz 100Hz/10kHz +10/+2dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 2dB

Power performance

Power output into 8Ω both L/R 41W
Power output into 8Ω single L/R 48/49W
Power output into 4Ω both L/R . . . . . —W
Power output into 4Ω single L/R . . . . . —W
Burst output into 8Ω single L/R 58W
Burst output into 4Ω single L/R . . . . . —W
Power output into half rated load L/R 4Ω 62/63W
Power bandwidth 8Ω 18W L/R . . . . . <10Hz to 12/13kHz
Power bandwidth 4Ω —W L/R . . . . . —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.11%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz . . . . . —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —72/75/57dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —76/76/56dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —75/74/70dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —75/80/>80dB

Noise performance

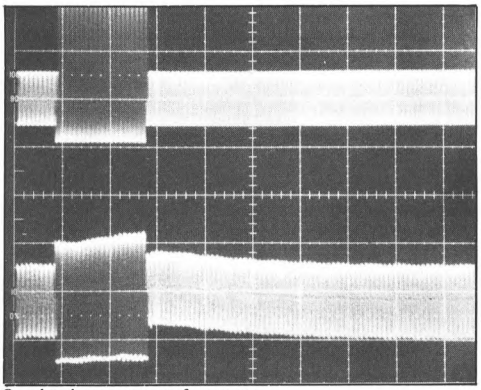
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 94.5/95.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 113dBV
Noise ref to input — average L/R CCIR/22kHz
Mic 114/121dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.40/0.20μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.63/0.25μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 80dB

Inputs and outputs

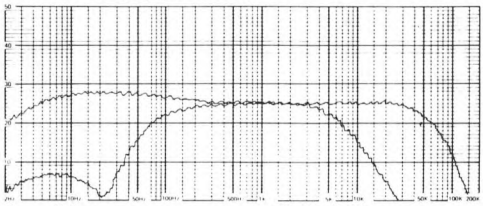
Input impedance on aux/tuner/tape
. . . . . 56/60 tape 65/56k 300/100pF
Input impedance on phono 50k 300pF
Input impedance on mic 20k 100pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 150mV 20V
Input sensitivity and clipping point at 1kHz
phono 2.25mV 140mV
Input sensitivity and clipping point at 1kHz mic 1.9mV 25mV
Output voltage and impedance for rated output —
headphone 17V 460Ω
Output voltage and impedance for rated output —
tape . . . . . 150mV VARIΩ
Output voltage and impedance for rated output —
DIN 29mV 79kΩ

Typical selling price including VAT £110.00

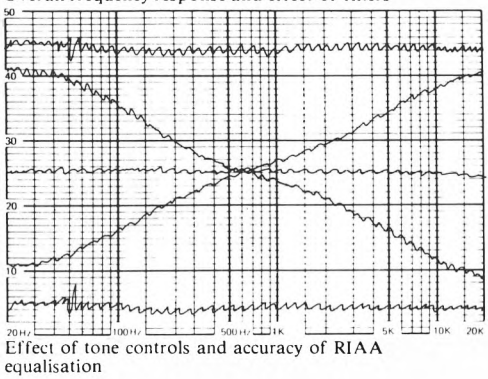
*See text



Overload recovery performance



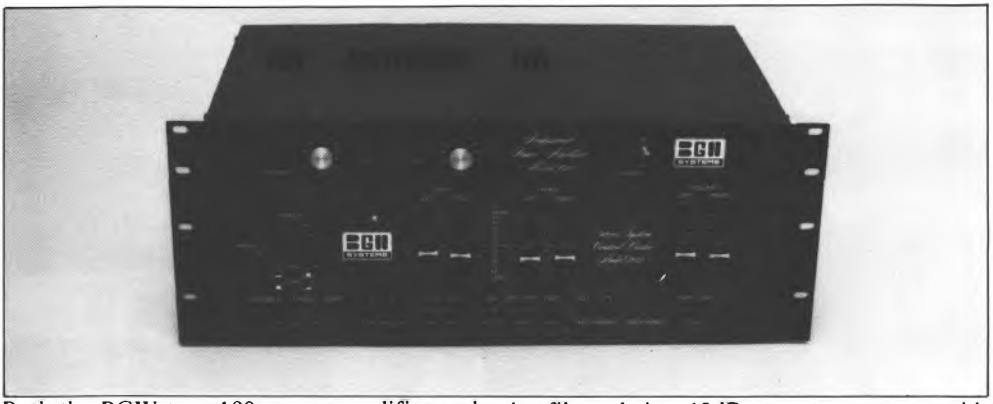
Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

BGW 100 and 202

Webland Int. Ltd., Mirabel House, 117/121 Wandsworth Bridge Road, London SW6. 01-736 0987.



Both the BGW type 100 power amplifier and type 202 pre-amplifier are self contained units which of course may be used with other power/pre-amplifiers. The type 100 power amplifier has separate volume controls for each channel, requiring a minimum of 0.775V for its 30W rated output into 8 ohms. The only other control is the on/off switch which could well do with some suppression.

To the rear there are two input jack sockets and loudspeaker terminals and a link for separating signal and chassis ground, plus the mains fuse which had an incorrect value fitted. Other aspects of electrical safety of the two units were also unhappy; there was no mains lead identification label, mains tappings could be altered without tools, US flat pin connectors are used and the mains tap switches have inadequate clearance between mains and the chassis.

Turning to the pre-amplifier, this accepts inputs from two pick-ups, two auxiliaries, a tuner and two tape units. Also, there are connections for an external equaliser, all by phono sockets. and a power connector for a moving coil pick-up pre- amplifier.

The required programme source is selected by interlocking pushbuttons for phono, auxiliary and tuner, plus two tape monitor pushbuttons and tape copy pushbuttons for copying to or from either tape unit. A 2 x 2 pushbutton matrix allows either or both input channels to be connected to either or both loudspeakers.

A high pass and a low pass filter can be switched into circuit by further pushbuttons, the filters being 18dB per octave types with —3dB at 20Hz and about 11kHz, a good combination, but the high pass filter introduced a 3dB bass boost at 30Hz which is not a desirable characteristic.

An unusual feature of this pre-amplifier is a 'high gain' pushbutton which increases the overall amplification by 11dB for all inputs, and in view of the relatively low sensitivity of the high level inputs this could be necessary.

The treble and bass tone controls are of the conventional characteristics, but both have a completely unnecessarily large range at extreme frequencies, also, being click stop slider types the resulting boost or cut per step is excessive at 3dB or more at 100Hz and 10kHz. Like the slider type volume controls, the tone controls are not ganged, but separate controls are fitted for each channel, and it was found that the operation of the controls was clumsy and their mechanical action poor.

The remaining pre-amplifier facilities include a tone control defeat button, and jacks for tape dubbing and for headphones.

The overall standards of construction was very good, with high quality components and tidy wiring, but components on the printed boards were not identified for servicing.

Listening tests showed that this amplifier offers good performance with the exception of the noise performance of the high level inputs which is rather poor, with the result that the available dynamic range falls short of very many amplifiers. It was also noted that there was an increase in hum level at half volume setting, but that the noise output at low

volume settings was completely satisfactory.

Whilst crosstalk between wanted and unwanted inputs was good, this was not the case with the tape monitor switches which had fairly serious breakthrough. It was also noted that the phono selector switches produced a quite large click if they were operated with the volume control at maximum; so much so that the overload lights on the power amplifier came on, and it must be mentioned that these are fast sensible devices which actually work.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz . . . . . >400
D C offset at loudspeaker and headphones L/R
. . . . . 4/3.5 and 211mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —74/—54/—35dB
Loudness control effect ref 1kHz 100Hz/10kHz . . . . . —dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 0.5dB

Power performance

Power output into 8Ω both L/R 32/36W
Power output into 8Ω single L/R 42W
Power output into 4Ω both L/R 45W
Power output into 4Ω single L/R 57W
Burst output into 8Ω single L/R 43W
Burst output into 4Ω single L/R 72W
Power output into half rated load L/R 2Ω 63/61W
Power bandwidth 8Ω 15W L/R . . . . . 10Hz to 60/64kHz
Power bandwidth 4Ω 20 W L/R . . . . 10Hz to 33.5 /36.5kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03/0.04%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.03/0.015%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —74/>80/47dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —>80/>80/71dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —>80/>80/>57dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —>80/>80/58dB

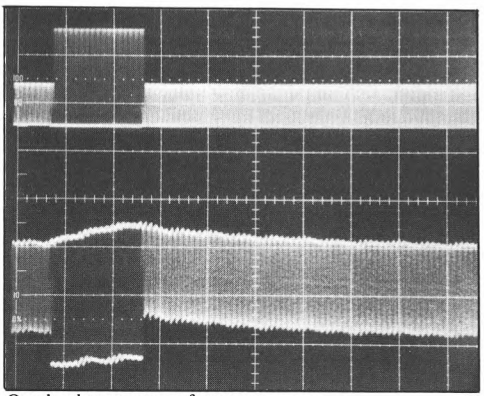
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 89/91dBV
Noise ref to input — average L/R CCIR/22kHz
Phono . . . . . 115 /116.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.10/0.025μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.10/0.025μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 78.5dB

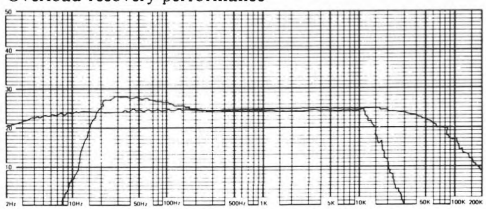
Inputs and outputs

Input impedance on aux/tuner/tape 90/90k 120pF
Input impedance on phono 45k 200pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 255mV 9.2V*
Input sensitivity and clipping point at 1kHz
phono 2.3mV 86mV*
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output —
headphone 15V 278Ω
Output voltage and impedance for rated output —
tape . . . . . 255mV VARIΩ*
Output voltage and impedance for rated output —
DIN . . . . . —kΩ

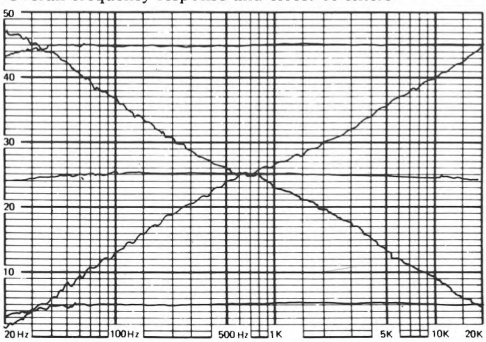
Typical selling price including VAT £790.00



Overload recovery performance



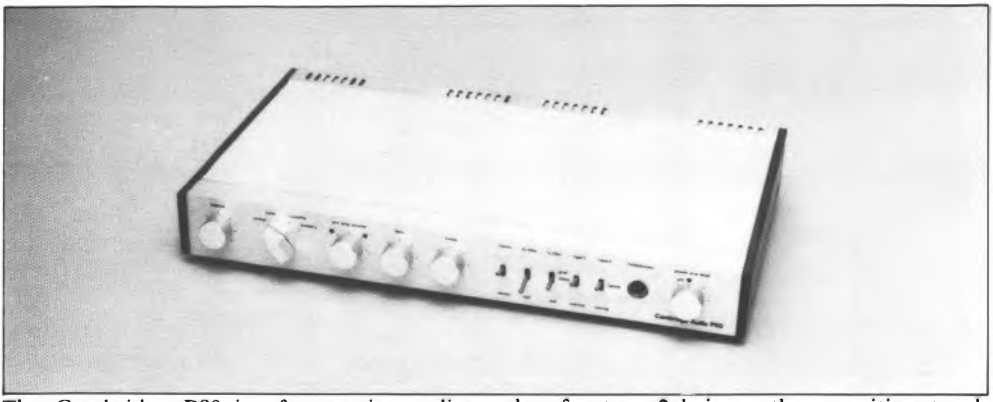
Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Cambridge Audio P80

C. E. Hammond & Co. Ltd., 111 Chertsey Road, Byfleet, Surrey. Byfleet 41131.



The Cambridge P80 is of attractive styling with a brushed alloy front panel and matching controls accompanied by wooden ends and a grey cover. The rear of the unit is occupied by the output transistors and their heatsinks, with the unidentified DIN loudspeaker connectors mounted on the heatsinks.

All input connectors which are the DIN type (but the tape input/output is not DIN compatible) are arranged in a recess underneath the amplifier, and whilst this means that the leads can be hidden, it is awkward to get at.

Within the amplifier, the layout was unusually tidy with proper component identifications for servicing, however the value of the internal fuses was not shown.

The front panel source selector switch offers selection of the pick-up, tuner, auxiliary or 'cassette' inputs; the latter being a tape replay only connection. Further DIN sockets provide connections for two record/replay tape units with monitoring facilities but without dubbing facilities. Also, the arrangement is unusual because the tape 1 connection is before the amplifier's tone controls so that the tone controls affect replay only, and the tape 2 connection is after the tone controls such that the signal being recorded has been affected by the tone controls. This arrangement clearly has advantages and disadvantages, but it's fine so long as you are aware of what you are doing.

Tied up with this, are the two toggle switches for tape monitoring, the switch for tape 1 being a normal two position toggle and that for tape 2 being a three position toggle with the centre position disenabling the tone controls.

The conventional treble and bass control had good handling characteristics with a more than adequate range and the switched low pass filter with its 'gradual' or 'steep' positions was very good. However, the high pass filter was not so clever because it affects a wide frequency range and has only 6dB per octave rate of attenuation.

The remaining features are a mono/stereo toggle switch, the front panel headphone jack and two separate volume controls. This arrangement is most unusual as there is a pre-amplifier volume control and a power amplifier volume control, the former being adjusted with the aid of two lights. A red light is illuminated under pre-amplifier overload conditions, and a green light when the signal is 20dB below overload, the idea being that you adjust the pre-amplifier volume for the green light flashing and no red light.

Any advantage to be gained by this system is well outweighed by the nuisance value, and the subjective effect of distortion produced by pre-amplifier overload was most objectionable.

Whilst the noise performance of the auxiliary input was quite good, that of the tuner and tape inputs was degraded, presumably as a result of the use of resistive attenuation. the phono input performance was however, quite good.

It was also found that the channel balance varied between inputs, with the auxiliary and

tape inputs being good but the tuner degraded and the cassette input worst with a 2dB unbalance.

Subjectively, high frequency transients appeared rather lacking in brilliance, a confirmation of the rather limited power bandwidth, and the overall sound quality was a little unclean.

Finally, using headphones, severe distortion was apparent at very low volume settings.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 84
D C offset at loudspeaker and headphones L/R
..... 11/23 & 0mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —56/—48/—33dB
Loudness control effect ref 1kHz 100Hz/10kHz—0dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 2dB

Power performance

Power output into 8Ω both L/R 57W
Power output into 8Ω single L/R 70W
Power output into 4Ω both L/R ..... —W
Power output into 4Ω single L/R ..... —W
Burst output into 8Ω single L/R 72/74W
Burst output into 4Ω single L/R ..... —W
Power output into half rated load L/R 4Ω 104/103W
Power bandwidth 8Ω 20W L/R ..... <10Hz to 5.9/3.8kHz
Power bandwidth 4Ω —W L/R ..... —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.1/0.13%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz ..... —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —58/58/46dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —62/60/50dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/70/67dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/73/47dB

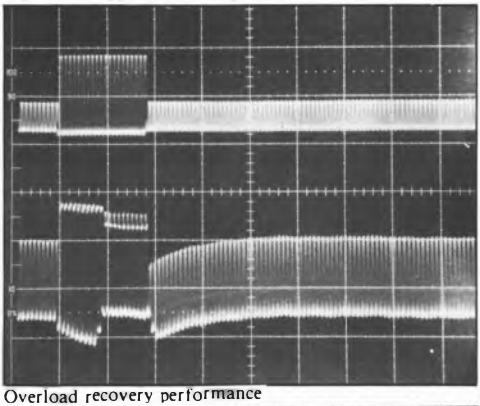
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape ..... 95/89.5, 88/84, 78.5/73 dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 113dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.005μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.005μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 73.5dB

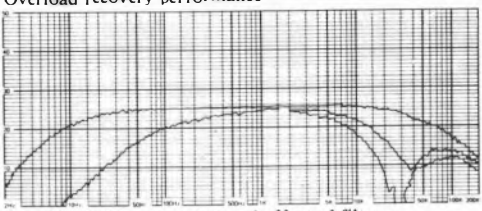
Inputs and outputs

Input impedance on aux/tuner/tape
..... 47k 10pF, 100k 12pF/47/21k 50pF
Input impedance on phono 50k 145pF
Input impedance on mic ..... —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape ..... 70/150/450mV >20V
Input sensitivity and clipping point at 1kHz
Phono 1.8mV 550mV
Input sensitivity and clipping point at 1kHz mic ..... —mV
Output voltage and impedance for rated output —
headphone 6.6V 44Ω
Output voltage and impedance for rated output —
tape 450mV 4700Ω
Output voltage and impedance for rated output —
DIN ..... —kΩ

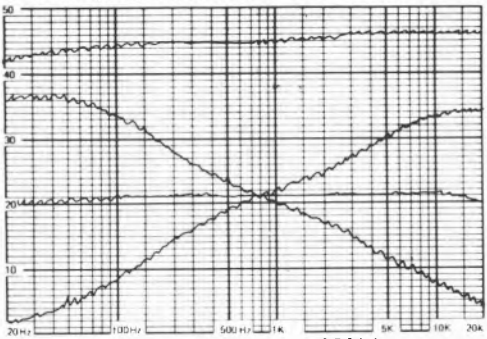
Typical selling price including VAT £185.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Eagle A6400

Eagle Int, Ltd., Precision Centre, Heather Park Drive, Wembley, Middlesex. 01-902 8832.

Perhaps not surprisingly in view of its low cost and quite reasonable facilities, this amplifier is not constructed to the highest standards, with rather untidy cabling within and no component identifications on the printed boards — something which doesn't help servicing.

The amplifier accepts inputs from two tape machines and has a tape dubbing switch in addition to tape monitoring. There is also switch selection of tuner, auxiliary or phono inputs plus a mono microphone jack input with its own level control which serves as a microphone mixing control. This means that you can talk over the other inputs.

On the output end, there is switch selection for two pairs of loudspeakers which may be used individually or together, or may be switched off for headphone listening, via the front panel jack socket.

The treble and bass tone controls performed satisfactorily and like the volume control did not upset the balance between channels, but the range of the tone controls was excessive and the use of detent mechanisms on the potentiometer controls led to large changes in cut or boost unless the controls were set to positions between the detents.

Whilst a high pass rumble filter is switchable in or out by a front panel switch, the low frequency attenuation offered by this filter makes it little short of useless. The remaining controls comprise a mono/stereo switch and a loudness control switch which boosts both treble and bass at low levels with the usual amount of effect. Finally, there is of course the balance control which is concentric with the large volume control knob.

At the rear of the amplifier all the inputs are clearly identified, including the pins of the single DIN tape connector which complies with the DIN standard. Loudspeaker outputs are sensible clip-type connectors and in addition to the phono socket tape outputs there is a pre-amplifier to main amplifier link which can be removed to insert other devices at this point.

Listening tests immediately showed that the amplifier was exceedingly noisy at certain volume control settings and none too good when the volume control was at zero, furthermore the input noise from the high level inputs was high and the phono input none too good either.

Whilst the bass performance on music was satisfactory, the poor power bandwidth shown by the measurements was apparent by the dullness of timpani and the performance was not particularly clean overall.

Examination of the power output into various loads shows that the use of 4 ohm loudspeakers is not to be recommended, and similarly trouble should be expected if two pairs of 8 ohm loudspeakers are used simultaneously.

All forms of distortion are on the high side, and examination of the crossover distortion at 1W output showed a spikey waveform which is indicative of a poor subjective performance.

Under all conditions, this ranks amongst the poorest amplifiers from the point of view of noise, and consequently offers a poor

potential dynamic range. In short, whilst the facilities available for the price are good, the performance is far too poor to recommend this amplifier.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0/13/4dB
Damping factor ref 8Ω at 1 kHz 60
D C offset at loudspeaker and headphones L/R
. . . . . 85/149 & 4/7mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —70/—53/—40dB
Loudness control effect ref 1kHz 100Hz/10kHz . +8/+4dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 1dB

Power performance

Power output into 8Ω both L/R 49/47W
Power output into 8Ω single L/R 58W
Power output into 4Ω both L/R 50/41W
Power output into 4Ω single L/R 46/42W
Burst output into 8Ω single L/R 49W
Burst output into 4Ω single L/R 48/42W
Power output into half rated load L/R 2Ω 10/8W
Power bandwidth 8Ω 17½W L/R . . . . . 20Hz to 11/8kHz
Power bandwidth 4Ω 20 W L/R . . . . . 48Hz to 2kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0. 2%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0. 3%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —68/80/33dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —>80/80/43dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —78/78/73dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —73/78/53dB

Noise performance

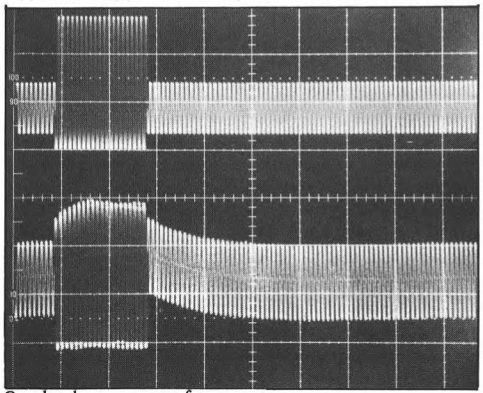
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 88.5/85.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 110.5/113dBV
Noise ref to input — average L/R CCIR/22kHz
Mic 105/112dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 2.5/1μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 79/16μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 73dB

Inputs and outputs

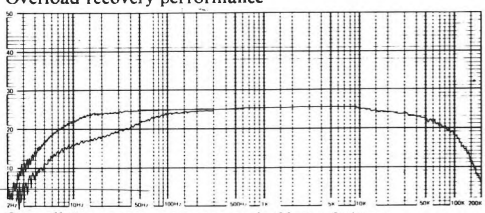
Input impedance on aux/tuner/tape
. . . . . 70/31k 750/740/340pF
Input impedance on phono 48k 90pF
Input impedance on mic 33k 10pF

Input sensitivity and clipping point at 1kHz
aux/tuner/tape . . . . . 140mV >20V
Input sensitivity and clipping point at 1kHz
phono 2.3mV 150mV
Input sensitivity and clipping point at 1kHz mic
. . . . . 3.6 mV >20mV
Output voltage and impedance for rated output —
headphone 0.75V 14Ω
Output voltage and impedance for rated output —
tape . . . . . 140mV VARIΩ
Output voltage and impedance for rated output —
DIN 100mV 59kΩ

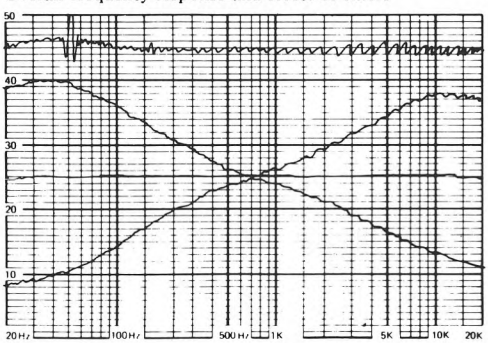
Typical selling price including VAT £110.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Harman Kardon A-401

Tannoy Products Ltd., St. John's Road, Tylers Green, High Wycombe, Bucks. 049-481 5221.

One of the cheapest amplifiers reviewed in this book, the Harman Kardon A-401 naturally does not have very many facilities, but it does all that is required for a simple audio system.

The rated power output of 20W per channel is quite adequate for many applications, and the amplifier is quite happy to drive this into 8 ohms and even more into 4 ohms with a good associated dynamic range and very sensible distortion performance at both high and low powers. In addition, the recovery from overload into clipping was exceptionally clean both subjectively and from the point of view of overload burst testing.

In operation, the balance control was found to be critical about the centre position, which made balance setting a little fiddly, but this is a fairly common complaint with full range balance controls which can eliminate either channel.

It was also found that the balance varied too much with the volume control setting — something that was not too serious when using loudspeakers, but rather tiresome with headphone listening where the volume control is likely to be set to a low level.

In other respects, operation of the amplifier's controls was good, with sensible treble and bass controls and a high pass filter which was placed at a frequency of 100Hz with 6dB per octave attenuation. Whilst this frequency may seem on the high side, it is far from silly with a 6dB per octave filter which must inevitably be used in a cheap amplifier.

The amplifier has three basic inputs for auxiliary, tuner and magnetic phono cartridge all with good sensitivities and overload capabilities, plus a tape input/output available at phono plugs like the other inputs or at a DIN connector. Unfortunately, the DIN connector's output impedance of 470,000 ohms is far too high, such that even short lengths of connecting cable between the amplifier and the tape unit will affect severe attenuation at high frequencies. However, it must be mentioned that this connection is in fact compatible with the DIN standard!

Tape monitoring is provided by a tape monitor switch, adjacent to which is a loudness control switch which is in effect a bass boost, the high pass filter switch and two loudspeaker switches. The latter provide selection of two sets of loudspeakers either of which may be on or off. In addition, jack sockets are located on the front panel for headphone listening.

On the rear of the amplifier there are the inputs and other outputs plus two flat pin mains outlets which have been blanked off to conform with UK safety requirements. It was however noted that one of these remained connected and that there was some rather untidy insulating tape used on this connection and also at the mains fuse.

Internally, the standard of construction was clean and tidy, with good printed circuit board layouts and properly identified components which is a great help when servicing.

This amplifier is generally a well made unit but unfortunately cannot be recommended because of its ridiculous DIN connection and poor power bandwidth.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 44
D C offset at loudspeaker and headphones L/R ... 5/11mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz..... —>80/—73/—54dB
Loudness control effect ref 1kHz 100Hz/10kHz . +8/+0dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 1dB

Power performance

Power output into 8Ω both L/R..... 24W
Power output into 8Ω single L/R..... 28W
Power output into 4Ω both L/R..... —W
Power output into 4Ω single L/R—W
Burst output into 8Ω single L/R..... 30W
Burst output into 4Ω single L/R..... —W
Power output into half rated load L/R 4Ω 40W
Power bandwidth 8Ω 10W L/R ..... 10Hz to 13. 5kHz
Power bandwidth 4Ω —W L/R..... —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.06%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz ..... —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz..... —65/68/<30dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz..... —>80/75/<30dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz..... —>80/80/43dB
IM distortion at 1W from phono input DF3
1/10/100kHz..... —>80/80/35dB

Noise performance

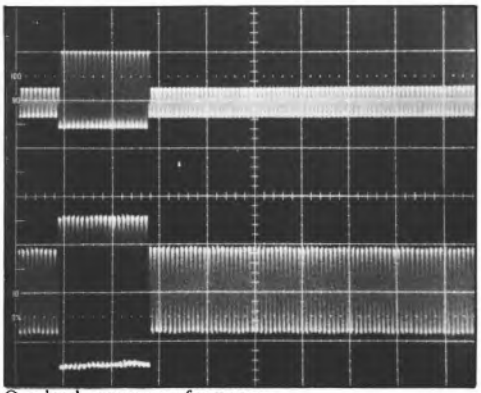
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape..... 101/98dBV
Noise ref to input — average L/R CCIR/22kHz
Phono..... 115/121dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz..... 0.10/0.06μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz..... 0.20/0.10μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR..... 86dB

Inputs and outputs

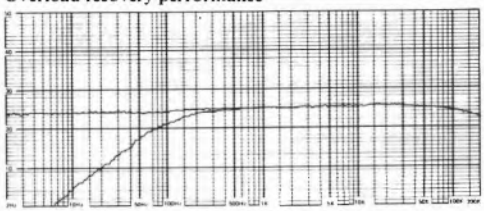
Input impedance on aux/tuner/tape volume . 41/35k 160pF
Input impedance on phono..... 50.5/250pF
Input impedance on mic ..... —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape ..... 125mV >20V
Input sensitivity and clipping point at 1kHz
phono..... 2.6mV 360mV*
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone 12.6V 330Ω
Output voltage and impedance for rated output —
tape..... 125mV VARIΩ
Output voltage and impedance for rated output —
DIN 70mV 470kΩ

Typical selling price including VAT £99.00

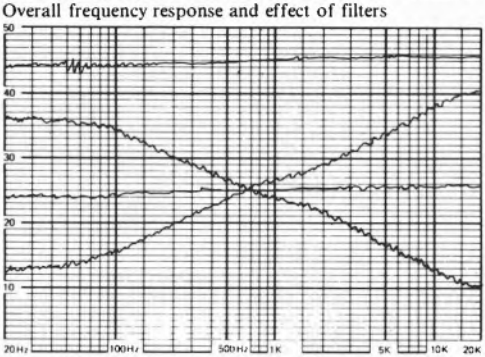
*See text



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Harman Kardon A-402

Tannoy Products Ltd., St. John's Rd., Tylers Grn., High Wycombe, Bucks. 049-481 5221.

This amplifier has an unusual front panel presentation of brushed alloy, with a section of black louvres associated with a display of operating level. It has two red lamps at high levels, and two yellow and four green lamps which indicate descending operating levels in 3dB steps. Four pushbuttn controls switch the display off, provide a test facility to test the lamps, and offer two display ranges. The first range lights all lamps at the full 40W rated power, the second increases the display sensitivity by about 8dB. In fact, it is of limited practical use, but being fast operating does warn of the onset of clipping.

Inputs comprise a tuner input, two auxiliary inputs and two phono inputs for magnetic cartridges all with practical sensitivities, but it is felt that the input overload point of the phono inputs is on the low side at 110mV.

Additional connections are provided for two tape recorders in the form of phono sockets, one connection is also available at a DIN socket. However, the output impedance of the DIN connection is far too high at 470,000 ohms, which whilst it is within the DIN standard is asking for trouble from capacitive loading from connecting cables. Also jack sockets on the front panel duplicate one of the sets of tape connections.

The remaining connections include two sets of loudspeaker outputs which are switchable individually, two front panel headphone jacks and pairs of phono connectors on the rear panel for separating the power and pre-amplifier to insert for example, equalisers.

High and low pass filters are included, the high pass being a very sensible filter but the low pass being far too fierce with its —3dB point at only 4kHz and 6dB per octave attenuation. This effect can be equally well achieved with the tone controls which are very good with switch selection of the treble and bass turnover frequencies to either 5kHz or 10kHz in the treble or 200Hz and 400Hz in the bass.

The loudness control had the normal large bass boost, being 9dB at 100Hz which is really excessive by any standards, there also being a mild treble boost.

Whilst the amplifier is rated at 40W into 8 ohms, considerably more power was available into 4 ohms and the power bandwidth was more than adequate with a good overall dynamic range and better than normal noise performance from all sources.

Whilst the input impedances were good for compatability, there is some concern about the capacitive loading at the inputs as 420pF for the high level inputs is on the high side and depending upon the output impedance of tuners and the like could lead to high frequency attenuation. In addition the capacitive component at the phono inputs was 250pF for phono 1 and 340pF for phono 2, the latter being on the high side.

Subjective testing gave good account of the performance and the versatility of the tone controls, but the setting of the balance control required fine adjustment. It was however, felt that transients sounded a little 'muddled' and that for some unexplained reason the bass

sounded rather 'boomy' with the Spendor BCIII loudspeakers.

With the exception of the mains switch which provided a serious click when switching the amplifier off, the controls were silent in operation and readily adjusted, but the volume control setting was rather critical when using headphones at low listening levels.

Both externally and internally the standard of construction was good, with quite tidy wiring and soldering, but no component identifications are provided for servicing.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 87
D C offset at loudspeaker and headphones L/R . . 39/25mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz. . . . . —>80/—71/—52dB
Loudness control effect ref 1kHz 100Hz/10kHz . +9/+3dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 0.5dB

Power performance

Power output into 8Ω both L/R 55W
Power output into 8Ω single L/R 55W
Power output into 4Ω both L/R . . . . . —W
Power output into 4Ω single L/R . . . . . —W
Burst output into 8Ω single L/R 57W
Burst output into 4Ω single L/R . . . . . —W
Power output into half rated load L/R 4Ω 82/80W
Power bandwidth 8Ω 20W L/R . . . . . 10Hz to 51.5kHz
Power bandwidth 4Ω —W L/R . . . . . —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz . . . . . —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —71/78/57dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —>80/78/47dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —>80/>80/69dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —>80/>80/68dB

Noise performance

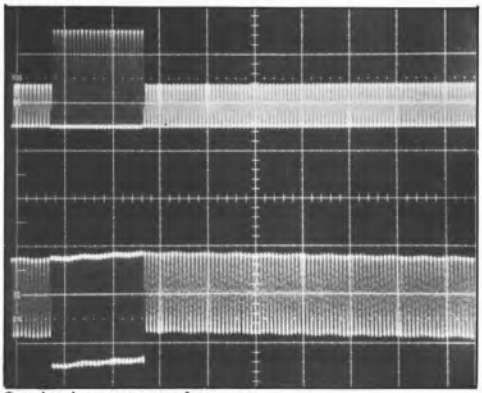
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 104/108.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 115.5/121.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.09/0.015μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.20/0.039μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 87.5dB

Inputs and outputs

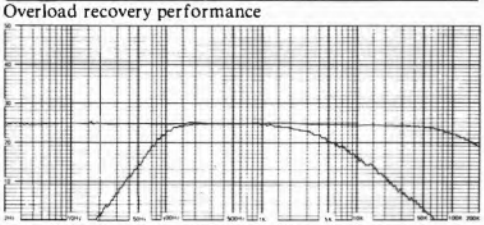
Input impedance on aux/tuner/tape 41/41k 420pF
Input impedance on phono 48k 250pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 130mV 20V
Input sensitivity and clipping point at 1kHz
phono 2.1mV 110mV*
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output —
headphone 18V 460Ω
Output voltage and impedance for rated output —
tape . . . . . 130mV >980Ω
Output voltage and impedance for rated output —
DIN 130mV 470kΩ*

Typical selling price including VAT £240.00

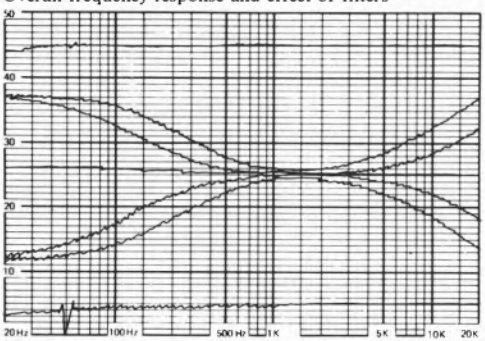
*See text



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Hitachi HA-330

Hitachi Sales (UK) Ltd., Station Road, Hayes, Middlesex. 01-848 8787.

This is a particularly well made amplifier offering the basic facilities for two tape units, an auxiliary input, a tuner input and a single magnetic phono input. A single selector switch is used for the phono input and the two high level inputs, whilst two switches associated with the tape facilities provide tape monitoring or tape dubbing in either direction between the two tape units. When in the tape monitor modes, it was felt that the crosstalk between the input and output connections was rather excessive, but crosstalk between other inputs was minimal.

In addition to the phono type connectors which provide these facilities, there is a DIN socket associated with one tape input/output, and this has sensible impedance and DIN compatability.

The balance control which is concentric with the volume control offered easy adjustment of balance, but the stepped volume control has rather coarse steps at all settings and quite impossible steps at low levels which are necessary for headphone listening. Similarly, the treble and bass tone controls are stepped by detent mechanisms, and whilst these were not unreasonable near the centre positions, the steps were far too coarse at extreme settings.

Amplifier noise was an embarrassment in many ways, the performance of the phono input being unusually poor in terms of weighted noise and the relation between output noise and the volume control setting being very bad for headphone listening with a peak in the noise at about the 9 o'clock volume setting.

The available power output into both 8 ohms and 4 ohms was satisfactory, with the amplifier performing well into lower impedances and being quite suitable for 4 ohm loudspeakers or a paralleled pair of 8 ohm units, two switched loudspeaker outputs being provided together with the single headphone jack.

Other facilities include a very good high pass filter which could well have been a permanent feature of the amplifier and be unswitched, as well as a loudness control which performed in the usual manner of boosting both bass and treble, but not in excess.

Whilst the high level input sensitivities and impedances were well chosen, there is some concern about the capacitive loading of the phono input which is decidedly on the high side at 450pF.

Like a number of recent amplifiers, this one is fitted with two level meters which are calibrated in watts into 8 ohms from 0.1W up to 100W in 3:1 steps. The operating speed of these meters was quite slow, and like many others, they are quite useless for indicating overload and clipping on any normal programme material, the meters hardly moving when the amplifier is driven into overload by plucked strings.

Whilst this amplifier can handle considerably more than its rated power under transient conditions, and therefore does not run hard into clipping, the subjective effects of overload were rather unpleasant if the

overload was provoked by low frequencies, but better than many at high frequencies.

Generally, the sound of the amplifier gave a slightly 'cramped' effect, probably as a result of the relatively high half-power intermodulation distortion at all frequencies and poor high frequency intermodulation at high and low levels which would be indicative of transient intermodulation problems.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 59
D C offset at loudspeaker and headphones L/R 112/118mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —51/—60/—37dB
Loudness control effect ref 1kHz 100Hz/10kHz . +6/+3dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 0.5dB

Power performance

Power output into 8Ω both L/R 48W
Power output into 8Ω single L/R 59/58W
Power output into 4Ω both L/R 46/40W
Power output into 4Ω single L/R 48/43W
Burst output into 8Ω single L/R 68W
Burst output into 4Ω single L/R 50W
Power output into half rated load L/R 2Ω 30/31W
Power bandwidth 8Ω 20W L/R . . . . . 10Hz to 54/23kHz
Power bandwidth 4Ω 20 W L/R . . . . 10Hz to 10.4/17.5kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.05/0.06%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.08/0.11%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —77/73/75dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —>80/>80/67dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —>80/>78/>70dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —>80/>80/58dB

Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 100.5/104.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 109.5/116.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.08μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.80/0.25μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 84dB

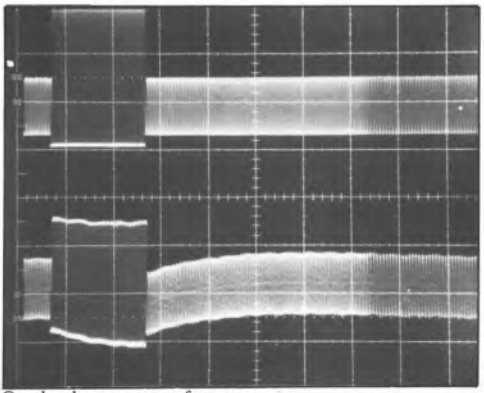
Inputs and outputs

Input impedance on aux/tuner/tape 61/48k 150pF
Input impedance on phono 43k 450pF
Input impedance on mic . . . . . —

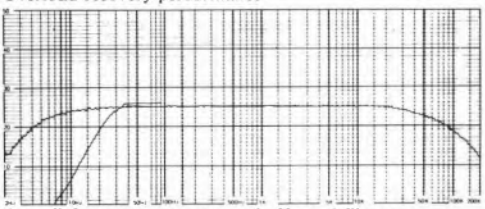
Input sensitivity and clipping point at 1kHz
aux/tuner/tape . . . . . 110mV >20V
Input sensitivity and clipping point at 1kHz
phono 1.9mV 155mV*
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output —
headphone 18V 270Ω
Output voltage and impedance for rated output —
tape . . . . . 110mV VARIΩ
Output voltage and impedance for rated output —
DIN 36mV 83kΩ

Typical selling price including VAT £124.00

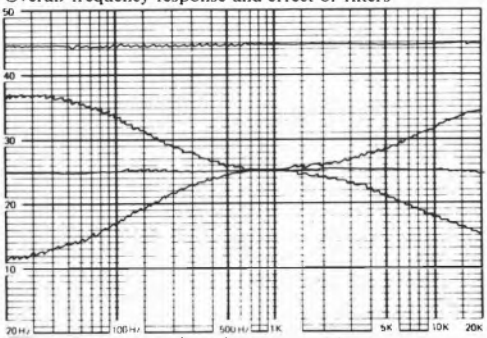
*See text



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

JVC JA-S11

JVC (UK) Ltd., Eldonwall Trading Estate, Staples Corner, 6-8 Priestley Way, London NW2. 01-450 2621.

This cheap amplifier has relatively few facilities and no frills, but has an uncomplicated practical approach which will appeal to many users.

The external finish is to a good standard with a deeply brushed front panel with clear control identifications and turned alloy finish knobs. Internally, the method of construction is based on domestic type printed circuit boards which have good access and clear component identifications for any necessary servicing. Almost all wire joints are made by the modern wire wrap technique which has proven reliability.

Two high level inputs, auxiliary and tuner, are provided together with a single magnetic phono cartridge input, these being selected by a three position toggle type switch. In addition, there are facilities for connecting two tape units, one at the rear panel by means of either phono plugs or a DIN plug, and the other unusually at the front panel by means of phono plugs.

Outputs are provided for two sets of loudspeakers with front panel switching to select either or both sets of loudspeakers, there being no loudspeakers 'off' position. When a set of headphones is inserted in the front panel headphone jack socket the loudspeakers are switched off, and this could be an annoying feature if you wished to listen with headphones at the same time as using a remote set of loudspeakers.

Further front panel controls include two toggle switches associated with the tape connections, one three position toggle switch for monitoring either tape unit or the input source, and another similar switch for dubbing from one tape unit to the other in either direction.

A fairly mild loudness control is activated by a further toggle switch and there are detented treble and bass tone controls, both of which had exceedingly large steps (up to 5½dB) at their extreme positions but were quite reasonable around the mid position and did not introduce any unwanted balance defects between the amplifier channels.

Similarly there was no trouble with the volume control, which like the tone controls has a detent action but which had reasonable volume increments between the steps even near the minimum end position. The separate balance control had a centre position well defined by a mechanical stop and gave easy adjustment of balance around the centre position whilst also providing a full range of control to shut off either loudspeaker.

As with so many amplifiers, the high frequency response is excessive, extending to a —3dB point at 100kHz, and it is felt that this could well have been intentionally limited like the bass response which arrived at the —3dB point at 15Hz. This feature which is a good one is reflected in the adjoining tables by what appears to be a rather large frequency response deviation, but this is no criticism of the amplifier.

In other respects, this amplifier offers good noise performance in all respects, low distortion and a good dynamic range. Whilst it is rated for 8 ohm loudspeakers and performs

RECOMMENDED

well into 8 and 4 ohm loads, there is reason to feel that 4 ohm loudspeakers would not present any problem and that two pairs of 8 ohm loudspeakers will be satisfactory.

In summary, this amplifier has limited facilities, and having regard to its price it is clear that much thought has been given to performance rather than to provision of extra facilities which may or may not be of practical use.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0/20/0dB
Damping factor ref 8Ω at 1 kHz 41
D C offset at loudspeaker and headphones L/R . . . 3/21mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —75/—70/—53dB
Loudness control effect ref 1kHz 100Hz/10kHz . +5/+4dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner. 1.5dB

Power performance

Power output into 8Ω both L/R 37/36W
Power output into 8Ω single L/R 41W
Power output into 4Ω both L/R . . . . . —W
Power output into 4Ω single L/R . . . . . —W
Burst output into 8Ω single L/R 47/46W
Burst output into 4Ω single L/R . . . . . —W
Power output into half rated load L/R 4Ω 61/62W
Power bandwidth 8Ω 15W L/R . . . . . 10Hz to 29kHz
Power bandwidth 4Ω —W L/R. . . . . —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03/0.04%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz . . . . . —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —75/78/47dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —>80/>80/>80dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —80/80/68dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —>80/>80/>80dB

Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 106/111.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114/118dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.16/0.008μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.16/0.05μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 90.5dB

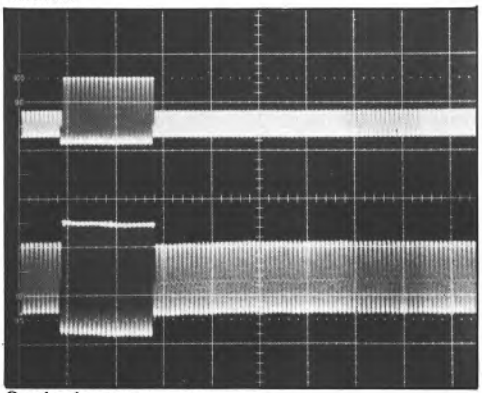
Inputs and outputs

Input impedance on aux/tuner/tape 55/43k 150pF
Input impedance on phono 48k 70pF
Input impedance on mic . . . . . —

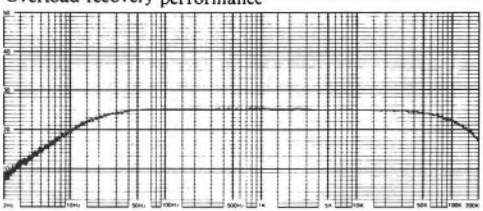
Input sensitivity and clipping point at 1kHz
aux/tuner/tape. 140mV 20V
Input sensitivity and clipping point at 1kHz
phono 2.4mV 155mV*
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output —
headphone. 16V 220Ω
Output voltage and impedance for rated output —
tape. . . . . 140mV VARIΩ
Output voltage and impedance for rated output —
DIN 27mV 78kΩ

Typical selling price including VAT £85.00

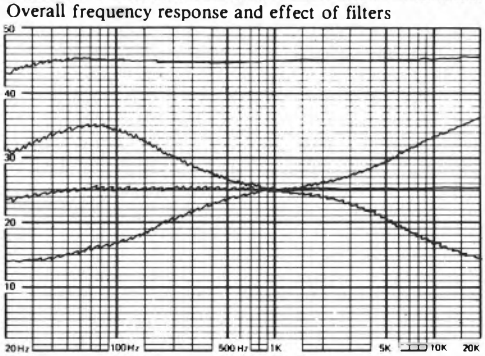
*See text



Overload recovery performance



Overall frequency response and effect of filters

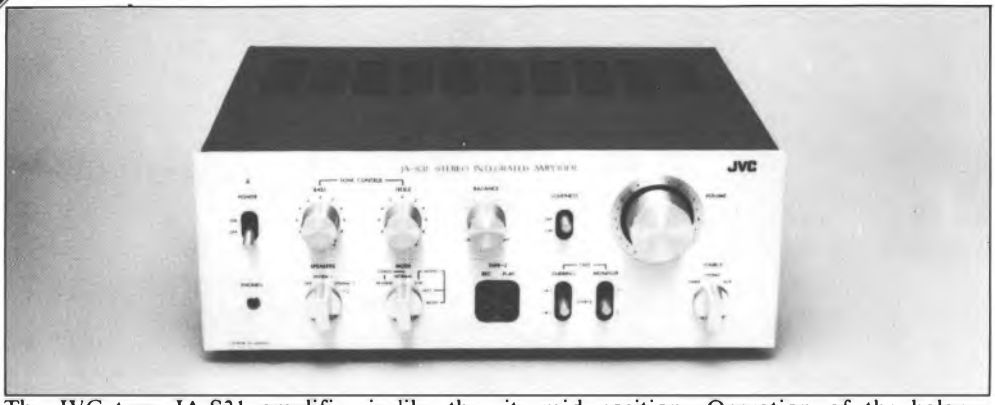


Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

JVC JA-S31

JVC (UK) Ltd., Eldonwall Trad. Est., Staples Corner, 6-8 Priestley Way, London NW2. 01-450 2621.



The JVC type JA-S31 amplifier is like the model JA-S11 — a basic amplifier without frills — but has a power rating of 40W per channel which makes it an interesting amplifier for its price.

With the exception of the DIN tape connector for one of the two tape interfaces, the connections are by phono sockets for inputs and clip type connectors for the two sets of loudspeaker outputs. These are switch-selected so that either or both sets of loudspeakers can be operated, and in addition there is an 'off' position for headphone listening via the front panel headphone jack socket.

A further switch allows selection of stereo operation, reverse stereo or monophonic listening to the left channel or the right channel or to the sum of the left and right channels. Tape monitoring is provided for either tape unit, and dubbing from one tape unit to another is switched in either direction.

Three basic inputs are available, two high level for auxiliary and tuner plus a magnetic cartridge input. All these have reasonable sensitivities and overload performance, and their noise performance is above average.

Whilst the available dynamic range at the output is good, as is the noise at the worst volume setting and at zero volume setting, it was disappointing to note that with headphone listening the noise was poor at about 11 o'clock volume control setting where a peak in the output noise occurred.

Separate volume and balance controls are fitted, the latter having a mechanical stop at its mid position. Operation of the balance control was good about the centre position giving accurate correction of any unbalance and the volume control also behaved well with adequately small volume increments between its steps.

The treble and bass tone controls also operate in steps and it was found that these were reasonable increments and did not introduce any unbalance. Furthermore, the range of the tone controls was not excessive as is the case with so many amplifiers which provide completely unnecessary amounts of cut and boost.

On the other hand, the loudness control introduced an enormous bass boost of 9dB at 100Hz and also a substantial treble boost of 5dB at 10kHz — maybe this is fine for those who use loudness controls, but it's hard to see how this can lead to faithful reproduction.

Two tape unit interfaces are fitted, one at the rear panel with phono sockets and a DIN compatible connector, and the second in the form of phono sockets on the front panel. These operate in conjunction with two toggle switches, a tape monitor switch for replaying from either tape unit and a tape dubbing switch for dubbing to and from either tape unit. Listening tests revealed that the crosstalk associated with the tape monitoring function was not all that it might be, but that the crosstalk between other inputs was insignificant.

No other shortcomings were revealed by listening tests and it was felt that the amplifier offered good performance for its price, the

RECOMMENDED

measured dynamic range, noise and distortion being to a high standard with the half power difference frequency distortion being the only matter of concern.

The standard of construction both externally and internally was good, with neat and tidy wiring, very good access to components and properly identified components.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0/16/0dB
Damping factor ref 8Ω at 1 kHz 75
D C offset at loudspeaker and headphones L/R . . . 7/30mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —75/—74/—56dB
Loudness control effect ref 1kHz 100Hz/10kHz . +9/+5dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 1dB

Power performance

Power output into 8Ω both L/R 48/46W
Power output into 8Ω single L/R 55/53W
Power output into 4Ω both L/R . . . . . —W
Power output into 4Ω single L/R . . . . . —W
Burst output into 8Ω single L/R 65/60W
Burst output into 4Ω single L/R . . . . . —W
Power output into half rated load L/R 2Ω 76/62W
Power bandwidth 8Ω 20W L/R . . . . 10Hz to 20.5/23.0kHz
Power bandwidth 4Ω —W L/R . . . . . —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz . . . . . <0.05/<0.06%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz . . . . . —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —68/73/42dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —<80/<80/54dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —<80/<80/65dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —<80/<80/55dB

Noise performance

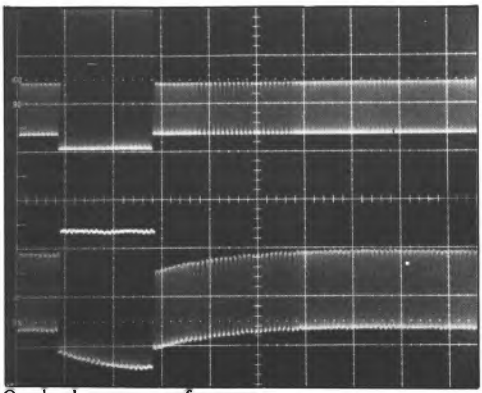
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 104.5/105.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114.5/118dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.049μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.02/0.08μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 89.5dB

Inputs and outputs

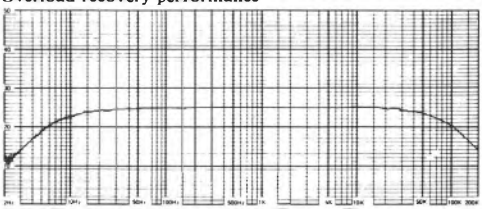
Input impedance on aux/tuner/tape
. . . . . 56/48k tape 70/55k 180 and 90pF
Input impedance on phono 51k 20pF
Input impedance on mic . . . . . —

Input sensitivity and clipping point at 1kHz
aux/tuner/tape . . . . . 147mV >20V
Input sensitivity and clipping point at 1kHz
phono 2.2mV 154mV
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output —
headphone 18V 220Ω
Output voltage and impedance for rated output —
tape 148mV VAR1Ω
Output voltage and impedance for rated output —
DIN 28mV 78kΩ

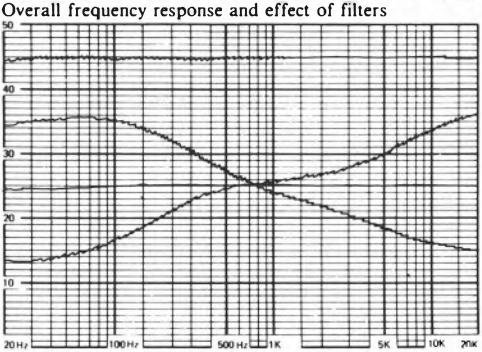
Typical selling price including VAT £120.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Leak 3900A

Rank Audio Products Ltd., PO Box 70, Great West Rd., Brentford, Middlesex. 01-568 9222.

This amplifier sold under the famous English name Leak is in fact made in Japan. It is a bulky and heavy amplifier with many good facilities which include excellent high pass and low pass filters with 12dB per octave attenuation and a choice of turnover frequency in the case of the high pass filters.

The treble and bass tone controls are eleven-position switches with approximately 2dB steps about the centre position, but in one case increasing to 4dB at the end position which is excessive. Both tone controls are associated with a three-position toggle switch which offers a choice of two turnover frequencies and a cancel position.

Neither the tone controls nor the loudness control which effects a small bass boost had any undesirable effect upon the balance between channels, and the balance control itself was easy to adjust for correct balance whilst offering a full range.

The volume control which is a switched attenuator had adequately small steps and in conjunction with the muting switch which inserted an extra 15dB attenuation offered a good range for loudspeaker listening, with the fully anticlockwise position being an 'off' position. However, when using headphones at low listening levels, the minimum volume setting was at too high a level, extra attenuation being desirable.

Further facilities include a mode switch with the usual stereo, reverse, left, right and sum positions, switch selection of two sets of loudspeakers with an 'off' position for headphone listening via the headphone jack, and a tape monitor switch which provides for monitoring either of two tape units and also for dubbing in either direction between them.

A function switch allows selection of two auxiliary inputs, a tuner input and two magnetic phono cartridge inputs. In addition, there is a microphone jack input with its own volume control for mixing a monophonic microphone into the programme.

The input impedance of the high level inputs was greatly dependent upon the volume setting and the use of the muting control, with a minimum impedance of 28.5k ohms which is on the low side for comfort. The phono inputs have switch selectable impedance and also switch selectable sensitivity giving a choice of three impedances and sensitivities, all of which had a very good overload margin.

Whilst the input and output connectors are phono sockets, one set of the phono inputs has a DIN and phono sockets, as do the tape input/outputs which are DIN compatible. Additionally, there are pre-amplifier output and power amplifier connections, which can be separated by a switch — the level being compatible with many other potential devices. The remaining facility is the two front panel memters which are calibrated in Watts into 8 ohms. They are quite useless on programme materials they are too slow to show peaks and gave different readings.

The amplifier is sensibly rated into 8 ohms or 4 ohms with a good performance into 2 ohms on bursts, but the internal protection circuits operated with long duration signals into 2 ohms and also at high frequencies into 4

ohms at full power.

Whilst the noise performance is generally good, distortion gives cause for concern as the harmonic distortion comprises crossover products and also the high frequency intermodulation performance is not very good, this being an indication of likely transient intermodulation troubles.

Internally the quality of the printed boards was found to be good, but components were not identified and the wiring was untidy.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 84
D C offset at loudspeaker and headphones L/R . . 23/15mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —84/—59/—39dB
Loudness control effect ref 1kHz 100Hz/10kHz . +3/+0dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 0.5dB

Power performance

Power output into 8Ω both L/R 93/92W
Power output into 8Ω single L/R 105W
Power output into 4Ω both L/R 128/126W
Power output into 4Ω single L/R 153/152W
Burst output into 8Ω single L/R 118/116W
Burst output into 4Ω single L/R 183/181W
Power output into half rated load L/R 2Ω . . . . . —W*
Power bandwidth 8Ω 40W L/R . . . . . 15Hz to 30kHz
Power bandwidth 4Ω 50 W L/R . . . . . 22Hz to 28kHz*

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.02/0.04%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.03/0.05%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —72/72/<30dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —>80/>80/<30dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —>80/>80/75dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . >80/>80/67dB

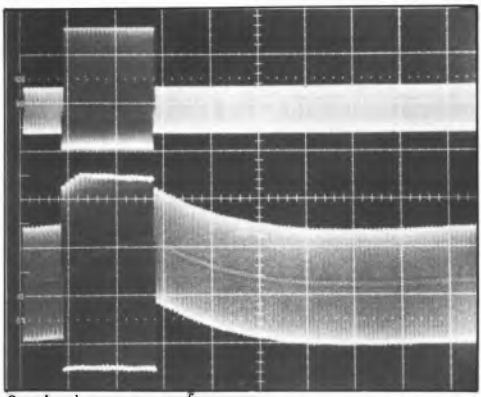
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 106/111.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114.5/115.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic 95/103dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.006μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.30/0.10μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 90dB

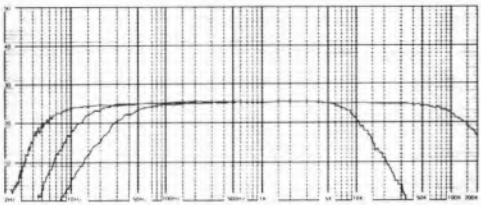
Inputs and outputs

Input impedance on aux/tuner/tape
. . . . . 31/29 tape 35k 230/130pF
Input impedance on phono 107/52/25k 190pF
Input impedance on mic . . . . . 47/27k —pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape . . . . . 125mV >20V
Input sensitivity and clipping point at 1kHz
phono 1.7mV 260mV*
Input sensitivity and clipping point at 1kHz mic . 22mV 10V
Output voltage and impedance for rated output —
headphone 25V 330Ω
Output voltage and impedance for rated output —
tape . . . . . 125mV VARIΩ
Output voltage and impedance for rated output —
DIN 45mV 86kΩ

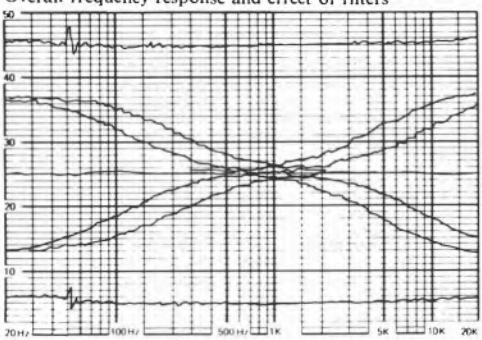
Typical selling price including VAT £275.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Lenco A50

C. E. Hammond & Co. Ltd., 111 Chertsey Road, Byfleet, Surrey. Byfleet 41131.

The first thing which strikes one about this amplifier is that it is fitted with a two core mains lead with black and blue insulation and no indication of which is the line or neutral conductor. A further point of criticism from the point of view of safety is that the mains fuseholder does not meet current safety requirements in the UK.

With the exception of the power amplifier/pre-amplifier link which uses phono sockets, all inputs and outputs are DIN connectors including the connections for the two sets of loudspeakers which are pushbutton selected. The recommended load of 8 ohms loudspeakers did not present any problem as neither did the headphone compatability, however the basic amplifier noise and hum was far too high for headphone listening and irritating with loudspeakers.

As is to be seen from the adjacent table all, noise sources are far too high and the dynamic range is poor. Additionally, hum modulation is severe and the intermodulation distortion performance leaves much to be desired.

The input facilities for two auxiliary inputs, two magnetic pick-ups and a tuner are sensible, and there are also facilities for two tape units of the DIN compatible type. However, this is rather restricting as most tape units nowadays are basically designed for high level inputs. Tape monitoring and dubbing in either direction is controlled by two toggle switches, but the crosstalk across these switches and also between input sources was rather poor. For instance, if you had a tuner connected and were playing discs, you would need to switch off the tuner to avoid breakthrough of the tuner's signal into the disc input.

The treble and bass tone controls had a wide range, and being eleven step switch type controls were rather coarse in action. Similarly, the balance control was difficult to adjust being not very effective around the centre position and then jumping.

Whilst high pass and low pass filters are fitted, both these had only 6dB per octave attenuation and with their —3dB points at around 200Hz and 5kHz their effect was pretty dramatic and of little practical use if it is intended to retain anything like fidelity in the output.

The remaining front panel facilities include a loudness control which boosts both treble and bass to a reasonable extent as is conventional, a mono/stereo switch and a microphone jack input with its associated level control. This is arranged so that you can talk over programme, but the overload performance of this input gave cause for concern as the distortion rose rapidly as the input level was increased above 10mV. It is likely that the microphone pre-amplifier is similar in design to the phono pre-amplifier, as this too had a marginal overload performance.

Giving credit where credit is due, the input function switch operates in conjunction with five light emitting diode indicators which indicate which source has been selected, this being a very clear indication which does not need close scrutiny like a knob.

Whilst this Lenco A50 amplifier does in fact have a large number of facilities for its price, the performance of these facilities such as the filters is very poor, and furthermore the overall performance of the basic amplifier itself leaves very much to be desired.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0/15/0dB
Damping factor ref 8Ω at 1 kHz 39
D C offset at loudspeaker and headphones L/R
. . . . . 74/107 and 3/4mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —60/—65/—53dB
Loudness control effect ref 1kHz 100Hz/10kHz . +8/+4dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 1.5dB

Power performance

Power output into 8Ω both L/R 55W
Power output into 8Ω single L/R 61W
Power output into 4Ω both L/R . . . . . —W
Power output into 4Ω single L/R . . . . . —W
Burst output into 8Ω single L/R 62W
Burst output into 4Ω single L/R . . . . . —W
Power output into half rated load L/R 4Ω 85/72W
Power bandwidth 8Ω 20W L/R . . . . . 10Hz to 14/19kHz
Power bandwidth 4Ω —W L/R . . . . . —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.04%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz . . . . . —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —54/50/<20dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —74/68/<20dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —80/77/61dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —80/77/61dB

Noise performance

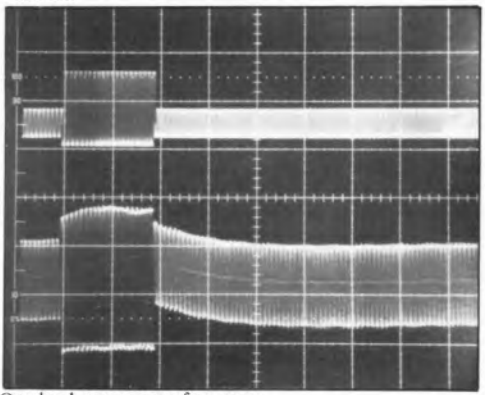
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 96/89dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 108/114dBV
Noise ref to input — average L/R CCIR/22kHz
Mic 111/117dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.20/0.98μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.20/0.98μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 81dB

Inputs and outputs

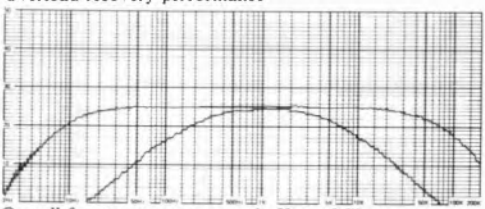
Input impedance on aux/tuner/tape
. . . . . 163/42; 63/42;105/67k 70; 220; 270pF
Input impedance on phono 45k 200pF
Input impedance on mic . . . . . 13k —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 140mV 20V
Input sensitivity and clipping point at 1kHz
phono 2.4mV 120mV
Input sensitivity and clipping point at 1kHz mic . . . 2.5mV*
Output voltage and impedance for rated output —
headphone 0. 8V 140Ω
Output voltage and impedance for rated output —
tape 65mV 97kΩ
Output voltage and impedance for rated output —
DIN . . . . . —kΩ

Typical selling price including VAT £174.00

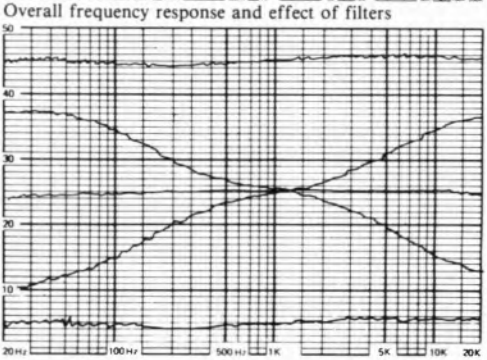
*See text



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Luxman 80V

Howland West Ltd., 3/5 Eden Grove, London N7. 01-609 0293.

The Luxman 80V has an expensive appearance, the front aspect being a shiny alloy panel with heavily knurled knobs with readily visible inbuilt 'pointers', and the whole is surrounded in a rosewood cabinet.

Both externally and internally the finish is very good, with clearly laid-out printed circuit boards and properly identified components, plus good soldering and tidy cabling.

There was, however, some concern from the electrical safety aspect in the area of the mains sockets (which are blanked off to meet UK regulations), as the clearance between the tag on one of these and the mains transformer was on the small side and bending the rear panel inwards could produce a short from chassis to mains.

Rear panel phono socket type inputs are provided for a tuner, two auxiliaries and two magnetic phono cartridges plus two tape units. In addition, one of the tape connections has a DIN compatible connection. All input/output connections were found to have sensible sensitivities and overload performance plus a reasonably constant input impedance. It was, however, felt that the impedance of the phono inputs was on the high side at 60k ohms.

Tape monitoring is provided by means of a three position toggle switch, as is dubbing in either direction between tape units. Crosstalk across the monitoring switch was not particularly good, but this problem was minimal with the input selector switch.

Further toggle switches provide mono/stereo/stereo reverse modes and also two forms of loudness control, one of which affected the bass only, and the other of which affected the treble and bass.

Very good treble and bass tone controls are fitted, both of which have three position switches for selecting a defeat mode or a choice of two turnover frequencies, and are themselves eleven-position switches with adequately fine steps in frequency response.

As is to be seen from the adjacent plot, two degrees of high pass filter and of low pass filter are available, and subjective effects of the low pass filters were found to be good. It is however, felt that a higher rate of attenuation could have been justified for the high pass filters in an amplifier in the price range.

The balance control, which is of the full range variety, was excellent in operation with a smooth mid-range effect. In addition, the volume control had very good performance with both loudspeakers and headphones, the operation of this control or the tone controls not upsetting the balance of the amplifier channels.

The final controls are two pushbutton switches for selecting either or both pairs of loudspeaker terminals, with a headphone jack also being provided. The amplifier performed well into its rated load of 8 ohms, giving a good distortion performance except for the half power intermodulation distortion which was on the high side.

High level input noise is adequate, but the performance of the phono inputs could well be a few decibels better, the output noise at the worst volume setting is too high and clearly audible on headphones and loudspeakers.

In fact, the dynamic range available with this amplifier can be bettered by many, but the performance under overload conditions was found to be satisfactory and the subjective performance was rated as good but with possibly a slightly muffled high frequency performance on plucked instruments. The latter may well be associated with the high frequency intermodulation performance and also the slightly restricted power bandwidth.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 67
D C offset at loudspeaker and headphones L/R 102/109mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —68/—64/—46dB
Loudness control effect ref 1kHz 100Hz/10kHz .... +5dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 0.5dB

Power performance

Power output into 8Ω both L/R 58W
Power output into 8Ω single L/R 68/67W
Power output into 4Ω both L/R ..... —W
Power output into 4Ω single L/R ..... —W
Burst output into 8Ω single L/R 79W
Burst output into 4Ω single L/R ..... —W
Power output into half rated load L/R 4Ω 101/99W
Power bandwidth 8Ω 25W L/R ..... 10Hz to 22/20kHz
Power bandwidth 4Ω —W L/R ..... —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.07%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz ..... —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —74/76/28dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —>80/80/35dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/80/80dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/80/67dB

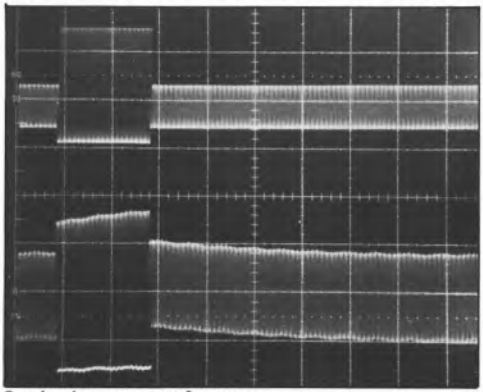
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 100.5/105.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 112/114.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.20/0.07μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.04/0.16μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 84dB

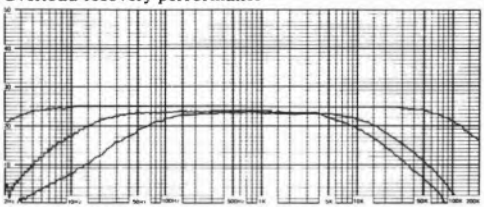
Inputs and outputs

Input impedance on aux/tuner/tape
..... 52/45 tape 63/52k 270; 180pF
Input impedance on phono 60k 65pF
Input impedance on mic ..... —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape ..... 120mV >20V
Input sensitivity and clipping point at 1kHz
phono 2.3mV 175mV
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone 2.6V 90Ω
Output voltage and impedance for rated output —
tape ..... 120mV VARIΩ
Output voltage and impedance for rated output —
DIN 60mV 77Ω

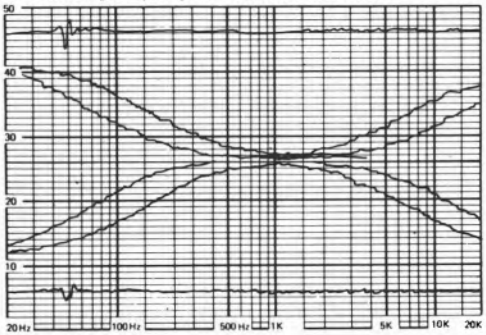
Typical selling price including VAT £300.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

Luxman 85V

Howland West Ltd., 3/5 Eden Grove, London N7. 01-609 0293.

The Luxman 85V is one of the more interesting amplifiers in this book, being very well made and also having many facilities which are practical as opposed to frills, but naturally there is a high price to pay for an amplifier of this class.

Three high level inputs are provided comprising two auxiliary inputs and a tuner input with a pre-set rear panel gain control which allows the sensitivity to be decreased from the 200mV of the other inputs down to 1.6V. In addition, there are two magnetic cartridge phono inputs with the ideal input impedance for most cartridges but perhaps a rather high input capacitance of 330pF, and also it is perhaps surprising that no switched input impedance is provided.

Provision is made for two tape units, one of which can be fed from a DIN compatible connector. Tape monitoring and dubbing is of course available and whilst the crosstalk between inputs was very good the crosstalk across the tape monitor switch was rated as medium.

On the output end, there is a headphone jack and two sets of loudspeaker outputs which are well suited to an 8 ohm impedance, the selection of either or both sets of loudspeakers is accomplished by a rotary switch which also has an 'off' position.

The high frequency filters were excellent, with a choice of 7kHz or 12kHz turnover frequency with an attenuation of 6dB per octave, and whilst low frequency filters have their turnover frequencies well chosen at 70Hz or 20Hz it is felt that the 6dB per octave rate of attenuation could have been bettered in the case of the 70Hz filter.

Similarly, the treble and bass tone controls are very good with a choice of three turnover frequencies in either case and the amount of cut or boost being controlled by 21-way switches which, with the exception of the end positions of the treble control, provided adequately small increments in cut or boost.

Like the tone controls the volume control is a multi-way switch which operates in conjunction with a pushbutton 20dB attenuator to give extra range. In practice, this was one of the best switched volume controls providing small increments and an adequate range for headphone listening with the added benefit that the output noise was excellent at all settings. Balance was to all intents and purposes unaffected by any control settings except that of the balance control which was excellent in its law and gave a full range at its end positions.

Other controls include a loudness control which offered either bass boost alone or combined treble and bass boost and also a mode switch which provides stereo, stereo reverse or mono functions. Finally there is associated with the phono inputs a 'linear equaliser' which provided an overall tilt to the RIAA equalisation curve; a thoroughly practical addition to the amplifier for correcting many cartridges.

Listening tests showed that the overall versatility of the controls was first class, all operations being performed without any bad effects. Noise performance was good as was

RECOMMENDED

the overall dynamic range at the output from all sources, but it was considered that when the amplifier was driven into slipping, the subjective effects were rather rough. However, with an output around 100W this will hardly apply to domestic conditions.

Subjectively, this was considered to be a particularly 'clean' amplifier at all power levels, and overall there is much to praise in its design, construction and performance.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 65
D C offset at loudspeaker and headphones L/R .. 13/17mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —68/—62/—43dB
Loudness control effect ref 1kHz 100Hz/10kHz . +5/+1dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner ..... <0.5dB

Power performance

Power output into 8Ω both L/R 94W
Power output into 8Ω single L/R 110W
Power output into 4Ω both L/R ..... —W
Power output into 4Ω single L/R ..... —W
Burst output into 8Ω single L/R 121W
Burst output into 4Ω single L/R ..... —W
Power output into half rated load L/R 4Ω 163W
Power bandwidth 8Ω 40W L/R ..... 10Hz to 23/43kHz
Power bandwidth 4Ω —W L/R ..... —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03/0.04%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz ..... —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —>80/76/38dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —>80/>80/52dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/>80dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/70dB

Noise performance

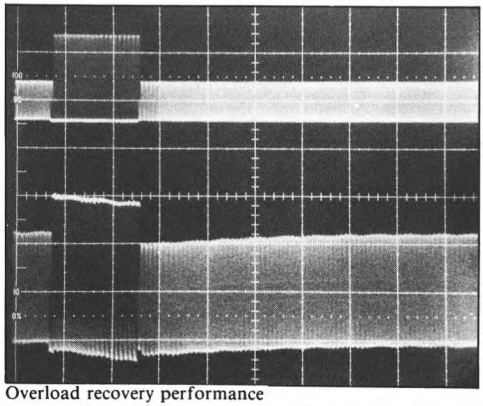
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 100/105dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 115/116.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.13/0.05μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.20/0.05μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 90dB

Inputs and outputs

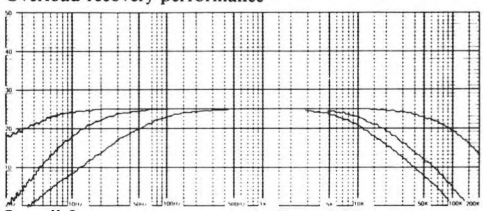
Input impedance on aux/tuner/tape
..... 70/51; 41/33; 78/56k 210; 230; 100pF
Input impedance on phono 46k 330pF
Input impedance on mic ..... —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 200mV 20V*
Input sensitivity and clipping point at 1kHz
phono 3.1mV 380mV
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone 25V 700Ω
Output voltage and impedance for rated output —
tape ..... 200mV VARIΩ
Output voltage and impedance for rated output —
DIN 92mV 86kΩ

Typical selling price including VAT £410.00

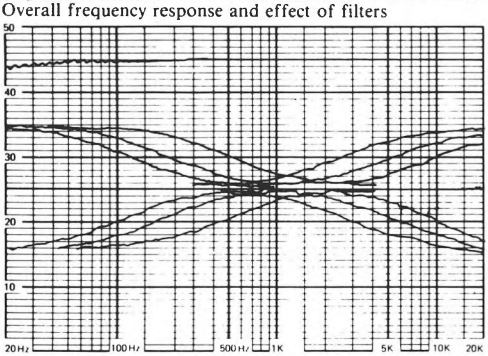
*See text



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Luxman M-4000 and C-1000

Howland West Ltd., 3/5 Eden Grove, London N7. 01-609 0293.

This combination of power and pre-amplifiers comprises the C-1000 pre-amplifier and the M-4000 stereo power amplifier which has the minimum of controls and connections. In general, the standard of finish and construction of both units was very good both internally and externally.

Turning to the power amplifier, the inputs are via two phono sockets with a sensitivity of 1V for the rated output of 180W per channel into 8 ohms. A single pair of loudspeaker outputs is provided, with the intention that these are fed via the pre-amplifier which has inbuilt loudspeaker switching for two pairs of loudspeakers together with a headphone jack socket.

The power amplifier controls consist of two 20dB step attenuators at the input, both of which have an 'off' position, and two pushbutton switches for the power level monitoring which is by meters and a light emitting diode display, both of which can have their sensitivities increased by 10dB by one of the switches, the other one of which switches the meters and display off. The LED display was fast and very good, but as usual the meters were far too slow to be of practical use.

Turning to the pre-amplifier, the basic inputs are two auxiliaries, a tuner and two magnetic pick-up cartridge inputs. Rear panel level controls are provided for the tuner and one auxiliary, whilst front panel screwdriver operated controls allow the phono sensitivities to be varied ±5dB and the phono input impedance to vary over the range 29k/103k ohms with a click stop at 50k ohms — a sensible and versatile arrangement.

Provision is made for two tape units with both phono and DIN compatible connections, plus tape monitoring and dubbing in either direction and it was found the crosstalk associated with the tape monitor switch or the input selector switch was minimal.

Further toggle switches allow the insertion of excellent high and low pass filters with a choice of two frequencies for both filters, and it was pleasing to note that the filters had 12dB per octave attenuation. An additional toggle switch is used to insert the loudness filter with or without the tone controls in circuit, the loudness or 'low boost' as it is called giving a 2dB boost at 100Hz.

The treble and bass tone controls themselves are 21 position switches associated with further switches which give three separate turnover frequencies for the treble and bass controls. This was found to be an excellent and most versatile arrangement, with the control steps being well appointed.

The pre-amplifier output is controlled by a separate output attenuator and volume control, the latter being associated with a 'touch mute' function which is really just a gimmick. The performance of the switched attenuator type volume control and also the balance control was very good, with good laws and small steps.

Last to be mentioned of the pre-amplifier controls is the 'linear equaliser' associated with the phono inputs alone. This is a frequency compensator which effectively tilted the RIAA curve by ±2dB providing a

useful pick-up compensation.

Subjectively the operation of these amplifiers gave a good impression, but there is concern about the high frequency IM distortion which would be indicative of transient intermodulation problems in the absence of a low pass filter in the system. In addition, the overall dynamic range was disappointing in spite of good but not outstanding input noise performance.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 84
D C offset at loudspeaker and headphones L/R .. 7.5/1mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz..... —>80/—72/—53dB
Loudness control effect ref 1kHz 100Hz/10kHz . +2/+0dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner ..... <0.5dB

Power performance

Power output into 8Ω both L/R 197/198W
Power output into 8Ω single L/R 198/201W
Power output into 4Ω both L/R..... —W
Power output into 4Ω single L/R..... —W
Burst output into 8Ω single L/R 218/210W
Burst output into 4Ω single L/R..... —W
Power output into half rated load L/R 4Ω 143W
Power bandwidth 8Ω 90W L/R ..... 10Hz to 50/51kHz
Power bandwidth 4Ω —W L/R..... —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.05%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz..... —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz..... —>80/>80/30dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz..... —>80/>80/30dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/75dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/75dB

Noise performance

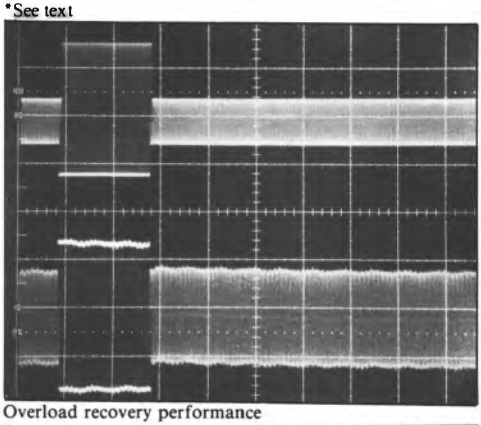
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape..... 105/107dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 113.5/119dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz..... 0.20μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz..... 0.5/0.25μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 88.5dB

Inputs and outputs

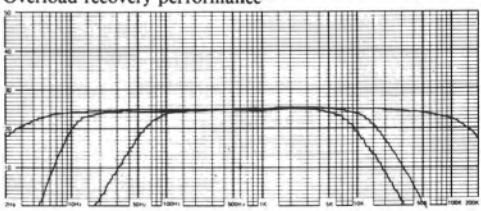
Input impedance on aux/tuner/tape
..... 76; 71; 102k 30; 30; 35pF*
Input impedance on phono 29/50/103k 220pF
Input impedance on mic at min/max volume ..... —pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape ..... 150mV >20V
Input sensitivity and clipping point at 1kHz
phono..... 2.8mV 400mV*
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone..... 31V 780Ω
Output voltage and impedance for rated output —
tape..... 150mV VARIΩ
Output voltage and impedance for rated output —
DIN 70mV 74kΩ

Typical selling price including VAT..... £1,710.00

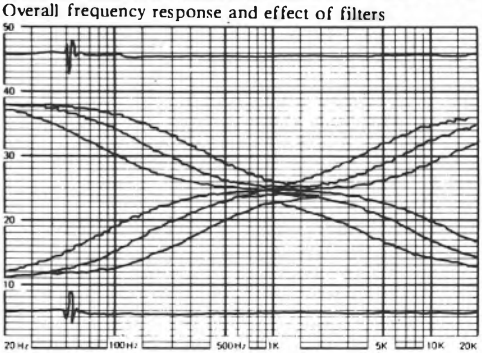
*See text



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Marantz 1030

Marantz Audio (UK) Ltd., Debmarc House, 203 London Road, Staines, Middlesex. Staines 50132.

One of the cheapest and lowest powered amplifiers to be reviewed, this amplifier is manufactured with good quality printed circuit boards and has a good mechanical layout with proper component identifications for servicing, the access for servicing also being good. Soldering was not to the highest standards, and some scruffy pieces of cut off wire were noted on the mains outlay sockets.

The exterior finish is a brushed alloy front panel with spun alloy finish knobs and a simulated wood grain metal case, the rear of the amplifier supporting the phono socket connections and a DIN compatible tape connection together with terminals for two pairs of loudspeakers which may be pushbutton-selected at the front panel. The amplifier is rated at 15W into either 4 or 8 ohms, and its performance was such that this is a reasonably realistic rating, but a bit marginal into 4 ohm loads.

A single rotary switch is used to select the basic inputs which consist of a microphone input via a front panel jack socket, a magnetic phono input and tape, tuner and auxiliary inputs. In addition, there is another tape input/output with a tape monitor switch, but tape duplicating is not provided for.

Pushbutton switches are used to select the loudness control, mono/stereo operation, the low pass filter and either or both of two sets of loudspeaker terminals, a stereo headphone jack being provided for headphone listening.

The loudness function is of the type which boosts both the treble and the bass, whilst the low pass filter is of the 6dB per octave variety with rather too low a turnover frequency giving an excessive cut so far as fidelity is concerned. A natural roll-off at the bass end provides a —3dB point at around 10Hz then falling at 6dB per octave and thus affecting a reasonable rumble filter.

The treble and bass tone controls are of the switched variety by means of 11 position switches, but unfortunately the law of these devices was such that the increments between positions were extremely variable giving increments anywhere between 1dB and an excessive 4dB. This factor is not improved by the very large range of correction available from the tone controls of about ±10dB at 100Hz and 10kHz, and such a degree of correction inevitably leads to excessive clipping with such a low power amplifier at reasonable listening levels.

In this context it was found that bass clipping led to a most objectionable form of distortion; a factor which tends to be confirmed by the adjacent oscillogram of the tone burst clipping characteristics.

Listening tests also confirmed the poor noise performance of the amplifier and then the quoted figures are in fact related to the better of the two samples which were examined. In both cases, there was very poor mains hum in one channel at anything but minimum and maximum volume settings, and this was rather disastrous with both loudspeaker and headphone listening.

It should however be noted that the performance of the pick-up pre-amplifier was unusually good, but the overall available

dynamic range ends up being very poor.

Listening tests also revealed a boomy bass characteristic and also the high frequency performance sounded rather 'muddled'. In addition, it was found that stereo image shifting occurred in conjunction with the setting of the volume control.

In spite of its very low price, it is impossible to recommend this amplifier in view of its very poor hum characteristic as well as other fairly serious shortcomings

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 83
D C offset at loudspeaker and headphones L/R 0mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz..... —67/—57/—43dB
Loudness control effect ref 1kHz 100Hz/10kHz . +7/+4dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 1dB

Power performance

Power output into 8Ω both L/R 17/19W
Power output into 8Ω single L/R 20/23W
Power output into 4Ω both L/R 20/21W
Power output into 4Ω single L/R 22/23W
Burst output into 8Ω single L/R..... 24W
Burst output into 4Ω single L/R..... 21W
Power output into half rated load L/R 2Ω 11/12W
Power bandwidth 8Ω 7½W L/R ..... 20Hz to 19/22kHz
Power bandwidth 4Ω 7½ W L/R ..... 80Hz to 15/12kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.08/0.09%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.10/0.14%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz..... —70/78/<30dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz..... —80/>80/78dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/58dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/58dB

Noise performance

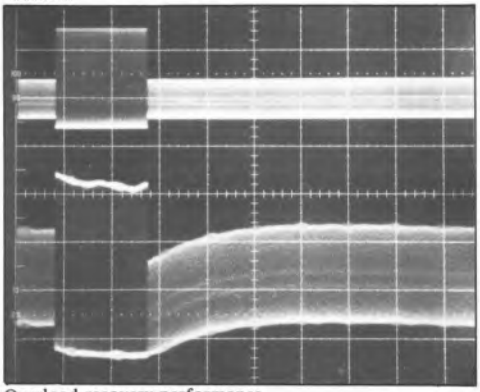
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 95/95.5dBV*
Noise ref to input — average L/R CCIR/22kHz
Phono..... 116/120dBV
Noise ref to input — average L/R CCIR/22kHz
Mic 110/114dBV*
Output noise power at zero volume (8Ω)
CCIR/22kHz..... 0.16/0.05μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz..... 1/31μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR..... 77dB

Inputs and outputs

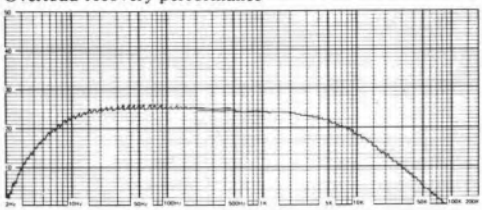
Input impedance on aux/tuner/tape 90/60k 170pF
Input impedance on phono 49k 250pF
Input impedance on mic 28k 650pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape..... 155mV 20V
Input sensitivity and clipping point at 1kHz
phono..... 2.1mV 125mV
Input sensitivity and clipping point at 1kHz mic
..... 2mV 165mV
Output voltage and impedance for rated output —
headphone 10.9V 31Ω
Output voltage and impedance for rated output —
tape..... 155mV VARIΩ
Output voltage and impedance for rated output —
DIN 36mV 79kΩ

Typical selling price including VAT £90.00

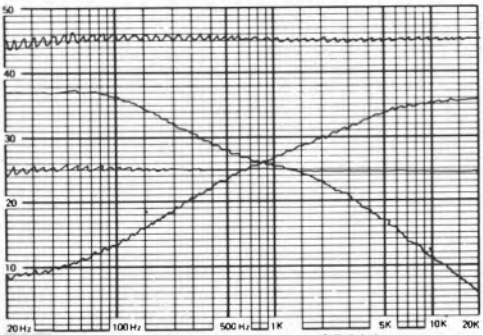
*See text



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

Marantz 1070

Marantz Audio (UK) Ltd., Debmarc House, 203 London Road, Staines, Middlesex. Staines 50132.

Rated by the manufacturer at 35W per channel into 4 or 8 ohms this amplifier is capable of considerably higher output at mid-frequencies and offered a respectable output into 2 ohms demonstrating its ability to handle 4 ohm loudspeakers of any type.

Two pairs of loudspeaker terminals are provided with individual switching of pairs by front panel switches, there also being a headphone jack which is always 'live'. There is also a remote/ambience switch on the rear panel associated with the second pair of loudspeakers, but all this switch actually does is place a resistor in series with the second pair of output terminals and thus reduce both volume and damping factor, the latter possibly being undesirable.

On the input end, a single rotary switch selects the source between microphone (via front panel jack socket), phono, tuner, auxiliary and two tape inputs. Sensitivities and impedances of all these inputs were sensible and with the exception of the phono input the overload margins were good, but that of the phono input must be considered to be marginal.

Noise from the high level inputs was satisfactory, and that from the phono input unusually good, as was the noise at the output for all volume settings.

A further front panel switch allows monitoring from either tape unit, and the crosstalk across this facility and between the input sources was excellent. With the exception of the two tape recorder facilities which are also DIN compatible, the input connectors are phono plugs, and extra phono connectors are fitted at the interface between the power amplifier and pre-amplifier for adding graphic equalisers and like accessories, it being necessary to remove two internal links to use this facility.

Stereo, reverse stereo, mono L+R and left or right channels can be selected by the mode switch and further pushbutton switches serve the purpose of inserting the loudness contour, the high filter and the low filter. The loudness contour is the type which boosts both treble and bass, and in the case of the amplifier the boost at both ends is considerable.

The subjective effect of both filters was not particularly satisfactory in that the high pass filter operated at 100Hz with only 6dB per octave attenuation — too high a frequency and inadequate slope, and the low pass filter operated at 5kHz with again 6dB per octave attenuation — this time too low a frequency completely removing much high frequency information.

Unlike most amplifiers, three tone controls are fitted in the form of vertical slider controls comprising treble, presence and bass controls. Whilst this type of control is attractive, it was found fiddly to adjust the filters, particularly in view of the fact that the treble and bass controls both had a large range of correction. On the other hand, the presence control was found to be very effective.

The function of both the balance control (which is a slider type) and the volume control were excellent when using either loudspeakers or headphones.

RECOMMENDED

Whilst the general subjective assessment of this amplifier was good, the filters were a disappointment as was the operation of the tone controls, but provided one can tolerate these shortcomings this amplifier has quite a few useful facilities. There were however some reservations about the performance on transients, and bass overload should definitely be avoided as the effect was very unpleasant. However the low signal level performance was good.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0/12/0dB
Damping factor ref 8Ω at 1 kHz 84
D C offset at loudspeaker and headphones L/R
. . . . . 9/11; 3/ 3mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —62/—73/—69dB
Loudness control effect ref 1kHz 100Hz/10kHz . +8/+5dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner . . . . . 1 .5dB

Power performance

Power output into 8Ω both L/R 47W
Power output into 8Ω single L/R 53W
Power output into 4Ω both L/R 65/63W
Power output into 4Ω single L/R 76W
Burst output into 8Ω single L/R 58W
Burst output into 4Ω single L/R 85/91W
Power output into half rated load L/R 2Ω 27/29W
Power bandwidth 8Ω 17½ L/R . . . . . 10Hz to 57/60kHz
Power bandwidth 4Ω 17½ W L/R . . . . . 10Hz to 28kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.04%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.04/0.06%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —76/73/48dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —>80/>80/72dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —>80/>80/66dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —>80/>80/66dB

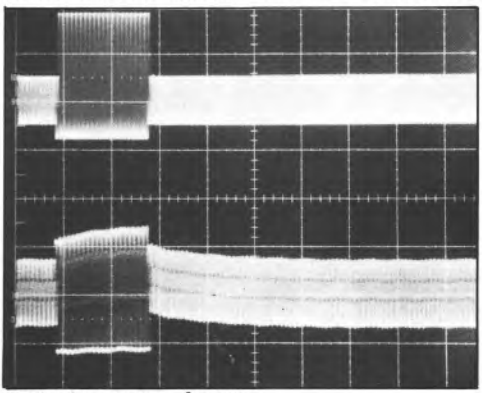
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 108/112dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 115/109dBV
Noise ref to input — average L/R CCIR/22kHz
Mic 114/122dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.016/0.006μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.13/0.03μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR . . . . . 94 .5dB

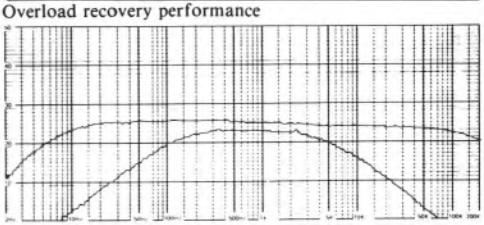
Inputs and outputs

Input impedance on aux/tuner/tape 73/60k 180pF
Input impedance on phono 47k 100pF
Input impedance on mic 47k/ 300pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape . . . . . 175mV >20V
Input sensitivity and clipping point at 1kHz
phono 2mV 125mV
Input sensitivity and clipping point at 1kHz mic
. . . . . 2mV 120mV
Output voltage and impedance for rated output —
headphone 5.3V 103Ω
Output voltage and impedance for rated output —
tape . . . . . 175mV VARIΩ
Output voltage and impedance for rated output —
DIN 33mV 79kΩ

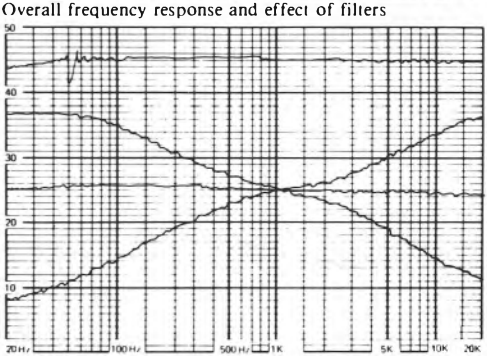
Typical selling price including VAT £145.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Marantz 1250

Marantz Audio (UK) Ltd., Debmarc House, 203 London Road, Staines, Middlesex. Staines 50132.

An unusual feature is incorporated in this amplifier so that either of the two tape outlets can be switched to any source — for instance, both tape units could be recording from different sources whilst you are listening to a third source. This is all accomplished by two five-position switches, one for each tape outlet. Each switch has positions for phono, tuner and auxiliary plus a tape copy position and a 'direct' position when the selected input is connected.

The input source selector consists of four pushbuttons for selecting phono 1, phono 2 or microphone when plugged in, tuner or auxiliary, plus two further pushbuttons for monitoring either tape unit. Both tape connections have a DIN compatible connection in addition to phono sockets which are also used for all other input signal connections, including a pre-amplifier output/power amplifier input connection which is activated by removing an internal link and provides a 1.4V interface for equalisers.

Two sets of loudspeaker terminals are provided, with pushbutton switching for each set of terminals, plus a headphone jack socket. Rated at 125W into 8 ohms, the amplifier has plenty of power reserve into 4 ohms, but the half power bandwidth into 8 ohms was distinctly disappointing as was the high frequency intermodulation distortion at all power levels.

On the bonus side, the noise at all inputs was good, with the noise at the output being to an exceptionally high standard and the available dynamic range good.

Similarly, the characteristics of the high pass and low pass filters were found to be excellent with —3dB points at 30Hz and 9kHz, and 12dB per octave rates of attenuation. The tone controls which consist of treble, bass and mid-frequency controls also had useful characteristics, but the available range of control was unnecessarily large in the case of the bass and treble controls leading to difficulty in fine setting. This problem was aggravated by the fact that each amplifier channel has its own slider controls such that individual channel compensation is possible, but in the case of stereo it is essential to match the control positions if image broadening is to be avoided.

In the cases of the treble and the bass control the turnover frequency can be selected by pushbuttons to give a wide variety of characteristics, and it was pleasing to note that a 'tone defeat' button was included.

The remaining front panel features include a slider type balance control of good characteristics and the volume control which was more than adequate for both loudspeaker and headphone listening, plus two tape dubbing jack sockets for patching an extra tape recorder into the system.

Both the external and the internal finish were first class, with good quality printed circuit boards complete with clear component identifications and the identification of all controls and connections was very clear.

Subjective listening tests demonstrated that all functions behaved well, but that is probably because of the unrestricted

bandwidth of the amplifier the unit could easily become unstable if the volume control was set to maximum without any filters in circuit. Normally this problem will not be found as one seldom works at maximum gain.

Whilst the amplifier exhibited a well controlled bass performance, it was suggested that the high frequency performance was not all that it might be with some high frequency saturation on high level brushes and a slight muddiness of the presence.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 84
D C offset at loudspeaker and headphones L/R
..... 11/13 and 3.6/4mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —73/—67/—61dB
Loudness control effect ref 1kHz 100Hz/10kHz +7/+2.5dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner ..... <0.5dB

Power performance

Power output into 8Ω both L/R 160W
Power output into 8Ω single L/R 166/165W
Power output into 4Ω both L/R ..... —W
Power output into 4Ω single L/R ..... —W
Burst output into 8Ω single L/R 144W
Burst output into 4Ω single L/R ..... —W
Power output into half rated load L/R 4Ω 281/278W
Power bandwidth 8Ω 62½W L/R ... 10Hz to 10.5/11.5kHz
Power bandwidth 4Ω —W L/R ..... —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.04/0.09%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —77/80/<30dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —>80/75/<30dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/80/60dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/80/64dB

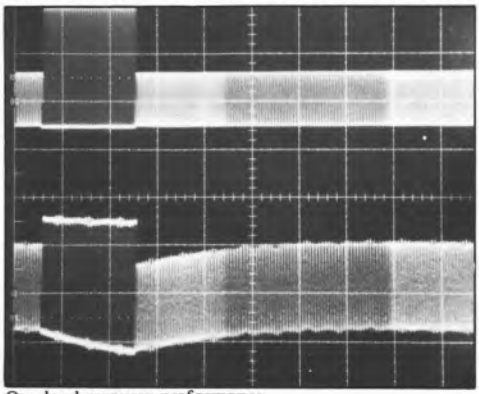
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 104/106dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114/118dBV
Noise ref to input — average L/R CCIR/22kHz
Mic 112/119.5dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.05/0.008μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.025/0.10μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 89dB

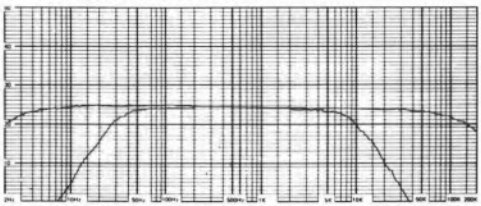
Inputs and outputs

Input impedance on aux/tuner/tape
..... 70/65; 61/65; 70/65k 220/265/210pF
Input impedance on phono 47k 250pF
Input impedance on mic 9. 2k 1000pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 175mV 20V
Input sensitivity and clipping point at 1kHz
phono 1.8mV 320mV
Input sensitivity and clipping point at 1kHz mic
..... 1.9mV 320mV
Output voltage and impedance for rated output —
headphone 10V 103Ω
Output voltage and impedance for rated output —
tape ..... 175mV VARIΩ
Output voltage and impedance for rated output —
DIN 32mV 102kΩ

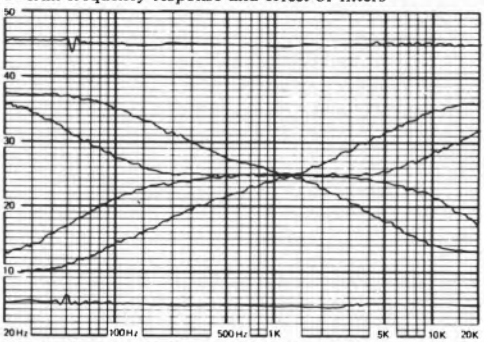
Typical selling price including VAT £500.00



Overload recovery performance



Overall frequency response and effect of filters

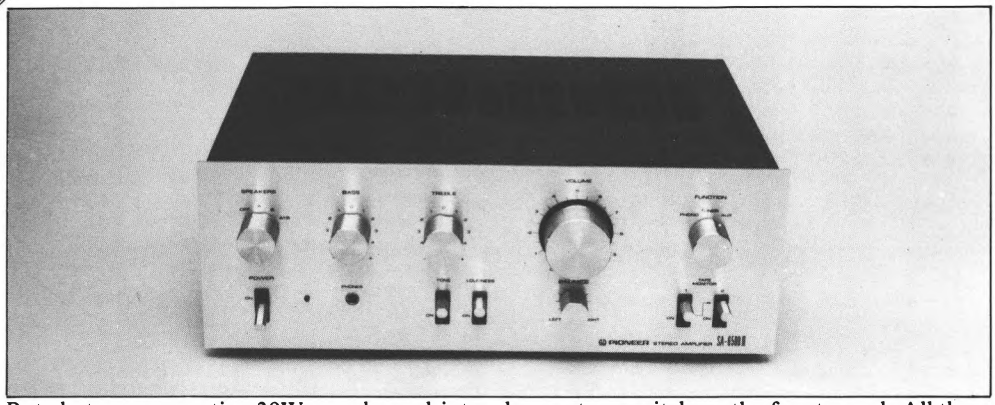


Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

Pioneer SA-6500 II

Shriro (UK) Ltd., Unit 5B, The Ridgeway, Iver, Bucks. 0753 65 2222.



Rated at a conservative 30W per channel into either 4 ohm or 8 ohm loudspeakers, and having all that is required of a basic amplifier, the Pioneer SA-6500 II offers good performance.

As is to be seen from the adjacent table, the power output available into half the rated load of 4 ohms (ie 2 ohms) is exceptionally good, and whilst the power bandwidth varied a little between the channels, it was entirely satisfactory.

The noise performance so far as the inputs are concerned was unusually good, as was the measured output noise. But, subjectively there was mild hum at the output, and this might be annoying particularly when listening with headphones, as it was present at all volume control settings.

Terminals are fitted for two sets of loudspeakers, there being a front panel switch for selecting either or both sets of loudspeakers and also having an 'off' position for headphone listening via the front panel headphone jack. Provision is made for two tape recorders with one interface having a DIN compatible connector in addition to the phono sockets used for all other inputs.

Separate toggle switches permit tape monitoring with either tape unit, but no tape dubbing facility is fitted. Subjective assessment of the crosstalk at the tape monitor switches and also between input sources showed that there was minimal interference between sources.

The basic inputs consist of magnetic phono, tuner and auxiliary inputs which are selected by a rotary switch on the front panel. All these inputs and also the tape unit connections had sensible impedances and overload margins together with adequate sensitivities.

Further facilities include tone controls and a tone control defeat switch. Both the treble and the bass tone controls are eleven-position controls, but as the manufacturers have had the sense to limit the available range of correction to that which is reasonable in practice, the increments between the tone control positions are adequately small.

Having given credit where credit is due, examination of the overall frequency response shows that it extends to very low frequencies but rolls off at the high frequency end just above 20kHz. As no filters are fitted it would have been only reasonable to restrict the low frequency response, particularly with the phono input where unwanted low frequency response is a menace.

The volume control is an analog control having a good law and not exhibiting any unbalance between channels, with the balance control itself being of the full range type but also being well conceived such that the law about the mid-position made balance correction very easy.

The final amplifier control is the loudness control which affected a relatively mild boost to both the treble and the bass. Unfortunately this control did introduce significant unbalance into the amplifier, so that it was necessary to re-adjust the balance after the loudness control had been operated if perfect amplifier balance was to be retained.

RECOMMENDED

However, the degree of unbalance introduced would probably not be noticed by many people on stereo programme material.

The overall subjective impression of this amplifier was good and driving it into overload did not have any particularly distressing effects. Finally, other than the standard of soldering at the DIN connector, the standard of construction was excellent with a clean component layout with proper identifications and good access for servicing.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 58
D C offset at loudspeaker and headphones L/R . . 14/28mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —75/—50/—42dB
Loudness control effect ref 1kHz 100Hz/10kHz . +7/+5dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 0.5dB

Power performance

Power output into 8Ω both L/R 35/37W
Power output into 8Ω single L/R 43/44W
Power output into 4Ω both L/R 39/41W
Power output into 4Ω single L/R 49/53W
Burst output into 8Ω single L/R 51/52W
Burst output into 4Ω single L/R 55/56W
Power output into half rated load L/R 2Ω 37/43W
Power bandwidth 8Ω 15W L/R . . . . . 10Hz to 32/36kHz
Power bandwidth 4Ω 15 W L/R . . . . . 10Hz to 34/40kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.04/0.05%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —71/68/38dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —80/80/48dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —80/80/73dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —80/80/65dB

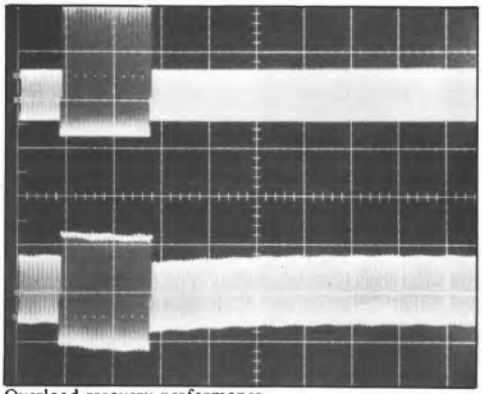
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 105/104dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114/117dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.03μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.10/0.05μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 90dB

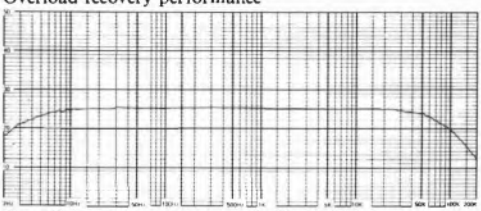
Inputs and outputs

Input impedance on aux/tuner/tape
. . . . . 63/51; tape 58/51k 150; 100pF
Input impedance on phono 50k 135pF
Input impedance on mic . . . . . —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape . . . . . 140mV >20V
Input sensitivity and clipping point at 1kHz
phono 2.2mV 210mV*
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output —
headphone 15V 150Ω
Output voltage and impedance for rated output —
tape . . . . . 140mV VARIΩ
Output voltage and impedance for rated output —
DIN 26mV 78kΩ

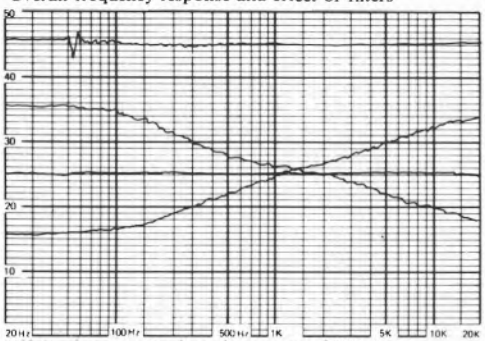
Typical selling price including VAT £150.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

Pioneer SA-8500 II

Shriro (UK) Ltd., Unit 5B, The Ridgeway, Iver, Bucks. 0753 65 2222.

Whilst the available number of inputs are limited to two phono cartridges, tuner and auxiliary plus two tape units, the facilities offered by this amplifier are comprehensive and the number of inputs should be adequate for most practical installations.

All input impedances and levels are well conceived, with a bonus that the capacitive components of the phono input impedance can be switch-selected by a small front panel control which is calibrated as 100/200/300/400pF but in fact gave input capacitances of 35/120/235/345pF. In practice the available selection is fine, and this facility is a very useful one.

A high pass and a low pass filter may be switch selected, both being 6dB per octave filters with sensible turnover frequencies. It is felt however that the rate of attenuation of the high pass filter should have been more, so far as the phono input is concerned.

This amplifier has treble and bass tone controls, but no presence control, the tone controls being eleven position switches which operate in conjunction with further switches which select the turnover frequency from a choice of three in each case. This arrangement gave excellent subjective results and the steps of cut and boost were adequately small whatever the selected turnover frequency.

Like the tone controls, the volume control is also a switched attenuator which works in conjunction with a 'mute' switch which provides an extra 20dB of attenuation over and above the volume control range of 70dB in 2dB steps plus an 'off' position. This range was quite adequate for both loudspeaker and headphone listening, and the balance between channels was unaffected by the volume control or by the tone controls.

The balance control itself is of the full range variety which can cut off either loudspeaker, but the operation around the centre position was generally good for correcting balance, but can be bettered.

Further front panel controls include a mode switch which has stereo, reverse stereo, left, right and sum positions. In addition, there are tape monitor and tape dubbing switches for the two tape connections, one of which has a DIN compatible connector in addition to the phono sockets which are used for all inputs.

The rear panel includes phono sockets for access to the output of the pre-amplifier and the input to the power amplifier for inserting equalisers etc and the clip type terminals for two sets of loudspeakers. Either or both of the sets of loudspeakers can be selected by a front panel selector switch which also has an 'off' position. Also on the front panel there is a standard headphone jack socket.

The overall standard of construction was good, but it was noted that no components on the good printed circuit boards were identified for servicing, and whilst the instructions include a circuit diagram, no layout information is provided.

From an operational point of view this amplifier gave good performance, with all controls behaving well and no troubles from switch clicks or crosstalk between inputs or across the tape monitor switch.

RECOMMENDED

The rated power of 60W per channel was readily available into 4 ohms or 8 ohms, with a good harmonic distortion performance and intermodulation distortion performance at audio frequencies. However, the intermodulation distortion rose to a rather high level outside the audio band at half power.

The noise performance of all inputs was very good and the amplifier generally gave a good account of itself, and considering its price it is felt that this unit has a lot to offer.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0/6/6dB
Damping factor ref 8Ω at 1 kHz 77
D C offset at loudspeaker and headphones L/R 0mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —65/—63/—57dB
Loudness control effect ref 1kHz 100Hz/10kHz . +6/+4dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner . . . . . <0.5dB

Power performance

Power output into 8Ω both L/R 81/80W
Power output into 8Ω single L/R 81/80W
Power output into 4Ω both L/R . . . . . —W
Power output into 4Ω single L/R . . . . . —W
Burst output into 8Ω single L/R 85W
Burst output into 4Ω single L/R . . . . . —W
Power output into half rated load L/R 4Ω 113/114W
Power bandwidth ref rated load & ouput
8Ω 30W L/R . . . . . 10Hz to 58/59kHz
Power bandwidth ref rated load and output 4Ω
—W L/R . . . . . —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz . . . . . —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —80/80/43dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —80/80/33dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —80/80/80dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —80/80/80dB

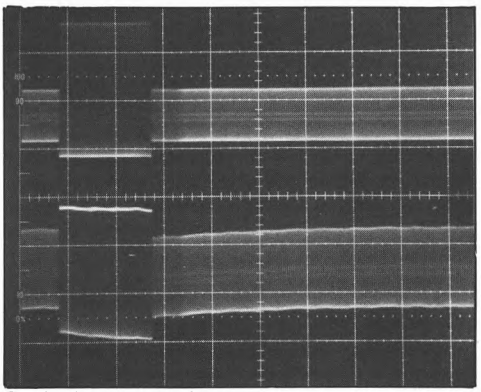
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 102/107dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114/116dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.06/0.03μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.31/0.10μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 86.5dB

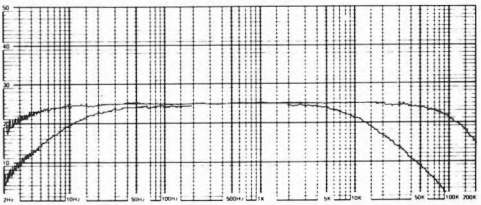
Inputs and outputs

Input impedance on aux/tuner/tape at min/max
volume . . . . . 58/47; tape 66/55k 210; 100pF
Input impedance on phono at min/max volume
. . . . . 51k VARIpF*
Input sensitivity and clipping point at 1kHz
aux/tuner/tape . . . . . 140mV >20V
Input sensitivity and clipping point at 1kHz
phono 2.5mV 300mV
Output voltage and impedance for rated output —
headphone 22V 150Ω
Output voltage and impedance for rated output —
tape 140mV 2200Ω
Output voltage and impedance for rated output —
DIN 23mV 78kΩ

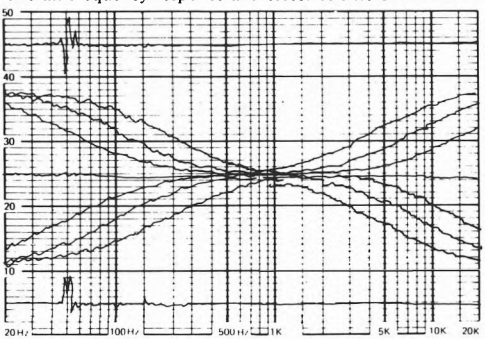
Typical selling price including VAT £280.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Pioneer SA-9900

Shriro (UK) Ltd., Unit 5B, The Ridgeway, Iver, Bucks. 0753 65 2222.

An unusual feature of this amplifier is that it has two separate sets of treble and bass tone controls which have different turnover frequencies, all controls being of the multi-position switch type. Seven position switches are used for the extreme controls which have turnover frequencies at 50Hz and 20kHz, whilst the remaining tone control at 100Hz and 10kHz use eleven position switches, thus providing a very versatile system with adequately small increments.

In addition to a tone control defeat toggle switch, there are two toggle switches which insert a choice of two high pass and two low pass filters. All these filters have a 12dB per octave rate of attenuation which is particularly desirable at low frequencies, and the turnover frequencies are well chosen. Furthermore, the manufacturer has had the sense to omit a loudness control.

The volume control which is a step attenuator covering the range of 60dB in 2dB increments works in conjunction with a three position attenuator switch which offers 15 or 30dB extra attenuation, thus providing a more than adequate range for headphone or loudspeaker listening. However, the basic amplifier noise was found to be far too high when using headphones, in addition to which there was a constant hum at any volume

With the exception of the balance control which had an unusually good characteristic, the other amplifier controls did not have any significant effect upon balance.

On the input end there is provision for two auxiliary inputs, a tuner and two phono inputs for magnetic cartridges with the option of using a microphone in lieu of one of the phono inputs. This is simply achieved by inserting a plug into the microphone jack socket. In addition, there are connections for two tape recorders; all inputs being via phono plugs as there is no DIN connection.

Both tape monitoring and tape dubbing in either direction are catered for by two switches, and it is found that the crosstalk associated with either tape monitoring or between the inputs was minimal.

Further phono connectors allow entry into the amplifier between the pre-amplifier and the power amplifier, the two being able to be separated by a small slide switch.

The physical layout of this amplifier is unusual because all connections are arranged at the sides of the amplifier, the right hand side housing all inputs together with a phono input impedance selector switch and a phono input attenuator giving a 12dB range in gain. The right hand side has the two sets of loudspeaker outputs which are switched from the front panel, and also the power/pre-amplifier breakpoint and its switch.

Both the external finish and the internal layout and tidiness of the amplifier was excellent, with good quality boards and widespread use of wire wrapping.

The measured amplifier performance showed that it was quite happy to work into 4 ohm loads and that the power bandwidth was quite adequate, but there is concern about the high frequency intermodulation distortion which would be indicative of transient

intermodulation problems.

The noise performance of the high level inputs was good, but that of the phono input was not to the very best standards and neither was the maximum available dynamic range.

So far as the overload performance was concerned, severe bass overload produced very unpleasant effects and high frequency overload gave a nasty splitting sound, but this shouldn't be a problem in domestic use.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 130
D C offset at loudspeaker and headphones L/R 0mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —65/—65/—56dB
Loudness control effect ref 1kHz 100Hz/10kHz ..... —dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner ..... <0.5dB

Power performance

Power output into 8Ω both L/R 132/131W
Power output into 8Ω single L/R 150/149W
Power output into 4Ω both L/R 190/188W
Power output into 4Ω single L/R 230/225W
Burst output into 8Ω single L/R 153/144W
Burst output into 4Ω single L/R 259/153W
Power output into half rated load L/R 2Ω 258/235W
Power bandwidth ref rated load & ouput
8Ω 55W L/R ..... 10Hz to 47/40kHz
Power bandwidth ref rated load and output 4Ω
55 W L/R ..... 10Hz to 37/30kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.040/0.04%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.05%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —80/>80/30dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —>80/>80/25dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/75dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... >80/>80/73dB

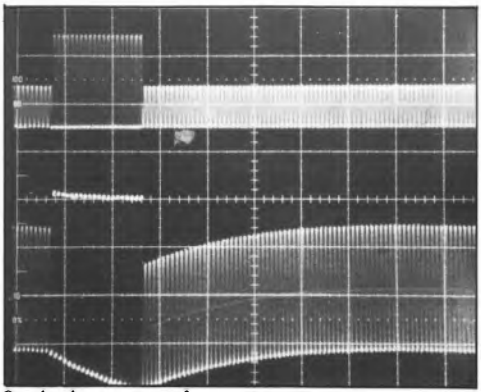
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 103.5/107.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 113dBV
Noise ref to input — average L/R CCIR/22kHz
Mic 106/105dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.20/0.10μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.31/0.10μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 87.5dB

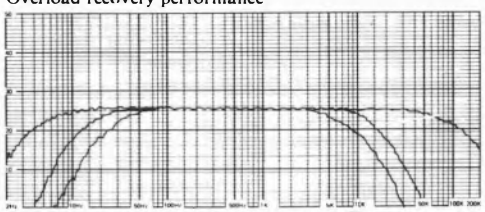
Inputs and outputs

Input impedance on aux/tuner/tape 52/52k 140pF
Input impedance on phono 35/50/71/104k 75pF
Input impedance on mic 88k 910pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape ..... 140mV > 20V
Input sensitivity and clipping point at 1kHz
phono 2.6mV 410mV
Input sensitivity and clipping point at 1kHz mic
..... 5.5mV 930mV
Output voltage and impedance for rated output —
headphone 30V 157Ω
Output voltage and impedance for rated output —
tape 140mV 2800Ω
Output voltage and impedance for rated output —
DIN ..... —kΩ

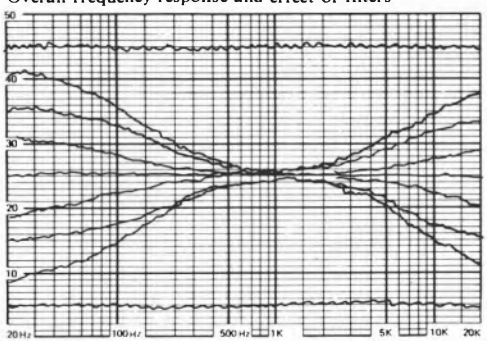
Typical selling price including VAT £580.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

Quad 33 and 405

Acoustical Manufacturing Co. Ltd., St. Peter's Road, Huntingdon, Cambs. 0480 52561.

These amplifiers comprise the Quad 33 pre-amplifier which has all the controls, and the Quad 405 power amplifier which is a straightforward power amplifier without any operational controls. The power amplifier is rated at 100W per channel into 8 ohms and behaved quite happily into 4 ohms which makes it suitable for 8 ohm loudspeakers, but its capabilities into 2 ohms make it a doubtful runner with some loudspeakers having a nominal 4 ohm impedance.

The input sensitivity of the power amplifier is 0.5V which is also the rated output of the pre-amplifier, so whilst the power amplifier can be used with many other pre-amplifiers, the pre-amplifier has a rather restricted output for use with many other power amplifiers.

With the exception of the loudspeaker outputs which are clip-type connectors, all signal connections are of the DIN type, including the input to the power amplifier which is a 4-pin DIN connector which makes an awkward interface.

The pre-amplifier has interlocked pushbutton switching for four inputs, disc, radio 1 and 2 and a tape input, all of which are DIN connectors but which are not DIN compatible. However, the input and output voltages at the tape connector can be varied over a very wide range by means of screw links on a plug-in printed board at the rear of the pre-amplifier. Similarly, a second plug-in board varies the sensitivity and impedance of the disc input so that it can readily handle high or low output magnetic cartridges and also ceramic cartridges.

Further front panel pushbuttons on the pre-amplifier allow selection of the stereo mode of operation, or alternatively the selection of left or right channels to either or both loudspeakers. The volume control is of the conventional type, whilst the balance control is a small slider control.

The performance of the balance control was excellent, neither the volume control nor the tone controls upset the balance.

Tone control and filter operation is controlled by four interlocked pushbuttons the first of which is a 'cancel' button which cancels the filter and the tone controls. The further three buttons select the turnover frequency of the low pass filter, whilst the slope of the filter is variable over a very wide range by means of a potentiometer control — this is the best arrangement to be found amongst the amplifiers in this book. The treble and bass tone controls are of the conventional type offering a wide range of control.

No high pass filter is fitted, but for once a manufacturer has seen the sense to limit the overall frequency response of the amplifier and thus make such a control unnecessary for most purposes. Whilst this shows as a 1.5dB response deviation in the table, this is no discredit to the amplifier in this instance.

Whilst the noise performance of all inputs was generally good, but not to the very highest standards, the inherent output noise was on the high side with the result that the available dynamic range is restricted. Harmonic distortion was very clean and the

RECOMMENDED

intermodulation distortion in the audio band was good, but at high frequencies the half-power intermodulation products rose sharply.

Subjectively no problems were found with the amplifier, and the recovery from either high or low frequency overload was remarkably clean. Operationally, the controls were really excellent and the crosstalk between inputs or across the tape monitor function was absolutely minimal.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 169
D C offset at loudspeaker and headphones L/R 3/5mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —71/—68/—56dB
Loudness control effect ref 1kHz 100Hz/10kHz ..... —dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 1.5dB*

Power performance

Power output into 8Ω both L/R 110/111W
Power output into 8Ω single L/R ..... 122 /123W
Power output into 4Ω both L/R 78/76W
Power output into 4Ω single L/R 68W
Burst output into 8Ω single L/R 138/132W
Burst output into 4Ω single L/R 63/59W
Power output into half rated load L/R 17/18W
Power bandwidth 8Ω W L/R ..... 20Hz to 33kHz
Power bandwidth 4Ω W L/R ..... 15 Hz to 31.5kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.05%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.07/0.06%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —80/70/<30dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —>80/80/<30dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/62dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/65dB

Noise performance

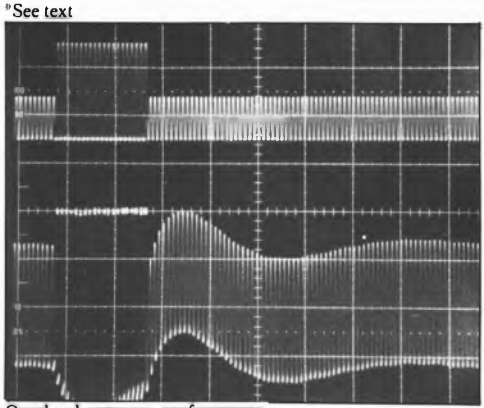
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 102/101dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 113/118dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.50/0.40μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.63/1.25μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 83dB

Inputs and outputs

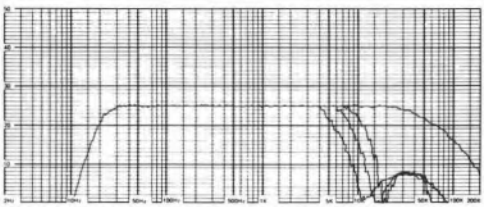
Input impedance on aux/tuner/tape
..... tuner 95; tape 44/33k 60; 50pF
Input impedance on phono at min/max volume . 63k 26pF*
Input impedance on mic at min/max volume ..... —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape ..... *V
Input sensitivity and clipping point at 1kHz
phono 2.2/6.3mV 150/55mV
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone ..... —Ω
Output voltage and impedance for rated output —
tape 99/20/3.6mV 800Ω*
Output voltage and impedance for rated output —
DIN ..... —kΩ

Typical selling price including VAT £265.00

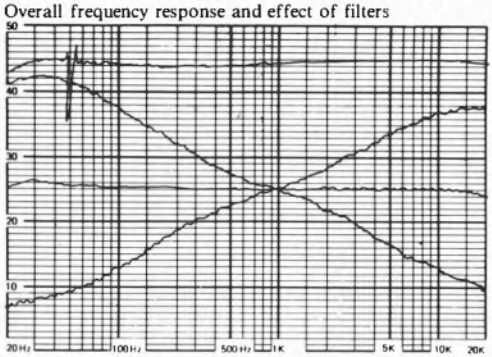
*See text



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Rotel RA-413

Rank Audio Products Ltd., PO Box 70, Great West Road, Brentford, Middlesex. 01-568 9222.

Rated at 35W per channel into 8 ohms and having few inputs or facilities this is a low price amplifier, the construction of which leaves something to be desired. The internal wiring was not particularly tidy and the standard of soldering could well be bettered; in addition the printed circuit boards were without any identifications with the exception of the fuses.

A rotary front panel switch selects the tuner, auxiliary or magnetic phono cartridge inputs, the latter having both phono and DIN connections for magnetic cartridges and also the unusual facility of a further pair of phono sockets for a ceramic cartridge. The sensitivity of the inputs was satisfactory, as was the input impedance, but it is felt that the overload margin associated with the phono inputs is marginal.

In addition to these inputs, provision is made for connecting two tape units, one via phono sockets and the other with the alternative of phono sockets or a DIN compatible connector. a single rotary switch allows monitoring either tape unit and also dubbing from one to the other in either direction.

Whilst high pass and low pass filters are fitted, both these were rather a disaster, as the high pass filter played havoc below 200Hz and the low pass filter with its —3dB point at only 4kHz and —10dB at 10kHz completely ruined any form of music.

Whilst the treble and bass tone control has a reasonably sensible range, the fitting of detent mechanisms to the potentiometers gave far too large steps between some positions, the worst case being a gigantic 4.5dB at 10kHz with the treble control.

All controls had to some extent an effect on the balance between the amplifier's channels, as did the errors in the RIAA equalisation at high frequencies, but these effects were not severe.

Further front panel pushbutton switches select the mono or stereo modes of operation, and select the loudness control which boosts both the treble and the bass to a fairly mild extent. In addition, there are locking pushbutton switches for selecting either or both sets of loudspeaker terminals, with a headphone jack being provided. However, the output noise at the worst volume settings was particularly bad such that if headphones are to be used it is essential to use low impedance and insensitive types.

In contrast to this the phono input noise was very good, but the available dynamic range left much to be desired. On the plus side, the low level intermodulation distortion was good and the harmonic distortion low and free from crossover products.

Whilst the overall frequency response shown in the adjacent table appears to be not particularly good, this is due to roll-off in the bass area, and the practical overall response must not be criticised.

Meters are fitted to this amplifier, with both calibrations of decibels and power into 8 ohm loads. However, as is all too common, the meters are quite useless for indicating transient levels to the extent that they

indicated only 0.5W when the amplifier was clipping on musical transients. It is hard to understand why manufacturers waste money on such useless meters, when it could well be spent to benefit other parts of the amplifier.

Finally, the operation of the balance control was good, but subjective testing was disappointing with severe distortion on overloads and the poor performance of the filters and tone controls.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 38
D C offset at loudspeaker and headphones L/R .. 21/18mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —63/—72/—61dB
Loudness control effect ref 1kHz 100Hz/10kHz . +6/+3dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 1.5dB

Power performance

Power output into 8Ω both L/R 42W
Power output into 8Ω single L/R 48W
Power output into 4Ω both L/R ..... —W
Power output into 4Ω single L/R ..... —W
Burst output into 8Ω single L/R 54/53W
Burst output into 4Ω single L/R ..... —W
Power output into half rated load L/R 4Ω 68/64W
Power bandwidth 8Ω 17½W L/R ..... 10Hz to 40kHz
Power bandwidth 4 Ω W L/R ..... —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.04%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz ..... —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —73/72/55dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —76/75/75dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/>80dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/>80dB

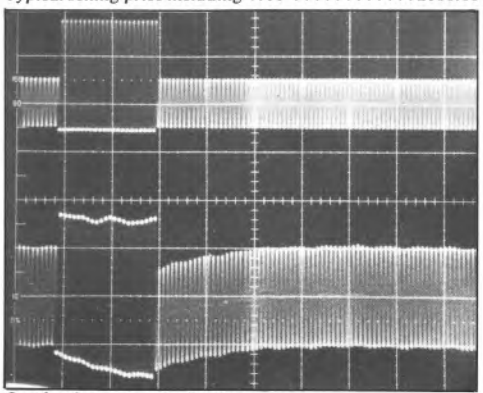
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 90/101dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114/120dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.08μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.63/0.20μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 77.4dB

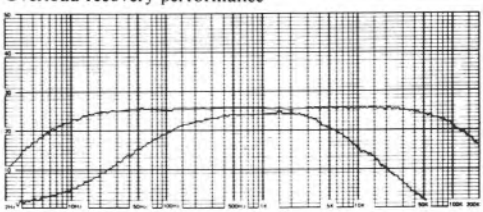
Inputs and outputs

Input impedance on aux/tuner/tape
..... 51/37-tape 59/41k 130:66pF
Input impedance on phono 48k 70pF
Input impedance on mic ..... —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 145mV 20V
Input sensitivity and clipping point at 1kHz
phono 2.5mV 130mV
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone 17V 320Ω
Output voltage and impedance for rated output —
tape ..... 145mV VARIΩ
Output voltage and impedance for rated output —
DIN 52mV 89kΩ

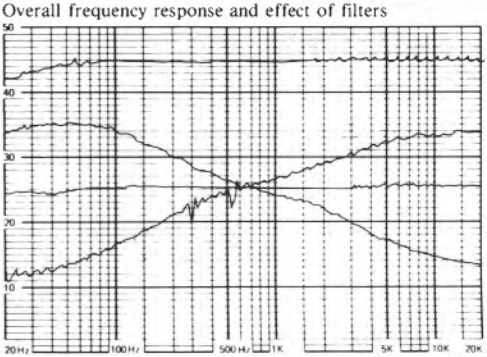
Typical selling price including VAT £100.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

BEST BUY

Rotel RA-1412

Rank Audio Products Ltd., PO Box 70, Great West Road, Brentford, Middlesex. 01-568 9222.

Rated at 110W per channel into loudspeakers of either 4 or 8 ohms impedance this is a substantial amplifier which also has a number of very sensible facilities. So far as power output is concerned, the measured performance was limited by the internal safety trip when working into 4 ohms, and this device also took exception to high frequencies into 8 ohms. Toneburst testing into 4 ohms showed that this trip was capable of producing large and fast spikes, with difficult material.

On the left hand side of the amplifier are three sets of loudspeaker terminals, selected by front panel pushbuttons. If the three sets are used in parallel, even 8 ohm units may not be sufficient.

To the right of the amplifier there are the inputs which comprise two auxiliary inputs and a tuner input as high level inputs which have sensible sensitivities, overload margins and impedance. In addition, there are two phono inputs which have switch selected sensitivity over the range 2.3, 3.8 and 7.6mV and also switch selected impedance over the range 25/50/100k ohms with a more than adequate overload performance — very good all round! Further facilities include two tape connectors which have DIN compatible connections in addition to the phono sockets which are available for all inputs, one of the phono inputs also having a DIN connector. Finally, there are pre-amplifier output/main amplifier input sockets which can be separated by a slide switch and also a microphone jack input on the front panel, the input having its own gain control for 'talk over'.

All except the tape connections are pushbutton selected, the tape connections having a monitoring/dubbing switch which includes dubbing in either direction. Crosstalk between inputs and across the tape monitor function was minimal.

This amplifier includes very good high pass and low pass filters, both of which have a choice of turnover frequency and 12dB per octave rate of attenuation. In addition, the switched tone controls for the treble and bass are each associated with a three position switch which provides an 'off' position and also a choice of two turnover frequencies. The tone control range is restricted to a practical amount of correction.

Neither the tone controls, nor the volume control or its associated attenuator, has any adverse effect upon the amplifier balance. Furthermore, the volume control increments of 2dB in addition to the attenuator range of —10 or —20dB provided well for both loudspeaker listening or listening via one of the two headphone jacks. The performance of the balance control was unusually good with a wide range of fine adjustment. The mode switch has the positions of stereo, reverse stereo, left, right or sum.

In addition to these controls, the front panel has two meters and an overload lamp which operated under tripped conditions. However, the meters are rather useless as they indicated only 0.5W, when running into clipping on transient programme material.

The noise performance was good in all respects with a good associated dynamic

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range, and with the exception of high frequency intermodulation distortion all measured performance parameters were to a high standard. The internal standard of construction was not too good, with untidy wiring and poor soldering where wire wrapping was not used. Also, there was no identification of components including a fuse and the mains lead was rather short in length.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 90
D C offset at loudspeaker and headphones L/R ... 4/38mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —75/—72/—48dB
Loudness control effect ref 1kHz 100Hz/10kHz+2/4/+0dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner ..... <0.5dB

Power performance

Power output into 8Ω both L/R 129/130W
Power output into 8Ω single L/R 130/131W
Power output into 4Ω both L/R 132/130W
Power output into 4Ω single L/R 179/175W*
Burst output into 8Ω single L/R 150/153W
Burst output into 4Ω single L/R 179/175W*
Power output into half rated load L/R 2Ω 100/87W
Power bandwidth 8Ω 55W L/R ..... 10Hz to 49.5kHz
Power bandwidth 4Ω 55 W L/R..... 10Hz to 45kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.04%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —79/80/*dB*
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —80/78/*dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/71dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/71dB

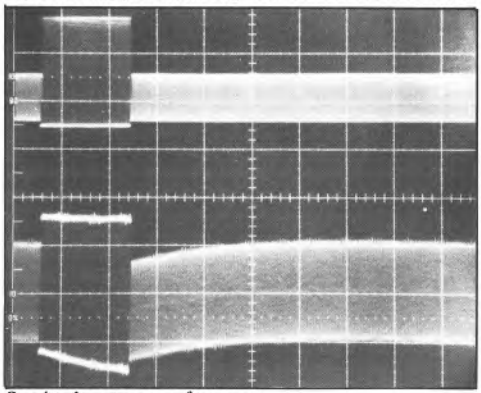
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 106/107dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114/119.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic 109/118dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.004/0.002μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.16/0.13μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 91dB

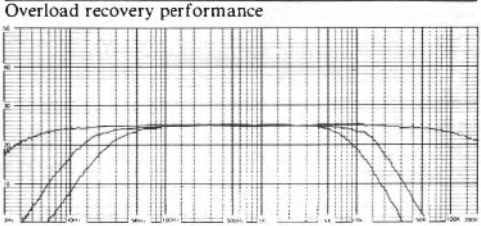
Inputs and outputs

Input impedance on aux/tuner/tape
..... 33/31; tape 42/39k 200; 110pF
Input impedance on phono at min/max volume
..... 25/50/100k 150pF
Input impedance on mic at min/max volume 48k 20pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape..... 140mV 20V
Input sensitivity and clipping point at 1kHz
phono..... 1.9mV 310mV*
Input sensitivity and clipping point at 1kHz mic
..... 1.8mV >20V
Output voltage and impedance for rated output —
headphone..... 30V 330Ω
Output voltage and impedance for rated output —
tape..... 140mV VARIΩ
Output voltage and impedance for rated output —
DIN 40mV 82kΩ

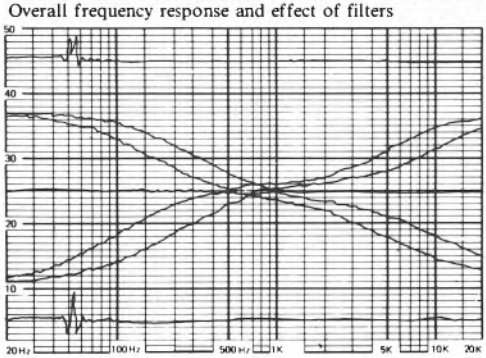
Typical selling price including VAT £454.40



Overload recovery performance



Overall frequency response and effect of filters

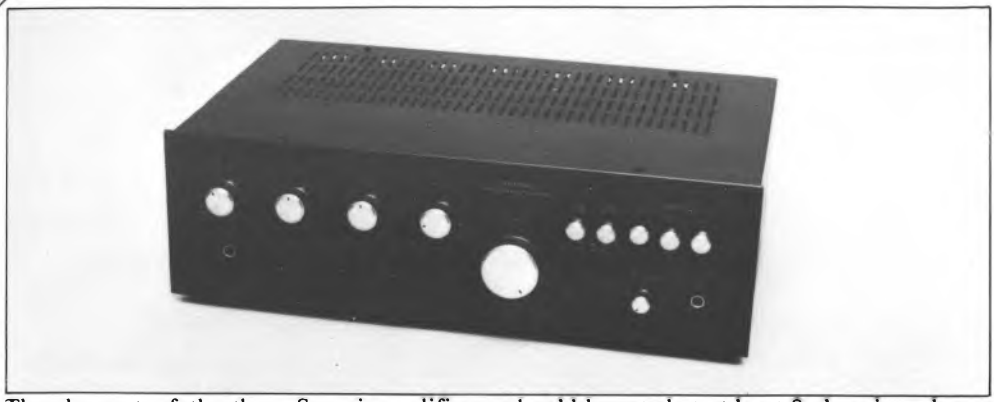


Effect of tone controls and accuracy of RIAA equalisation

BEST BU

Sansui AU-3900

Sansui London Showroom, 39/41 Maple Street, London W1. 01-580 5353.



The cheapest of the three Sansui amplifiers reviewed in this book, the model AU-3900 offers the basic facilities required for a straightforward audio system in a neat and well finished package.

The three basic inputs comprising auxiliary, tuner and magnetic phono are selected by front panel pushbuttons as are a stereo/monophonic mode and the tape monitor function of the tape input/output which is connected by phono sockets and is not DIN compatible. The levels and impedances of all these connections are all sensible, and the phono input has an adequate overload margin.

In addition to these facilities, there is a microphone input by means of a front panel jack socket, the input being activated when a jack is inserted, and the level being controlled by a separate level control such that it is possible to 'talk over' the inputs from other sources. The microphone input which is a monophonic connection had adequate sensitivity for high impedance moving coil microphones.

Output facilities include provision for connecting two sets of loudspeakers, with switch selection of either 'on/off' position for headphone listening via the front panel headphone jack, or selection of either or both sets of loudspeakers.

The amplifier performance was found to be such that the protection circuits operated at relatively low powers into 2 ohms, and it is recommended that where two sets of loudspeakers are in simultaneous use they should be rated at at least 8 ohms impedance. In other respects, the power output was well up to standard with the manufacturers' rating of 25W into 8 ohms or 26W into 4 ohms being met with a good power bandwidth and reasonable distortion performance.

Whilst no high pass filter is fitted, the manufacturer has seen the sense to roll off the low frequency performance below 20Hz and the low pass filter which is operated by a toggle switch offers a reasonable performance but may be thought to offer too much high frequency attenuation for some purposes.

Further controls comprise the treble and bass tone controls which are in the form of eleven position rotary controls and it was felt that the available range was rather large and that the steps between positions was subjectively on the large side. The volume control which is of the conventional potentiometer type had good performance for both loudspeaker and headphone listening without any alteration to the balance between amplifier channels, as was the case with the tone controls.

The final front panel control is the loudness control which provided a 7.5dB boost at 100Hz and at 10kHz, the effect being rather dramatic, but maybe suitable for those who like this type of control.

From a point of view of noise, this amplifier offers very good performance at the phono input together with a good performance in all other respects and minimal output noise which could affect headphone listening.

Subjectively this amplifier behaved very

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well, except under low frequency overload conditions where the effect was unpleasant. Crosstalk between inputs and across the tape monitor switch was minimal and to an unusually high standard.

Likewise, the standard of finish and construction was excellent with very clear printed circuit board layouts and a high standard of soldering.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 105
D C offset at loudspeaker and headphones L/R 3/5mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —79/—65/—41dB
Loudness control effect ref 1kHz 100Hz/10kHz ... +7.5dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner ..... <0.5dB

Power performance

Power output into 8Ω both L/R 27W
Power output into 8Ω single L/R 33W
Power output into 4Ω both L/R 31/30W
Power output into 4Ω single L/R 40W
Burst output into 8Ω single L/R 35/39W
Burst output into 4Ω single L/R 55/57W
Power output into half rated load L/R 2Ω 29/33W
Power bandwidth 8Ω 12.5W L/R ..... 10Hz to 52kHz
Power bandwidth 4Ω 13 W L/R ..... 11Hz to 43kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.04%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.05%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —74/78/57dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —74/68/46dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —80/72/68dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —80/80/61dB

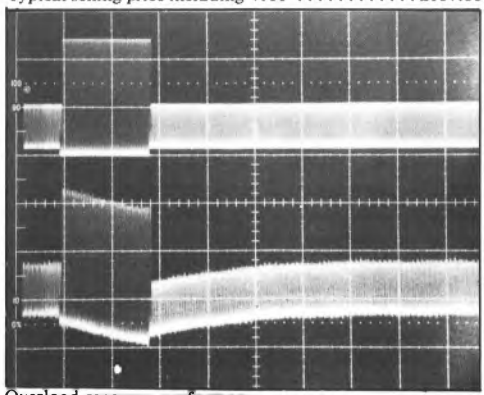
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 102.5/108.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114/117dBV
Noise ref to input — average L/R CCIR/22kHz
Mic 111/116.5dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.03/0.008μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.025/0.063μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 91.5dB

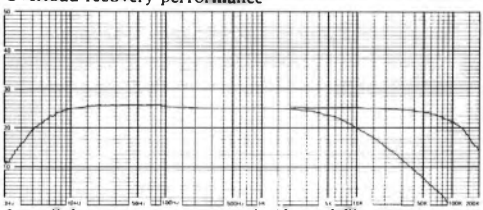
Inputs and outputs

Input impedance on aux/tuner/tape 51k 60pF
Input impedance on phono 50.1k 36pF
Input impedance on mic 10.6k 20pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 120mV 20V
Input sensitivity and clipping point at 1kHz
phono 2.3mV 200mV
Input sensitivity and clipping point at 1kHz mic
..... 2.1mV 150mV
Output voltage and impedance for rated output —
headphone 14V 220Ω
Output voltage and impedance for rated output —
tape 104mV 4.4Ω
Output voltage and impedance for rated output —
DIN ..... —kΩ

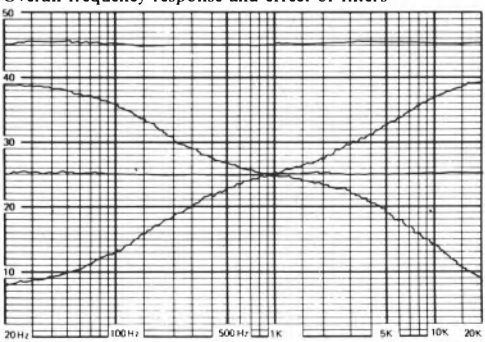
Typical selling price including VAT £107.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Sansui AU-7900

Sansui London Showroom, 39/41 Maple Street, London W1. 01-580 5353.

Rated at 75W per channel into 8 ohms, this amplifier is not only quite powerful enough for domestic listening but also has unusually comprehensive facilities combined with a very good all round performance.

The styling is unusual with the rear of the amplifier having a shelf upon which all the connectors are mounted. Also, the front panel is well designed with all alloy finished knobs being clearly identified on the dark panel.

The amplifier's inputs cater for two auxiliaries, a tuner and two magnetic pick-up cartridges in addition to two tape units, the latter having one DIN connector and phono connectors like the other inputs. Whilst one phono input has a fixed input impedance, the other has switch selection of 33/53/110k ohms in parallel with 56pF the sensitivity of both inputs being fixed at 2.7mV with an adequate overload margin. So far as the tape units are concerned, full tape dubbing and monitoring facilities can be selected by a single switch.

Noise performance was well above average so far as the inputs are concerned and the available dynamic range is excellent. However, the noise at the worst volume setting was not good with noise peaks occurring at both 10 o'clock and 2 o'clock settings. However, in other respects the volume control worked well, and in conjunction with the switched 'mute' facility of either 10dB or 26dB (nominally 30dB) — an adequate range for loudspeaker or headphone listening.

Provision is made for two sets of loudspeakers with switch selection of either or both sets, but the amplifier performance was such that 8 ohm loudspeakers should be used and perhaps the use of a single pair of 4 ohm loudspeakers is not the optimum in view of the loss of power into 2 compared with 4 ohms.

Tone controls and filters are selected by a three position toggle switch which offers a 'defeat' position plus 'filters only' or tone control and filters positions. Two high pass and two low pass filter combinations are available, the high pass filters being of the 12dB per octave type at good frequencies, whilst the low pass filters are also excellent and certainly close to the ideal.

Similarly, the tone controls are comprehensive with bass, mid-range and treble controls. Both the treble and the bass controls have a choice of three turnover frequencies with the controls themselves being eleven position switches like the mid-range control. Whilst the correction range of the mid-range control was first class, it is felt that the available range of the treble and bass controls is unnecessarily wide, with the result that the steps between the switch positioning are on the large side.

The remaining facilities on the front panel include a stereo/reverse stereo/mono switch plus the balance control which is concentric with the volume control and had an excellent correction characteristic.

Like quite a few recent amplifiers, connections at the rear are available to give access to the pre-amplifier output and the power amplifier input, the two being separable by a rear panel slide switch which gives an input/output interface at 0.7V.

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Other than the worst volume setting noise, the subjective performance of this amplifier was excellent with good filters and tone controls and a clean overload performance. The standard of construction was very high with well made circuit boards, tidy wiring and proper component identification.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz..... 100
D C offset at loudspeaker and headphones L/R . . 18/23mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz..... —80/—75/—41dB
Loudness control effect ref 1kHz 100Hz/10kHz +7/+7.5dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner ..... <0.5dB

Power performance

Power output into 8Ω both L/R..... 79W
Power output into 8Ω single L/R 83/87W
Power output into 4Ω both L/R..... 132W
Power output into 4Ω single L/R 142W
Burst output into 8Ω single L/R..... 77W
Burst output into 4Ω single L/R..... 145W
Power output into half rated load L/R 2Ω 55W
Power bandwidth ref rated load & ouput
8Ω 37½W L/R ..... 10Hz to 28kHz
Power bandwidth ref rated load and output 4Ω
37½W L/R..... 10Hz to 24kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.05%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.03/0.04%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz..... —>80/77/52dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz..... —>80/78/50dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/>80dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/76dB

Noise performance

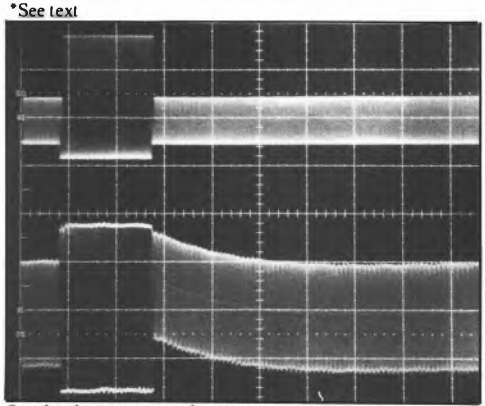
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape..... 110/155dBV
Noise ref to input — average L/R CCIR/22kHz
Phono..... 114/119dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz..... 0.04/0.01μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz..... 0.31/0.079μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR..... 92dB

Inputs and outputs

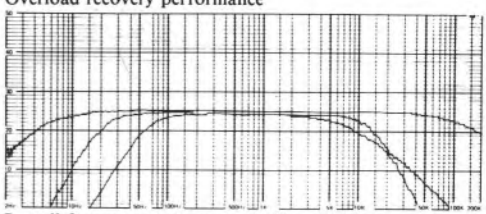
Input impedance on aux/tuner/tape at min/max
volume..... 46/33k 170; 180; 140pF
Input impedance on phono at min/max volume52.5k 56pF*
Input impedance on mic at min/max volume ..... —pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape ..... 130mV >20V
Input sensitivity and clipping point at 1kHz
phono..... 2.7mV 280mV
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone..... 25V 220Ω
Output voltage and impedance for rated output —
tape..... 130mV VARIΩ
Output voltage and impedance for rated output —
DIN 38mV 73kΩ

Typical selling price including VAT £253.00

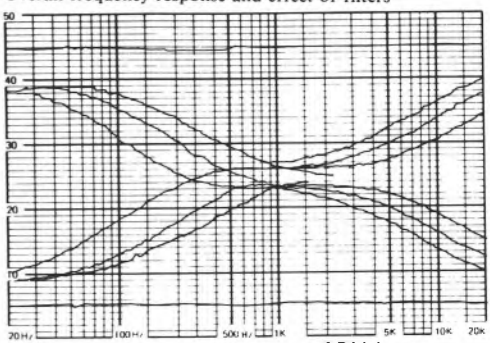
*See text



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

BEST BUY

Sansui AU-11000A

Sansui London Showroom, 39/41 Maple Street, London W1. 01-580 5353.

Rated at 110W per channel into either 4 or 8 ohms this is a large and powerful amplifier which has complex facilities including tape monitoring and dubbing and a good choice of inputs.

Input selection is by means of two switches, a toggle switch which selects the tuner input or the other inputs which are associated with a rotary switch. The latter selects a choice of two high level auxiliary inputs or a choice of two magnetic cartridge inputs one of which has variable sensitivity and input impedance. Both phono inputs had an input capacitance of 200pF which could be on the high side with a resistance of 50k ohms, but the input resistance of the phono 1 inputs can be switched to alternatives of 98k or 32k ohms and its sensitivity varied from the 1.8mV sensitivity of the phono 2 input in 6dB steps up to 8mV nominal. Even at the 1.8mV sensitivity the overload margin was very good at 320mV.

The remaining inputs had a satisfactorily high input impedance and the tape connections, one of which has a DIN compatible socket in addition to the phono sockets, offered a versatile system.

Outputs are provided for two sets of loudspeakers and for headphones, the operation being controlled by a switch which selects either or both sets of loudspeakers or an 'off' position. As can be seen from the adjacent tables this is one of the few amplifiers which really doesn't mind 2 ohm loads, so no troubles will be encountered with running two sets of 8 ohm loudspeakers.

The noise performance of all the inputs was good, with the phono input offering a really exceptional performance and the zero volume setting noise also being good. However, the headphone arrangement was such that noise can be troublesome at worst case volume control settings in spite of a 20dB 'mute' switch associated with the volume control.

In other respects, the performance of the volume control was good, and the balance control offered an easily set control of balance which remained good with the operation of any other controls.

The operation of the tone controls and the filters is by a three position rotary switch which has a 'defeat' position and positions for filters only or tone controls and filters. The characteristics of the latter were extremely well chosen with 12dB per octave high pass filters and a choice of two low pass filters neither of which was too drastic in its subjective effects.

Likewise, the tone controls which comprise bass, mid-range and treble controls in the form of eleven position switches presented a versatile correction system as the bass and treble controls each have switch selection of three turnover frequencies with the mid-range control giving a fine mid-frequency correction.

Subjective testing did not reveal any shortcomings in this amplifier and confirmed that the performance under overload conditions was excellent with a clean recovery. Crosstalk between input sources was effectively non-existant with the rotary

BEST BUY

selector switch and very good with the tuner switch and the tape switches.

So far as the standard of construction is concerned, this is superb, with first quality printed circuit boards with full identifications. Similarly, the exterior presentation is workmanlike and the design does not have unnecessary frills such as a loudness control or other knobs which are of little practical use.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 128
D C offset at loudspeaker and headphones L/R ... 5/11mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —76/—68/—47dB
Loudness control effect ref 1kHz 100Hz/10kHz ..... —dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner ..... <0.5dB

Power performance

Power output into 8Ω both L/R 128W
Power output into 8Ω single L/R 133/135W
Power output into 4Ω both L/R 193/192W
Power output into 4Ω single L/R 205/206W
Burst output into 8Ω single L/R 127/132W
Burst output into 4Ω single L/R 205/206W
Power output into half rated load L/R 2Ω 173/191W
Power bandwidth ref rated load & ouput
8Ω 55W L/R ..... 10Hz to 57kHz
Power bandwidth ref rated load and output 4Ω
55 W L/R ..... 10Hz to 21kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.06%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.08/0.07%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —80/80/53dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —>80/>80/36dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/>80dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/>80dB

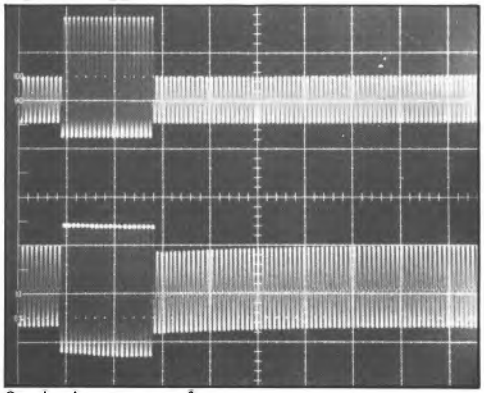
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 104/110dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 118.5/123.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.006/0.055μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.79/0.20μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 87dB

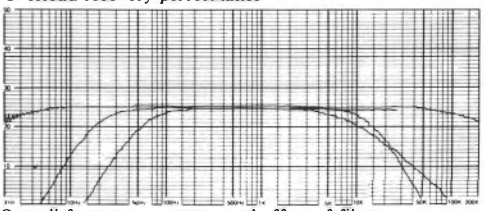
Inputs and outputs

Input impedance on aux/tuner/tape at min/max
volume 155/148K 210pF
Input impedance on phono at min/max volume
..... 60/53k 100pF
Input impedance on mic at min/max volume .. 49k 200pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 135mV 20V
Input sensitivity and clipping point at 1kHz
phono 1.8mV 320mV*
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone 30V 220Ω
Output voltage and impedance for rated output —
tape ..... 135mV VARIΩ
Output voltage and impedance for rated output —
DIN 28mV 75kΩ

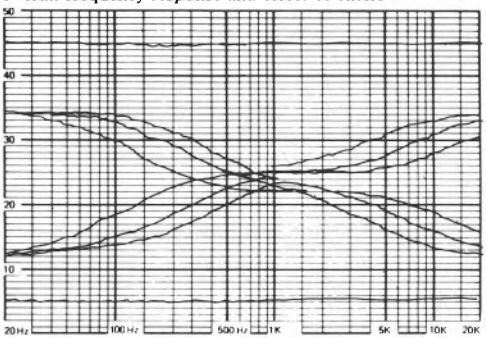
Typical selling price including VAT £496.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

BEST BUY

Sanyo DCA-1001

Sanyo Marubeni Ltd., Bushey Mill Lane, Watford, Herts. Watford 30421.

This model is a simple basic amplifier which has a rating of 50W into 8 ohms for each channel and does not object too much to a load of 4 ohms which will be presented by some loudspeakers with a nominal impedance of 8 ohms.

A selector switch accepts the inputs from a tuner and auxiliary input plus a single magnetic cartridge input, all these inputs having adequate sensitivities and sensible impedances. The phono input has perhaps a marginal overload capability, with input clipping occurring at 135mV, but its input resistance is sensible and the input capacitance small.

Tape input and output voltages are generally compatible with most tape units, but no DIN connection is fitted and the use of DIN compatible tape units requires a special adaptor lead.

Control of the tape signals is by a single rotary switch which selects either of the two tape units for monitoring, and also has positions for dubbing from tape 1 to tape 2 or vice versa. The crosstalk performance of this switch and of the input selector was minimal, the input selector being to an unusually high standard.

The amplifier has output terminals for two sets of loudspeakers and for one pair of headphones, via a front panel jack socket, the loudspeakers being selected by a rotary switch which has an 'off' position and positions for either or both sets of loudspeakers.

Whilst the noise performance of the high level inputs was good, the noise associated with the phono input was well below average and also noise was troublesome when listening with headphones. This was caused by two positions of the volume control where noise was high, in association with the high output voltage at the headphone jack socket.

In other respects, the volume control provided a full and adequate range without interfering with the amplifier balance, and the balance control itself was also easy to use. A large toggle switch is used to select the filter which consists of a high pass filter with 6dB per octave rate of attenuation and a —3dB point at 70Hz — it was not felt that this is a very good combination, and whilst the amplifier's frequency response is rolled off above 20kHz it was felt that a low pass filter would have been of far more practical use.

A further toggle switch inserts the loudness control which had a massive 8dB boost at 100Hz plus a milder 5dB boost at 10kHz; goodness knows how that 8dB boost at 100Hz can be justified on subjective grounds!

The final front panel controls of interest are the treble and bass tone controls and their associated on/off switch. The tone controls are of the potentiometer type with a mechanical detent giving the effect of an eleven position switch. Unfortunately the control laws were such that the difference between adjacent positions could rise to an excessive 4dB, and the controls would as a result have been far better without the mechanical detent mechanism. In other respects the tone controls were satisfactory, with their operation having little effect upon

BEST BUY

the amplifier balance and with the range of correction available not being excessive.

The general presentation of this amplifier is conventional, and the standard of construction was good with tidy wiring and properly identified printed circuit boards.

Listening tests showed that the performance was reasonable, but the criticisms of the headphone output, the tone controls and the loudness control plus the poor filter do not make this amplifier particularly attractive.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz..... 109
D C offset at loudspeaker and headphones L/R . . . 6/25mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz..... —>80/—74/—65dB
Loudness control effect ref 1kHz 100Hz/10kHz . +8/+5dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 1dB

Power performance

Power output into 8Ω both L/R..... 57W
Power output into 8Ω single L/R..... 65W
Power output into 4Ω both L/R..... —W
Power output into 4Ω single L/R..... —W
Burst output into 8Ω single L/R..... 72/67W
Burst output into 4Ω single L/R..... —W
Power output into half rated load L/R 4Ω 35/34W
Power bandwidth 8Ω 25W L/R ..... 10Hz to 24/23kHz
Power bandwidth 4Ω —W L/R..... —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03/0.08%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz ..... —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —75/77/60dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —80/77/44dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz..... —80/73/56dB
IM distortion at 1W from phono input DF3
1/10/100kHz..... —>80/72/54dB

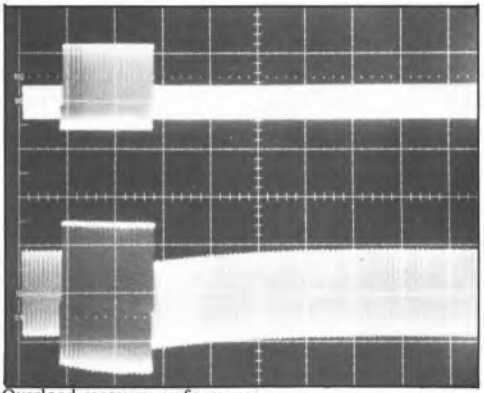
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 106/110.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 112.5/118dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz..... 0.07/0.025μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz..... 0.30/0.17μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 90dB

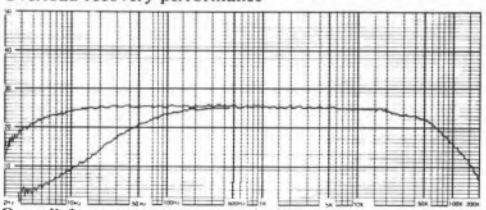
Inputs and outputs

Input impedance on aux/tuner/tape at min/max
volume..... 92/77k 150; 140; 70pF
Input impedance on phono at min/max volume . . 51k 25pF
Input impedance on mic at min/max volume..... —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape..... 130mV 20V
Input sensitivity and clipping point at 1kHz
phono..... 2.5mV 135mV
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone..... 20V 460Ω
Output voltage and impedance for rated output —
tape..... 130mV VARIΩ
Output voltage and impedance for rated output —
DIN ..... —kΩ

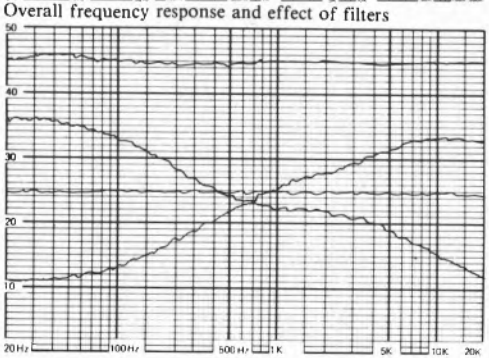
Typical selling price including VAT £120.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Setton AS-3300

Lewin-Adams Marketing Ltd., Clarke Road, Mount Farm, Milton Keynes, Bucks. 0908 75764.

The first thing which strikes one about this amplifier is its unusual styling with unconventional knobs and a section of the front panel which has two meters and a similarly sized section called the 'security panel'. In practical terms this panel and the meters are of negligible use, as the meters are far too slow to indicate anything like the peak power on transient music (up to 26dB error!) and all the 'security panel' does is to have three lights which respectively indicate overheating, that protection circuits have shut down the amplifier, or that the amplifier is operating.

So far as the styling of the knobs is concerned, the potentiometer and switch knobs have a lozenge shaped bar bisecting them, but this styling was rather confusing as it is not clear which end of the bar shows the direction in which the knob is pointing.

The amplifier's inputs include two auxiliary inputs, a tuner and two magnetic pick-up inputs of fixed and sensible impedance but switchable sensitivity to 2.5mV or 5mV with an adequate overload margin. In addition there is a front panel jack for a stereo microphone of the high impedance moving coil type, this input having its own gain control.

Provision is also made for two tape units with the addition of a single DIN compatible connection for one unit. Two pressbutton switches allow monitoring of either tape unit and also allow dubbing.

Outputs include terminals for three sets of loudspeakers with rotary switch selection of any individual loudspeaker or the pairs of loudspeakers 1 and 2, or 1 and 3. The switch also has a 'phones' position which is in fact a speakers 'off' position, as the headphone jack socket is always connected.

Whilst the manufacturer rates the amplifier into 8 ohm loads there is more than adequate power available into 4 ohms and the clipping point into 2 ohms is in excess of 80W. Therefore the use of two sets of 8 ohm loudspeakers should not present any problems. All forms of distortion were of a very good standard and the noise performance of the inputs was excellent. However, headphone listening revealed the presence of hum and noise — a worst case occurring at the 9 o'clock volume control setting.

The volume control itself had a good performance, and being of the switched attenuator type it did not affect amplifier balance and it was pleasing to note that the attenuator steps were adequately small. Concentric with the volume control there is the balance control which offered reasonable performance.

Three neat pushbutton switches are used to select the loudness contour, insert the filter and activate the tone controls. As is all too usual, the loudness control introduced an enormous bass boost plus a mild treble boost.

No high pass filter is fitted, and the existing low pass filter was subjectively a disaster as its frequency was far too low. On the other hand, the switched bass, mid-frequency and treble tone controls were good, with the turnover frequency of the bass and treble controls being

selectable by means of two pushbuttons.

As can be seen from the adjacent plot of frequency response, the RIAA equalisation showed some unbalance between channels at high frequencies but the tone controls did not have this shortcoming to a significant extent.

Finally it must be mentioned that the standard of construction of this amplifier was excellent both externally and internally.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz. 115
D C offset at loudspeaker and headphones L/R . . 28/37mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz. . . . . —>80/—75/—50dB
Loudness control effect ref 1kHz 100Hz/10kHz . +8/+3dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 1dB

Power performance

Power output into 8Ω both L/R 67W
Power output into 8Ω single L/R 78/79W
Power output into 4Ω both L/R . . . . . —W
Power output into 4Ω single L/R . . . . . —W
Burst output into 8Ω single L/R 86/88W
Burst output into 4Ω single L/R . . . . . —
Power output into half rated load L/R 4Ω 113/117W
Power bandwidth ref rated load & ouput
8Ω 27½W L/R . . . . . 10Hz to 44/45kHz
Power bandwidth ref rated load and output 4Ω
—W L/R . . . . . —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.02/0.03%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz. . . . . —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —77/75/45dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz. . . . . —>80/>80/60dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz. . . . . —>80/80/70dB
IM distortion at 1W from phono input DF3
1/10/100kHz. . . . . —>80/79/58dB

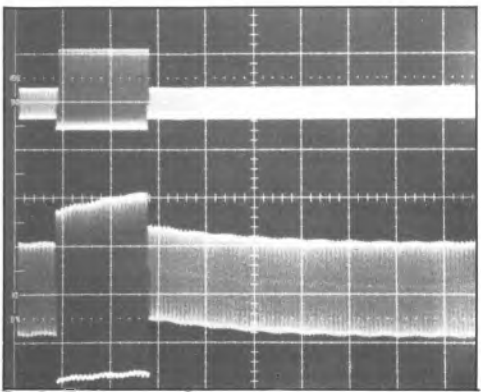
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 115/119.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114/115.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic 113/120dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz. 0.06/0.03μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz. 0.20/0.06μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 90.5dB

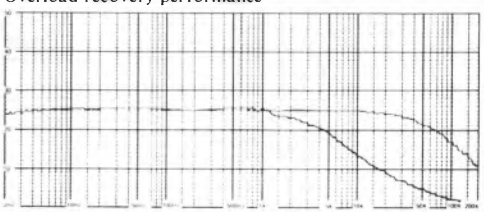
Inputs and outputs

Input impedance on aux/tuner/tape at min/max
volume 71/91k 150pF
Input impedance on phono at min/max volume . . 50k 20pF
Input impedance on mic at min/max volume . . . 10k 140pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape . . . . . 150mV >20V
Input sensitivity and clipping point at 1kHz
phono. 2.5mV 190mV
Input sensitivity and clipping point at 1kHz mic
. . . . . 5.4mV >20mV
Output voltage and impedance for rated output —
headphone. 21V 270Ω
Output voltage and impedance for rated output —
tape. 150mV 2200Ω
Output voltage and impedance for rated output —
DIN 28mV 23kΩ

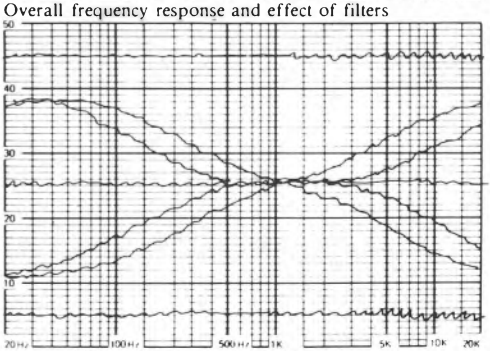
Typical selling price including VAT £293.71



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Sony TA-2650

Sony London Showroom: 134 Regent Street, London W1. 01-439 3874.

With a rating of 43W per channel into 8 ohms this amplifier has quite adequate power for domestic listening even with inefficient loudspeakers. Furthermore, the amplifier can produce even more power into 4 ohms which gives it a good safety margin when working into nominal 8 ohm loudspeakers. Two loudspeaker outputs are provided, with switch selection of either or both outputs in addition to an 'off' position for headphone listening. An unusual feature of this arrangement is that when both outputs are in circuit they are arranged so that the two sets of loudspeakers are wired in series, therefore the amplifier sees the sum of the loudspeaker impedances which is better than the common arrangement of seeing the loudspeakers in parallel.

Unfortunately the headphone output proved to be a disaster, as the amplifiers' noise at the worst volume settings was extremely high, to the extent that the use of headphones of most types is intolerable. Similarly, the use of efficient loudspeakers will have the same snag, and on these grounds alone this amplifier cannot be recommended.

The volume control itself is a stepped attenuator type which works in conjunction with a 20dB muting switch, giving a good control for both loudspeaker and headphone listening without any change of amplifier balance with the control settings. Similarly other controls had no significant effect upon balance and the eleven position treble and bass tone controls had a more than adequate correction range, however the correction steps became rather large at the extreme settings of both controls.

Operation of the balance control was rather coarse about the mid position, the control offering a full range so that either loudspeaker could be cut off. Unfortunately this amplifier does not have any filters, and as its bandwidth is not restricted to the audio frequency band this is rather a serious omission.

A toggle switch, labelled Acoustic compensation' provides a loudness contour in one position, and introduces a presence boost in the other position with a mid position being an 'off' position. The degree of presence boost was quite reasonable and useful, being in practice a boost of about 3dB between 500Hz and 5kHz.

Further amplifier controls consist of the input source selector which selects the tuner, auxiliary or magnetic phono inputs and two toggle switches which control the two tape inputs. Crosstalk between input sources was not particularly good, and similarly crosstalk across the tape monitor switch could have been better.

With the exceptions of a DIN compatible tape connector and twin jacks for connecting a tape unit at the front panel, all connections for inputs are phono sockets, the front panel jacks being wired in parallel with the rear panel tape connectors.

The impedances, levels and overload margins of all inputs were satisfactory and the noise performance of the magnetic cartridge input was unusually good.

Whilst the harmonic distortion performance was to a high standard, intermodulation

distortion was disappointing at high and at low powers in comparison with many amplifiers, however the overload recovery characteristics were subjectively excellent.

Also on the credit side, the external finish of the brushed alloy front panel and the wooden ends was excellent, with the internal parts of the amplifier also being well finished with a high standard of workmanship and properly identified components.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0/6/0dB
Damping factor ref 8Ω at 1 kHz 50
D C offset at loudspeaker and headphones L/R . . 25/19mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —80/—74/—61dB
Loudness control effect ref 1kHz 100Hz/10kHz +6/+1.5dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 0.5dB

Power performance

Power output into 8Ω both L/R 53W
Power output into 8Ω single L/R 61W
Power output into 4Ω both L/R . . . . . —W
Power output into 4Ω single L/R . . . . . —W
Burst output into 8Ω single L/R 64W
Burst output into 4Ω single L/R . . . . . —W
Power output into half rated load L/R 4Ω 66/65W
Power bandwidth 8Ω 21½W L/R . . . . . 10Hz to 47/41kHz
Power bandwidth 4Ω —W L/R . . . . . —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.04%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz . . . . . —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —74/72/40dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —74/75/40dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —75/75/72dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —75/75/76dB

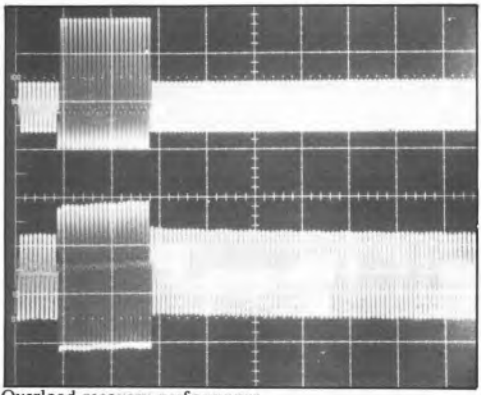
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 102/106dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114/118dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.16/0.06μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.63/0.20μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 86dB

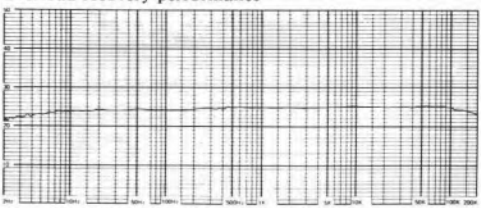
Inputs and outputs

Input impedance on aux/tuner/tape
. . . . . 94/66; 94/66; 119/77k 150; 170; 120pF
Input impedance on phono 50k 75pF
Input impedance on mic . . . . . —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 130mV 20V
Input sensitivity and clipping point at 1kHz
phono 2.6mV 200mV
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output —
headphone 18. 5V 475Ω
Output voltage and impedance for rated output —
tape 130mV 10kΩ
Output voltage and impedance for rated output —
DIN 21mV 77kΩ

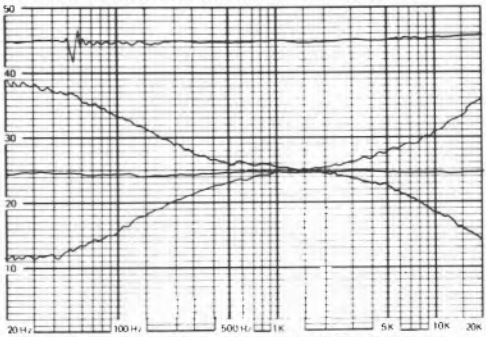
Typical selling price including VAT £135.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Sony TA-3650

Sony London Showroom, 134 Regent Street, London W1. 01-439 3874.

One of the most impressive features of this amplifier is the extremely clean front panel layout with neat knobs, toggle switches and pushbutton switches on the brushed alloy front. Not only is the external finish excellent, but within the amplifier, first class printed circuit boards are used with good layouts and proper component identification.

The rear of the amplifier houses the IEC mains connector and clip type connectors for the two sets of loudspeakers, in addition to the phono sockets for the signal connections. Of the two connections for tape units, one has a DIN compatible socket and the other a jack socket on the front panel for tape monitoring.

The basic inputs consist of single auxiliary and tuner inputs and also two inputs for magnetic cartridges, all inputs having fixed and sensible impedances and sensitivities and the pick-up inputs having an adequate overload capability. These four basic inputs are selected by a rotary switch which exhibited rather poor crosstalk between wanted and unwanted inputs; similarly the tape monitor switch was not particularly satisfactory. This switch is a three-position toggle type like the tape dubbing switch which permits dubbing in either direction between tape units. A similar switch selects the stereo mode, reverse stereo or monophonic operation.

A further pair of toggle switches insert the high pass and the low pass filters, both of which are subjectively mild in their functions and generally are not a particularly good compromise for an amplifier in this price bracket, as they are the only restriction to the amplifier's bandwidth. The treble and bass tone controls are however very good in their operation as they both have the right choice of turnover frequency which is selected by a pair of pushbuttons, in addition to which there is a tone controls defeat pushbutton.

Further buttons insert the loudness contour which is not particularly violent in its treble and bass boosts, and also a presence contour which is a very mild mid-frequency boost amounting to around 2dB in the 1kHz area.

The volume control is of the stepped attenuator type and works in conjunction with a 20dB 'muting' switch such that the full control range of the pair is adequate for both loudspeaker listening and for headphone listening. However, when using the headphones there was a very high level of noise at the worst case volume control setting and also an intolerable amount of mains hum at the maximum volume setting — a problem if using efficient loudspeakers

Selection of the two sets of loudspeakers is by a rotary switch which has listening positions for selecting either or both sets of loudspeakers and for switching off the headphones. When both loudspeakers are selected they are in fact wired in series so that the amplifier works into the sum of their impedances. This is generally a very good idea allowing the use of 4 ohm loudspeakers.

The noise performance of the amplifier was good except for the previously mentioned output noise problem, and also the audio frequency distortion was very low, but the high frequency intermodulation performance

would suggest that the amplifier may be prone to transient intermodulation problems.

Practical operation of the amplifier was found to be simple as a result of the excellent layout, and the subjective effects of the controls were without problems. It was however noted that the amplifier sounded rough under overload conditions, and this may be explained by the current limiting which restricted the measurement of power output into 2 ohm loads.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 10/10/8dB
Damping factor ref 8Ω at 1 kHz 43
D C offset at loudspeaker and headphones L/R
. . . . . 19/40 and 10/20mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —>80/—>80/—67dB
Loudness control effect ref 1kHz 100Hz/10kHz . +6/+3dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner . . . . . <0.5dB

Power performance

Power output into 8Ω both L/R 64/62W
Power output into 8Ω single L/R 73/71W
Power output into 4Ω both L/R 78/81W
Power output into 4Ω single L/R 97/105W
Burst output into 8Ω single L/R 80/81W
Burst output into 4Ω single L/R 128/130W
Power output into half rated load L/R 2Ω 49/48W*
Power bandwidth 8Ω 30W L/R . . . . . 10Hz to 37/28kHz
Power bandwidth 4Ω 35 W L/R . . . . . 10Hz to 21/19kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.04%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.06/0.04%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —80/80/30dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —80/80/30dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —80/80/64dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —80/80/70dB

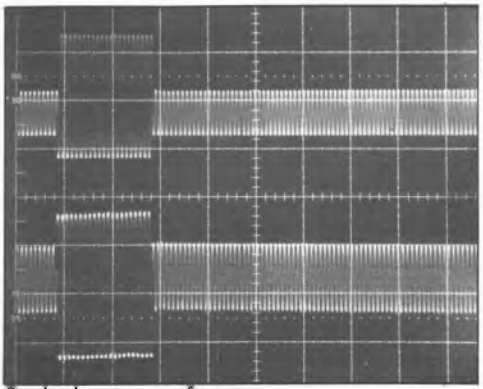
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 107.5/112dBV
Noise ref to input — average L/R CCIR/22kHz
Phono . . . . . 113.5/117 .5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.05/0.016μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.20/0.063μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 91.5dB

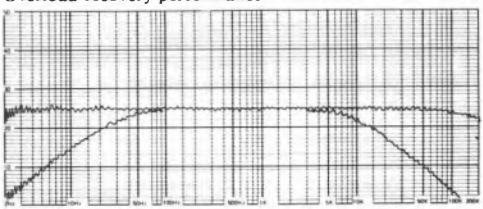
Inputs and outputs

Input impedance on aux/tuner/tape
. . . . . 97/72 tape 118/83k 300; 140pF
Input impedance on phono 45k 98pF
Input impedance on mic . . . . . —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape . . . . . 135mV >20V
Input sensitivity and clipping point at 1kHz
phono 2.2mV 220mV
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output —
headphone 11V 220Ω
Output voltage and impedance for rated output —
tape . . . . . 132mV VARIΩ
Output voltage and impedance for rated output —
DIN 18mV 83kΩ

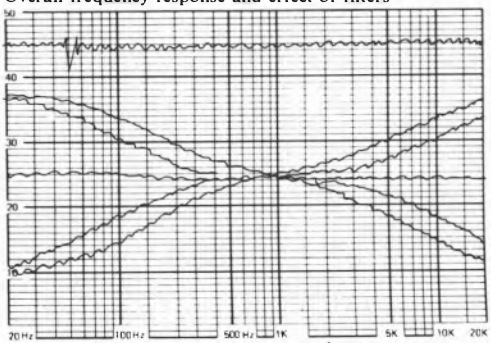
Typical selling price including VAT £190.00



Overload recovery performance



Overall frequency response and effect of filters

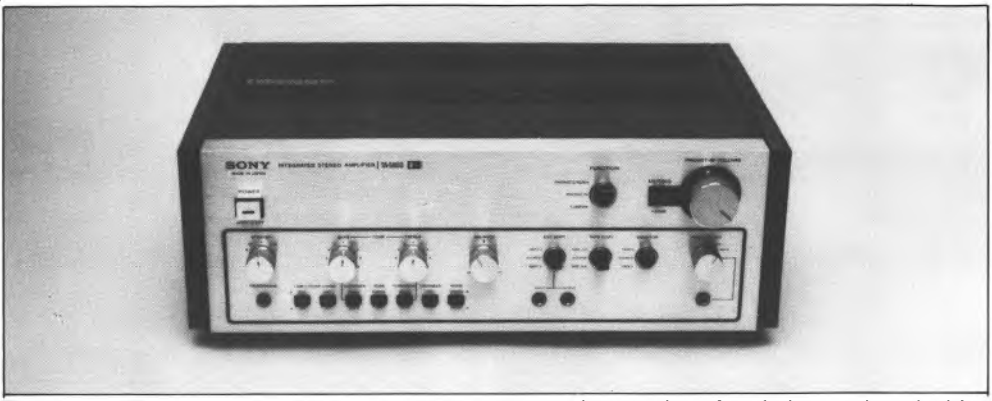


Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

Sony TA-5650

Sony London Showroom, 134 Regent Street, London W1. 01-439 3874.



This amplifier is one of the very few commercially available which use a sort of transistor known as a 'vertical junction field effect' device. Such devices overcome many difficulties found with conventional transistors as used in amplifier output stages, and examination of the distortion performance of this amplifier demonstrates some of the advantages which have been gained; it will however be noted that the intermodulation distortion of the phono input is not as good as some amplifiers.

Another area where the Sony TA-5650 is particularly good is the input noise from the high level inputs, with the phono inputs also giving a good noise performance. The noise at the worst volume setting is no cause for concern so far as loudspeaker listening is of interest, but the headphone output arrangement makes the noise a possible problem, with the worst noise condition occurring at the 11 o'clock setting of the volume control and being unaffected by the operation of the 20dB 'muting' attenuator which is associated with the volume control. The volume control itself is of the analog potentiometer type, but is fitted with a mechanical click stop which can be adjusted to any desired setting, so that it is easy to pre-set the volume control to any desired point.

The amplifier has three auxiliary inputs plus a tuner as high level inputs, two magnetic phono cartridge inputs of identical sensitivity and impedance which are fixed, but the overload margin is more than adequate. Further connections allow the use of two tape units, one interface being equipped with a DIN compatible connector, and with full tape monitoring and dubbing being activated by front panel toggle switches. Additional connections are fitted for external devices such as equalisers, and two of these can be individually selected by a further toggle switch, one set of connections being rear panel phono sockets like the other connections and the other being via front panel jack sockets.

Output terminals are provided for two sets of loudspeakers, the combination of either or both loudspeakers being selected by a front panel switch which places the loudspeakers in series when both are selected. This is an obvious requirement as the amplifier takes exception to 2 ohm loads, and it is felt that some care should be exercised when selecting suitable 4 ohm loudspeakers and any which exhibit substantial impedance drops will probably disagree with this amplifier.

High and low pass filters are fitted, and these are pushbutton selected by two of a row of 6 front panel buttons. Both filters have good characteristics and there was no complaint about their subjective effects. Likewise the treble and bass tone controls had a satisfactory range over their 11 switched positions, but it was felt that the treble control had rather large steps when the turnover frequency was set to its lower value of 2.5kHz as opposed to its upper frequency of 5kHz. The same subjective comment did not apply to the bass control which also has its turnover frequency selectable from 250Hz or 500Hz.

The remaining controls are a mono/stereo

RECOMMENDED

switch and a switch which inserts the loudness control which boosts the bass to a substantial amount and the treble to a lesser degree, plus of course the power on/off switch which could do with a suppressor to remove the large switch-off click.

In other respects this amplifier behaved well, with minimal crosstalk between inputs and no subjective problems. So far as the standard of construction is concerned this is really excellent in all respects.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 47
D C offset at loudspeaker and headphones L/R
. . . . . 13/33 and 7/16mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —74/—72/—59dB
Loudness control effect ref 1kHz 100Hz/10kHz . +7/+3dB
Frequency response deviation from 20Hz to
20kHz aux/tape /tuner . . . . . <0.5dB

Power performance

Power output into 8Ω both L/R 76/78W
Power output into 8Ω single L/R 87W
Power output into 4Ω both L/R 94/96W
Power output into 4Ω single L/R 109/113W
Burst output into 8Ω single L/R 90W
Burst output into 4Ω single L/R 128W
Power output into half rated load L/R 2Ω 26W
Power bandwidth 8Ω 30W L/R . . . . . 10Hz to 50/32kHz
Power bandwidth 4Ω 25W L/R . . . . . 10Hz to 43/25kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.02%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.03%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —78/74/55dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —>80/>80/76dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —>80/>80/77dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —70/66/80dB

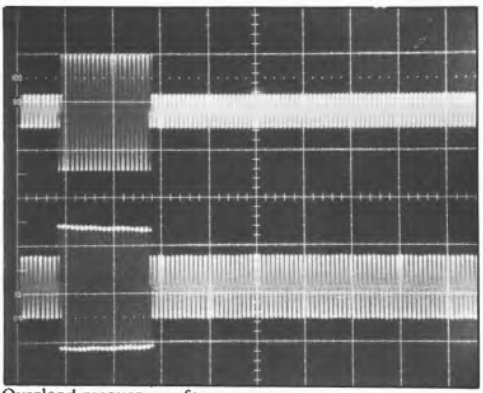
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 110.5/115dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 113/117.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.039/0.013μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.04/0.10μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 93dB

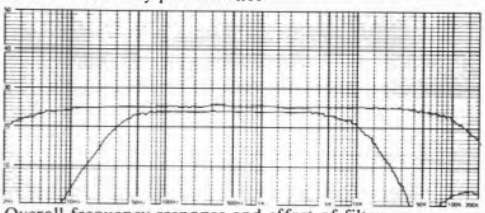
Inputs and outputs

Input impedance on aux/tuner/tape
. . . . . 110; 110; 138k 440; 430; 280pF*
Input impedance on phono 54k 110pF
Input impedance on mic . . . . . —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape . . . . . 105mV >20V
Input sensitivity and clipping point at 1kHz
phono 1.9mV 480mV
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output —
headphone 11V 230Ω
Output voltage and impedance for rated output —
tape 105mV 5700Ω
Output voltage and impedance for rated output —
DIN 14mV 71kΩ

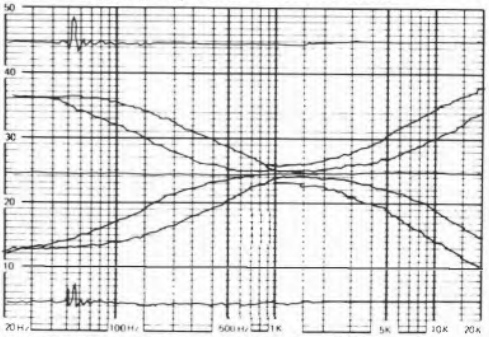
Typical selling price including VAT £270.00



Overload recovery performance



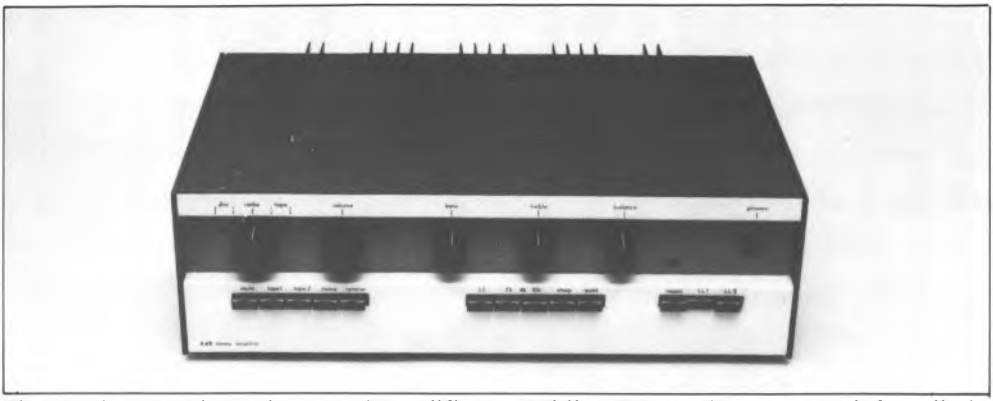
Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Sugden A48

J. E. Sugden & Co. Ltd., Carr Street, Cleckheaton, W. Yorkshire. 027487 2501.



The Sugden A48 is an integrated amplifier with a manufacturers' power rating of 40W per channel into 8 ohm loads, but as is to be seen from the adjacent tables the available power only just scrapes above the specification at 1kHz with both channels driven. Furthermore, the power bandwidth at half the manufacturers' rated power is abysmal into 8 ohms at 2kHz. When working into 4 ohms the situation was even worse because 0.1% total harmonic distortion could not be reliably reached at any frequency at half the manufacturers' rated power, and the power had to be reduced from 20W to 15W to produce the figures shown in the table.

The power bandwidth was limited at the low frequency end to 40Hz into 4 ohms, or 30Hz into 8 ohms, and the amplifier did not like working into 2 ohms. The intermodulation distortion at half power was bad, but the harmonic distortion and intermodulation distortion at 1W were good. Phone input noise was reasonable, but the high level input noise was bad and the dynamic ranges restricted. Also, the ouput noise on headphones was very poor expecially at the 2 o'clock volume setting, with mains hum at zero setting.

So far as the phono cartridge input was concerned the sensitivity and resistive component of the input impedance were satisfactory, but the input capacitance was unduly high at 300pF. A similarly high capacitance was associated with the high level inputs, the tape input varying from 150pF to 260pF depending upon whether the tape monitor function was selected.

Whilst DIN sockets are used for all the signal inputs, the tape connection did not have a DIN compatible impedance and also the wiring of the two phono inputs on a single DIN socket was, to say the least, unusual, and most certainly extremely inconvenient in use. A single front panel selector switch is used to select disc 1 or 2, radio, or tape 1 or 2 as signal sources, with further pushbuttons used to select tapes 1 or 2 in the monitor mode. The crosstalk across these switches was poor.

Further pushbuttons in this group are used to select mono or stereo operation, and also to select reverse stereo, plus an unusual feature in the form of a 'mute' button which simply disenables the amplifier when depressed.

A second group of pushbuttons is concerned with the filters which are unusually good, there being a steep 12dB per octave high pass filter based on a —3dB point of 80Hz plus a selection of three low pass filter frequencies of 4, 7, or 10k Hz with a choice of steep roll off or normal. There is also of course the ubiquitous loudness control identified as 'quiet' — this inserted an enormous boost of 9dB at 100Hz.

Tone controls consist of the usual treble and bass controls of the potentiometer type, and while there was no particular adjustment problem, the range of both controls was grossly in excess of any normal requirements.

The balance control was entirely satisfactory in operation as was the volume control when using loudspeakers, but when using headphones the lower volume control settings were far too coarse.

Listening tests confirmed the good and bad

points about this amplifier, and in addition to the high frequency compression resulting from the very poor power bandwidth, the overload recovery sound was most unpleasant.

As a final point, the standard of construction was quite good, but internally, there was no component identification and even worse, the fuse values were not shown on or within the amplifier.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 16
D C offset at loudspeaker and headphones L/R 0mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —46/—49/—49dB
Loudness control effect ref 1kHz 100Hz/10kHz . +9/+0dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 1dB

Power performance

Power output into 8Ω both L/R 43/42W
Power output into 8Ω single L/R 44W
Power output into 4Ω both L/R 48/45W
Power output into 4Ω single L/R 50/49W
Burst output into 8Ω single L/R 54W
Burst output into 4Ω single L/R 56/54W
Power output into half rated load L/R 2Ω 30W
Power bandwidth 8Ω 20W L/R ..... 30Hz to 2kHz
Power bandwidth 4Ω 15 W L/R ..... 40Hz to 3.5kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.04/0.06%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.05/0.09%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —55/64/33dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —80/68/45dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/80/70dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/>80dB

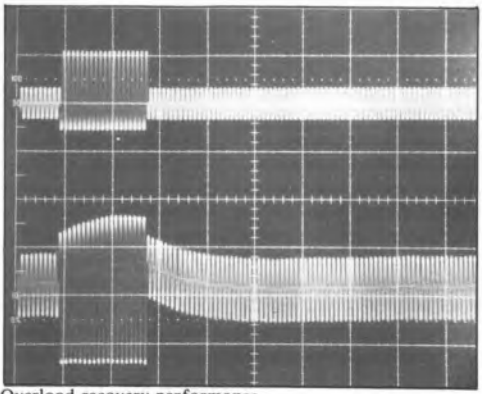
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 98.5/94dBV
Noise ref to input — average L/R CCIR/22kHz
Phono ..... 112.5 /110dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.16/0.79μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.79μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 84.5dB

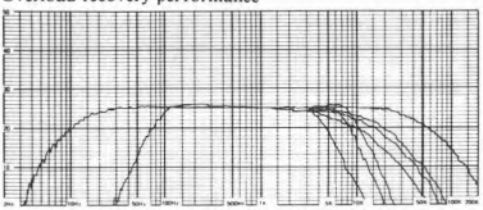
Inputs and outputs

Input impedance on aux/tuner/tape
..... 250/125k 300; 150pF*
Input impedance on phono 50k 300pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape ..... 180mV >20V
Input sensitivity and clipping point at 1kHz
phono 3.5mV 130mV
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone 9.3V 212Ω
Output voltage and impedance for rated output —
tape ..... 180mv VARIΩ
Output voltage and impedance for rated output —
DIN ..... 180mV VARIkΩ*

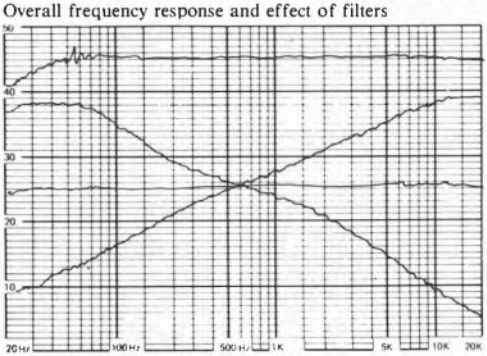
Typical selling price including VAT £165.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Sugden C51 and P51

J. E. Sugden & Co. Ltd., Carr Street, Cleckheaton, W. Yorkshire. 027487 2501.

These separate units comprise the type C51 control unit and the type P51 power amplifier which connects to the control unit via a mains lead with IEC connectors and a five-pin DIN lead. The power amplifier has a single set of banana socket loudspeaker connections and an auxiliary mains outlet in the form of an IEC socket. In addition there is a further DIN socket for connecting more power amplifiers and a mono/stereo slide switch.

Both the power amplifier and the pre-amplifier are pretty basic in their form of construction but the standard of wiring and soldering was reasonable. The printed circuit boards had no component identifications and the ratings for the mains fuses were not shown.

Input connections to the pre-amplifier were a real cocktail of DIN and phono connectors which provide the following inputs:— (1) Two magnetic phono cartridge inputs with a reasonable sensitivity but a poor overload performance and good noise performance. Both have phono connections and one a DIN socket. (2) A high level radio input with not so good noise performance via phono sockets. (3) An auxiliary input via phono sockets, this input being duplicated on a DIN socket which is identified as cassette' and includes a DIN compatible output. (4) A DIN 'tape' connector which is not DIN compatible and which includes inputs and outputs.

If this isn't already confusing, the switching between inputs is very badly identified on the front panel. The tape input/output is straightforward as this is operated in the monitor mode with a 'tape' push-button, but the remainder are activated by two push-buttons which are identified as 'disc' and 'aux' with the radio input being selected by pushing both — but what about cassette and disc 1 or 2? It's all right when you know, but it would help if the front panel told you.

Four further push-buttons on the front panel control the filters which consist of a sensible high pass filter and very good low pass filters. The latter have their turnover frequency selected by two buttons, one each for 7kHz and 10kHz or both for 4kHz, with a third button selecting the filter slope of 12dB per octave or 18dB per octave — a most excellent arrangement.

A further button labelled 'quiet' introduces 13dB attenuation at 1kHz and at the same time acts as a loudness control by inserting 8dB boost at 100Hz, but unwittingly also introducing 1dB attenuation at 10kHz

Finally there is mono/stereo switching which can select either the left or the right channels to both outputs, or mix the left and right inputs to both outputs.

Treble and bass tone controls are fitted in the form of conventional potentiometers, and whilst their range at 100Hz and 10kHz appears to be reasonable, the boost or cut continues above and below these points, with the result that the subjective correction range available is far in excess of any practical requirement. Furthermore, the amplifier balance was upset by some tone control settings and the bass control was found to have a 'dead' area around its mid position.

The operation of the balance and volume controls were adequate. The power bandwidth was poor, as was the intermodulation distortion at half rated power. The output noise at zero and worst case volume setting was poor and the overall dynamic range reasonable. Subjectively, its overload recovery sounded objectionable and high frequency transients were poor.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 35
D C offset at loudspeaker and headphones L/R 0mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —54/—54/—50dB
Loudness control effect ref 1kHz 100Hz/10kHz . +8/+1dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 1dB

Power performance

Power output into 8Ω both L/R 48/50W
Power output into 8Ω single L/R 51/52W
Power output into 4Ω both L/R 54/53W
Power output into 4Ω single L/R 53/52W
Burst output into 8Ω single L/R 56W
Burst output into 4Ω single L/R 53/52W
Power output into half rated load L/R 2Ω 27/22W
Power bandwidth 8Ω 25W L/R ..... 19/14Hz to 10/8kHz
Power bandwidth 4Ω 25W L/R ..... 21/15Hz to 5/6kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03/0.04%
Total harmonic kistortion at 1W into 4Ω
1kHz/10kHz 0.04/0.07%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —61/61/44dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —74/64/56dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —80/75/65dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —77/73/65dB

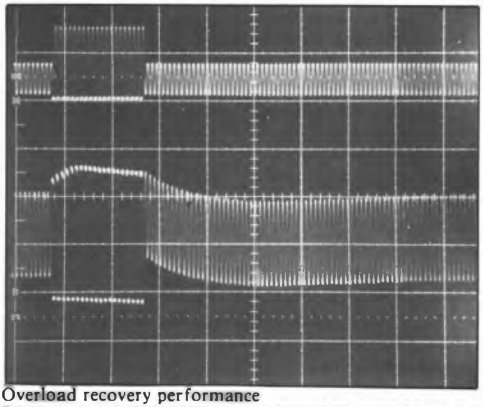
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 98dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 113/108dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.20/0.63μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.79/0.99μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 84.5dB

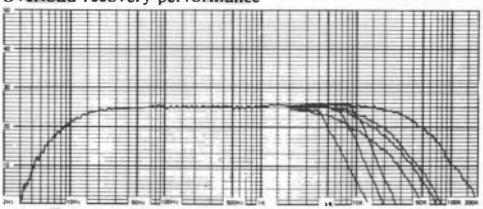
Inputs and outputs

Input impedance on aux/tuner/tape
..... (aux) 312/132; 166/104k 130; 240pF
Input impedance on phono 57k 200pF
Input impedance on mic ..... —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 205mV 20V
Input sensitivity and clipping point at 1kHz
phono 3.2mV 44mV
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone ..... —Ω
Output voltage and impedance for rated output —
tape ..... 205mV VARIΩ
Output voltage and impedance for rated output —
DIN ..... —kΩ*

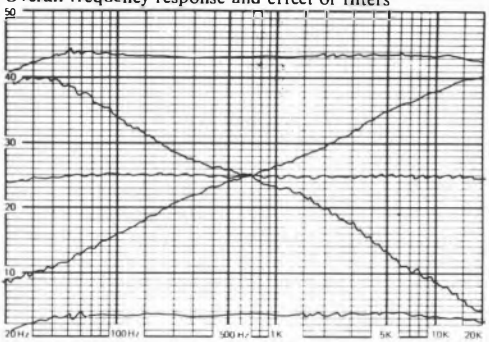
Typical selling price including VAT £120.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

Technics SU-7300

National Panasonic (UK) Ltd., 107/9 Whitby Road, Slough, Bucks. Slough 27516.

This amplifier has the basic inputs required for a simple system comprising a single phono input, a tuner and a couple of tape systems. Switching between the tuner and phono cartridge inputs is by means of two push-buttons which provided excellent isolation with effectively non-existent crosstalk.

With the exception of the single DIN compatible tape connector, all the signal inputs are rear panel phono sockets with terminals being used for the two sets of loudspeakers and a front panel jack socket for the headphones. An unusual feature is that the loudspeaker switching is such that either the local or the remote loudspeakers can be used, but not both sets. Similarly the use of headphones cuts off the loudspeakers. So far as loudspeaker impedance is concerned, the amplifier was quite happy to work into 4 or 8 ohm loudspeakers.

Further front panel controls include a low pass filter which is sensibly aimed in frequency and attenuation such that it does not ruin the reproduction of music, whilst providing a reasonable noise and scratch attenuation, plus three position toggle switches for tape monitoring and for tape dubbing in either direction between tape units.

Two front panel meters are provided and are calibrated in dB and in Watts, there being a meter sensitivity switch which increases the meter sensitivity by a factor of 10 when depressed. Calibration of the meters was sufficiently accurate, and it was pleasing to note that these meters were very considerably faster in attack than the meters fitted to most amplifiers. However, the meters did not respond fully to transients in music, and were not therefore a particularly reliable indicator of overload conditions.

Treble and bass controls are in the form of eleven-position rotary knobs, but as a result of the wide tone control range available and a poor law of the control, the extreme steps of both the treble and the bass controls were excessive and extended to 4dB in one instance.

So far as the measured performance is concerned, the power bandwidth was excellent as was the harmonic distortion. Furthermore, intermodulation distortion at half power was also unusually good, and even better at 1W.

Noise from the phono input was outstandingly good, with the high level inputs offering a good performance. However, the output noise associated with the worst case volume setting was noticeably disturbing when using headphones, and none too good with loudspeakers.

Inputs had adequate sensitivity and the phono input had a reasonable but not outstanding overload margin; it was however felt that the input capacitance of the tuner input at 430pF was decidedly on the high side and that input resistance variations were rather large.

Subjectively, the amplifier gave no cause for concern in normal use, but the overload distortion was rough if the amplifier was overdriven. Also, the loudness control was rather unusual, because whilst it boosted the bass by an enormous 8dB at 100Hz it at the same time cut the treble by 1.5dB at 10kHz.

RECOMMENDED

From the points of view of finish and overall construction, this amplifier was first class, with a tidy external appearance and the internal parts being mounted on printed circuit boards which had a clean layout and proper components identification for servicing.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 38
D C offset at loudspeaker and headphones L/R . . 31 /11mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —54/—53/—55dB
Loudness control effect ref 1kHz 100Hz/10kHz
. . . . . +8/+—1.5dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 1dB

Power performance

Power output into 8Ω both L/R 48W
Power output into 8Ω single L/R 56W
Power output into 4Ω both L/R 64W
Power output into 4Ω single L/R 80/81W
Burst output into 8Ω single L/R 62/66W
Burst output into 4Ω single L/R 100/105W
Power output into half rated load L/R 2Ω 85/87W
Power bandwidth W L/R . . . . . 10Hz to 96.5kHz
Power bandwidth 4Ω W L/R . . . . . 10Hz to 76kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.02%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.03%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —>80/79/53dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —>80/80/65dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —>80/>80/70dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —>80/>80/63dB

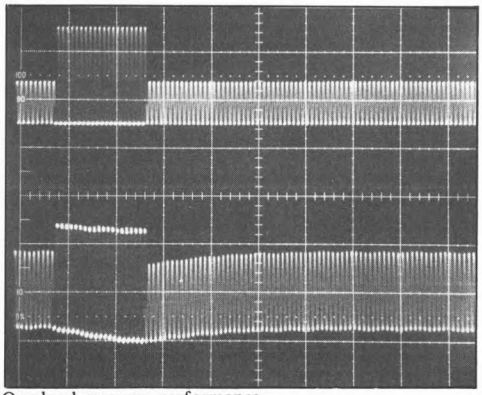
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 103/107dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 116/121.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.019/0.02μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.20/0.05μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 88.5dB

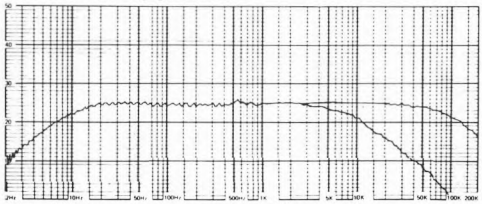
Inputs and outputs

Input impedance on aux/tuner/tape
. . . . . —;140/35;195/42k —; 430;260pF
Input impedance on phono 50k 160pF
Input impedance on mic . . . . . —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 160mV 20V
Input sensitivity and clipping point at 1kHz
phono 2.4mV 140mV*
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output —
headphone 18V 330Ω
Output voltage and impedance for rated output —
tape 160mV VAR1Ω
Output voltage and impedance for rated output —
DIN 31mV 84kΩ

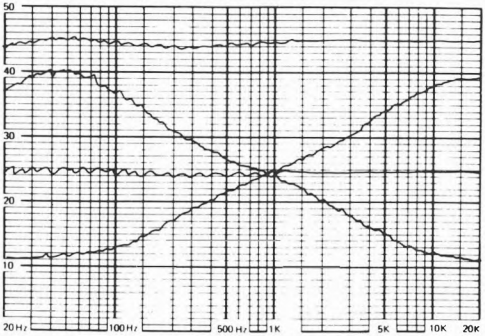
Typical selling price including VAT £130.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

Technics SU-7700

National Panasonic (UK) Ltd., 107/9 Whitby Road, Slough, Bucks. Slough 27516.

In many ways, this amplifier, the bigger brother of the Technics SU-7300, may well be of particular interest because of its overall performance and the facilities which it offers, although outside the lower price bracket.

The three basic inputs for a magnetic phono cartridge, tuner and auxiliary are selected by neat push-button switches, whilst the two tape connections are controlled by three position toggle switches. These permit monitoring either tape unit, and also tape dubbing in either direction.

All the inputs had a practical sensitivity and good overload margins, but the input impedance variations of the high level inputs were rather large and also it is felt that the capacitive component of the high level input impedances is on the high side at over 300pF.

Input signal connections are, with the exception of one tape connection which also has a DIN compatible connector, phono sockets; the two sets of loudspeakers outputs are terminals, either or both sets of loudspeakers being selected by push-button switches. Examination of the power output capability of the amplifier shows that it is quite happy with single 4 ohm loudspeakers and the manufacturer wisely recommends the use of 8 ohm loudspeakers where two sets are to be used simultaneously.

Further facilities include a sensible low pass filter, which is subjectively useful for reducing noise without having a drastic effect upon music, the usual loudness control which has an 8dB bass boost at 100Hz and peculiarly, a 1dB treble cut at 10kHz, and a mono/stereo switch. In addition, there is what has been termed a 'subsonic equaliser' associated with the phono input. This is in fact a very sensible addition of a high pass filter for reducing turntable rumble, the filter having a well chosen —3dB point at 30Hz and a rate of attenuation of 12dB per octave.

The treble and bass controls are of the eleven position switched type providing ±10dB range at 100Hz and at 10kHz, and with the exception of the extreme positions, the increments between steps are reasonable, but the extreme steps are too large.

The remaining front panel controls consist of the balance control which was found to have excellent performance whilst providing a full range, so that either loudspeaker could be muted, and the volume control which was well suited to both loudspeaker and headphone listening. However, it was found that the high noise at the worst case volume setting was particularly objectionable with headphones, and none too good with loudspeakers.

In other respects the noise performance was good, with the noise associated with the phono input being outstandingly good. Also the crosstalk between input source and across the tape monitor switch was unusually good.

The power bandwidth and both harmonic and intermodulation distortion were excellent at both half power and at 1W output with the intermodulation distortion at 100kHz being outstandingly low.

The amplifier includes two front panel meters which are calibrated in Watts with respect to 8 ohms and in decibels in relation to

RECOMMENDED

full power output, and whilst these meters do not read fast transients it is pleasing to say that they are much faster than meters fitted to many amplifiers. In addition, the meter sensitivity is controlled by a switch which provides an X10 sensitivity, and this completes the list of facilities.

The standard of construction of this amplifier was very good both internally and externally.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 71
D C offset at loudspeaker and headphones L/R 6/2mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —52/—52/—51dB
Loudness control effect ref 1kHz 100Hz/10kHz . +8/—1dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner ..... <0.5dB

Power performance

Power output into 8Ω both L/R 58W
Power output into 8Ω single L/R 67W
Power output into 4Ω both L/R 80W
Power output into 4Ω single L/R 96/97W
Burst output into 8Ω single L/R 70/72W
Burst output into 4Ω single L/R 117/122W
Power output into half rated load L/R 2Ω 95/101W
Power bandwidth 8Ω 25W L/R ..... 10Hz to 110kHz
Power bandwidth 4Ω 30W L/R ..... 10Hz to 80kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.04/0.03%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.06/0.05%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —75/78/73dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —>80/>80/73dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/73dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/68dB

Noise performance

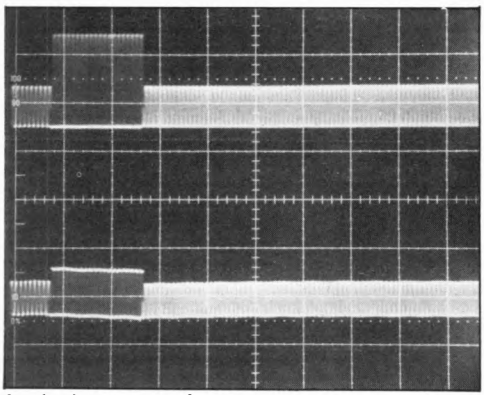
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 103/107.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 115/118.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.08/0.03μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.25/0.06μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 88.5dB

Inputs and outputs

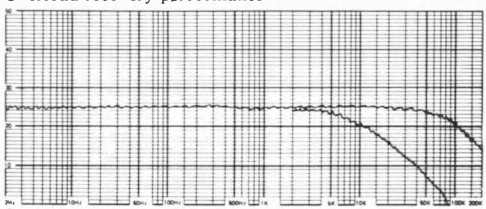
Input impedance on aux/tuner/tape
..... 136/36-tape 192/43k 315;160pF
Input impedance on phono 51k 200pF
Input impedance on mic ..... —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 160mV 20V
Input sensitivity and clipping point at 1kHz
phono 2.9mV 165mV*
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone 20V 333Ω
Output voltage and impedance for rated output —
tape ..... 160mV VARIΩ
Output voltage and impedance for rated output —
DIN 31mV 75kΩ

Typical selling price including VAT £160.00

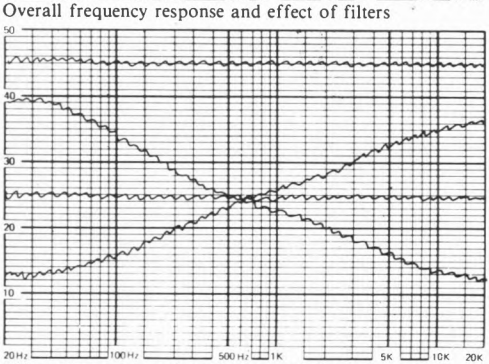
*See text



Overload recovery performance



Overall frequency response and effect of filters

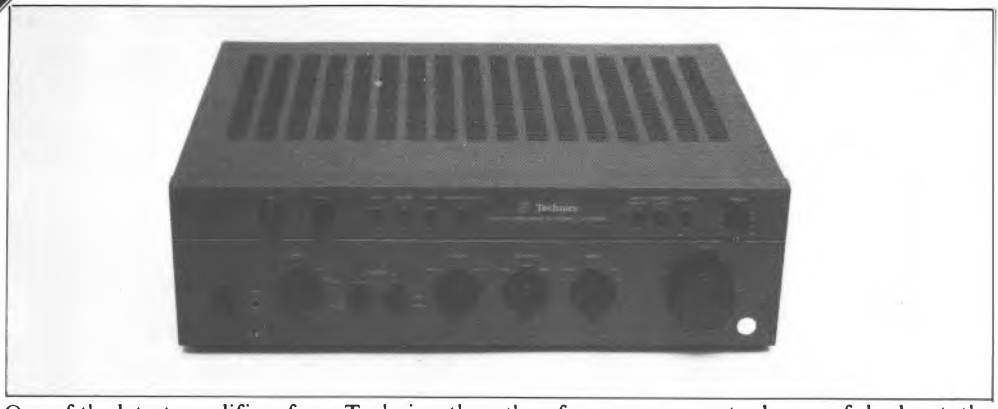


Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

Technics SU-8080

National Panasonic (UK) Ltd., 107/9 Whitby Road, Slough, Bucks. Slough 27516.



One of the latest amplifiers from Technics, the SU-8080 is in the new brown cabinet styling with a clear but unobtrusive front panel layout. With the exception of the front panel headphone jack socket, all connections are at the rear of the amplifier, including connections for two sets of loudspeakers and phono connectors for all signals, except for a DIN compatible connector for one of the two tape unit connections.

Input source selection is by one of the high class rotary switches which allows the choice of a tuner or auxiliary high level input and two magnetic phono cartridge inputs all of which had reasonable sensitivities and overload margins. Whilst the phono inputs have slide-switch selection of the input resistance (24k or 47k measured) and input capacitance over the range 180pF or 410pF, it is felt that the input capacitance of the high level inputs is on the high side at 350pF.

Crosstalk between input sources was virtually non-existant, and that across the tape monitor switch, which can monitor either tape unit, was to a high standard. A further rotary switch allows recordings to be made from the input source, or for either tape unit to dub to the other tape unit.

Loudspeaker outputs are selected by a further rotary switch which allows either or both loudspeakers to be connected; with the headphone jack permanently in circuit. Examination of the power output capabilities shows that the amplifier is very happy to work into either 8 ohms or 4 ohms, but that disaster strikes if the load is reduced to 2 ohms. It is therefore necessary to be careful about the choice of loudspeaker impedance in relation to frequency if either single 4 ohm loudspeakers are to be used, or pairs of 8 ohm loudspeakers.

The combined effect of the analog volume control and the 14dB muting switch offered very good control of the amplifier output into either loudspeakers of headphones, the output noise performance being very good even into headphones. Similarly, the phono input noise was outstandingly good and the noise from other sources was to a high standard with a resultingly excellent dynamic range.

The power bandwidth and all forms of distortion within the audio frequency band were to a very high standard with the high frequency intermodulation distortion at low power levels also being excellent.

Both the tone controls and the filter arrangements of this amplifier are unusual and decidedly practical, it being clear that the manufacturer has given serious thought to the problem of what is really necessary. For instance, the eleven position bass and treble controls have their range limited to ±7dB at 100Hz and 10kHz respectively. Such a range is quite adequate for any high quality listening and any further compensation is completely unnecessary and if used, often leads to distortion. Likewise many high pass filters are ill designed, but this amplifier includes a switchable high pass filter in the pick-up inputs where it is wanted, and furthermore it rolls off at the right frequency — 30Hz.

Two further filters are provided, a low pass switchable filter with a —3dB point at 10kHz

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and a sensible rate of attenuation, and also a high pass filter which operates about 2Hz and blocks the direct current path through the amplifier which is normally direct coupled.

The final controls are a very good balance control, a mono/stereo, switch, and the inevitable loudness control. Quaility and operational characteristics were first class, the overall standard of construction was excellent and subjective testing offered good performance.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 130
D C offset at loudspeaker and headphones L/R
..... 19.8/13.6mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —70/—70/—64dB
Loudness control effect ref 1kHz 100Hz/10kHz . +8/—1dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 0.5dB

Power performance

Power output into 8Ω both L/R 81/83W
Power output into 8Ω single L/R 81/83W
Power output into 4Ω both L/R 93/83W
Power output into 4Ω single L/R 94/82W
Burst output into 8Ω single L/R 74W
Burst output into 4Ω single L/R 95/89W
Power output into half rated load L/R 2Ω 12/10W
Power bandwidth 8Ω 36W L/R ..... 10Hz to 57kHz
Power bandwidth 4Ω 45W L/R ..... 10Hz to 37kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.01%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.01/0.03%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —>80/>80/44dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —>80/>80/44dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/76dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/76dB

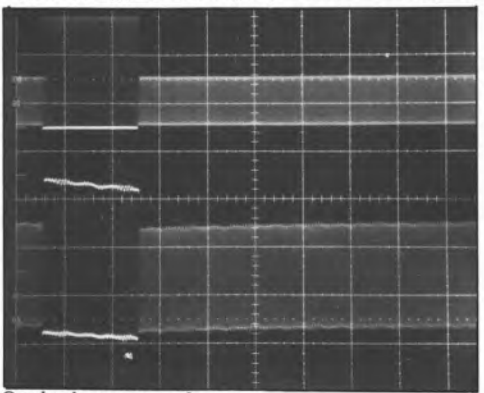
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape ..... 106/117; tape 104/113.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 115/122.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.025/0.004μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.10/0.02μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 92dB

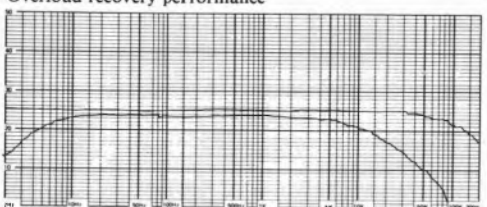
Inputs and outputs

Input impedance on aux/tuner/tape
..... 84/32; tape 107/39k 350; 180pF
Input impedance on phono 47/24k 180/410pF
Input impedance on mic at min/max volume ..... —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 200mV 20V*
Input sensitivity and clipping point at 1kHz
phono 2.6mV 285mV
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone 24V 330Ω
Output voltage and impedance for rated output —
tape ..... 200mV VARIΩ
Output voltage and impedance for rated output —
DIN 38mV 88kΩ

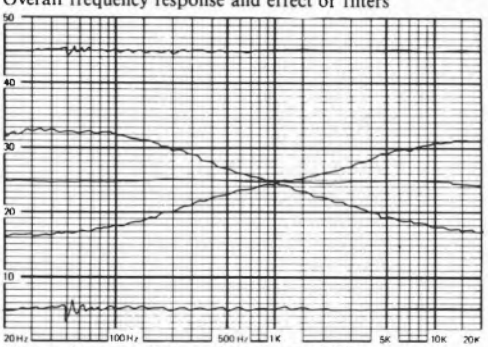
Typical selling price including VAT £255.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

Toshiba SB-420

Toshiba (UK) Ltd., Toshiba House, Great South West Road, Feltham, Middlesex. 01-751 1281.

Considering that this amplifier is in the cheapest group it has a very wide range of sensible controls, as well as offering a generous 42W into 8 ohms or 50W into 4 ohms with minimal distortion.

Two fixed impedance and sensitivity phono inputs are provided for magnetic cartridges, in addition to the high level inputs which consist of an auxiliary and a tuner input plus an additional low level input for a microphone. This input has its own level control such that the microphone signal can be added to the source in use.

All input sensitivities were reasonable and the overload margins adequate, but it is felt that the capacitive component of the two high level inputs is on the high side at 360pF and that this could cause high frequency losses with some input sources.

Two sets of loudspeaker terminals are provided, with front panel switching for either or both sets of loudspeakers, plus an off position for headphone listening via the front panel headphone jack socket. The amplifier has more than adequate capability for driving single sets of 4 ohm loudspeakers or two sets of 8 ohm loudspeakers used simultaneously.

Whilst the noise level from the inputs was to a high standard, it is unfortunate that the output noise at the worst case volume setting was poor, and this was particularly objectionable when listening on headphones.

Whilst the power bandwidth is a bit restricted when working into 4 ohms, it is reasonable when using 8 ohm loads, and the very low harmonic distortion and inter-modulation distortion at half power and at 1W output more than compensate for this shortcoming.

In addition to the inputs mentioned above, there are two tape input/output facilities, one of which has a DIN compatible socket. Tape dubbing in either direction is controlled by a three-position toggle switch, with a rotary switch controlling tape monitoring, the crosstalk associated with this switch and also the input source switch being to a good standard.

The volume control and its associated 'muting' attenuator which offered either 10dB or 20dB extra attenuation worked well without upsetting the amplifier balance, and the full range balance control had a satisfactory performance.

Both a high pass and a low pass filter are fitted, these being 6dB per octave filters with —3dB points at 15Hz and 8kHz respectively. In addition to these well selected filters, the treble and bass tone controls which are of the detent mechanism type offer a choice of both treble and bass turnover frequencies, these being selected by a three-position toggle switch which is associated with each tone control and which also provides a 'defeat' position.

Finally there is a mono/stereo switch and the loudness control which provided a large boost to both the treble and the bass.

Additional phono sockets at the rear of the amplifier provide access to the output of the pre amplifier and the input to the power amplifier for connecting equalisers or four channel decoders, and a further pair of phono

RECOMMENDED

sockets allow the connection of a third tape recorder for recording the combined microphone and source signals.

From the point of view of construction standards, the electronics of this amplifier are not to the highest quality, with some untidy components and not the best workmanship so far as soldering is concerned. However components are properly identified for servicing, and having regard to the price tag this amplifier has a great deal to offer.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0/0/5dB
Damping factor ref 8Ω at 1 kHz 79
D C offset at loudspeaker and headphones L/R . 2.5/36mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —73/—56/—37dB
Loudness control effect ref 1kHz 100Hz/10kHz . +8/+6dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner . . . . . <0.5dB

Power performance

Power output into 8Ω both L/R 52W
Power output into 8Ω single L/R 60W
Power output into 4Ω both L/R 72W
Power output into 4Ω single L/R 87W
Burst output into 8Ω single L/R 68/66W
Burst output into 4Ω single L/R 105/103W
Power output into half rated load L/R 2Ω 131/122W
Power bandwidth 8Ω 21W L/R . . . . . 10Hz to 16kHz
Power bandwidth 4Ω 25W L/R . . . . . 10Hz to 10/11kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03/0.04%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.04/0.07%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —80/80/61dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —>80/>80/65dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —>80/>80/>80dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —>80/>80/>80dB

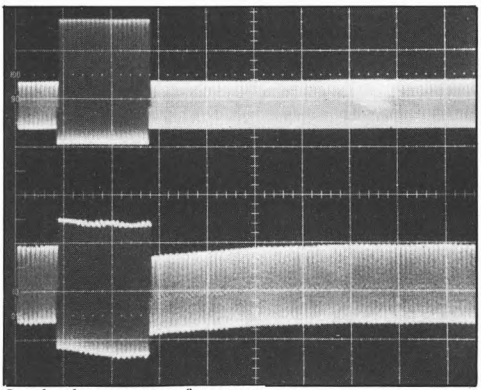
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 106/108dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114/118.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.09/0.02μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.29/0.10μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 90.5dB

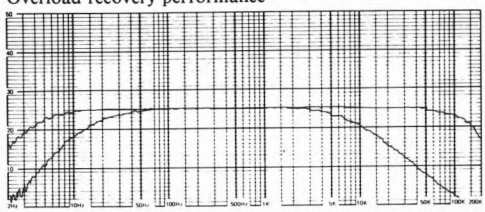
Inputs and outputs

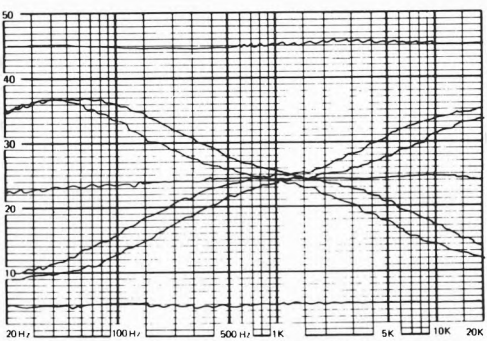
Input impedance on aux/tuner/tape
. . . . . 80/71-tape 71k 360;180pF
Input impedance on phono 53k 116pF
Input impedance on mic 25k 580pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 135mV 20V
Input sensitivity and clipping point at 1kHz
phono 2.2mV 400mV
Input sensitivity and clipping point at 1kHz mic
. . . . . 3.2mV 200mV
Output voltage and impedance for rated output —
headphone 18V 220Ω
Output voltage and impedance for rated output —
tape . . . . . 135mV VARIΩ
Output voltage and impedance for rated output —
DIN 29mV 80kΩ

Typical selling price including VAT £145.00



Overload recovery performance





Effect of tone controls and accuracy of RIAA equalisation

Trio KA-3500

B. H. Morris Ltd., Precision Centre, Heather Park Drive, Wembley, Middlesex, 01-9029422.

This is a simple amplifier with the minimum of facilities and inputs but giving adequate power for normal domestic applications, being rated at 40W per channel into 8 ohms or 45W into 4 ohms. However the available power into 2 ohms was well down on the 4 ohms performance, with the result that the use of 4 ohm loudspeakers requires some caution in selecting units which do not exhibit a low impedance.

Very sensibly the two sets of loudspeakers' outputs have been arranged to put the sets of loudspeakers in series when both sets are selected, so at least the amplifier never looks into a nominal impedance of less than 4 ohms. In addition to the loudspeaker outputs, there is a headphone jack and the loudspeaker selector switch has an 'off' position for headphone listening.

Whilst the volume control gave a good performance when listening on loudspeakers, the use of headphones meant that the volume control was always near its minimum setting, and the volume steps were far too large for comfort. However, output noise was low and did not present any problem as neither did the input noise from any of the sources, with the pick-up input being very good.

The input impedance and sensitivity of the high level auxiliary and tuner inputs was satisfactory, but that of the magnetic cartridge input was a little on the high side at 58k ohms.

In addition to these three inputs which are pushbutton selected, there is provision for two tape units via rear panel phono sockets and a single DIN compatible socket associated with one tape unit. Control of the tape functions is by means of two three-position toggle switches, one of which provides tape dubbing in either direction and the other of which selected either tape unit for tape monitoring, the crosstalk associated with this switch and with the source selector pushbuttons being mediocre.

Only one filter is provided, being a low pass filter of sensible performance, but we would like to have seen some roll-off in the low frequency response at the phono input, as amplifiers in this price range are likely to be used with cheaper turntables which need the use of a rumble filter.

An unusual and rather impractical feature of the filter is that it is selected by a three position toggle switch, the third position of which is used for the loudness control. As the loudness control therefore cannot be used in conjunction with the filter, this seems to be a peculiar idea.

The treble and the bass tone controls are of the types which use a potentiometer with a detent mechanism which really doesn't achieve anything very useful. Furthermore, with this amplifier the tone controls did little around their centre positions and were far too sensitive in their increments at the extreme positions, but it must be added that the overall tone control range was restricted to a sensible ±9dB.

The final control is the balance control which is a potentiometer with a central click stop. It was very smooth in action whilst allowing either loudspeaker to be cut off.

Measurements show that the low power distortion is to a high standard, but there are reservations about the half power intermodulation performance and the wide variation between the power bandwidth of the two channels, in addition to which the amplifier did not like high power transients.

The standard of construction was generally good with clean board layouts and widespread use of wire wrapping which is more reliable than soldering.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 57
D C offset at loudspeaker and headphones L/R ... 6/38mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —80/—66/—51dB
Loudness control effect ref 1kHz 100Hz/10kHz +8/+10dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner ..... <0.5dB

Power performance

Power output into 8Ω both L/R 51W
Power output into 8Ω single L/R 58/60W
Power output into 4Ω both L/R 65W
Power output into 4Ω single L/R 74/73W
Burst output into 8Ω single L/R 69/68W
Burst output into 4Ω single L/R 66/68W
Power output into half rated load L/R 2Ω 14/13W
Power bandwidth 8Ω 40W L/R ..... 10/9Hz to 30/60kHz
Power bandwidth 4Ω 45W L/R .... 14/16Hz to 19/31kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.05%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —61/61/51dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —>80/76/68dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/>80dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/78dB

Noise performance

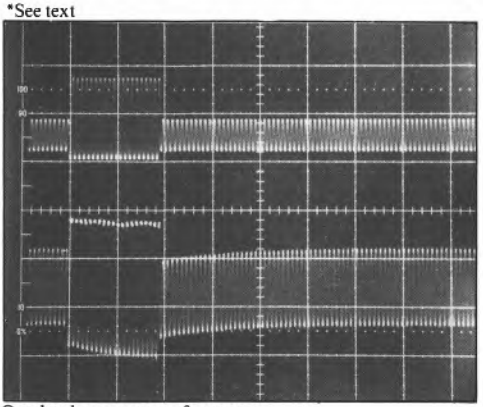
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 106/107dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114/118.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.04/0.013μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.02/0.04μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 90.5dB

Inputs and outputs

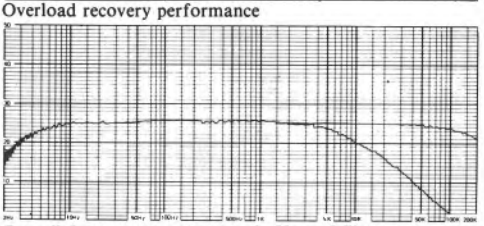
Input impedance on aux/tuner/tape
..... 35/30-tape 40/32k 120;70pF
Input impedance on phono 58k 130pF
Input impedance on mic ..... —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 140mV 20V
Input sensitivity and clipping point at 1kHz
phono 2.8mV 230mV*
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone 18V 220Ω
Output voltage and impedance for rated output —
tape ..... 150mV VARIΩ
Output voltage and impedance for rated output —
DIN 27mV 80kΩ

Typical selling price including VAT £110.00

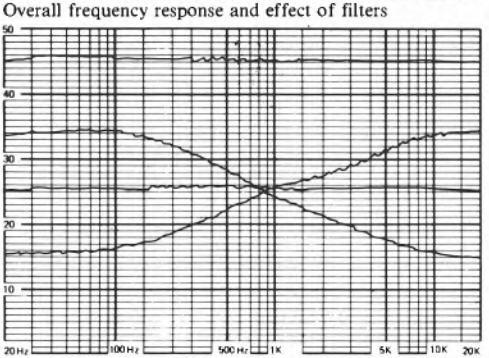
*See text



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

Trio KA-7100

B. H. Morris Ltd., Precision Centre, Heather Park Drive, Wembley, Middlesex. 01-902 9422.

This is a smart looking amplifier with its polished alloy front panel having a clean layout and clear functional identifications. Internally, it was well engineered, with very tidy printed circuits and good component identification.

A rotary selector switch selects the magnetic cartridge phono input or either the tuner or auxiliary input, there being negligible crosstalk between these inputs. With the exception of the phono input which has a rather high resistive component of its impedance, input impedances and sensitivities are good with satisfactory overload margins.

Provision is made for connecting two tape recorders with one connection having a DIN compatible connector in addition to the phono sockets which are used for all signal inputs. The arrangement of the tape recorders is controlled by a single switch which permits monitoring of either tape unit, but only allows dubbing from tape A to tape B. However, whilst dubbing, the switch allows monitoring of the signal before or after recording. This limitation in dubbing could be annoying.

Two sets of loudspeaker outputs are fitted, with switch selection of either set or both sets in parallel, plus an 'off' position for headphone monitoring by a jack socket. Unfortunately the amplifier takes exception to 2 ohm loads, so pairs of 4 ohm loudspeakers cannot be used, and it would be wise to select single 4 ohm loudspeakers which do not exhibit large drops in their impedance.

The treble and the bass tone controls which are of the eleven position rotary type are activated by a 'tone defeat' toggle switch. The range of correction of both controls has been wisely restricted to practical limits, with the result that the increments between tone control steps are adequately small and even.

Both high pass and low pass filters are fitted, the low pass filter being subjectively satisfactory with its 6dB per octave attenuation rate and its —3dB point at 8kHz. However the high pass filter's —3dB point was at 20Hz and it also had 6dB per octave attenuation rate — it is felt that in an amplifier of this price a 12dB per octave high pass filter could well be justified.

Headphone listening showed that the volume control had an adequate range in conjunction with its associated 20dB switched attenuator, and neither of these or the tone controls upset the amplifier balance. It was however considered that the balance control itself was rather coarse in action about its mid-point setting.

Two further features are the mode switch which permits selection of the common stereo/reverse/mono combinations, but not selection of the left or right inputs, and also the loudness control which has two positions of mild bass boost.

Subjective testing did not reveal any complaints about this amplifier which was found to have a good overall measured performance. Noise from all sources was low, very low by many standards, and the harmonic distortion and low level intermodulation distortion was also good. However, at high frequencies there was a

RECOMMENDED

sharp increase in half power intermodulation and the amplifier tripped at 65kHz. It is however likely that this is due to the use of slow output transistors which are not always a bad thing as they tend to be more reliable than fast transistors.

In summary this is a good amplifier for 8 ohm loudspeakers, and it offers a wide dynamic range and exceptionally good noise and distortion performance with a good power bandwidth.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 66
D C offset at loudspeaker and headphones L/R . . . 5/31mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz . . . . . —>80/—>80/—72dB
Loudness control effect ref 1kHz 100Hz/10kHz
. . . . . +2 or +4.5/+0dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner. 0.5dB

Power performance

Power output into 8Ω both L/R 71/73W
Power output into 8Ω single L/R 95/97W
Power output into 4Ω both L/R 95/97W
Power output into 4Ω single L/R 100/104W
Burst output into 8Ω single L/R 86/88W
Burst output into 4Ω single L/R 95/100W
Power output into half rated load L/R 2Ω 16/17W
Power bandwidth 8Ω 30W L/R . . . . . <10Hz to 57/58kHz
Power bandwidth 4Ω 40W L/R . . . . . <10Hz to 33kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.04%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz. . . . . —79/>80/<30dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —>80/>80/>30dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —>80/>80/73dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —>80/>80/73dB

Noise performance

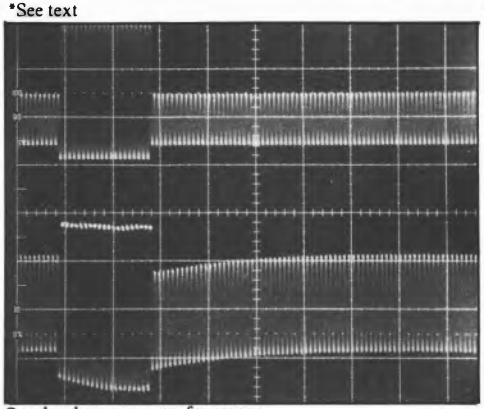
Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape. 113/117dBV
Noise ref to input — average L/R CCIR/22kHz
Phono. 115/121dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz. 0.013/0.003μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz. 0.10/0.03μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 98.5dB

Inputs and outputs

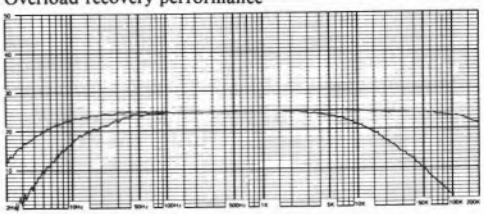
Input impedance on aux/tuner/tape
. . . . . 63/49-tape 72/54k 140;120pF
Input impedance on phono. 56k 90pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape. 153mV 20V
Input sensitivity and clipping point at 1kHz
phono. 2.6mV 255mV*
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output —
headphone 22V 220Ω
Output voltage and impedance for rated output —
tape. . . . . 153mV VARIΩ
Output voltage and impedance for rated output —
DIN 28mV 82kΩ

Typical selling price including VAT £198.00

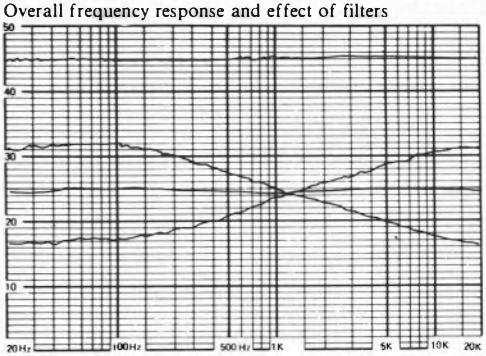
*See text



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

Trio Model 600

B. H. Morris Ltd., Precision Centre, Heather Park Drive, Wembley, Middlesex. 01-902 9422.

Ranking amongst the most expensive integrated amplifiers in this book, it has quite a few good but also some very bad points.

Amongst these is the appalling power bandwidth which was as bad as only 2kHz when working into 4 ohm loads, and only 3.5kHz into 8 ohm loads. Another matter was that intermodulation distortion at half power was poor at 10kHz and rose sharply as the frequency was increased until the amplifier tripped around 15kHz.

Whilst the measured harmonic distortion was reasonably low, the distortion products consisted of crossover spikes which tend to be subjectively objectionable, and also the intermodulation performance at 1W is bettered by many amplifiers.

So far as the output load is concerned the amplifier was quite happy working into 4 ohms, but one channel gave up the ghost when loaded into 2 ohms. There are three loudspeaker outputs. If only individual loudspeakers or one pair in series is selected, 4 ohm speakers should be adequate.

In addition to the loudspeaker outputs, there is a headphone jack, and the output level and impedance here were most sensible, with the output noise performance of this amplifier being far better than average. Similarly the noise performance of the two phono inputs was good, with the auxiliary, tape and tuner noise being respectable.

One phono input has three switchable impedances of 28/49/95k ohms which is a good selection, whilst the other phono input has a front panel pre-set sensitivity control which covered the range 2.8 to 5.5mV with a good associated input clipping level of 224 to 460mV. The sensitivities and clipping levels of the other inputs were good, but the tape input's shunt capacity was too high at 430pF and likely to lead to loss of high frequencies with some tape recorders.

Both tape inputs are provided with DIN compatible connections as well as phono sockets, and tape switching is by two three position controls, allowing versatile monitoring and dubbing.

The only remaining signal connection is the provision of pre-amplifier output and power amplifier input sockets for connecting equalisers etc. If required, these sockets can be separated by a rear panel switch.

Concentric controls are used for the volume and balance controls, both of which had an excellent performance, the volume control being a fine stepped attenuator type which works in conjunction with a three position attenuator switch which provides an extra 15 or 30dB attenuation after the volume control.

An unusual feature is that concentric controls are also used for the treble and bass tone controls, so that the tonal balance can be changed between channels, the tone controls being stepped controls with realistic 2dB steps at 100Hz and 10kHz. Both tone controls have a choice of turnover frequency, 150Hz or 400Hz in the bass and 800Hz or 6kHz in the treble. In addition there is a presence switch which gives a broad spectrum boost of 7dB

centered on either 800Hz or 3kHz, and it was felt that this boost was subjectively excessive. Finally there is the four position loudness control which applies a varying amount of bass boost, and the high and low pass filters of the 12dB per octave type with —3dB points at 40Hz and 7kHz, the former being good but the latter too fierce subjectively.

Whilst this amplifier is well made with many good features, it is severely let down by its power performance related to distortion, and thus cannot be recommended.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz..... 102
D C offset at loudspeaker and headphones L/R .. 80/45mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz..... —74/—66/—50dB
Loudness control effect ref 1kHz 100Hz/10kHz
..... +up to 10/+0dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner ..... <0.5dB

Power performance

Power output into 8Ω both L/R 156/138W
Power output into 8Ω single L/R 156/138W
Power output into 4Ω both L/R 220/113W
Power output into 4Ω single L/R 220/113W
Burst output into 8Ω single L/R 169/144W
Burst output into 4Ω single L/R 276/117W
Power output into half rated load L/R 2Ω 242/69W
Power bandwidth 8Ω 67½W L/R ..... 10Hz to 3.5kHz
Power bandwidth 4Ω 45W L/R..... 10Hz to 2/5 .5kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.04/0.08%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.06/0.12%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... >80/55/<30dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz..... —>80/45/<30dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz..... —>80/78/58dB
IM distortion at 1W from phono input DF3
1/10/100kHz..... —>80/74/57dB

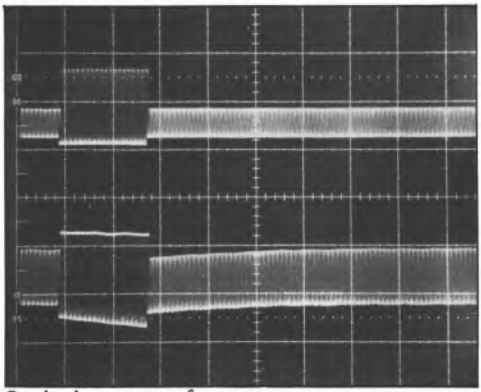
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 100.5/104dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114/114.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.013μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.016μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 85.6dB

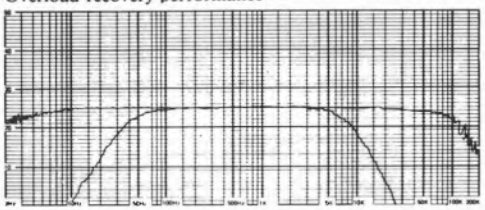
Inputs and outputs

Input impedance on aux/tuner/tape
..... 42/60;40;51/49k 230;430;200pF
Input impedance on phono 28/48/95k 140pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape ..... 175mV >20V
Input sensitivity and clipping point at 1kHz
phono..... 2.8mV 240mV*
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone..... 33V 680Ω
Output voltage and impedance for rated output —
tape..... 175mV 600Ω
Output voltage and impedance for rated output —
DIN 32mV 78kΩ

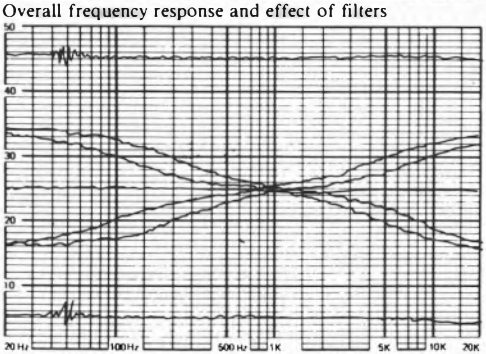
Typical selling price including VAT £550.00



Overload recovery performance



Overall frequency response and effect of filters



Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

Yamaha CA-610

Natural Sound Systems Ltd., 10 Byron Road, Wealdstone, Harrow, Middlesex. 01-863 8622.

The control arrangements of this amplifier are unusual because a single rotary switch is used to select all inputs including tape monitoring, the basic inputs being a magnetic phono cartridge input, tuner and auxiliary inputs, plus two tape units.

Input signals to the tape units are selected by a further rotary switch which feeds the tape units from the phono, auxiliary or tuner sources and also allows tape dubbing in either direction. All input impedances and levels are sensible as are overload margins, and in addition to the phono sockets used for the signal inputs the tape units can also be fed from DIN compatible connections.

Clip type connectors are fitted for two sets of loudspeakers which are selected individually or as pairs in parallel by the front panel speakers switch which also has an 'off' position for use when listening with headphones via the front panel headphone jack socket. Examination of the power output capability of the amplifier shows that it delivers a good power into either 4 or 8 ohms, but that 2 ohm loads provoke disaster. It is therefore suggested that some care is required in selecting suitable 4 ohm loudspeakers, or for that matter when running two sets of 8 ohm loudspeakers simulatneously because some of these which have a nominal impedance of 8 ohms can halve their nominal impedance at discrete frequencies.

Both harmonic and intermodulation distortion were at very low levels within the audio frequency band, and intermodulation distortion at high frequencies was also very respectable. Similarly the noise performance of all the inputs was to a high standard providing a good dynamic range. However the worst volume setting noise which occurs at 10 o'clock on the volume control may be troublesome when listening with headphones.

In other respects the performance of the volume control and its 21dB 'muting' switch were very good, and neither these or any other controls introduced significant unbalance between the amplifier channels. The balance control itself was also good with a fine control area around its mid position which had a useful mechanical click stop.

The treble and the bass tone controls are of the potentiometer type, each having an associated 'defeat' toggle switch — two switches seem a bit unnecessary. Subjectively the tone control had a very wide range, but as they are pure potentiometer types this didn't matter as their control law was satisfactory and permitted fine adjustment.

The amplifier is fitted with a single high pass filter which has been well conceived with its —3dB point at 25Hz and a rapid roll off at 12dB per octave, in addition to which the amplifier has been rolled off with a similar rate of attenuation below 7Hz, but unfortunately the high frequency response has not been similarly controlled and extends unnecessarily to above 200kHz.

The remaining features of this amplifier are the switched loudness control which gives a substantial boost to both the treble and the bass, and two meters which are scaled in Watts into 8 ohms. As is common with so many

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amplifiers which have meters these are far too slow to indicate peak overload conditions, to the extent that they indicated only 1W under transient overload conditions.

Both bass and treble overload was subjectively smooth, and other than a parasitic oscillation at 1.6mHz in one sample of the amplifier, no troubles were encountered. The standard of construction was generally good with a reasonable standard of wiring, but component identifications were mediocre and the mains cable clamp loose.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0/16/0dB
Damping factor ref 8Ω at 1 kHz 64
D C offset at loudspeaker and headphones L/R 3/4mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz. . . . . —>80/—77/—60dB
Loudness control effect ref 1kHz 100Hz/10kHz . +7/+4dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner. 0.5dB

Power performance

Power output into 8Ω both L/R 40/42W
Power output into 8Ω single L/R 60W
Power output into 4Ω both L/R 63W
Power output into 4Ω single L/R 79W
Burst output into 8Ω single L/R 65/64W
Burst output into 4Ω single L/R 99/95W
Power output into half rated load L/R 2Ω 6W
Power bandwidth 8Ω 20W L/R . . . . . 10Hz to 69kHz
Power bandwidth 4Ω 25W L/R . . . . . 10Hz to 41kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.03/0.02%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.03%
IM distortion at half rated power into 8Ω
DF2 1/10/100kPz . . . . . —>80/>80/69dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz. . . . . —>80/>80/61dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —>80/>80/76dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —>80/>80/80dB

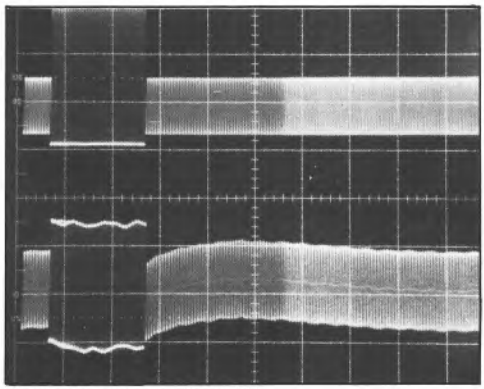
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 106/101.5dBV
Noise ref to input — average L/R CCIR/22kHz
Phono. 113.5/116.5dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.016/0.010μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.13μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 91.5dB

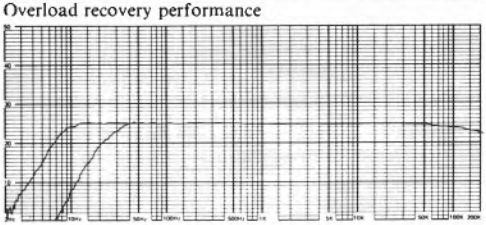
Inputs and outputs

Input impedance on aux/tuner/tape
. . . . . 68/47-tape 63/44k 140;170pF
Input impedance on phono 51k 130pF
Input sensitivity and clipping point at 1kHz
aux/tuner/tape . . . . . 155mV >20V
Input sensitivity and clipping point at 1kHz
phono. . . . . 2.8mV 185 mV*
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output —
headphone 18V 217Ω
Output voltage and impedance for rated output —
tape. . . . . 155mV VARIΩ
Output voltage and impedance for rated output —
DIN 30mV 44kΩ

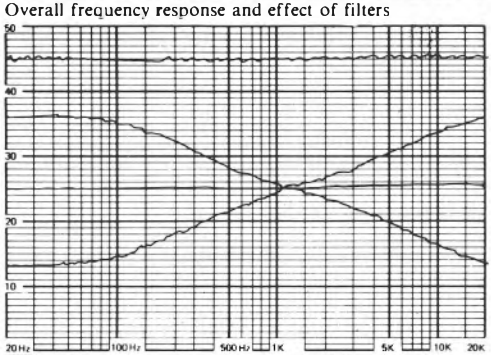
Typical selling price including VAT £155.00



Overload recovery performance



Overall frequency response and effect of filters

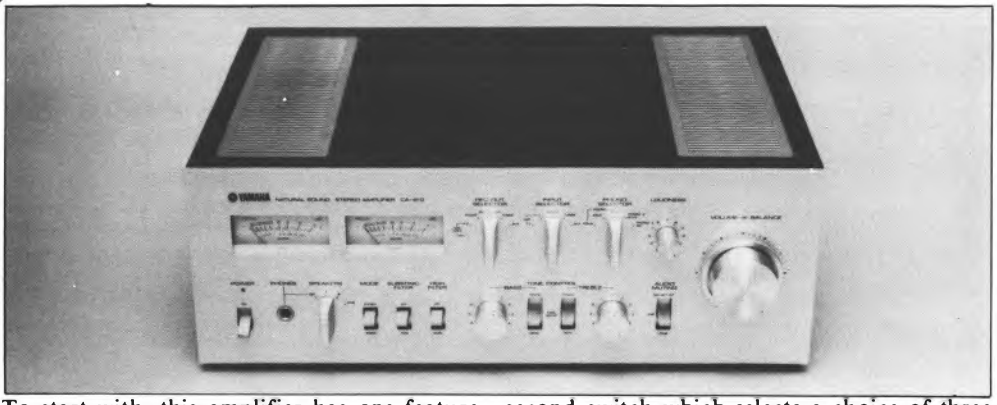


Effect of tone controls and accuracy of RIAA equalisation

BEST BUY

Yamaha CA-810

Natural Sound Systems Ltd., 10 Byron Road, Wealdstone, Harrow, Middlesex. 01-863 8622.



To start with, this amplifier has one feature which comes as a surprise; the two front panel level meters, which are calibrated in decibels above and below maximum output and in watts into 8 ohms, are actually useful. Unlike other amplifiers the meters had a fast rise time, and really did indicate peak levels and the onset of distortion.

A headphone jack socket and two sets of loudspeakers connections are provided, with switch selection of 'off' and either or both sets of loudspeakers in parallel. However caution is required in the selection of suitable loudspeakers, as the amplifier does not take kindly to 2 ohm loads with the result that audible distortion occurred when using two loudspeakers of nominal 8 ohm impedance in parallel, particularly when loudspeakers of a nasty impedance characteristic were used.

In other respects the power capabilities of this amplifier were really excellent, with minimal harmonic and intermodulation distortion and a very wide power bandwidth, the intermodulation distortion above the audio frequency band being incredibly good.

The noise associated with all the inputs was to a high standard, the magnetic phono cartridge input being unusually good, and whilst the measured output noise at the worst case volume setting looks poor, in practice the use of the attenuator associated with the volume control gave an extremely good output noise performance.

Input source selection is by two rotary switches, one of which selects the auxiliary, tuner or one of the two tape inputs plus the second switch which selects a choice of three phono cartridge inputs. Two of these are for magnetic pick-up cartridges, and the third for a moving coil cartridge with a sensitivity of 60μV and good noise performance. A slightly odd arrangement is that this selector switch also selects a choice of three input impedances for the 'phono 1' input, measured as 98/67/49k ohms, and it is felt that this function would have been better separated from the selector switch.

The source to be recorded onto tape is selected by a further rotary switch which allows a choice, dubbing in either direction between tape units and also the selection of the tuner, auxiliary or any pick-up input. No DIN connections are fitted to this amplifier, but in addition to the inputs there is available the interface between the pre-amplifier and the power amplifier for the connection of equalisers or decoders etc.

In addition to the amplifier's frequency response being normally rolled off at low frequencies, a high pass filter of good design is fitted in addition to the low pass filter which has its —3dB point at 10kHz with an attenuation rate of 12dB per octave. The subjective effect of this filter suggested that its frequency is set on the high side to be effective as a scratch filter or for reducing tape noise.

The treble and bass tone controls both have a choice of two turnover frequencies, the controls themselves being of the eleven position type and offering a fine correction in view of the sensible limited range.

Finally there is a variable loudness control

BEST BUY

which acts as an attenuator at the same time as altering the frequency response, and of course the volume control which is concentric with a good balance control.

Subjective testing of this amplifier gave pleasing results with 8 ohm loudspeakers, and crosstalk between inputs etc. was to a very high standard, but this amplifier is not recommended with 4 ohm loudspeakers if they have awkward impedance characteristics.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 86
D C offset at loudspeaker and headphones L/R . . 1.5/6mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz. . . . . —>80/—80/—66dB
Loudness control effect ref 1kHz 100Hz/10kHz +11/+6dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 0.5dB

Power performance

Power output into 8Ω both L/R 89W
Power output into 8Ω single L/R 100W
Power output into 4Ω both L/R 120W
Power output into 4Ω single L/R 140/141W
Burst output into 8Ω single L/R 100W
Burst output into 4Ω single L/R 149/153W
Power output into half rated load L/R 2Ω 15W
Power bandwidth 8Ω 32¼W L/R . . . . . 10Hz to 110kHz
Power bandwidth 4Ω 40W L/R . . . . . 10Hz to 92kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.01/0.02%
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz 0.02/0.03%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz . . . . . —80/70/70dB
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz . . . . . —80/80/72dB
IM distortion at 1W from auxiliary input DF3
1/10/100kHz . . . . . —77/80/73dB
IM distortion at 1W from phono input DF3
1/10/100kHz . . . . . —80/80/72dB

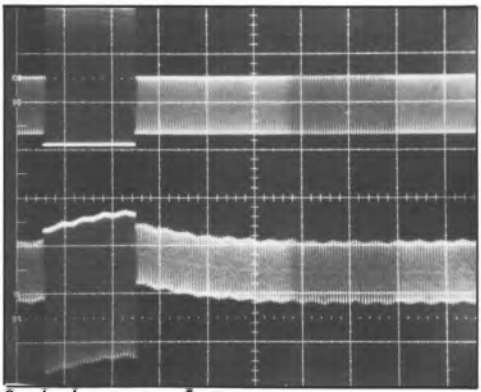
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 106.5/110dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 115/122dBV
Noise ref to input — average L/R CCIR/22kHz
Mic . . . . . —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.05/0.03μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.50/0.13μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 92.5dB

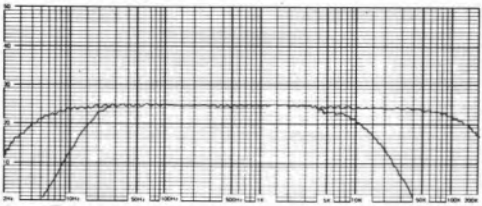
Inputs and outputs

Input impedance on aux/tuner/tape
. . . . . 65/50k 130;110;100pF
Input impedance on phono 98/67/49k 250pF
Input impedance on mic . . . . . —
Input sensitivity and clipping point at 1kHz
aux/tuner/tape 160mV 20V
Input sensitivity and clipping point at 1kHz
phono. 2.6mV 255mV
Input sensitivity and clipping point at 1kHz mic . . . . —mV
Output voltage and impedance for rated output —
headphone 23V 340Ω
Output voltage and impedance for rated output —
tape. . . . . 160mV VARIΩ
Output voltage and impedance for rated output —
DIN . . . . . —kΩ

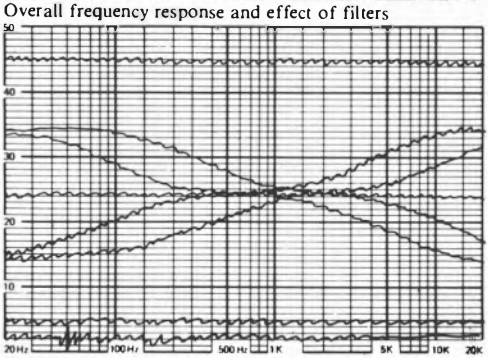
Typical selling price including VAT £249.00



Overload recovery performance



Overall frequency response and effect of filters

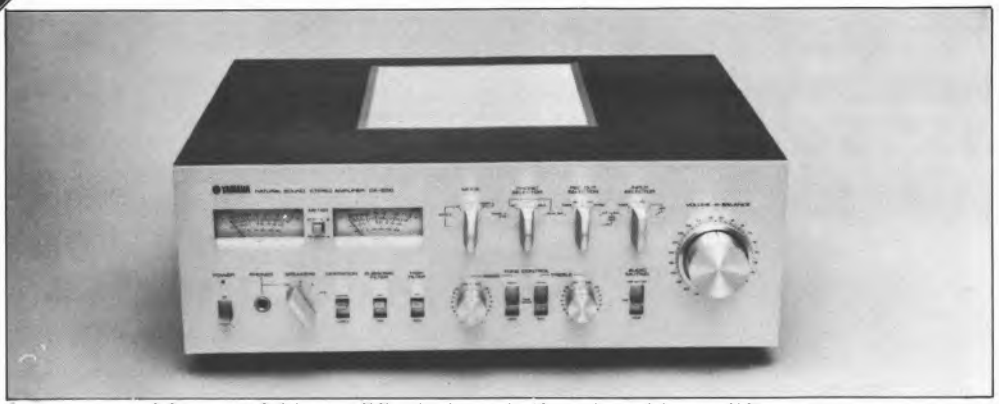


Effect of tone controls and accuracy of RIAA equalisation

RECOMMENDED

Yamaha CA-2010

Natural Sounds System Ltd., 10 Byron Road, Wealdstone, Harrow, Middlesex. 01-863 8622.



A very unusual feature of this amplifier is that it has the switched option of two modes of operation of the output stages, class A/B or class A operation, the latter being claimed to give even lower distortion. The penalty for class A operation is that the rated output power into 8 ohms drops from 120W to 30W, and all figures in the adjacent table are related to the 120W output.

Measured distortion in this condition was first class and similar excellent results were obtained with class A operation, the high frequency intermodulation distortion being extremely low, and also the power bandwidth extending above 100kHz.

Not only was distortion performance outstanding, but also the noise associated with all the inputs was amongst the best measured in these amplifier reviews and the output noise was good. Because the manufacturer has had the sense to place the 'muting' attenuator after the analog volume control, noise was no problem when using headphones and the action of the volume control was found to be very good. Neither the volume control nor the treble and bass tone controls upset the amplifier balance and the tone controls were a delight to use with their small switched steps and sensible restricted range. The defeat tone control switches provided a choice of two well chosen turnover frequencies for each control.

High pass and low pass filters are of the 12dB per octave type with well chosen turnover frequencies at 30Hz and 10kHz respectively and it was noted that the common and unnecessary loudness control was not to be found on this amplifier.

On the output end two sets of loudspeaker terminals are available, with switch selection of either loudspeaker or both in parallel — in which case use 8 ohm speakers.

The basic input selector switch provides for the two tape inputs and the tuner and auxiliary inputs, with a further position selection selecting the phono inputs switch. The latter selects the fixed sensitivity and impedance 'phono 2' input or the 'phono 1' input which accepts either a magnetic pick-up cartridge with a choice of 99/68/50k ohm input impedance or a moving magnet cartridge with a low input impedance and a sensitivity of 70 microvolts. But amplifier balance was poor using this input — see graph.

The arrangement of the two tape inputs and outputs which do not have DIN connectors is such that tape monitoring is achieved by the input source switch, and the signal to be recorded is selected by a further rotary switch which has positions for all the input sources in addition to positions for the two tape units, such that tape dubbing can be done in either direction. Crosstalk across all selector switches was satisfactory, such that there was little interference from unwanted sources.

In addition to the inputs and outputs already mentioned, the rear of the amplifier also has pre-amplifier output and power amplifier input connections which can be separated by a slide switch.

A final feature is two front panel meters calibrated in millivolts for measuring the record output level, and in decibels and watts

RECOMMENDED

into 8 ohms for measuring the power amplifier output. These were fast acting meters which really did indicate peak conditions — amplifier clipping and distortion could be easily read.

Internal and external finish were both good, with excellent and clearly identified circuit boards and components, but access for servicing appeared to be restricted.

Overall this is an excellent amplifier with all the facilities which may be required, but it is of course expensive.

General Data

Hum modulation at rated output into 8Ω
50/100/150Hz 0dB
Damping factor ref 8Ω at 1 kHz 58
D C offset at loudspeaker and headphones L/R ... 8/21mV
Crosstalk at 1W output 100Hz/1kHz/
10kHz ..... —74/—70/—55dB
Loudness control effect ref 1kHz 100Hz/10kHz ..... —dB
Frequency response deviation from 20Hz to
20kHz aux/tape/tuner 0.5dB

Power performance

Power output into 8Ω both L/R 139/135W*
Power output into 8Ω single L/R 156W*
Power output into 4Ω both L/R ..... —W
Power output into 4Ω single L/R ..... —W
Burst output into 8Ω single L/R 176W*
Burst output into 4Ω single L/R ..... —W
Power output into half rated load L/R 4Ω 250/254W*
Power bandwidth 8Ω 60W L/R ..... 10Hz to 100kHz
Power bandwidth W L/R ..... —kHz

Distortion

Total harmonic distortion at 1W into 8Ω
1kHz/10kHz 0.04%*
Total harmonic distortion at 1W into 4Ω
1kHz/10kHz ..... —%
IM distortion at half rated power into 8Ω
DF2 1/10/100kHz ..... —>80/>80/74dB*
IM distortion at half rated power into 8Ω
DF3 1/10/100kHz ..... —72/74/74dB*
IM distortion at 1W from auxiliary input DF3
1/10/100kHz ..... —>80/>80/>80dB
IM distortion at 1W from phono input DF3
1/10/100kHz ..... —>80/>80/>80dB

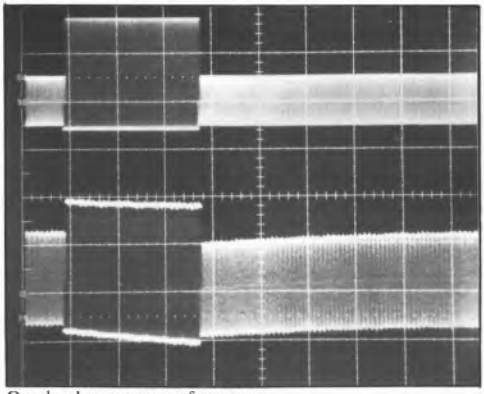
Noise performance

Noise ref to input — average L/R CCIR/22kHz
aux/tuner/tape 109/117dBV
Noise ref to input — average L/R CCIR/22kHz
Phono 114/121dBV
Noise ref to input — average L/R CCIR/22kHz
Mic ..... —dBV
Output noise power at zero volume (8Ω)
CCIR/22kHz 0.05/0.006μW
Worst case volume setting auxiliary input (8Ω)
CCIR/22kHz 0.10/0.02μW
Burst dynamic range aux input ref 8Ω worst
channel CCIR 92.5dB

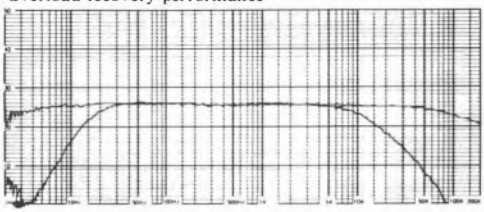
Inputs and outputs

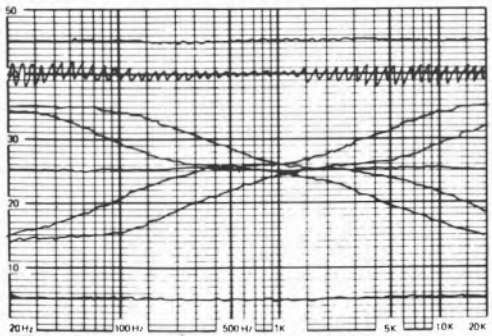
Input impedance on aux/tuner/tape
..... 42/40k 120-tape 98pF
Input impedance on phono 99/68/50k 255pF*
Input sensitivity and clipping point at 1kHz
aux/tuner/tape ..... 125mV >20V
Input sensitivity and clipping point at 1kHz
phono 1.8mV 350mV
Input sensitivity and clipping point at 1kHz mic .... —mV
Output voltage and impedance for rated output —
headphone 31V 270Ω
Output voltage and impedance for rated output —
tape ..... 125mV VARIΩ
Output voltage and impedance for rated output —
DIN ..... —kΩ

Typical selling price including VAT £500.00



Overload recovery performance





Effect of tone controls and accuracy of RIAA equalisation

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Advertising of any audio equipment is almost always based upon its excellent frequency response flat from DC to infinity if possible, and it is clear from the measurements on all the amplifiers that the manufacturers have been at pains to compete in this rat race. Not a single amplifier has given cause for complaint about its poor frequency response, but unfortunately there is a saying that 'the wider you open the window the more dirt flies in'. This applies well to frequency response, the wider the response the more unwanted signals get through an amplifier — rumble from turntables, hiss, radio interference, and transients, which can produce intermodulation effects.

Unfortunately few manufacturers have opted out of the rat race and seen realism, there is little point in the low frequency response of any domestic amplifier being flat below 30Hz or above 20kHz (most programme sources only extend to 15kHz any way), so why go further, particularly in the cheaper amplifiers which do not include filters?

Filters are fine for dealing with poor programme material such as poorly recorded tapes and rumbly discs, but they should be aimed in this direction and not included to limit the frequency response at the low frequency end where this should be part of the basic amplifier design. Similarly at the high frequency end, the low pass filter should be aimed at reducing tape hiss and record scratch defects without providing the amplifier with a 'telephone' quality of reproduction.

It is paradoxical that the cheaper amplifiers do not have any filters and it is in this area where filters are really required, for cheaper amplifiers are likely to be used with cheaper turntables which produce rumble and cheaper tape units which produce excessive noise — it is here that decent filters are really essential; not with expensive peripheral equipment.

Another area where advertisers have had a heyday is that of power output ratings, but this has now been dealt with by legislation. In the United States, the Federal Trade Commission realised that the public were being deceived and took the matter to task with a vengeance, so power output ratings are now in general more realistic and the amplifiers in this book have been fairly rated by their manufacturers', but be careful, the problem still exists in this country.

In the past there has been much criticism of the electrical safety of imported audio equipment, but here again legislation has taken its toll in the United Kingdom, and the improvement in this direction is amazing over the past few years. However, there are still some offenders, including some of the amplifiers reviewed here.

It is hard to understand why loudness controls are fitted to almost all the amplifiers, because it is our opinion that the not insignificant cost of this type of circuit could well be better spent on decent filters.

We were most encouraged to find that the distortion performance of many of the amplifiers was really excellent with few amplifiers exhibiting crossover distortion or significant harmonic distortion. However, the high frequency intermodulation distortion gives cause for concern in some designs, resulting from the failure of the manufacturers to limit the high frequency performance at the amplifier's input.

Whilst most amplifiers showed a good input noise performance, it appears that little thought is directed to headphone listening with the result that output noise is troublesome with headphones and also the output voltage available to headphones is often unnecessarily high.

Most amplifiers had sensible input impedances and sensitivities, but one manufacturer included a DIN compatible tape connector with 470,000 ohms output impedance which is far too high whilst being within the DIN standard. Similarly the input overload margins were generally good, but some pick-up inputs fell short in this direction. It was however encouraging to see several amplifiers which had a choice of phono input impedances, and could therefore do justice to modern pick-up cartridges.

A worrying aspect of many amplifiers was the loudspeaker matching problem. It is generally recognised that the actual impedance of some loudspeakers can fall to about half their rated impedance, but some amplifiers cannot cope with this, and even worse they allow the connection of pairs of loudspeakers

in parallel, with the exception of one manufacturer who has seen the light and connects the pairs in series.

It is unfortunately a fact of life that faults will eventually occur in amplifiers, and in these circumstances at least a circuit of the amplifier and component identifications within the amplifier can often come to the rescue. All manufacturers were requested to submit user and service manuals, two didn't even send user manuals and you can count on one hand the manufacturers who sent even a circuit, let alone a service manual.

Your choice of amplifier

Probably the first consideration when choosing is the output power required for your installation, but it is then essential to make sure from the review tables that a particular amplifier is capable of driving your existing loudspeakers, preferably being able to drive happily into half their rated impedance.

Obviously you must make sure that a particular amplifier has enough inputs for tape units, tuners etc. but don't forget that you may for instance want to add to your installation in the future; perhaps you will buy another tape unit and then want tape dubbing.

If you are improving an existing system you will probably buy an amplifier with good tone controls and filters, but if it's a new system you may be in the market for a cheap amplifier to accompany other relatively cheap components such as turntables and tape units.

If this is the case it's well worth while investing in an amplifier which has good high and low pass filters, but the performance and versatility of the tone controls is not so important.

All the amplifiers reviewed were designed to accept the output from magnetic pick-up cartridges, with two also having facilities for ceramic cartridges, and the Yamaha CA-2010 also having a socket for moving coil cartridges. If you already use a magnetic cartridge all is well and some ceramic cartridges will feed a magnetic cartridge input, but proceed with caution and make sure that a particular amplifier will suit your cartridge from the points of view of input impedance, sensitivity and overload capability.

It's very unlikely that you will have trouble matching tuners to any of the amplifiers, but the input sensitivity and impedance may not match so check that the tuner's output is greater than the amplifier's input sensitivity and that the amplifier's input impedance is high enough.

If you have a tape unit with a DIN compatible connector this will fit any amplifier with a similar connector, but with some amplifiers there is a DIN socket which is not DIN compatible and therefore will not match.

In almost all amplifiers the output to tape is directly derived from the high level inputs, so the output level and impedance are those of the programme source. It follows that caution is required here because the levels and impedances of the tape recorder's input and the programme source's output must match.

Similarly, where tape dubbing is available, the two tape recorders are normally connected directly to each other, and it is the tape recorders which must match each other.

Our choice of best buys and recommendations for amplifiers which cost over £150 is based on the overall standard of performance in relation to price, and most of these amplifiers have a very good performance. However within the range of amplifiers costing £150 or less the choice of amplifiers was found to be extremely difficult. All amplifiers had either very limited facilities or shortcomings, with the result that the recommended amplifiers are the best of a bad bunch and that the two best buys in this price bracket are based on value for money more than performance.

If you can manage to afford a little more you will do well to spend say £200 for which you will get a far better amplifier, but we can't see that it is worth spending more than £500 on a domestic amplifier.

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Amplifiers costing more than £350
In this high priced group of amplifiers, the **Rotel RA-1412** and the **Sansui AU-11000A** at approximately £454.00 and £495.00 inc. VAT respectively rate as joint best buys. Neither are perfection, but both have excellent facilities and a good performance, and we would suggest a bias towards the Sansui if you use 4 ohm loudspeakers. If the meters had been left off the Rotel it could have been a little cheaper and even more tempting.

The remaining amplifiers in this price category, the **Luxman 85V** (typically £410.00 inc. VAT) and the **Yamaha CA-2010** at typically £500.00 inc. VAT are both to be recommended. The Luxman is remarkably cheap for the well conceived and practical facilities which it offers and it is a particularly well built amplifier with an attractive finish.

The Yamaha is considerably more expensive and performs better, and if it had been cheaper would certainly have been a best buy. However, the inclusion of the switchable class A/B or class A mode of operation has obviously taken its toll on the price and we don't think that this facility is of any real practical use.

We can't see that you will benefit by paying more than £500 for any of the amplifiers in this book and you would be hard put to hear the difference in power output between the very expensive Luxman C1000 and M4000 combination and our best buys the Rotel RA-1412 and the Sansui AU-11000A or the recommended amplifiers the Luxman 85V and the Yamaha CA-2010.

Amplifiers costing between £250 and £350
Out of the eight amplifiers in this price group three of them were out of the running for recommendation due to relatively serious shortcomings.

At typically £253.00 inc. VAT we rate the **Sansui AU-7900** the best buy in this price group of amplifiers, as it offers very good value for money in combination with a most respectable overall performance. Furthermore it has a power rating of 75W per channel into 8 ohms plus good filters and comprehensive tone controls which include not only treble and bass controls with a choice of turnover frequencies, but also a mid range 'presence' control.

In alphabetical order, the next amplifier in this price group to be recommended is the **Pioneer SA-8500 Mk II** with a price tag of approximately £280.00 inc. VAT and a manufacturers' power rating of 60W into 8 ohms. Whilst this amplifier offered good performance and is generally to be recommended, it is felt that the price is too high for what it offers.

In contrast to this, the combination of the **Quad 33** Pre-amplifier and **405** power amplifier at a total price of typically £265.00 inc. VAT offers very good value for the 100W per channel power output in combination with a good but not outstanding performance. Whilst this combination is recommended, the value for money of the Quad 405 power amplifier alone is excellent and the combination of the power and pre-amplifiers is the only pair to be recommended in this book.

Also to be recommended are the **Sony TA-5650** and the **Technics SU-8080** at typically £270.00 and £255.00 inc. VAT respectively. Clearly the Sony TA-5650 is rather expensive and we rate it is average value for money as it does not offer outstanding performance but has many good features. Whilst the Technics SU-8080 offers a generally very good performance, the tone controls are perhaps not as versatile as they might be in comparison with other amplifiers in this class and we feel that the 350pF shunt capacitance at the high level inputs is on the high side.

In summary we recommend the Pioneer SA-8500 Mk II and Sony TA-5650 as average value for money and good performance, with the Quad 33 and 405 and the Technics SU-8080 being recommended as good value for money and the Sansui AU-7900 at £253 being a clear best buy.

Amplifiers costing over £150 to less than £250
The joint best buys in this price group are the **Akai AM-2600** selling at around £200.00 inc. VAT and the **Yamaha CA-810** which just falls into this price group at £249.00 inc. VAT. Both amplifiers are very good value for money, and of course the Yamaha has more to offer than the Akai which is quite a lot cheaper.

The Yamaha CA-810 comes out well on

measured performance and with its rated power output of 65W per channel into 8 ohms is quite powerful enough for most domestic requirements, but we would not recommend 4 ohm loudspeakers. The Akai AM-2600 takes more kindly to 4 ohm loudspeakers and has a similar power rating at 60W per channel into 8 ohms, the disadvantage being that its tone controls are not so sophisticated and its facilities are more restricted.

At the cheaper end, we recommend the **Yamaha CA-610** at £155.00 inc. VAT and the **Technics SU-7700** at typically £160.00 inc. VAT. Both these offer good performance for their cost, but the Yamaha lacks any low pass filter and both have meters which are an unnecessary feature of little use.

Also recommend is the **Trio KA-7100** at the higher price of approximately £198.00 inc. VAT but this amplifier is slightly overpriced and can only be considered average value for money in view of its relatively limited facilities. It does however offer a very good measured performance.

Amplifiers costing £150 or less

As the £150 price barrier is crossed, the amplifiers change their nature rapidly and all amplifiers costing below £150 had shortcomings of one nature or another. This made it very difficult to decide upon which amplifiers to recommend, and it is suggested that you look through the individual reviews of the recommended amplifiers to decide if their particular shortcomings are embarrassing in conjunction with your other hi-fi equipment.

Out of the nineteen amplifiers costing below £150 we do not recommend eight, as we feel that their shortcomings are particularly serious, a further nine amplifiers are recommended for consideration, leaving the two best buys which both have some very good parameters and also some shortcomings.

The best buy positions for amplifiers costing £150 or below are taken by the **Sansui AU-3900** at about £107.00 inc. VAT and the **Sanyo DCA-1001** at about £120.00 inc. VAT. Both had respectable distortion and noise performance, the Sansui having a reasonable low pass filter and also an inbuilt bass roll-off and the Sanyo an average high pass filter and offering twice the power of the Sansui at 50W per channel into 8 ohms.

Turning now to the recommended amplifiers, it is pleasing that these include the cheapest amplifier reviewed, the **JVC JA-S11** at approximately £85.00 inc. VAT. This is a basic amplifier without filters, but the bass has been sensibly rolled-off and with regard to the price, we can forgive the 'average' distortion performance and accept that the noise performance is good and the power output adequate at 30W into 8 ohms.

With a little more power than the Rotel, the **JVC JA-S31** offers 40W per channel into 8 ohms with 'average' distortion performance and good noise performance, but it doesn't have any filters. Costing about £120.00 inc. VAT, this is a 'clean' amplifier which is well made.

For another £5 or so the **A & R A60** amplifier offers a low pass filter and very sensibly has its bass rolled off instead of a high pass filter. High level input noise was good and the phono noise, average. This amplifier was unusually well made, but we didn't like the tone controls and the volume control.

Advancing a little further, the **Technics SU-7300** at about £130.00 inc. VAT also has a low pass filter and generally offers a reasonable performance for its price, with a power rating of 40W per channel into 8 ohms, but we didn't like the tone control steps at some settings and the high level input capacitance was high.

Both selling at about £145.00 inc. VAT the **Marantz 1070** and the **Toshiba SB-420** both have filters, but not very good ones. The Marantz has in addition a presence control, and both these amplifiers are worthy of consideration as is the **Pioneer SA-6500 Mk II** (typically £150.00 inc. VAT) which had good pick-up noise and very good high level noise performance with average distortion performance and no filters.

What opinion poll ever based any conclusion on a sample of one?

If any ever did, the results would be regarded as a joke. And yet, that's precisely what hi-fi reviewers try to do. Products are condemned or praised entirely on that basis. Recommendations are made and reputations destroyed solely on the performance of one sample. Selected, supposedly at random, from a production run of many thousands.

However, it's the manufacturers who supply the sample to be tested. And it would be naive to assume that these were never checked prior to delivery to the reviewer. If only to ensure that they at least meet their specifications.

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Analog: An analog device is one which works with continuously variable signals, as opposed to one which works with signals which vary in discrete steps, such as digital devices.

Audio frequency: An audio frequency is one which is in the frequency range of the human ear. At the extremes this is generally accepted to be in the frequency range from 20Hz at the low end to 20,000Hz (20kHz) at the upper limit.

Auxiliary input: The auxiliary input to an amplifier is a high level input which is intended to accept input signals from such devices as radio tuners. It is not suitable for accepting signals directly from pick-up cartridges and microphones.

Average voltage: The average voltage of a varying (alternating or random) voltage is literally its average value over a period of time. This is quite different to its peak voltage or its root mean square (rms) voltage which represents power.

Bandwidth: The bandwidth of an amplifier is the frequency range over which it operates efficiently. This range is normally defined as the limits at which the output has fallen to half power (—3 decibels) when a constant input level is applied.

Capacitance/capacitor: Circuits consist of three types of non-active components, resistors, capacitors and inductors. When the applied frequency is varied, the resistance or obstruction offered by a resistor remains constant but that offered by a capacitor or inductor varies — the amount of obstruction is known as the impedance and this varies according to the frequency.

Ceramic pick-up cartridge: A ceramic pick-up cartridge is one which uses a crystalline structure to transform the movement of the pick-up stylus into a voltage. The other common type of cartridge is the magnetic cartridge which uses a magnet in a coil to convert the stylus movement into a voltage.

Chip: An integrated circuit is often referred to as a 'chip'.

Clipping: When a signal in an amplifier is already so large that the amplifier is not able to enlarge it, the peaks of the signal are cut off. This is known as clipping.

Crossover distortion: Many amplifiers use one transistor, or set of transistors, to pull the output positive and another to pull the output negative. Around the zero voltage area, neither transistor or set of transistors is working very hard and this can create distortion which is called crossover distortion because it occurs at the point where the zero output voltage point is crossed.

Crosstalk: This is the Leakage of the signal in one channel of a stereophonic amplifier into the other channel.

Damping factor: If you move the cone of a loudspeaker this generates a voltage at the loudspeaker terminals. If the terminals are not connected, it is easier to move the cone than if they are shorted together because the loudspeaker acts as a generator and shorting the terminals loads the generator. It follows that shorting the terminals damps the movement of the loudspeaker cone. The damping factor relates the internal resistance of an amplifier to the amount by which it damps the loudspeaker.

Decibel (dB): The logarithmic relation between two signals is measured in decibels. If the signals are measured as voltages the decibel difference is twenty times the logarithm of one voltage divided by the other. For convenience, signal levels are sometimes referred to a level of one volt in decibels, and this is abbreviated as 'dBV'. a trained ear will be hard put to hear a difference in programme level of one decibel and 6 decibels is something like doubling the volume. When power is measured in decibels a difference of 3 decibels represents two to one in power, thus —3dB represents half power. In the case of voltages a difference of 10dB is about three to one, 20dB is ten to one.

Detent mechanism: This is a mechanical device which provides, for example, a volume control with a series of fixed positions which can be felt, so that the control feels as if it were a multi-position switch.

DIN: This is the German Standards Authority which is in full the Deutscher Normenausschuss and produces standards called Deutscher Industrie Normen, some of

these standards are used for specifying the performance of hi-fi equipment.

DIN connector: These connectors are the German Standard connectors for hi-fi equipment and are to be found with a number of different pin configurations. The common ones are the two-pin loudspeaker connector and the five-pin audio connector. The latter has standard connections for stereophonic inputs and outputs and should be used with standard signal levels.

Discrete components: Where an amplifier is constructed from individual resistors, capacitors, etc as opposed to the use of integrated circuits it is said to be made from discrete components.

Distortion: Distortion in an amplifier is any unwanted modification of the audio signal between the amplifier's input and output. This generally takes the form of the addition of unwanted tones, and whilst the addition of noise or hiss may be considered to be distortion of a form it is normally treated separately. See harmonic distortion and intermodulation distortion.

Earth loop: If two pieces of equipment, such as an amplifier and a turntable are earthed by their mains cables and also connected together by means of the audio cables this forms a wired loop. Any leakage of electricity from the mains will flow round this loop which is called an earth loop, and this will cause hum problems.

Equalisation: When records are made, the low frequencies are attenuated and the high frequencies boosted in order to take account of the machanical problems associated with the shape and size of the groove on the record, this modification to the frequency response is called equalisation, and the reverse process of equalisation is also done in amplifiers for the phono input. A standard equalisation characteristic is used and this is called the RIAA Curve.

Filter: A filter is like a sieve in that it cuts out some things and passes others through. In an amplifier a filter passes signals at some frequencies and reduces or eliminates others. A high pass filter passes high frequencies and rejects low frequencies. A low pass filter passes low frequencies and rejects high frequencies and as a result reduces hiss.

Frequency response: The frequency response of a device is its relative performance in terms of output level in relation to frequency. If an amplifier has a frequency response from 20Hz to 30kHz this doesn't mean anything unless you are told how much the performance has dropped off at the limits. This drop in performance is specified in decibels; thus we may say that the frequency response is —3dB at 20Hz and 30kHz relative to the performance at 1kHz.

Harmonic: The harmonic of a tone or musical note is a multiple of its frequency.

Harmonic distortion: Harmonic distortion is the unwanted generation of harmonics.

Heatsink: In order to keep large transistors and other devices cool they are often bolted to a large piece of metal which is commonly painted black — this is called a heatsink.

High level input: The inputs to an amplifier which are intended to accept signals above around 100 millivolts are called high level inputs and are used for tuners and like, as opposed to low level inputs which work at very low input voltages and are intended for pick-up cartridges and microphones.

Hum: Unwanted breakthrough from the mains into audio circuits causes a humming sound in the loudspeakers, this is called hum.

Hum loop: See Earth loop.

IM distortion: See Intermodulation distortion.

Impedance: At any fixed frequency a capacitor or inductor offers the same resistance to current as a certain value of resistor, but in this case the effective resistance is known as impedance.

Integrated circuit: An integrated circuit is a micro sized circuit consisting of transistors, resistors etc which are in a small package which usually has four or eight electrical connections.

Intermodulation distortion: When two or more tones pass through an amplifier which is non-linear they will form other tones which are at the sum and difference frequencies of

the original tones. The addition of these tones is called intermodulation distortion.

Loudness control: A control on an amplifier which boosts the bass, and sometimes the treble too, at low volume settings. This is intended to compensate for the characteristic of the human ear at low listening levels.

Magnetic pick-up: See Ceramic pick-up.

Matching: When two devices are connected together they must present the correct voltage and not overload each other — these problems are called matching.

Noise: This is the unwanted hissing sound which is added to the audio signal by amplifiers, but not normally including hum. This may be measured as unweighted noise or as weighted noise where the frequency response of the measuring instrument is modified to attempt to compensate for the relation between the frequency spectrum of the noise and the subjective effect.

Phono input: An amplifier's input which is a low level input which has been equalised for a magnetic pick-up cartridge.

Phono plug: A type of audio connector with a single pin, sometimes called a RCA phono plug.

Power bandwidth: This is normally the frequency range over which an amplifier will deliver more than half its rated power output with less than a given amount of total harmonic distortion.

Protection circuits: Circuits within a power amplifier which protect the output transistors from excessive current, power dissipation or temperature are called protection circuits.

RIAA: See Equalisation.

Sensitivity: The voltage which must be applied to a particular amplifier input in order to give the amplifier's rated power output at maximum volume setting.

Slew rate: The maximum rate of change of output voltage from an amplifier, which is limited by the speed at which the circuits in the amplifier can operate.

Tone burst: A short duration 'pulse' of fixed frequency tone.

Unweighted noise: See Noise.

Watt: A unit of power which in simple terms is the voltage multiplied by the current, or in the case of an alternating voltage, the root mean square (rms) voltage multiplied by the root mean square current.

Weighted noise: See Noise.

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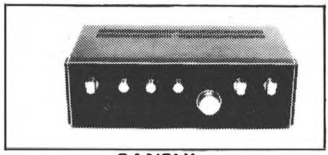

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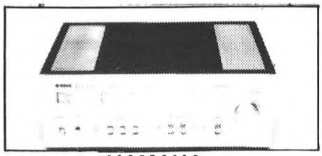

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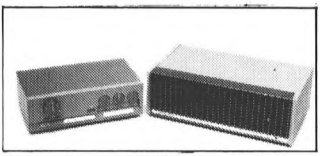

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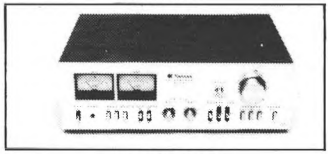

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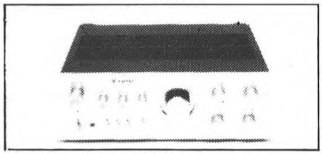

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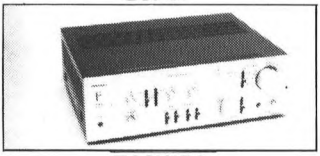

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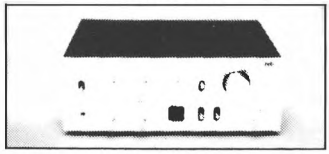
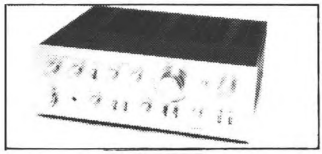
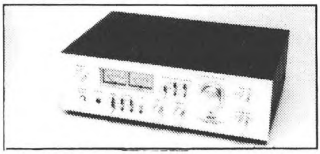


JVC



PIONEER



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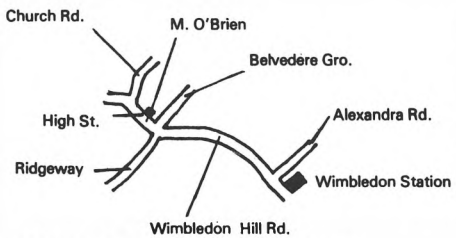

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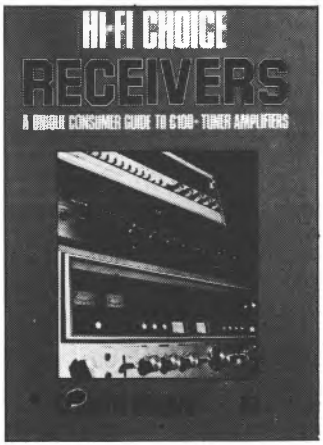

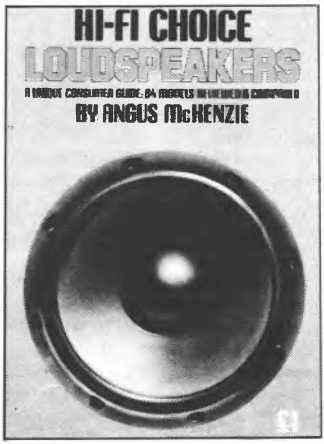

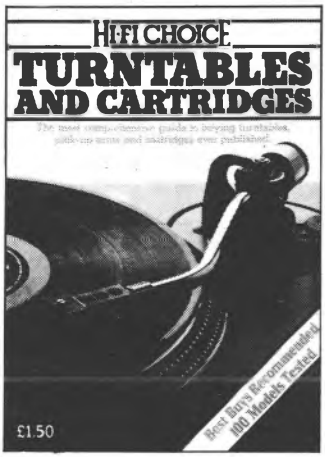

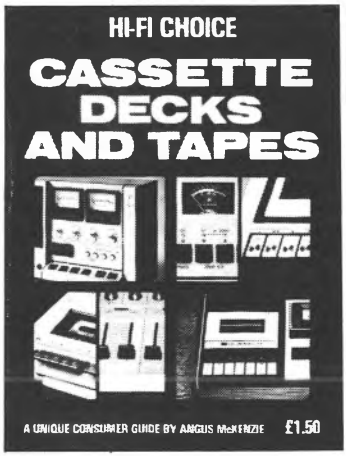

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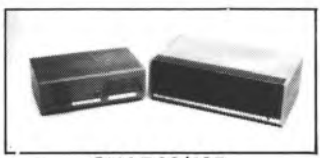

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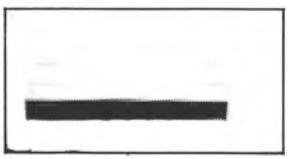

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Overall comparison chart

	Power output into 8 ohms	Power output into 4 ohms	Power output into half rated load	Power bandwidth — into 8 ohms (worst figure)	Overall distortion rating	Noise from high levels inputs	Noise from phono inputs	Dynamic range
Accuphase E202	128W	185W	18W	63kHz	good	good	average	average
Akai AM-2600	74W	94W	70W	43kHz	good	good	good	good
Alpha FA-600	22W	—	38W	2kHz	poor	poor	average	poor
Amcron IC150A and D150A	102W	—	130W	38kHz	v. good	v. good	v. good	good
A & R A60	34W	—	46W	36kHz	good	v. good	average	good
Armstrong 621	53W	—	88W	3kHz	average	poor	good	average
Audiotronics LA-4040	41W	—	62W	12kHz	average	poor	good	average
BGW 100 and 202	34W	45W	62W	60kHz	good	poor	good	average
Cambridge Audio P80	57W	—	103W	4kHz	average	poor	average	poor
Eagle A6400	48W	45W	9W	8kHz	poor	poor	poor	poor
Harman Kardon A-401	24W	—	40W	14kHz	average	good	good	average
Harman Kardon A-402	55W	—	81W	52kHz	good	good	v. good	average
Hitachi HA-330	48W	43W	30W	23kHz	average	good	poor	average
JVC JA-S11	36W	—	61W	29kHz	average	v. good	good	good
JVC JA-S31	47W	—	67W	21kHz	average	v. good	v. good	good
Leak 3900A	92W	127W	—*	30kHz	average*	v. good	v. good	good
Lenco A50	55W	—	78W	14kHz	poor	average	poor	average
Luxman 80V	58W	—	100W	20kHz	good*	good	average	average
Luxman 85V	94W	—	163W	23kHz	good*	good	good	average
Lux C1000 and M4000	197W	—	143W	50kHz	v. good*	good	good	average
Marantz 1030	18W	20W	11W	19kHz	average	poor	v. good	average
Marantz 1070	47W	64W	28W	57kHz	good	good	good	good
Marantz 1250	160W	—	279W	11kHz	good	good	good	good
Pioneer SA-6500 II	36W	40W	40W	32kHz	average	v. good	good	v. good
Pioneer SA-8500 II	80W	—	113W	58kHz	v. good*	good	good	average
Pioneer SA-9900	131W	189W	246W	40kHz	v. good*	good	average	average
Quad 33 and 405	110W	77W	17W	33kHz	good	good	average	average
Rotel RA-413	42W	—	65W	40kHz	good	average	good	average
Rotel RA-1412	129W	131W	93W	50kHz	good	v. good	good	good
Sansui AU-3900	27W	32W	31W	52kHz	good	good	average	good
Sansui AU-7900	79W	132W	55W	28kHz	good	v. good	good	good
Sansui AU-11000A	128W	192W	182W	57kHz	v. good	good	v. good	average
Sanyo DCA-1001	56W	—	34W	23kHz	good	v. good	average	good
Setton 3300	67W	—	113W	44kHz	good	v. good	average	good
Sony TA-2650	53W	—	65W	41kHz	good	good	average	average
Sony TA-3650	63W	80W	48W	28kHz	v. good	v. good	average	good
Sony TA-5650	77W	95W	26W	32kHz	good	v. good	average	good
Sugden A48	42W	47W	30W	2kHz	poor	average	average	average
Sugden C51 and P51	49W	54W	25W	8kHz	poor	average	average	average
Technics SU-7300	48W	64W	83W	97kHz	good	good	v. good	good
Technics SU-7700	58W	80W	98W	>110kHz	good	good	good	good
Technics SU-8080	82W	88W	11W	57kHz	v. good	v. good	good	good
Toshiba SB-420	52W	72W	127W	16kHz	v. good	v. good	average	good
Trio KA-3500	51W	66½W	113W	30kHz	poor	v. good	average	good
Trio KA-7100	72W	96W	16W	57kHz	good	v. good	good	v. good
Trio Model 600	147W	166W	155W	4kHz	poor	good	average	average
Yamaha CA-610	41W	63W	6W	69kHz	v. good	v. good	average	good
Yamaha CA-810	89W	120W	15W	>110kHz	good	v. good	good	good
Yamaha CA-2010	137W	—	252W	>110kHz	good	v. good	average	good

DIN compatibility	High pass (rumble) filter	Low pass (scratch) filter	Headphone socket	Mirco input	Recommended loudspeaker compatibility*	Tone controls	Typical selling price inc. VAT	Value for money
no	good	poor	1	NO	8 ohms	average	£580	average
yes	good	good	1	NO	4/8 ohms	average	£200	v. good
yes	poor	poor	1	YES	8 ohms	average	£100	poor
no	average	poor	1	NO	8 ohms	average	£920	poor
no	—	good	1	NO	8 ohms	average	£125	good
no	good	good	1	NO	8 ohms	average	£130	poor
yes	good	poor	1	YES	8 ohms	average	£110	poor
no	average	good	2	NO	4/8 ohms	average	£790	poor
no	poor	good	1	NO	8 ohms	average	£185	poor
yes	poor	—	1	YES	8 ohms	average	£110	poor
yes*	good	—	2	NO	8 ohms	average	£99	average
yes*	good	poor	2	NO	8 ohms	comprehensive	£240	average
yes	good	—	1	NO	4/8 ohms	average	£124	poor
yes	—	—	1	NO	8 ohms	average	£85	good
yes	—	—	1	NO	8 ohms*	average	£120	good
yes	good	good	1	YES	8 ohms	comprehensive	£275	average
no	poor	poor	1	YES	8 ohms	average	£174	poor
yes	good	good	1	NO	8 ohms	comprehensive	£300	poor
yes	good	good	1	NO	8 ohms	comprehensive	£410	good
yes	good	good	1	NO	8 ohms	comprehensive	£1710	poor
yes	—	average	1	YES	8 ohms	average	£90	poor
yes	poor	poor	1	YES	8 ohms	average	£145	good
yes	good	good	1	YES	8 ohms	comprehensive	£500	average
yes	—	—	1	NO	4/8 ohms	average	£150	good
yes	average	good	1	NO	8 ohms	comprehensive	£280	good
no	good	good	1	YES	4/8 ohms	comprehensive	£580	average
no	—	good	—	NO	8 ohms	average	£265	good
yes	poor	poor	1	NO	8 ohms	average	£100	average
yes	good	good	2	YES	4/8 ohms	comprehensive	£454	v. good
no	—	average	1	YES	4/8 ohms	average	£107	v. good
yes	good	good	1	NO	4/8 ohms*	comprehensive	£253	v. good
yes	good	good	1	NO	4/8 ohms	comprehensive	£495	v. good
no	average	—	1	NO	8 ohms	average	£120	v. good
yes	—	poor	1	YES	8 ohms	comprehensive	£290	poor
yes	—	—	1	NO	8 ohms	average	£135	average
yes	average	average	1	NO	8 ohms	comprehensive	£190	average
yes	good	good	1	NO	8 ohms	comprehensive	£270	good
*	good	good	1	NO	4/8 ohms	average	£165	poor
no	average	good	—	NO	8 ohms	average	£200	poor
yes	—	good	1	NO	4/8 ohms	average	£130	good
yes	good	good	1	NO	4/8 ohms	average	£160	good
yes	good	good	1	NO	8 ohms	average	£255	good
yes	poor	average	1	YES	4/8 ohms	average	£145	good
yes	—	average	1	NO	8 ohms	average	£110	poor
yes	poor	average	1	NO	8 ohms	average	£198	good
yes	good	good	1	NO	4/8 ohms	comprehensive	£550	poor
yes	good	—	1	NO	8 ohms	average	£155	good
no	good	good	1	NO	8 ohms	comprehensive	£249	v. good
no	good	good	1	NO	8 ohms	comprehensive	£500	good

Summary and index of products reviewed

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