# HI-FI CHOICE

# RECEIVERS

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# 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.

It's why, before you buy hi-fi, you must listen to whatever you're thinking of taking home. So that you know exactly what you're getting. Otherwise, you may discover that what you believe to be your best buy isn't. And, once it's home, it's too late.

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# Hi-Fi Choice No.7
# Receivers by Angus McKenzie

## Contents




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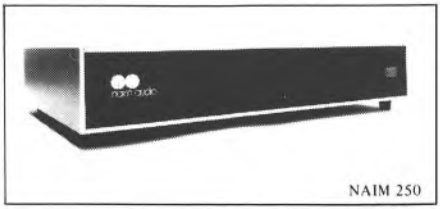
Product photographs by Kokon Chung

# don't call in the receiver

NAIM 32



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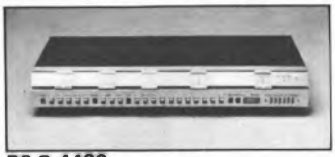
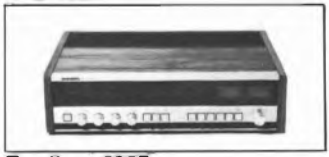
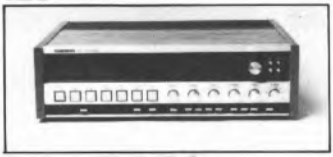


B&O 4400

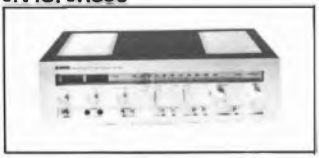
J.V.C. JRS50



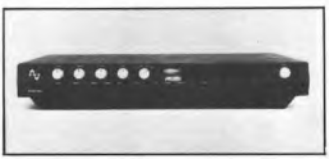
Tandberg 2025



Tandberg 2075 MkII



Yamaha CR620



Armstrong 626

Pioneer SX550

Trio 4070

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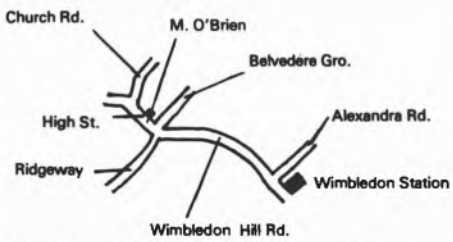


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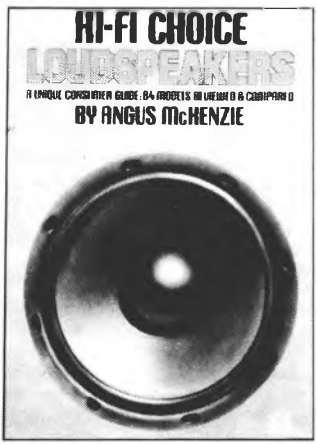


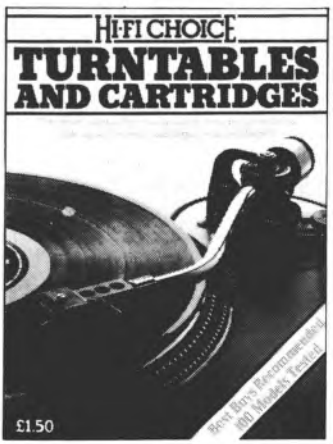


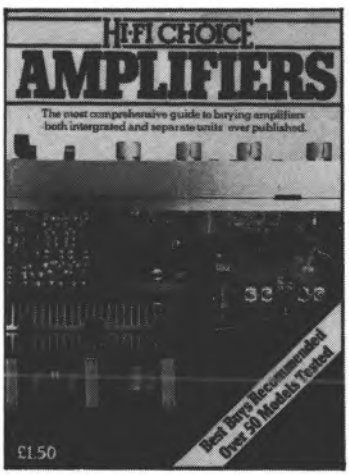

We'll admit it. Hi-Fi Choice is not a cheap publication. A single copy will cost you £1.50. A set of four, £5.50. But mistakes made when buying hi-fi equipment come a good deal more expensive than that.

There are so many products and models on the market now. So much technical jargon. So many pages of claims and counter claims in manufacturer's advertisements. No wonder people make mistakes. And mistakes cost money.

The Hi-Fi Choice series is dedicated to guiding you out of the hi-fi jungle. Every issue is researched and written by an acknowledged expert in the field who exhaustively tests, compares and reviews at least fifty models in any one product category.

The recommendations, best buys and conclusions sections in every Hi-Fi Choice are the result of months of work. They are written in plain English, without the jargon. We don't pull any punches and we don't disguise the fact when we're unhappy with a particular model. Alternatively, a recommendation in Hi-Fi Choice offers the reader a foolproof guide to value-for-money hi-fi.

There are now four editions of Hi-Fi Choice available, including our new issue on Receivers. Hi-Fi Choice is available at good newsagents and many hi-hi-fi dealers. And if you want to keep your copies in pristine condition, order a binder (holding a complete set) from the publishers now, at a cost of £1.95 each including postage and packing.

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| CELESTION | KOSS | JR | TECHNICS |
| CHARTWELL | LECSON | SENNHEISER | THORENS |
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# How to use this book

**Each edition of 'Hi-Fi Choice' aims 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, receivers. It is invaluable for anybody interested in audio, from the first time buyer to the professional audio engineer. It can serve as anything from a buyers guide to a survey of the current state of the art.**

If, as a first time buyer, you want to know which receivers we can confidently recommend, then all you have to do is to turn to the 'Best Buy' section at the back of the book. To simplify matters further, we have also marked the best buy and recommended models at the top of the relevant review pages. If you wish to see how each model has performed in comparison with its competition, then just turn to the overall comparison chart and the summary and index of products at the end of the book. But, we would like to stress the importance of reading all the reviews for yourself. There may be some receivers which have narrowly missed a recommendation but which may appeal to you in appearance or be more suited to your particular needs. And 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 discussed. So, for those of you who are new to hi-fi technology, just turn the page and read on. For the more knowledgeable reader, the technical introduction explains the test methods employed and how they were carried out.

This particular issue is a successor to 'Hi-Fi Choice: Receivers' published in April 1976. Thirteen of the models originally reviewed are still available and these reviews are reprinted taking into account any changes made in the model over the past eighteen months.

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 thank his wife, Fiona McKenzie, for her many hours of typing and proof-reading, and his assistants, Nicky Paul-Barron, David Goran, Andrew Collins and Andrew Quick, for their conscientious hard work.

**What is a receiver?**
A receiver, or tuner amplifier, as it is sometimes called, is an integrated piece of hi-fi equipment consisting of a power amplifier which drives the loudspeakers, a pre-amplifier with tone controls and a tuner, incorporating stereo FM and sometimes one or more AM bands.

The tuner section, as far as all the receivers in this book are concerned, always contains a VHF band, and in the UK at the moment this extends from 88MHz to 98MHz. Whereas most stations transmit in stereo, all BBC local radio stations are only mono, and so the tuner has to sort out and switch accordingly to mono or stereo, as received. A few receivers have several push buttons which when depressed choose a pre-determined station. Most receivers also incorporate a medium wave section for receiving both local stations and distant ones, perhaps from all over Europe.

The power amplifier section converts the small electrical voltages from the pre-amplifier and tone control sections to much larger ones, required to drive loudspeakers. This section has to do this without adding undesirable distortion whether the system is being auditioned at a lower volume or a very high one, provided that the latter is within the capabilities of the equipment.

The pre-amplifier contains switching to select various inputs (eg tuner section or gramophone record pick-up amplifying section), and the volume, balance and tone controls, all of which adjust volume and tonal balance in one way or another.

A complete receiver is thus the heart of the hi-fi system, through which all the electrical signals, equivalent to sounds, must pass. In this survey we have chosen models in the price bracket of £125 minimum to £750 maximum, since below our minimum price, quality falls more rapidly than price, whilst at the top end we are including almost all the most expensive receivers available in the UK.

**What are the advantages and disadvantages of buying a receiver as opposed to a separate tuner and amplifier?**
The most obvious advantage in purchasing a receiver is compactness and neatness, since only one mains connection is required instead of two, and no separate audio cables are required to link the tuner section to the pre-amplifier section inside a receiver. Also if you study prices you will see that separates cost quite a lot more than a receiver. Since a receiver is in one box it is less costly to produce, and in most receivers one mains power supply feeds all the different circuits with appropriate components to operate all the electronics at the required voltages. Each separate, however, requires its own power supply, fuses and mains input, as well as on/off switch, and whilst a receiver's power supply is necessarily more complicated than a power amplifier's one, it costs far under the combined cost of two power supplies to build.

The main disadvantage to having a receiver is the very fact that you will have all your eggs in one basket, and the system is less adaptable to more unusual uses than are separates. In one particular field a receiver is almost invariably sadly lacking, and this is in provision for connecting the tuner section directly through to a tape recorder via the tape recorder sockets in case the user wants to listen to records. I frequently like to record a broadcast at the same time as playing discs or tapes to visitors, and thus having separates is very useful. Another advantage with separates is the possibility of purchasing a very high quality and high powered amplifier, but with a separate tuner which may be in a far lower price bracket, if stereo sound is not that important to you. Conversely, you may not require high volume whilst nevertheless appreciating the qualities of an extremely fine and expensive tuner. Such combinations are likely to be cheaper than a complete receiver with excellent tuner, pre-amplifier and main amplifier sections, which may also deliver high power. Buying separates also allows you to update each individual piece if something better takes your fancy.

**What external influences can control the performance of a receiver?**
A receiver, if it is a good one, is only going to produce sounds which are as good as the programme being fed through it, and furthermore the quality will be largely determined by how good your loudspeaker

## BBC VHF Radio Transmitting Stations

Engineering Information Department, BBC, Broadcasting House, London W1A 1AA. Tel: 01-580 4468 Ext. 292.
Names of relay stations are inset under the main station of the group.

### ENGLAND

| | Radio 1/2, Radio 3, Radio 4 | | | | Local Radio | | |
|---|---|---|---|---|---|---|---|
| | Frequencies (MHz) | | | Max | | Frequency | Max |
| | R1/2 | R3 | R4 | erp kW | | MHz | erp kW |
| **London and South East** | | | | | | | |
| Oxford | 89.5s | 91.7s | 93.9s | 22 | Radio London | 94.9 | 16.5 |
| Swingate | 90.0s | 92.4s | 94.4s | 7 | Radio Medway | 96.7 | 5.6 |
| Wrotham | 89.1s | 91.3s | 93.5s | 120 | Radio Oxford | 95.2 | 4.5 |
| **Midlands** | | | | | | | |
| Sutton Coldfield | 88.3s | 90.5s | 92.7s | 120 | Radio Birmingham | 95.6 | 5.5 |
| Churchdown Hill | 89.0s | 91.2s | 93.4s | 0.025 | Radio Derby (main) | 96.5* | 5.5 |
| Hereford | 89.7s | 91.9s | 94.1s | 0.025 | (relay) | 94.2+ | 0.01 |
| Northampton | 88.9s | 91.1s | 93.3s | 0.06 | Radio Leicester | 95.1 | 0.3 |
| | | | | | Radio Nottingham | 95.4* | 0.3 |
| | | | | | Radio Stoke-on-Trent | 96.1 | 2.5 |
| **East Anglia** | | | | | | | |
| Peterborough | 90.1 | 92.3 | 94.5 | 20 | | | |
| Cambridge | 88.9 | 91.1 | 93.3 | 0.02 | | | |
| Tacolneston | 89.7s | 91.9s | 94.1 | 120 | | | |
| **South** | | | | | | | |
| Rowridge | 88.5s | 90.7s | 92.9 | 60 | Radio Brighton | 95.3 | 0.5 |
| Brighton | 90.1s | 92.3s | 94.5 | 0.15 | Radio Solent | 96.1 | 5 |
| Ventnor | 89.4s | 91.6s | 93.8 | 0.02 | | | |
| **West** | | | | | | | |
| Wenvoe | 89.95s | 96.8s | 92.125s | 120 | Radio Bristol | 95.5 | 5 |
| Bath | 88.8s | 91.0s | 93.2s | 0.035 | | | |

## Stereo Broadcasting in the UK

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **South West** | | | | | | | |
| Les Platons | 91.1 | 94.75 | 97.1 | 1.5 | | | |
| North Hessary Tor | 88.1s | 90.3s | 92.5 | 60 | | | |
| Barnstaple | 88.5s | 90.7s | 92.9s | 0.15 | | | |
| Okehampton | 88.7s | 90.9s | 93.1 | 0.015 | | | |
| Redruth | 89.7s | 91.9s | 94.1 | 9 | | | |
| Isles of Scilly | 88.8s | 91.0s | 93.2 | 0.02 | | | |
| **North** | | | | | | | |
| Belmont | 88.8s | 90.9s | 93.1s | 8 | Radio Humberside | 96.9 | 4.5 |
| Holme Moss | 89.3s | 91.5s | 93.7s | 120 | Radio Leeds | 92.4* | 5.2 |
| Scarborough | 89.9s | 92.1s | 94.3s | 0.025 | Radio Sheffield (main) | 97.4* | 5.2 |
| Sheffield | 89.9s | 92.1s | 94.3s | 0.06 | (relay) | 88.6 | 0.05 |
| Wensleydale | 88.3s | 90.5s | 92.7s | 0.025 | | | |

's' Transmits stereo programmes *Slant polarisation +Vertical polarisation All others use horizontal polarisation

# Radio stations in the UK


**North West**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Holme Moss | 89.3s | 91.5s | 93.7s | 120 | Radio Blackburn | 96.4* | 1.6 |
| Douglas | 88.4 | 90.6 | 92.8 | 6 | Radio Manchester | 95.1* | 4.2 |
| Kendal | 88.7s | 90.9s | 93.1s | 0.025 | Radio Merseyside | 95.8 | 5 |
| Morecambe Bay | 90.0s | 92.2s | 94.4s | 4 | | | |
| Windermere | 88.6s | 90.8s | 93.0s | 0.02 | | | |

| North East | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pontop Pike | 88.5s | 90.7s | 92.9s | 60 | Radio Carlisle | 95.6 | 5 |
| Weardale | 89.7 | 91.9 | 94.1s | 0.1 | Radio Cleveland | 96.6 | 5 |
| Whitby | 89.6 | 91.8 | 94.0 | 0.04 | Radio Newcastle | 95.4 | 3.5 |
| Sandale | 88.1s | 90.3s | 94.7s | 120 | | | |

## SCOTLAND

**Radio 1/2, Radio 3, Radio Scotland**

| | Frequencies (MHz) | | | | | Frequencies (MHz) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | R1/2 | R3 | Radio Scotland | Max erp kW | | R1/2 | R3 | Radio Scotland | Max erp kW |
| Kirk o'Shotts | 89.9s | 92.1s | 94.3s | 120 | Grantown | 89.8 | 92.0 | 94.2 | 0.35 |
| Ashkirk | 89.1s | 91.3s | 93.5s | 18 | Kingussie | 89.1 | 91.3 | 93.5 | 0.035 |
| Ayr | 88.7s | 90.9s | 93.1s | 0.055 | Orkney | 89.3 | 91.5 | 93.7 | 20 |
| Campbeltown | 88.6 | 90.8 | 93.0 | 0.035 | Thrumster | 90.1 | 92.3 | 94.5 | 10 |
| Forfar | 88.3s | 90.5s | 92.7s | 10 | Rosemarkie | 89.6 | 91.8 | 94.0 | 12 |
| Lochgilphead | 88.3s | 90.5s | 92.7s | 0.01 | Ballachulish | 88.1 | 90.3 | 92.5 | 0.015 |
| Millburn Muir | 88.8s | 91.0s | 93.2s | 0.025 | Fort William | 89.3 | 91.5 | 93.7 | 1.5 |
| Perth | 89.0 | 91.2 | 93.4 | 0.015 | Kinlochleven | 89.7 | 91.9 | 94.1 | 0.002 |
| Pitlochry | 89.2 | 91.4 | 93.6 | 0.2 | Melvaig | 89.1 | 91.3 | 93.5 | 22 |
| Rosneath | 89.2s | 91.4s | 93.6s | 0.025 | Oban | 88.9 | 91.1 | 93.3 | 1.5 |
| Toward | 8[illegible]s | 90.7s | 92.9s | 0.25 | Penifiler | 89.5 | 91.7 | 93.9 | 0.006 |
| Meldrum | 88.7 | 90.9 | 93.1 | 60 | Skriaig | 88.5 | 90.7 | 92.9 | 10 |
| Bressay | 88.3 | 90.5 | 92.7 | 10 | Sandale | 88.1 | 90.3 | 92.5 | 120 |

## WALES

**Radio 1/2, Radio 3, Radio 4**

| | Frequencies (MHz) | | | | | Frequencies (MHz) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | R1/2 | R3 | R4 | Max erp kW | | R1/2 | R3 | R4 | Max erp kW |
| Blaenplwyf | 88.7 | 90.9 | 93.1 | 60 | Llangollen | 88.85 | 91.05 | 93.25 | 10 |
| Dolgellau | 90.1 | 92.3 | 94.5 | 0.015 | Wenvoe | 89.95s | 96.8s | 94.3s | 120 |
| Ffestiniog | 88.1 | 90.3 | 92.5 | 0.05 | Brecon | 88.9 | 91.1 | 93.3 | 0.01 |
| Machynlleth | 89.4 | 91.6 | 93.8 | 0.06 | Carmarthen | 88.5 | 90.7 | 92.9 | 0.01 |
| Haverfordwest | 89.3 | 91.5 | 93.7 | 10 | Llandrindod Wells | 89.1s | 91.3s | 93.5s | 1.5 |
| Llanddona | 89.6 | 91.8 | 94.0 | 12 | Llanidloes | 88.1 | 90.3s | 92.5 | 0.005 |
| Betws-y-Coed | 88.2 | 90.4 | 92.6 | 0.01 | | | | | |

## NORTHERN IRELAND

**Radio 1/2, Radio 3, Radio 4**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Divis | 90.1s | 92.3s | 94.5s | 60 | Larne | 89.1s | 91.3s | 93.5s | 0.015 |
| Ballycastle | 89.0s | 91.2s | 93.4s | 0.04 | Londonderry | 88.3 | 90.55 | 92.7 | 13 |
| Brougher Mountain | 88.9s | 91.1s | 93.3s | 2.5 | Maddybenny More | 88.7s | 90.9s | 93.1s | 0.03 |
| Kilkeel | 88.8s | 91.0s | 93.2s | 0.025 | Newry | 88.6s | 90.8s | 93.0s | 0.03 |

*Information courtesy BBC Engineering Information Department and Independent Broadcasting Authority*

## Independent Local Radio Network

**Belfast**
Downtown Radio
PO Box 293, Newtownards, Co. Down, N. Ireland
Tel: Newtownards (0247) 815555.
293 metres (1025kHz), VHF 96.0MHz.

**Birmingham**
BRMB Radio
Radio House, PO Box 555, Birmingham B6 4BX
Tel: 021-359 4481/9
261 metres (1151kHz), VHF 94.8MHz.

# Radio stations in the UK

**Bradford**
Pennine Radio
PO Box 235, Pennine House, Forster Square, Bradford BD1 5NP
Tel: Bradford (0274) 31521
235 metres (1277kHz), VHF 96.0 MHz.

**Edinburgh**
Radio Forth
Forth House, Forth Street, Edinburgh EH1 3LF
Tel: 031-556 9255
194 metres (1546kHz), VHF 96.8MHz.

**Glasgow**
Radio Clyde
Ranken House, Blythswood Court, Anderston Cross Centre, Glasgow G2 7LB
Tel: 041-204 92555
261 metres (1151kHz), VHF 95.1MHz.

**Ipswich**
Radio Orwell
Electric House, Lloyds Avenue, Ipswich IP1 3HU
Tel: (0473) 216971
257 metres (1169kHz), VHF 97.1MHz.

**Liverpool**
Radio City
PO Box 194, 8-10 Stanley Street, Liverpool L69 1LD
Tel: 051-227 5100
194 metres (1546kHz), VHF 96.7MHz.

**London**
Capital Radio
Euston Tower, London NW1 3DR
Tel: 01-388 1288
194 metres (1546kHz), VHF 95.8MHz.

**London**
London Broadcasting Co.,
Communications House, Gough Square, London EC4P 4LP
Tel: 01-353 1010
261 metres (1151kHz), VHF 97.3 MHz.

**Manchester**
Piccadilly Radio
127-131 The Piazza, Piccadilly Plaza, Manchester M1 4AW
261 metres (1151kHz), VHF 97.0MHz.

**Nottingham**
Radio Trent
29-31 Castle Gate, Nottingham NG1 7AP
Nottingham (0602) 581731
301 metres (998kHz), VHF 96.2MHz.

**Plymouth**
Plymouth Sound
Earl's Acre, Alma Road, Plymouth PL3 4HX
Tel: Plymouth (0752) 27272
261 metres (1151kHz), VHF 96.0MHz.

**Portsmouth**
Radio Victory
PO Box 257, Portsmouth PO1 5RT
Tel: Portsmouth (0705) 27799
257 metres (1169kHz), VHF 95.0MHz.

**Reading**
Thames Valley Broadcasting
PO Box 210, Reading, Berkshire RG3 5RZ
Tel: Reading (0734) 413131
210 metres (1430kHz), VHF 97.0MHz.

**Sheffield & Rotherham**
Radio Hallam
PO Box 194, Hartshead, Sheffield S1 1GP
Tel: Sheffield (0742) 71188
194 metres (1546kHz), VHF 95.2MHz.

**Swansea**
Swansea Sound
Victoria Road, Gowerton, Swansea SA4 3AB
Tel: Gorseinon (0792) 893751
257 metres (1169kHz), VHF 95.1MHz.

**Teeside**
Radio Tees
74 Dovecot Street, Stockton-on-Tees, Cleveland TS18 1LL
Tel: Stockton-on-Tees (0642) 615111
257 metres (1169kHz), VHF 95.0MHz.

**Tyne/Wear**
Metro Radio
Newcastle upon Tyne NE99 1BB
Tel: Newcastle upon Tyne (0632) 884121
261 metres (1151kHz), VHF 97.0MHz.

**Wolverhampton/Black Country**
Beacon Radio
PO Box 303, Wolverhampton WV6 0DQ
Tel: Wolverhampton (0902) 757211
303 metres (989kHz), VHF 97.2MHz.

system is. In order to provide good quality for your receiver to amplify, the tuner section must have an adequate VHF receiving aerial (see aerial section). For playing discs you should choose as good a quality tuntable, pick-up cartridge and arm as you can afford (see 'Hi-Fi Choice: Turntables and Cartridges'). If you wish to make recordings from the tuner section, or indeed from records for your private use, then the reproduced quality from your tapes will be almost entirely dependant on the quality of the external recorder, although there are internal connection problems which are explained later. The loudspeakers chosen should be compatible with the receiver, and this again is explained later.

Even the type of connecting cables used for both inputs and outputs is important, for poor input wiring from a pick-up cartridge can cause hum, poor aerial cable can give a weak signal or interferance, an aerial incorrectly positioned can actually introduce distortion on loud passages of music reproduced through the tuner, and long or inappropriate types of wire used for interconnecting loudspeakers can alter the quality of the reproduced sounds. Finally, in many cases the stability and quality of your AC mains supply may alter the amount of power that you can get, and can even introduce mechanical acoustic hum into equipment if you are near a factory which uses high power rectifiers of an inefficient type. In one case a user reported that his equipment buzzed audibly, but only at certain times of day, and this was found to be due to direct current impurities in the mains causing saturation of the mains transformer.

**How necessary is an aerial system?**

The importance of a good aerial system cannot be stressed too much.If you are within a few miles of your local area transmitters you might be able to get away with a small antenna in your loft, but a simple aerial in the same room as the receiver will usually be unsatisfactory. Many a case of ignition interference has been completely eradicated when a good aerial system on the roof has been installed, and such an installation is not likely to cost more than £15-£30 including the cost of aerial, cable and erection. Specialist antennae, though, of course can be quite expensive and many people, including myself, have beam aerials above remote controlled rotators, which thus allow the antenna to point in any desired direction. If you notice hiss and slight crackling on your local stereo station, but recieve mono signals perfectly, your aerial system may well be inadequate. In some instances local planning authorities or landlords do not allow the erection of outside aerials. Since a radio service must be available to anyone requiring it, such authorities have installed a community aerial system in which a main antenna is fed to a pre-amplifier and thence to a distribution amplifier with multi outlets covering all the required points.

These points are usually shared for radio and television and most installations are rather unsatisfactory in that radio performance seems to be compromised in favour of television. Some systems may have been installed before the era of stereo radio and whilst they provide a reasonable signal to noise ratio on mono broadcasts, stereo programmes become hissy. If you can prove that the inadequacy is in the installation, and not in your tuner, it would seem reasonable to make a strong complaint to the owner of the aerial system, expecially if you are not allowed to erect your own antenna. Do not accept "no" for an answer, and if necessary get all your neighbours on the same circuit to complain as well. Do not forget that such a distribution system may well give you a very strong input signal, but this strong signal might include considerable hiss, which no tuner will remove.

All the tuner sections of the receivers tested in this book, had either 75 ohm or 300 ohm aerial inputs or a facility for both. In the UK, 75 ohm installations are very much more common than 300 ohm ones, the former using coaxial cable for connecting the aerial to the set whilst the latter uses flat 300 ohm ribbon which has two wires separated by a flat plastic separation ribbon. Coaxial cables are what is termed unbalanced and have a wire down the centre, around which is some form of insulation or foam. Outside this insulation is a metal sheathing lapped in the case of cheaper cables or interwoven in the case of higher quality ones. Surrounding this metal sheathing is an outer protection insulated sleeve. Some tuners incorporated coaxial sockets, usually of


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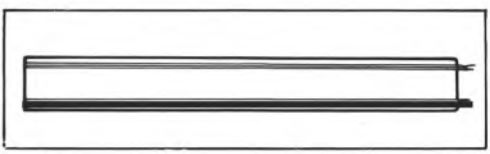
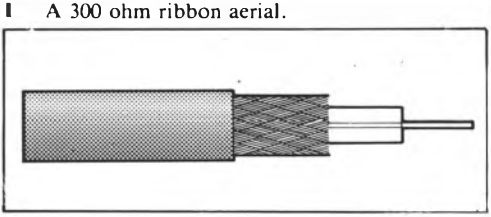
the ubiquitous television set type, but occasionally an odd type of Japanese coaxial socket having a special mating plug, was provided. 300 ohm inputs were either screw teminals or a special type of 2 or 3 pin socket for direct connection to 300 ohm ribbon (see fig 1). FM band 2 aerials are of many different types (see fig 2), varying from the simple dipole to antennas having many elements. If you live on or very close to a main road, you would be well advised to have a beam antenna having at least 3 elements installed on your roof somewhere, so that the ratio between the signal received from radio stations is as high as possible to the intensity of ignition interference, which the aerial would also pick up from passing vehicles.

After an antenna has been installed, it is most important to point it in a direction which gives the cleanest signal. This direction is normally one which points straight at the transmitter, but sometimes a tall building or a hill is in the way, and you may get a better signal as a reflection from the side or even behind you, if you are facing the transmitter. When an aerial is pointed in such an unusual direction, great care must be taken to ensure that you do not get multi-path reception. In television such reception leads to what is termed "ghosting" and this shows itself as additional faint images to the side of the main one. If you are receiving multi path signals, these become evident as an odd fuzzy distortion occurring normally only when the programme is very loud. The effect is obvious if you turn your antenna round whilst listening to the tuner. Many transistor portables receiving VHF broadcasts receive this effect if you move them around the room, and sometimes you can even get it if the set is on a table, and you move across the room causing reflections of the radio signals to reach the set from your own body.

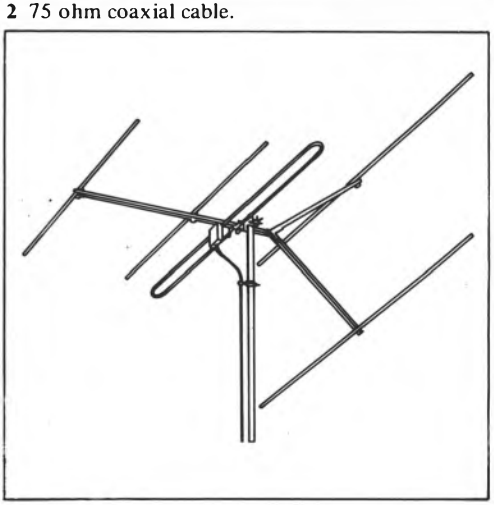
One further word of warning is to question the direction that your antenna is pointing in, if it does not seem geographically correct. All too often an aerial erector just copies the direction of the aerial next door and that aerial may well be a copy of another and another etc! In such circumstances an entire street may be receiving diabolical signals if the original erection firm made a mistake in the way they set the aerial. This actually happened in Chelsea, when a firm installed an aerial at exactly 90° off Wrotham, with the elements rather than the boom pointing towards the station! It was not until I checked over the installation myself, and had a quick look at the position of the aerial that the reason for the poor signals became evident! The actual dipole together with any additional elements must always be broad side on to the station (see fig 3), the longest arms being at the back of the aerial (reflectors) whilst the shortest one should be at the front (directors). The element known as the radiator is the one having wires connected to it.



**1** A 300 ohm ribbon aerial.



**2** 75 ohm coaxial cable.



**3** A typical 75 ohm aerial (Fuba 5).

**What facilities are important on a receiver.?**

Obviously, the amount of facilities available on a receiver will depend how much you wish to pay. But there are some facilities which are virtually indispensable.

The input selector switch should select between pick-up, tuner, and at least one further input, normally labelled auxiliary. A tape monitoring button should be provided to allow the user to listen direct to the tuner, for example, or via tape. Many receivers have provision for feeding and monitoring two separate recorders and, whilst this is useful, I would suggest that relatively few people have two recorders. Again, it is useful to have tape-recorder feeds on both phono sockets and 5-pole DIN ones. I am not sure that the 5-pole DIN socket is justified though, since if they are fitted, they have to accord with DIN standards and can only be used with tape recorders having 5-pole DIN sockets. There has been, in the past, so much confusion about this, and so often I have seen a "5-pole DIN to four phono plugs" interconnection lead used to connect the phono sockets of a tape-recorder with a DIN socket on the receiver, with the record levels nearly flat out on the recorder in an attempt to get a satisfactory record level on tape. It is no secret that I dislike the DIN interconnection standard intensely, but at least the DIN type equipment should have phono sockets available to give higher record output levels for line-in sockets on tape-recorders.

Every receiver must have efficient tone controls, but in addition, filters are very useful. Filters, however, should alternate by 12dB per octave at least to be worthy of the name, and I consider that appropriate filters are important. Tone controls should also be provided with a tone control cancel button, or centre nicks which I term indents in this book, allowing the user to have a nominally flat position, irrespective of whether the knob has worked loose, fallen off, or is just simply misset on the spindle. Similarly, the balance control should also have a nominally centre position with an indent so that the user does not have to stare at it in order to set it centrally, but can rapidly feel the half-way click.

Some people find loudness correction controls useful, and these should allow all frequencies to be audibly equally loud, no matter what position the volume control is in. If the level of music is reduced so that it becomes very quiet, low frequencies and very high ones tend to get lost, and an automatic loudness control corrects this. However, I personally do not like them, since I like to listen to my music at a sensible level. If I do require quiet background music, I prefer to simply reduce the volume without loudness compensation.

Far more important than a loudness control is a stereo/mono switch, since it is useful to be able to play monophonic recordings without stereo disc crackle. Pressing a mono button in such circumstances often dramatically reduces background noise, and so it should be fitted on every receiver.

Since most users keep their speakers permanently connected to the output of the receiver, he does not want to hear a loud thump every time he switches on or off. Some amplifiers that I have tested have made such a loud crack that they could destroy the voice coil etc. of some types of speaker. Many modern receivers incoporate relay switching on the outputs in order to withhold connection until the amplifier has been on for a few seconds. Other manufacturers achieve results by appropriately designed circuitry.

**What other facilities are useful on a receiver?**

Many people like to interconnect an extension pair of speakers as well as a main pair, and it is useful if you can switch them on and off independently from the receiver. Furthermore, a headphone jack is usually provided, allowing headpones, when connected, to mute the loudspeakers. The headphone drive circuitry has to be a compromise which will allow models of any impedance to be used, but I would like to see an impedance switch so that optimum performance can be obtained into any normal type of headphone. Unfortunately, I have only rarely come across this facility.

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**How useful are graphic equalisers?**

Many receivers have what are called break points between the output of the tone control section and the input of the power amplifier. They are usually fitted with "u" links to make the normal connection through, but if these links are withdrawn, external equipment can be inserted in the chain, such as a complex graphic equaliser which a few users like to install to correct for room acoustics etc. Whilst bass and treble controls are essential on a receiver, mid-frequency adjustment is often useful in order to correct the mid-frequency tonal balance. Such correction is not usually pssible if a receiver only has bass and treble controls. I must add though that if it is necessary to use mid-frequency correction, either something is wrong with the loudspeakers, or their room positioning, or the programme being heard, unless the user has a funny idea of sound balance! Graphic type equalisers, such as are fitted on many JVC receivers, can be very useful, and they have in general a minimum of five controls, allowing a very comprehensive range of adjustment. The range is considerably more comprehensive than that available with normal tone controls, and if they are used correctly, many a poor recording can be made to sound acceptable. Mis-use though can make the best recording sound diabolical, and it may take you a while to become familiar with their operation and use.

**What else is useful?**

Many receivers have an audio mute knob which de-sensitises the volume by 20dB or so, and this is handy if you wish to answer the telephone quickly whilst you are playing something rather loud. Some volume controls have individual steps rather than being continuously variable, and this can be useful if you like to re-establish constant listening levels, since the positions are often marked in dBs. Many tone controls, too, have stepped positions, almost always with five steps of cut, and another five of boost. You may like to make a note of the optimum positions when you buy a new record and re-establish these each time you listen. Provided the individual steps are reasonably equal, I like such controls, but too many of them have seriously unequal steps, jumping perhaps 4dB on the last step, which is ridiculous.

Some families like to have two separate turntables, one being a very high quality transcription type, whilst the second is provided perhaps for the children who will appreciate auto-change facilities for parties etc. It is a nuisance to have to plug the appropriate lead into the receiver, and so many have two more phono pick-up inputs. If you switch from one input to another frequently, you will become annoyed with clicks or even thumps when switching, and so many receivers have electronic switching circuits which operate virtually silently, although this is perhaps a luxury.

Whilst not being too important, it is useful to be able to match the volumes up from each source, and so many models have small pre-sets to allow you to do this. Pick-up cartridges have different sensitivities, and pre-sets on the pick-up pre-amplifier will allow you to match the maximum levels of gramophone records with the equivalent levels from the tuner. Some receivers are literally sprinkled with pre-sets, and whilst this is a luxury, it is convenient if you use external sources for interconnection.

Unfortunately, pick-up cartridges of different makes require different input conditions on the receiver if they are to perform at their best. Comparatively few receivers have switches to optimise resistive and capacitive loading. Many expensive pre-amplifier units though incorporate such switching, but it is not expensive to provide the facility at the manufacturing stage. Perhaps manufacturers of the more expensive receivers should provide simple slide switches on the rear panel immediately adjacent to the pick-up input sockets.

One facility that is very sadly lacking from nearly every receiver that I have ever checked is the availability of an independent output which could be used to feed an external recorder, whilst the user is listening to gramophone records. In the first edition of this book, only the Pioneer model 737 had the facility, and of the new models, only the Yamaha models provided it.

A few receivers have switches allowing meters to read the output voltage, expressed as

power into 8 ohms. This facility is useless unless the meters actually read the peak voltages applied, since very fast peaks are normally badly under-read by most meters. Even an indicator to show the onset of slight clipping may be useful to some users, although most people can detect clipping audibly quite easily.

**What are the important facilities on the tuner section of a receiver?**

The tuner section incorporates a stereo decoder, and this must be switchable to mono either automatically or manually by the user at will. A muting facility is highly desirable so that the loud hissing noise that would otherwise be heard in between stations during tuning can be eliminated. Many people find it rather difficult to tune in stations on an FM tuner, and so a well-aligned tuning metre is important, and it should indicate appropriately when the set is itself ideally tuned. The tuning wheel or knob should feel reasonably free and should have good bearings, thus making it simpler to change stations quickly and effectively.

I consider that pre-set stations are a great advantage, and I am most dismayed to find that not not one Japanese model is provided with these. It must be remembered that the hi-fi system these days is not so much a luxury as part of a household, and everyone should be able to use it with ease. A ferrite rod is useful for AM reception, but many of them just pull in and out from the chassis without the provision of turning it to obtain the optimum signal. Medium wave and long wave should not be ignored, and far too many tuners have badly designed filters giving insufficient rejection of adjacent stations, whilst having too much top cut. An expensive tuner should have a far higher quality filter for this so that the edges of the passband are steeper, thus preserving response within the passband, but rejecting signals outside this much more adequately.

**What other features are useful on the tuner section?**

Additional facilities that can be useful on a tuner section are the provision of sockets for both 75 ohm unbalanced, and 300 ohm balanced aerial connections. Almost invariably though, an installation in the UK will include a coaxial cable feed from the aerial which is almost always 75 ohms. Belling Lee type coaxial sockets, such as are used on most television sets, should be fitted on the back of the receiver for such coaxial cables, rather than the annoying terminals, or extraordinary range of Japanese aerial sockets which often need soldering onto the plug, if indeed you can find the plug in the first place! A separate AM aerial socket is only useful if you are not reasonably close to an AM transmitter (see chapter on aerials). Some receivers have mysterious sockets labelled "multiplex output", or "multipath output", or even "four channel decoder". The first two are never likely to be used by more than one user in several thousand, whereas the last one is of no use at all unless broadcasting organisations agree on some new form of quadraphonic broadcasting, requiring additional pilot tones, which is not yet under serious discussion even.

If you like to listen to weak distant stations, you may find them particularly hissy in stereo, but more than acceptable in mono. Relatively few receivers have a control which will provide you with a partial stereo image, with degraded crosstalk, but less hiss than full stereo. Such a facility can provide a clear, but narrower, stereo image, which is more acceptable than pure mono. All tuners should be fitted with a filter on the output of the decoder to take away any supersonic frequencies resulting from the breakthrough of multiplex tones produced in the stereo decoder. One of my colleagues can easily hear beyond 19kHz and found pilot tone breakthrough quite annoying on some of the receivers that clearly have either poor filters or none at all. Apart from the effect on human beings, I dread to think of what the budgerigar or the cat thinks of a high pitched whistle behind any music programme!

Whereas tuning meters are essential, some receivers also incorporate a signal strength indicator, and this is ueful if you wish to tune in the strongest station of many that you might pick up transmitting the same programme. If your local station appears to be giving a signal strength reading well under its usual one, your aerial might have turned in


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The SX-1250 specifications sheet ☐ The Pioneer Colour Catalogue ☐

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the wind, or indeed, the coaxial cable might have become partially disconnected. It is surprising how often this happens without a user realising it for some time. The provision of long wave and medium wave on a high quality receiver is frankly questionable. A good quality portable transistor radio is generally far more convenient, and the provision of AM on an expensive receiver probably bumps up the cost quite a lot. If it is provided, it should clearly be better quality than that from a "tranny", but I am worried that the BBC's changeover to long wave for Radio 4 in the near future is an extreme nuisance, since most receivers do not incorporate long wave. However, since Radio 4, at many times, will not be on VHF, it will probably be cheaper to buy a portable radio for the purpose.

**How much power do I need from my receiver?** This question is a surprisingly difficult one, since power requirement is dictated by the sensitivity of the loudspeakers, the maximum volume that you like to listen to, the quality of the programme being reproduced, and the size and acoustics of the listening room. In "Hi-Fi Choice: Loudspeakers", I quote the approximate maximum power level that each model of loudspeaker would take without severe degradation of sound quality. I also quote figures which represent the output sound level obtained 1 metre away from the front of each speaker from an amplifier which would be giving 1W into a pure 8Ω resistor. The sensitivities of the speakers were amazingly varied and, whilst some gave a loud room volume with only the equivalent of 10W input, others needed 100W or so for the same subjective sound level.

As a rough guide, you will need a receiver which will give a maximum of 100W per channel into 8 ohms for the most insensitive speakers used in a fairly large room. Most speakers though should provide adequate volume from an amplifier having a 60W capability. Models giving no more than 25W or so will not give enough output for insensitive speakers if you require clean reproduction of transients in a medium sized room, although it may be sufficient if your room is very small and you do not want to play music too loud. A receiver with a capability of no more than 15 watts may well be satisfactory with very sensitive speakers in a small room, but unfortunately, many of the better models of loudspeaker are less sensitive, and so would not be suitable. One person's idea of normal volume is rather different to another's and, in making my suggestions, I am trying to adopt an average as I see it.

One other point which is important is that the highest quality recordings having sharp transients reproduced from them, are far more demanding on amplifier power than pre-recorded cassettes, for example. Perhaps the most demanding records are the Sheffield direct-cut discs which, if played back properly, present very high peak-to-peak voltages to the loudspeaker, whilst the average power may be no more than from a normal record played back at the same audible volume. I have found that, when listening to the main output from my mixing control desk, used on recording sessions, I may require amplifiers in excess of 100-watt rating, whereas when I play the tapes back, one of 50W per channel may be adequate in the same room. If a transient is taped, it suffers what is termed "phase shift", which means that on replay the maximum peak-to-peak voltage of the transient may be appreciably less, although the subjective sound quality may be only marginally different. To play safe, I have always advised people to purchase an amplifier which is rated at a higher power level than they think they might normally need, and so I suggest that if you choose a receiver that has a potential of less than 40W per channel, you may be disappointed at a later date if you change your speakers for a less sensitive but better pair, for example.

If you wish to connect extension speakers, then remember that it is not the voltage capability of the amplifier which will be strained, but it will be the current capability, and if the extension speakers are connected at the same time as the main ones, and they are not provided with their own separate, appropriate gain controls, you will have to look at the performance of the amplifier into 4 ohms as well as into 8 ohms. This is particularly important if either the extension speakers are 4 ohm ones, which may be

inadvisable anyway, or if either pair of speakers has an impedance curve drop to significantly below 8 ohms in the audio range.

**What are the problems encountered in interconnection with pick-up cartridges?**

The main problem that you may run into here is that of hum or a buzz when the volume control is brought up to listening level, or perhaps slightly above it. (To avoid this, you should use the best quality screened cable to correct the turntable and the receiver. Screened cable for the purpose is of two types, the best one incorporating an interwoven screen around the centre live wire, whilst the inferior type has, what is called, lapped screening, which is literally wound round and round the inner wire. You must ensure that the screened cables are well away from any mains wiring, as if they are in close proximity, hum may well be induced. Remember that mains voltages are perhaps one hundred thousand times larger than pick-up voltages and currents, and so the minutest amount of induction may be audible as a low pitched hum.

If the normal interconnection still presents a problem, you will also have to try different combinations of earthing the turntable to the receiver. Each half of the stereo pick-up cartridge is connected to earth at the receiver, but is sometimes bonded to the pick-up arm earth and even turntable earth in the complete turntable system. Sometimes this bonding is made to the earth of one screened wire only, but in the best installations the pick-up earths are kept completely separate from the arm and motor earths, so that they only meet on the input to the receiver. Most receivers have an earth terminal for connection to motor and arm earths, and this should be used if possible.

Sometimes you may notice a hum when the cartridge is in a particular position, whilst the hum reduces considerably when the arm is swung into another position. Although this may be due to hum induction from the motor, it may be caused by the pick-up cartridge being too close to the mains transformer in the receiver. Check this by moving the turntable around a bit, and re-locate it if necessary. Sometimes you may experience the intrusion of locally transmitted signals (through the pick-up cartridge?), perhaps from a television transmitter, or even a local radio amateur. If you get this type of interference, then you will have to contact the manufacturers, since they will be responsible for effecting a cure.

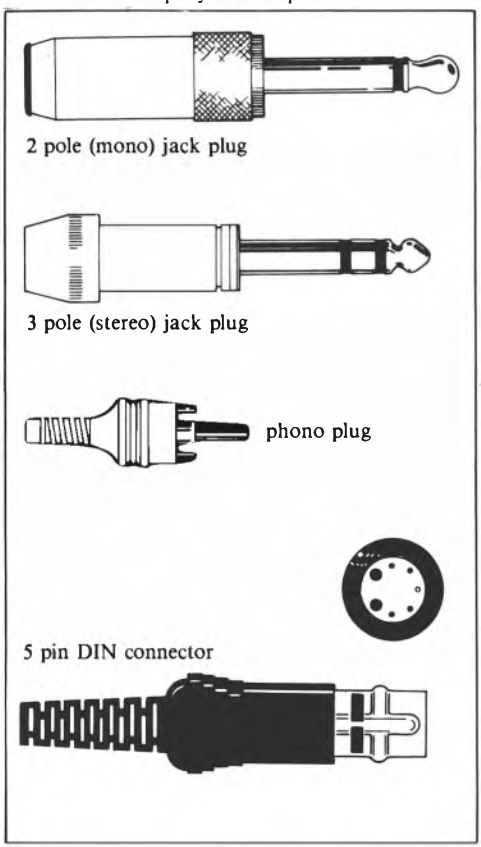
If you have a very high output cartridge, you might notice a suspicion of clipping on the loudest transients, and although it is more likely that this is because the cartridge is mistracking, it may be due to insufficient clipping margin on the pick-up input. Some receivers have pre-sets at the back to reduce the input gain, and so adjust these if possible until you no longer notice any problem. One final point is that you may have to choose the best loading conditions for your cartridge, and I suggest you do this by experimentation, unless the pick-up manufacturer specifies the loading conditions precisely. Even so, some manufacturers do not seem to be fully conversant with the best subjective loading anyway.

**What problems are associated with interconnecting a receiver with a tape deck?**

Receivers employ two different types of socket which can provide interconnection with external tape recorders. The more usual type is commonly known as a phono socket, but the 5-pole DIN socket is found on most models, and indeed some are only provided with such sockets. Phono sockets incorporate just one connection per socket, and thus to connect a stereo recorder two are necessary to provide the signal to be recorded, whilst an additional pair accept the play back signal. The 5-pole DIN socket however has all four live connections incorporated together with a common earth pin. To prevent interaction between record and replay wires, the correct type of lead fitted with 5-pole DIN sockets has individually screened live wires, although all the screens are connected to the common earth pin in the DIN plug.

Phono sockets for recording provide a maximum power level usually between 250mV and 1V, and the same voltage is applied into almost all tape recorder phono input sockets, whether they are medium or high impedance. Thus the same voltage is available in the electronic circuits of the recorder that is actually generated in the receiver, provided the

latter is correctly designed. Only very rarely have I noted any problems with levels when interconnecting receiver phono sockets with recorder line in ones. Similarly for play back, the play back line out sockets of the tape recorder should be interconnected with the tape monitor or play back input sockets of the receiver. Most recorders have play back level controls so that levels can be optimised in the receiver between direct and via tape, but some receivers nevertheless have pre-set gain controls on the play back inputs.




Various types of connecting plugs

The 5-pole DIN socket should incorporate attenuation which converts the voltage from the receiver into one which will be proportional to the input impedance of the recorder. This is done by inserting a high value resistor in series, which decreases the level to a significantly lower one, dependant upon the equivalent input impedance of the DIN socket on the tape recorder. Since the DIN inputs of many cassette decks employ the same circuitry as the mic inputs, they are very sensitive, but are at a low impedance, and the DIN socket circuitry on the receiver helps to attenuate the level to almost microphone level in the recorder. Provided that this is done precisely to the German DIN standard in the receiver, and that the recorder's input circuits are correctly designed, there should be no problem, and of course it is convenient for all the interconnections to be in just one lead. However, as stated in "Hi-Fi Choice: Cassette Decks and Tapes", many of the Japanese decks have DIN inputs that are far from compatible, or alternatively offer a much poorer performance than do the line inputs when appropriately driven.

In each review in this book I comment on the appropriateness of the phono output and DIN output levels, but for the reason explained this does not necessarily mean that your cassette deck will receive an adequate level. As a general rule, always use phono leads where possible, and avoid leads which mix the two standards, ie ones which have a 5-pole DIN at the receiver end with phonos into the cassette deck, or phono outputs from the receiver to a five pole DIN on the cassette deck. In the first case, input levels to the deck will be much too low, whereas in the latter case you may well have overload problems on the deck.

The difference between the two standards is so great that they should not be intercoupled without competant technical advice or knowledge. In effect this means that receivers having only five pole DIN sockets will probably only work satisfactorily with tape recorders also having them, and so if your recorder only has phonos, then before purchase you must look at the problem very carefully to avoid disappointment. In the case of receivers having phono sockets, however, adaptors are available which will decrease the level at the cassette deck end, thus avoid overloading. You might nevertheless experience slight breakthrough from record to

replay circuits if your lead contains all the live wires in one cable, and the adaptor is placed at the recorder end.

You will also have to be concerned with deciding which pieces of equipment should be earthed. To start with I would advise earthing everything, but if this produces a hum problem the earth should be taken off the piece of equipment that has a double insulated mains transformer, thus retaining the earth on equipment not having this. Once again, your dealer should be able to help with this problem. When trying out earths, never plug in or unplug leads unless the relevant equipment is switched off first, preferably at the mains.

You are not likely to encounter problems in connecting playback circuits, but make sure that you are running suitable levels from the deck to the receiver to allow the main volume control to operate in a sensible position. If you notice peak distortion it may well be that you are trying to drive the recorder's output circuits too hard, but it is more likely that you are simply over-recording on tape, in which case reduce the recording levels.

**If the receiver can have its tone controls switchable between the feed to the tape recorder or into playback circuits, which position should normally be used?**

The cassette recorder should be set up at the factory so that on a good brand of tape an average programme will be recorded reasonably clearly and with a flat overall response. Furthermore, bearing in mind the average power levels in different frequency bands in the audio spectrum, it should be optimised for unacceptable distortion to occur over the complete audio spectrum at about the same maximum volume level. For this reason, when recording the average programme (ie from tuner or disc), no tone controls should be used in the record feed, for otherwise if some frequencies are boosted distortion will become apparent on peaks of music containing excessive energy in the boosted region. If you wish to alter the tonal balance, it is better to do it on play back, and it is largely for this reason that most tone controls apply on play back only. Receivers such as the Tandberg 2075 Mk II, having a facility for tone control in the record feed do allow the user to correct serious deficiencies in the programme source before it is taped, and this can be useful providing that the tone controls are used very carefully. You might well want to use them if you are using brands of tape that sound rather muffled on your recorder.

**What problems are likely to be experienced when interconnecting amplifiers with speakers?**

Since loudspeakers are themselves of very low impedance, nominally around 8 ohms, and some as low as 4 ohms, the wire used for connecting the power amplifier section to the speaker should not itself have any appreciable resistance in it. Wire can be made from many different types of metal, and whilst copper wires have in general a low resistance per meter, some alloy wires have a much higher resistance, but are quite a bit cheaper for a given length. As a general rule, the resistance of the wire should be significantly less than 5% of the lowest impedance (equivalent resistance) of the speaker when measured across the audio spectrum. In effect this means that you should use wires in which the combined series resistance of live and neutral is less than 0.3 ohms or so. If you are only using short leads, then most types of wire should be satisfactory, unless very thin, but for runs longer than 12ft or so you would be advised to use much thicker wires, eg 13 amp 2-core mains lead. Some shops sell special wire for use with loudspeakers, and this may be better provided it really is designed for the purpose.

Different receivers are provided with many alternative forms of loudspeaker wire connector, and you should be careful to ensure that firm connections are made to the terminal, socket or clamp. Always use twin wires having two different colours, and connect the positive coloure to the positive, or live, terminal, and the more negative colour to the negative, or earth, terminal. If you keep to this colour discipline you are not likely to connect your speakers out of phase by mistake. Be very careful to avoid small whiskers of wire shorting across to a wire of the opposite polarity, since this will present a short circuit to the amplifier. You should also

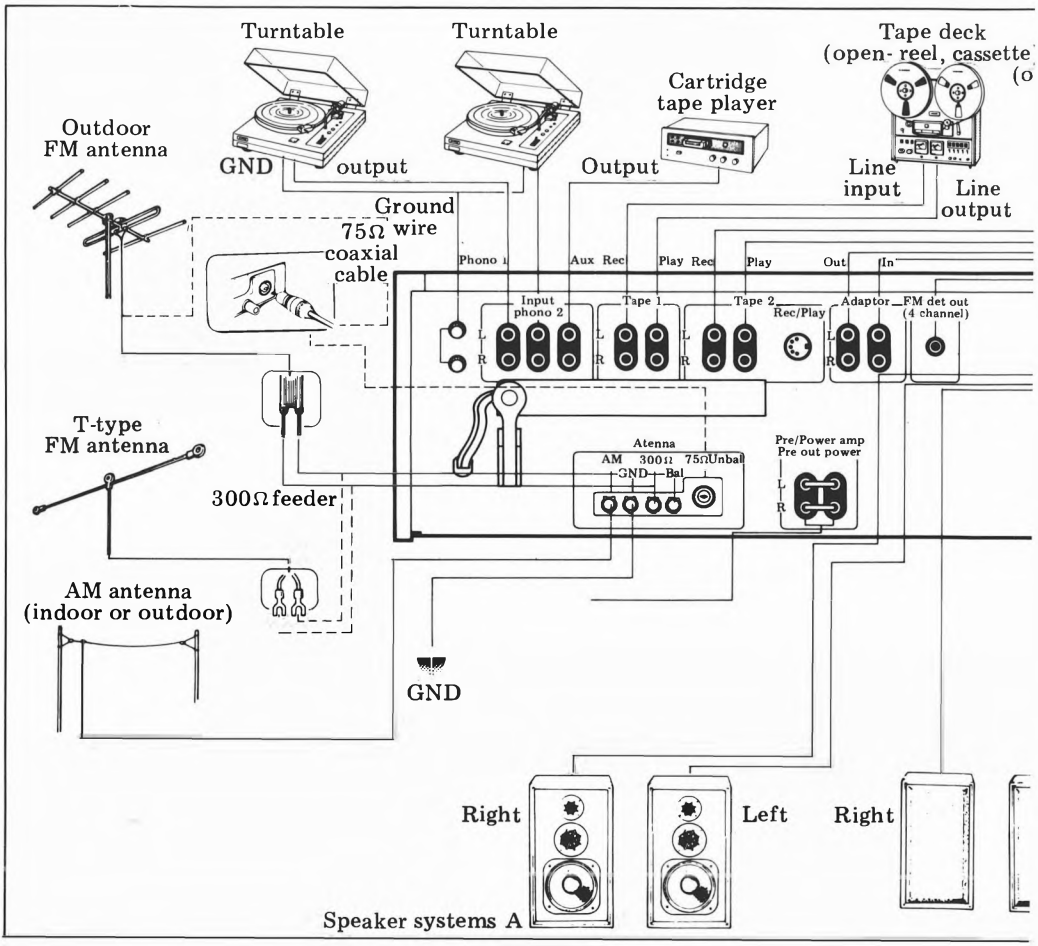
make your connection with the amplifier switched off. If you connect the loudspeaker end first you should avoid the possibility of a short circuit appearing on the amplifier if you forget to turn it off.

Some receivers are provided with DIN standard loudspeaker sockets, and these incorporate a flat pin and a round one. The negative, or earth, wire should be soldered or screwed to the flat pin, and the positive to the round pin.

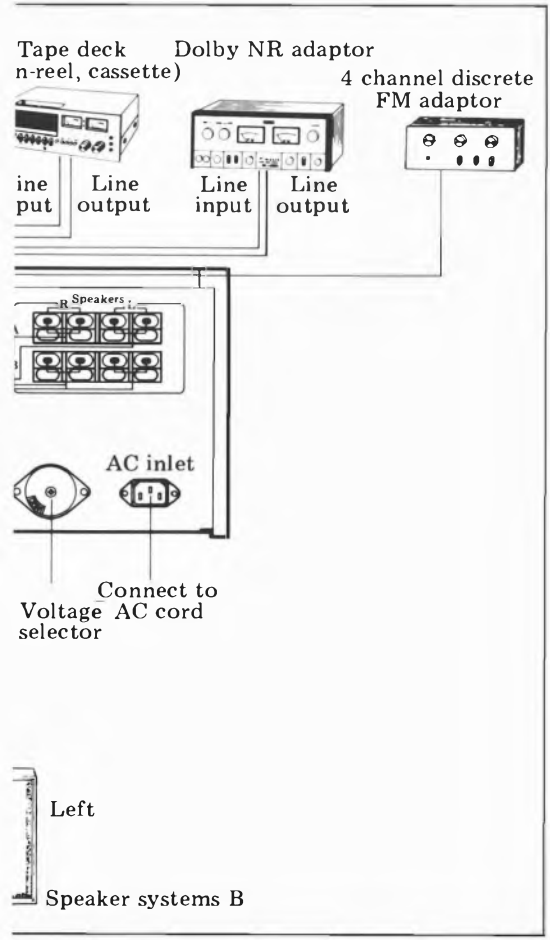
**Can I connect more than one pair of loudspeakers to the receiver?**

Most receivers can drive two pairs of loudspeakers, these being switchable with push buttons or a rotary switch on the front panel. I strongly advise you to avoid all 4 ohm loudspeakers unless the receiver is specifically designed to provide enough power in to substantially below this impedance, since receivers designed primarily for 8 ohm models may not take kindly to driving 8 and 4 ohm speakers in parallel. If you connect two 8 ohm speakers to each channel, and select both at

The rear panel connections of a typical receiver.



the same time, you will be presenting approximately a 4 ohm load to the amplifier, and since we have measured the power in to 4 ohm on all the latest models tested you will be able to check how loud you can have the entire system operating. A system giving no more power into 4 ohms than into 8 ohms will have its power distributed between the extension and the main speakers, and the maximum voltage available will be 3dB or so less, so that each speaker system will only be capable of half the power that it would have driven on its own.




Some receivers can be interconnected with three pairs of speakers, but usually their instruction manuals indicate that not more than two pairs should be connected at any one time. Although most receivers are protected against too great a current requirement from the speaker systems, some do not have this protection, and so if you demand too much of the amplifier you run the risk of blowing up the output stage. I therefore strongly advise you to read the instruction manual.

**How do I check the phasing of my loudspeaker system?**

If a mono signal, or a signal coming from the centre of the stereo stage is driven to each of the speakers, the cones should move in and out together and not in opposition. If they are working in opposite directions when identical signals are fed to both of them, they are said to be out of phase, and whilst this is not immediately obvious to the uninitiated, the sound will appear to be muzzy in the centre, and low notes will probably be noticeably attenuated in the average room, and you might even feel a slight giddy sensation. An easy check on this is to place the loudspeakers face to face within a few inches of each other, and then feed a mono source to both through the stereo system. Reverse the connections to one speaker only, and you should notice that virtually all the low notes disappear. The correct connection is when low frequencies are louder. You will notice a considerable improvement in the clarity of sounds after correction of a phase error.

**What design problems are encountered on the tuner section of a receiver?**

The FM tuner section may well have to cope with very strong local stations coming down from the aerial at many millivolts, ie mV, as well as very weak ones which may be 1000 times weaker, ie a few microvolts, ie $\mu$V. The radio frequency parts of the tuner circuitry have to receive all these stations at once, and discriminate them from one another, presenting only the wanted signal for further amplication.

It is surprisingly difficult to design front end circuits (eg UHF or radio frequency (RF) circuits) to reject unwanted stations without

detrimental effects. This the designer must do whilst avoiding any reduction of sensitivity. All receivers convert the wanted station to a fixed low frequency which is almost always between 455kHz and 475kHz for medium wave or long wave and much higher at 10.7mHz for VHF. Thus the fixed intermediate frequency, or IF as it is abbreviated, is common to all stations in a particular mode. Incidentally an IF is required since it is easier to amplify a fixed frequency than a variable one. To convert the required station to this IF, the receiver incorporates an oscillator (known as a local oscillator), which is almost always 10.7mHz above the frequency of the required station for VHF. The station's signal mixes with the receiver's local oscillator in electronic circuits which pick out the difference (the IF) and then further circuits amplify the IF and turn the signal into normal audio voltages. The tuner's audio circuits include the stereo decoder which extracts left and right signals from the encoded wave form and passes these on to the pre-amplifier switching circuits.

**What exactly does the IF section do?**

The IF section has to amplify the signal from the mixer and pass this on to the discriminator, which converts the FM radio signal to audio. The IF section contains filters which should pass the complete mono or stereo required signal whilst rejecting signals from stations that are close in frequency to the required one. The designer has to match all his circuits for optimum performance, both in the filters and in the discriminator circuit to minimise breakthrough from unwanted stations, whilst preserving the fidelity of conversion of the radio signals to audio. He has to design all the tuning components so that they are always in tune together at the same point, which should correspond to the indication of the tuning dial. Most sets have a tuning indicator, and the designer must ensure that when the tuning meter is indicating correct tuning, the tuner is actually receiving optimally and is not tuned slightly to one side or the other of the exact centre of the radio signal. My colleagues and I found that many receivers had meters indicating incorrectly, and thus that when the meter was theoretically tuned to the indicated position, reception was not as clean as it could be if retuned slightly to one side or the other.

**What is the function, and design problems, of the stereo decoder?**

The stereo decoder has to be designed so that only signals intended to be produced on the left or right are indeed reproduced there. Incorrect factory alignment, or poor design, will cause information intended for one channel to be reproduced at a significant level on the opposite channel, perhaps with some distortion. Unwanted signals of this type are termed "crosstalk". The decoder must also reproduce signals with a sensibly flat response so that low notes, middle notes and high notes are all reproduced out of the tuner at the same intensities as they are intended to be by the broadcaster. To enable stereo to be transmitted on a single radio frequency carrier by one transmitter, the information which determines the position of the sound has to be transmitted supersonically on the sub carrier. The tuner's outputs must contain just the left and right outputs without any significant traces of the supersonic carriers coming through them which could disturb some types of tape recorder and external equipment or even young ears. After decoding the multiplex signal into left and right channels the electronics feed the signal through a filter which should stop supersonic frequencies from passing through, but without in any way affecting audio frequencies. Only very well designed filters can do this effectively, and unfortunately many receivers either do not filter out the supersonic frequencies properly, or do so with an audible effect on the very highest notes.

The tuner has to pass all audio information converted from the radio carrier faithfully and without undesirable shrillness, spitchiness or other forms of distortion. It must also do this without adding noise or lower frequency buzzing, known as hum, for naturally such noise would distract the listener from the music or programme content. Unfortunately, too many tuners fail here. In the lab all these important design points have been examined closely to ensure that the receiver can do its job satisfactorily. Unfortunately, many of the

tests are very time consuming, although essential. In particular, there are degrees of goodness or poor quality which must be indicated.

**What design problems are encountered on the pre-amplifier section of a receiver?**
The pre-amplifier section has to accept signals from a pick-up, the tuner section, auxiliary inputs, such as a television sound tuner or tape recorder replay, perhaps a microphone, normal tape monitor, and any other type of input. It then has to amplify or control the volume of these signals in addition to allowing the user to vary the tonal balance before the signal goes into the power amplifier section. Many receivers incorporate very comprehensive switching which allows the user to select stereo or mono from any input to any output.

**What specifically are the problems on the pick-up cartridge inputs?**
The pick-up pre-amplifier has to convert the minute electrical voltages obtained from the pick-up cartridge to higher ones, which should be compatible with the levels from other inputs fed to an external tape recorder, or of course to the volume control. The pick-up cartridge input circuits also have to alter the frequency response produced by the pick-up in combination with the record to a flat one which can then be amplified by the power amplifier etc. This process is termed "equalisation", and in the case of pick-up inputs lower notes (frequencies), have to be boosted, and very high ones attenuated. The designer has to achieve this to a very precise agreed amount, and he must also design this without the circuits adding any audible noise or distortion of any kind that is not present in the output from the pick-up. He has to optimise the input circuitry so that most good pick-ups will match into it reasonably, but in this case, if he designs around the average cartridge performance, quite naturally some types of cartridge will be a little outside the optimisation area. Bad design can cause high notes to be too shrill, or indeed muffled, whilst very low notes might be reproduced too quietly or perhaps too loud with respect to middle notes. The pick up input stage is frequently referred to as the RIAA input circuit.

**What are the problems encountered with the input selection and tape recorder feeds?**
The designer has to arrange for the receiver's sensitivity to be compatible with the outputs of external equipment likely to be interconnected with it. There are standardised levels and parameters which a designer must meet concerning interconnection with tape recorders. A DIN 5-pole socket must have the correct circuitry designed around it so that interconnection with the DIN socket on a recorder presents no problem when the correct leads are used. It is necessary to provide all the required switching without degradation of quality on any of the circuits, and this is not as simple as it sounds, since hum picked up from the mains must be avoided, and this is quite difficult. When switching from one input to another, a user does not want to hear clicks or thumps, and so the circuits must be designed to avoid this. Even the switches themselves have to be designed carefully, since unsuitable components may well become noisy in operation, or may become intermittant, and maintenance here can quite easily be expensive.

**What are the problems encountered on the tone controls of the pre-amplifier?**
In this part of the receiver, the chosen signal, whether direct, via tape or tape recorder playback, is connected through to the volume control which almost invariably has a switchable loudness control associated with it. The output from the volume control then drives the tone control section, which usually incorporates also a balance control to shift the sound towards left or right. Many receivers also contain switches or buttons termed filters, which allow either extreme low notes or very high notes to be attenuated to reduce extraneous unwanted sounds or distortion.

The output from the tone control section then drives the output power amplifier, and quite a few models incorporate break points here to allow external equipment to be plugged in to modify the sound in one way or another. A few receivers incorporate the tone controls actually in the power amplifier itself, in which

case the circuit arrangements are different, but have the same basic operational principles.

Tone control design is not as easy as you might think, since they have to provide an adequate range of adjustment, but without an excessive degree of boost continuing outside the audio range. Many controls are of the eleven stepped position type, and these steps should be reasonably regular, but frequently they are not. Many receivers also incorporate mid frequency correction, and sometimes an excessive amount of equalisation is available. Low frequency and high frequency filters should cut rapidly beyond the designated frequency, and it is my opinion that many of them might be said to infringe the Trades Description Act, since surely filter implies a removal of something, and thus the cut-off rate should be rapid and not gradual as it often is.

Some receivers, such as the JVC models, employ graphic equalisers, allowing the user to adjust the tonal balance of each part of the frequency range independently. The circuits have to be designed so that they do not distort or have unpleasant side effects. The equipment must not go unstable under any conditions of operation when the user is adjusting the tone controls anywhere within their working range. This means that the designer has to provide very stable HT supplies which prevent audio voltages from feeding back inappropriately through the power system, rather than through feedback circuits. All the controls should be easy to adjust and should be labelled appropriately. I like to see a tone control cancel button which bypasses tone controls, filters and loudness control, and at least a centre indent to mark mechanically the centre position.

**What exactly is the function of a loudness control?**

The loudness control allows low frequencies to be boosted fairly heavily at lower volume control settings, and sometimes high frequencies are also boosted, but to a lesser extent. This circuit is normally passive, and immediately prior to the volume control, but unfortunately attenuates the signal fairly substantially before it reaches the basic volume control. To make up for this loss of signal, the tone control section usually has some gain, although occasionally it has too much, thus introducing hiss when the volume control is in an unfavourable position. The designer has to choose carefully how much bass boost he can provide in the loudness circuit without losing too much signal, especially when the circuit is not switched in. He must always choose the type of stereo volume control very carefully so that when the volume is changed, the left/right balance is not disturbed, ie when turning the volume down, the programme does not swing to the left or right. If he chooses a stepped position volume control, he must design the amount of volume reduction appropriately for each step, and here some designers incorporate too few steps, thus having larger jumps between positions.

**What are the design problems encountered in the power amplifier section?**

In this section the relatively small voltages on the output of the pre-amplifier have to be increased to much higher ones in order to adequately drive loudspeakers connected to the receiver. Loudspeakers have a comparatively low impedance, and so high audio currents are required to drive them. The most insensitive speakers can require peak powers of 100W or so to attain a reasonably loud room volume, and so the amplifier has to be man enough to supply whatever is required by the speaker without distress. The problems involved in this are so great, and so technical that it is difficult to simplify them sufficiently in this introduction, but suffice it to say that the equivalent resistance of a typical loudspeaker can vary across the audio range from 6 ohms to 30 ohms, and thus the demands on the power amplifier vary greatly with frequency. One type of loudspeaker though may be totally different to another, and if the receiver is required to drive extension speakers, it must be capable of doing this without any detrimental effect to the sound heard from the main system. Many users like to plug in headphones, and the jack sockets provided should present the appropriate levels to the phones without hum or hiss being heard continually in the background. Many receivers have a problem

# A.T. Labs

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Like 'Hi-Fi Choice', we also listen to lots of receivers and sell most of those recommended in this issue. From our experience we know which are likely to spend as much time in our service department as in your living-room!

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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**

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here, showing lack of careful thought from designers. Another annoying problem is a loud thump or crack reproduced from the speakers when the amplifier is switched on or off. Some amplifiers, in the past, have been so bad in this respect that they have actually blown speaker cones on being turned on!

**What are the problems of distortion in a power amplifier?**
Many different forms of distortion can be generated inside the power amplifier; the more usual ones being harmonic distortion and intermodulation distortion (see separate sections). Other types of distortion, however, can rear their ugly heads, such as transient intermodulation distortion, instability on peaks, hum and noise, crossover distortion or just a change in the sound quality which is frequently difficult to define. Soggy bass, for example, can be caused by an amplifier's failure to stop a loudspeaker cone from resonating at will. The designer has to bear all these factors in mind by choosing a compromise between the best performance, development costs and manufacturing costs. It is a pity that frequently a manufacturer will save pence by sacrificing quality and, in the long run, such manufacturers may well be losing sales, since it is now well-known that the average user is far more discriminating than he used to be. No doubt the influence of competent reviews in hi-fi magazines has played an important part in encouraging general improvements in standards, and this has been very noticeable since the first "Hi-Fi Choice" on receivers published eighteen months ago.

The design of loudspeaker connectors is frequently overlooked, but such connectors should be easy to use and should not have any effect on the quality of reproduction. The DIN loudspeaker socket is just not capable enough when it is required to deliver high currents, but sometimes they are used inappropriately. A few manufacturers use such fiddly and horrible terminals that it is difficult for a user to connect a wire to them because of the close proximity of other terminals. A designer must look at ergonomics as well as performance, and my colleagues and I all too often have to criticise rather stupid failings in the ease of use of controls and equipment in general.

**What types of test have been applied to the receivers?**
After each receiver has arrived, details as to its facilities, types of connector etc., are filled in on special printed forms. The receivers are then given a thorough subjective test on an aerial, then on a laboratory stereo transmitter, and finally the amplifier section is listened to using loudspeakers as a load. Various types of loud speaker have been used in the tests including Chartwell 450s, Spendor BC3's, KEF 103s and Quad electrostatics. 15 ips master tapes are used as source material, both for sending through the stereo transmitter, and for amplifier tests. A "standard" set up includes a Yamaha CT-7000 tuner and a Quad 405 amplifier. Comparisons are made between the sound quality on the "standard" set up against the receiver under test, and the results are dictated to my secretary or my wife during the tests so that a permanent record is available of the test results. If any problems arise at this stage, specific notes are made to draw special attention to them when the equipment is later tested in the laboratory. After the subjective test has been completed, the tuner section is tested thoroughly, and finally, the amplifier and pre-amplifier sections are tested in another laboratory in the same building.

**When listening to the tuner sections, what particular problems can be noted?**
When a high quality external aerial (the Fuba 8) is connected to the receiver, signals of several millivolts are received from BBC Wrotham, but also Capital Radio and LBC should be obtainable without trouble from Croydon. Distant stations can also be received and the performance can be compared with that of the "standard" set-up, since distant stations tend to come and go, depending upon weather conditions etc. The presence of spurious transmissions across the VHF band, which are produced by interaction between strong signals, can be easily detected as the tuning knob is turned to scan the whole band. The ease of general tuning, and the presence of backlash, ie loose tuning, are noted at this

stage. The basic sensitivity can be estimated, as can the adjacent and alternate channel selectivities. Even frequency response, general audio quality and signal to noise ratio can be estimated as well as many of the other RF parameters.

The receiver is then checked on any AM bands available, such as medium wave, and in particular, Radio 4 Brookmans Park (the main medium wave transmitter for the South-East) is monitored to see if a whistle is audible. This whistle is developed internally within the set if the IF is chosen inappropriately by the manufacturer. The IF bandwidth can be estimated by listening to the audio response, and sensitivity and RFIM performance can also be noted. The effectiveness of the ferrite rod (which is the attached MW aerial) is also checked at this stage. The output of a laboratory stereo transmitter is then connected to the tuner input, and test tones of various types are applied to the modulator and auditioned on the receiver. Notes were then made as to the degree of crosstalk, distortion, noise and response of the system. At this stage I also tune either side of the transmitted carrier to see how critical the tuning is to obtain low distortion and good crosstalk. Notes are made if optimum performance is obtained at other than the theoretically correct tuning positions, as indicated by the tuning meter.

A special stereo test tape was prepared including pink noise (a continuous tone of equal volume per octave), a clock gong sequence, speech and music, either recorded specially or copied off master tapes. This tape is played through the transmitter, and any problems in reproduction are noted. The clock sequence was made by recording my own hall grandfather clock striking with modulation sent left only, right only, left and right, and right minus left. The recording was made at a fairly low level so that all the transients are preserved, and the deviation of the transmitter is very carefully controlled by examining a peak reading modulation meter, so that high frequency transients are not allowed to peak above 100% deviation. Careful note is made of the characteristics of the reproduction in the crosstalk, the worst receivers reproducing nasty cracks, whereas the best produced a faint ting. A very clean speech recording is then sent through each channel in turn, and the quality noted again in the crosstalk. Bad tuners show up spitch and bad distortion in the crosstalk, whereas good ones produce a very quiet, reasonably flat reproduction of what is on the main channel. Where necessary, the quality is compared with the 'standard' set-up, known to be, as far as audio performance is concerned, beyond criticism. Finally, examples of music are auditioned in stereo, and a careful note is made of any problems heard, such as hiss in the background, hum on one channel or the other or, in the worst cases, clear signs of distress on peak modulation. We also compare the stereo positioning accuracy of each tuner section with that produced by the standard, and occasionally out of phase crosstalk shows up by reproducing slightly fuzzy images.

Very great care is taken to ensure that the receiver gain is identical to that of the standard, and the outputs to the speakers are always monitored with the new Technics peak reading stereo meter connected across the loudspeakers, thus indicating the peak power levels used in each test. By this means, clipping is avoided in the subjective listening tests. A comparison of background noise produced by the receiver's tuner section is made with that of the 'standard' set-up, and since the latter has been very carefully tested, an estimate can be made of the signal to noise ratio of the tuner section.

**What subjective tests are made on the amplifier section?**

Pink noise is introduced into the system, and the working of all the tone controls, volume control, balance control, filters and loudness controls are checked. By experience it is easy to tell whether a tone control has an uneven rate of variation, or whether filters have inappropriate cut-off rates, or turnover frequencies. The effectiveness of the loudness control can be estimated, and volume control and balance control tracking can be checked. At this stage, the general ergonomics receive comment.

After this has been done, a carefully prepared test tape, copied direct from master tapes, was passed through the system at an

identical gain setting to that on the 'standard' set-up, and since all types of music were represented in one way or another, many problems can be detected. At this stage though, it is only fair to comment that usually the differences in quality were surprisingly marginal, and relatively few amplifier sections actually sounded poor. Speech sometimes showed up a problem, but a harpsichord recording was also particularly useful. We also compared the sound of wide range white noise through the standard and test receiver set ups, and surprisingly we did notice differences which we attribute to the effects of damping factor, minor differences in response, and possible transient intermodulation distortion. One or two receivers actually sounded coloured on white noise, which was later confirmed by listening to speech, and we find this almost incredible. When receivers were tested on the pick-up input, a Technics SP-10 turntable, mounted in the lava stone plinth, was used with an AKG 8ES cartridge, and a selection of records were auditioned. For a list of records and music used on the test tape, please see the Technical Introduction.

**What types of test were carried out in the lab. on the tuner section, and how do they correlate with the tuner's subjective performance?**

A tuner should be capable of reproducing strong local stations with very low distortion and with a generally excellent performance, but should also reproduce much weaker stations adequately, and without intereference from strong ones comparatively close in frequency. Extremely weak stations will naturally be noisy, but the better tuners pick them out much more clearly. In the subjective tests, we obtained a reasonably accurate idea of each receiver's performance on a very high quality VHF aerial above my roof, and connected straight through to the set with high quality coax cable. We tuned in to local stations and to very distant ones, and noted any difference in quality, and also any intereference problems. We compared the quality at any one moment with a standard set up, but obviously it was difficult to estimate exactly how good or poor a receiver was comparatively. After a subjective test programme from our stereo transmitter had been used, we were able to get closer to a reasonable subjective evaluation, but it is still vitally important to test each receiver thoroughly in the lab. The tests were divided into two basic parts, those checking out the actual radio frequency performance, and those testing the audio performance. Some tuners were relatively insensitive but reproduced strong local stations extremely well, whereas others might have a superb radio frequency section, but comparatively poor audio quality

**What is the relevance of sensitivity, muting, image response and rejection?**

The RF or front end tests checked out the mono and stereo sensitivity of the complete tuner, which represents an enumeration of the degree to which a tuner can cope with weak signals, and in the sensitivity columns in the tables the lower the figure in $\mu$V that can be received the better is the receiver. A tuner having a mono IHF sensitivity reading of around 1$\mu$V is very good indeed, whereas one which measured perhaps 3$\mu$V is considerably inferior. It is important for weak and strong stations to be equally loud so that you will not have to continually vary the volume as you change from one station to another. The limiting threshold is a test for this, and the figure quoted on a good receiver should be at a lower level than the mono IHF sensitivity figure, thus allowing all usable signals to be equally loud. Many users like to use a muting control to cut out the hiss between stations. Muting should be achieved at around three times the IHF sensitivity figure. If it is lower than this, then any extraneous noise generated down the aerial lead is likely to operate the mute as if a station were present, and you might notice hiss jumping as you tune the dial. Furthermore every very weak station will become audible, which may be a nuisance. If you are near aircraft flight paths, and in particular near an airport, then transmissions from air to ground may be picked up on your receiver, and interfere with the station you want to hear. A poor image response would cause this, and in the tables the smaller the number of dBs the more inferior is the set. I

like to see an image response ratio of at least 80dB. You might live near a short wave transmitter, transmitting very close to the 10.7 mHz frequency normally used inside the tuner to amplify up signals before converting them into audio. Some tuners do not reject signals in this frequency band sufficiently, and in bad cases morse code or telephony noises may be heard in the background. We test any possibility of this happening by generating 10.7mHz in the lab and measuring how much the tuner rejects it in its aerial circuits. Most tuners will not even pick it up, but a figure of 80dB or more will usually be satisfactory.

**What is radio frequency modulation?**
Sometimes two or more very strong stations can interact in the receiver and generate mixtures of the stations at various spots on the dial. For example, you might receive a mixture of Radio 4 and Radio London at a point coinciding with a very distant station. In the worst cases such spurious carriers can be found right across the dial, and are positively maddening, but the best receivers will be completely clear of them, even on a very efficient aerial bringing in strong signals. This problem is known as radio frequency intermodulation (RFIM). Receivers that are poor in this respect give figures of 65dB or worse, whereas really good figures are equal to, or better than, 75dB.

**What about local oscillator radiation?**
Sometimes the oscillator inside the receiver that is responsible for tuning the set, presents its output at an objectionable level on the aerial socket. If the level is high it could be picked up on a nearby receiver, and cause whistles by interaction. This is known as local oscillator radiation, and the figure is poor if more than 250$\mu$V is developed on the aerial terminal.

**What do you mean by adjacent and alternate channel selectivities?**
To establish how good the set is in discriminating one station from another very near one, we measured what is termed the adjacent and alternate channel selectivities. By developing two transmissions in the lab, we determined the amount of interference that a stronger one had on the weaker one with the receiver tuned in to the lattter. The adjacent channel selectivity shows how good the receiver is at rejecting a very close station, whereas the alternate selectivity refers to the rejection of one slightly further away in frequency, but still fairly close. For adjacent selectivity, figures of 10dB or higher are good, whereas lower ones are poorer. For the alternate selectivity, good figures are 60dB or better, and poor ones correspond to lower numbers in dBs.

**What is capture ratio and how important is it?**
Sometimes a strong station is on the same frequency as a weak one, and a poor tuner will reproduce the weak station as a slight twittering bubbling noise in the background of the stronger one. The degree to which a tuner can favour the strong station and render the weaker one less objectionable is termed the capture ratio, the smaller the figure quoted the better. Good tuners have capture ratios of 1.5dB or lower.

**How important are the distortion measurements?**
Distortion has been measured in mono and stereo modes. We checked the performance of the tuner when just one stereo channel was driven and when both were driven in or out of phase. The best tuners add less than 0.2% distortion, and since the best BBC transmissions peak at about this figure the user does not want the tuner to degrade this relatively good overall measurement. When an instrument is reproduced on the left channel, poor tuners reproduce some of the instrument on the opposite channel, in the worst cases with distortion as well. This effect is termed crosstalk, and we measured it at a medium frequency and at a very high one. Measurements of 36dB or better at 1kHz are good, whereas figures of 32dB are acceptable at very high frequencies. The figures include distortion in the crosstalk, and the evaluation of performance is therefore not too easy, but in each review comments are made as to whether crosstalk is distorted or not, which should give a useful guide.

**What about the noise measurements?**
Whilst the tuner may be noisy on very weak

stations, it should be virtually silent on very strong ones, provided the programme itself is not noisy. We measured the background noise that might be audible behind the programme. Almost all the mono figures were very good, but CCIR weighted stereo noise figures shown for 1mV and 3mV should be better than 64dB if a tuner is not to add significantly more noise than is present on the best broadcasts. Tuners inferior to 61dB here are rather poor (the smaller the number the poorer the tuner). Sometimes hum is appareent in the background, although the hiss level is relatively good. The unweighted stereo noise figure on a good tuner should be a larger number than 66dB. A smaller number than this indicates the presence of hum.

**How important is frequency response?**
The frequency response was measured in mono and stereo, and we noted the variation at the extreme ends of the broadcast audio spectrum, as well as noting any anomalies well within it. The point at which the response drops by 3dB should be at 30Hz or lower at the bass end, and between 15kHz and 17kHz at the high end. The ideal response should be virtually flat to 15kHz, and then as rapid a fall off of as possible above this frequency.

**Are the tuning dial and meter relevant?**
Sometimes you will want to find a station that you listen to irregularly, but have to hand the advertised frequency. You will naturally want the indicated frequency to be accurate, and this was measured at three points across the dial. I like to see significantly less than 150 kHz errors right across the dial, and this receives comment. We also checked the accuracy of the tuning meter, since obviously the best quality reception ought to be at the point where the meter indicates optimum tuning. If the meter is poor, you will note a considerable improvement in distortion between the figures quoted for centre tuning and optimum tuning in the mono distortion columns.

**What about the signal to noise ratio measurements?**
We measured the weighted signal to noise ratio for mono signals at 25μV and 1mV, whilst stereo ones were checked at 100μV, 1mV and on the latest receivers 3mV. Sometimes tuners performed comparatively well on weak stereo stations, but were noisier than average on stronger ones. If you compare the performance of the different receivers you will be able to select one for your particular requirements, provided you also check on its other parameters. You should also be able to get a good idea of performance by consulting the overall comparison on page 00, the most important parameters are asterisked at the head of the relevant columns.

**What laboratory tests were applied to the pick-up input pre-amplifier section of the receiver and how do they relate to audible performance?**
The pick-up pre-amplifier section has to amplify the minute voltages from the cartridge to a level equivalent to the output from the tuner, so that on changing from one source to another, the same order of volume is heard. The pre-amplifier has to boost low frequencies and cut high ones, so that the overall response from the playback of the disc, to the pre-amplifier and tone control section of the receiver, should be flat, assuming the ideal cartridge. An international standard, known as the RIAA equalisation curve, has been adopted, and so each pre-amplifier must have a precise amount of bass boost and treble cut. We checked the frequency response of the pre-amplifier to ensure that it was indeed correct. Only rarely did we notice errors which were sufficiently serious as to cause significant alterations in tonal balance. The maximum ouput of a cartridge at middle frequencies is only a few thousandths of a volt, and so the pre-amplifier had to amplify these voltages, perhaps fifty or one hundred times. This amplification has to be carried out without hiss, rumble or hum becoming audible from the amplifier itself, and so the signal to noise ratio of the pre-amplifier was measured, both unweighted and weighted.

**How important is the signal to noise ratio and what do the figures mean?**
In order to relate the noise to a typical situation, a pick-up cartridge with an average resistance and impedance was mounted in a

mumetal box and connected to each receiver in turn with extremely high quality screened cable. The noise level was measured on the record output sockets, or if these were only 5-pole DIN, on the loudspeaker output terminals, loaded with 8 ohm resistors. The noise level was referred to the maximum average level obtained from the pick-up at middle frequencies. Amplifiers with worse than average noise could produce audible hiss or rumble in the background of the quietest moments of a record playback, whereas the best receivers had pick-up pre-amplifiers with virtually no audible hiss at all. In the tables, weighted noise levels better than 71dB are more than adequate, whereas receivers having figures worse than 69dB could produce audible hiss in the background. The input impedance of the pick-up pre-amplifier stage should be 47K ohms in parallel with the fairly low capacitance. The best loading conditions for any particular cartridge are stipulated in "Hi-Fi Choice: Turntables and Cartridges", written by Martin Colloms. In the laboratory we checked to see that the input impedance was around the average required for most pick-ups, and that the capacity was reasonable. We also checked to see that the impedance at very low frequencies did not fall seriously below that at middle frequencies. In one or two cases we found the impedance falling to as low as 5K ohms at very low bass frequencies, and this could result in a marked attenuation of these frequencies from some types of pick-up cartridge, having a higher than average impedance.

**What other noise problems can be encountered and what do the pick-up noise figures represent?**

Pick-ups not only reproduce the music on the record, but also the background noise of the record as well, and this noise includes sharp clicks and scratches. Clicks can be represented by a very high transient output from the cartridge, and we checked the clipping margin of the pick-up input stages to make sure that the clicks were reproduced accurately through the pre-amplifier, rather than causing audible deterioration for a few thousandths of a second to the actual music itself. Ordinary meters will not read the maximum volume of a sound source, but special peak reading meters will, and in the laboratory we have found that the maximum output levels from pick-up cartridges are much higher than one might think. The clipping point of a good pick-up pre-amplifier should be better than 90mV or so, and stages that show clipping at below 60mV are rather wanting in this respect. The clipping tests were all carried out at a frequency of 1kHz on the input, and if we suspected any input stage of having a problem elsewhere in the audio range, this was also checked appropriately.

**What about distortion in the pick-up pre-amplifier section?**

Some pick-up pre-amplifiers add slight distortion to the sound from the cartridge, whilst others are clearly very clean indeed. We tested the distortion of each pick-up input by sending two tones, one a very low frequency, whilst the other was a high one, through the pre-amplifier, and measured the distortion produced by interaction between the tones. The best pre-amplifiers had significantly less than 0.01% distortion at the level of the test, this being approximately equal to the maximum volume on the average record. In order to ensure that the pick-up input had enough gain in it to bring the volume up from any normal cartridge to reasonable room volume, with perhaps a little to spare, we measured the sentivity of each pick-up input and expressed this in the mV at 1kHz required to give full output. We also checked to see whether the typical output from the pre-amplifier was about the same as that from the tuner, and that these two outputs were at reasonable levels to feed through to an external tape-recorder. Finally, if any particular problems were noted, either in the subjective performance of a pre-amplifier input, or in the measurements, these were investigated by examining the receiver's circuit diagram, and extra tests were introduced to find out the cause of any problem.

**What laboratory tests were made on the input switching sections of the receiver?**

The sensitivity of each external input was checked through to the loudspeaker output, with the volume control at maximum, in order

to ascertain that there was sufficient gain to allow any normal input to be heard by the user at a reasonable volume. Each input impedance was also checked to ensure that the receiver did not present an inappropriate load on any external equipment. Very few pieces of hi-fi equipment have output levels of less than 250mV maximum, so if this sensitivity is available for full output, it should be adequate. However, a few pieces of equipment encountered by the writer in the last few years have output levels as low as 100mV, and so some receivers may not give sufficient volume from such equipment. Don't forget though that the figures specified are input sensitivities for the full output of the amplifier to be attained, and you will very rarely need the full power output of the more powerful receivers. Thus one that is rated at 250mV input for 200W output will be equivalent in sensitivity and volume to another having 125mV input for 50W output. We also checked input selector switches to make sure that they worked without putting clicks through the system. Tape output source impedances and levels were checked, as were tape input sensitivities, and we almost always found that auxiliary inputs and tape inputs had the same sensitivities, although there were one or two isolated examples when this was not so.

**What tests were made on the volume and loudness controls?**

Most receivers have the volume control immediately after the tape monitor switch, and we checked to see that this control operated equally on both channels at the same time. If you wish to change the volume, it would obviously be tiresome if the sound image swung to the left a little bit or to the right, since you would then have to correct it by using the balance control each time you changed volume. The volume control was checked for this, both between the maximum volume and about halfway on the control and between halfway and about a quarter of the way on the control, and any errors in gain of more than 1dB might well be noticeable, although most people can tolerate shifts of perhaps 1.5dB. Shifts of more than 2dB are certainly not tolerable by the vast majority of listeners. Incorporated around most of the volume controls was the automatic loudness control, and this received a subjective test only on the latest receivers, since the response became so variable at different positions of the control, that it was difficult, and perhaps unfair, to choose any specific position for the measurement.

**What were the tests carried out on the tone controls and filters?**

Tone controls and filters were tested subjectively very carefully on various types of programme, but in addition, pen chart recordings were made of the maximum boosts and cuts that were available to the user. Chart recordings were also made of the response of the rumble and treble filters, and these are also shown where appropriate. Again, we checked in the laboratory to make sure that the effect of the tone controls and filters was equal on both channels. Balance controls were checked subjectively to make sure that the rate of change of balance was reasonably even and, in particular, not too fast across the centre. Checks were made to see at what point each particular input became distorted, since some pieces of external equipment that could be interconnected with the receiver might not have volume controls. One or two receivers showed serious overload problems on their inputs from even fairly average input levels. No auxiliary or tape recording input should clip at below 6 volts if it is to be completely clear of any problem with any normal piece of domestic or semi-professional hi-fi equipment that might be interconnected with it. Finally, we checked any special facilities offered to ensure that they operated as intended, and these received comments in the review.

**What tests were carried out on the power amplifier section of the receiver?**

The amplifier tests can be divided into two groups of tests. The first group includes noise tests, impedance tests and switch on and off transient tests, and all these tests include continuous tones. The second group includes tone burst and music tests.

The frequency response was measured in conjunction with that of the pre-amplifier. Distortion tests were carried out into 4 ohm and 8 ohm loads. The receivers whose reports

are reprinted from the first book were tested for power output into 8 ohms, and distortion was measured by the SMPTE method at three different levels. All the new receivers were measured for harmonic distortion at 1dB below clipping and 3dB below clipping, but additionally any signs of cross over distortion were noted at lower levels. Furthermore, complete swept IM distortion curves were pen charted from 200Hz to 200kHz, looking at what are termed second and third order products, equivalent to second and third order harmonic distortion.

Additional tests were introduced where necessary to investigate any particular problems, and circuit analysis frequently showed the cause of such problems.

Noise levels were measured on the amplifier output, and hum components were individually measured since low frequency hum is not so noticeable as higher frequency hum. Some receivers produced a slight hiss or even a noticeable hum into sensitive speakers, whereas others were virtually completely silent. Noise levels were taken with the volume control at minimum, but afterwards this control was advanced to obtain measurements of the worst noise, the input being switched to auxiliary or tape inputs, and the appropriate socket being loaded with screened 10k ohms resistors. With volume control down, weighted noise measurements were better than around 80mV on good receivers, but noise significantly worse than 1mV might become audible.

The headphone outputs were checked to see what voltage was available into both 8 and 600 ohm models. In most cases the volume available into high impedance models was grossly excessive, and incidentally such models would show up any hiss problem in the amplifier much more severely.

Switch on/off thumps were tested by connecting a storage oscilloscope in which the intensity of the thump was represented by a stored line on the cathode ray tube, vertical height representing intensity, and left/right position representing time. Comments are made in the review where applicable.

The output impedance of the amplifier was measured at a very low frequency of 40Hz, and from this the damping factor was calculated. Only occasionally was a problem encountered here.

The dynamic tests were very involved, and were intended to show any trouble that the amplifier has in reproducing changes of level. Some amplifiers gave more output on a transient than on a continuous tone, and we determined this by examining a storage oscilloscope, noting the point where the tone burst became distorted, and calculating the power produced during the burst. Many amplifiers produced more power into 4 than into 8 ohms, but a few gave significantly less, which is most unfortunate. Other tests were introduced on many models, these including tests in the inductive and capacitive loads, and additional swept IM pen charts into a dummy loudspeaker. We have been able to ascertain that the general tests applied to all the receivers are sufficient to show up audible problems, and in particular you should note the difference in power ratings into 8 and 4 ohms, both for tone bursts and for continuous power. The perfect amplifier should give double the power into 4 ohms as compared with the measurements into 8 ohms, but only rarely is this achieved in practice. Comments are made in the latest reviews as to the performance on speakers of different impedances.

**How can pen charts be interpreted by the layman?**

A pen chart is, in the context of this book, a graph usually drawn automatically showing frequencies from left to right, and intensity of volume from top to bottom. For example, frequency response is traced across the chart, with the lowest frequencies (measured in Hz-Herz) on the left and the highest ones (measured in kHz — kiloherz) on the right. Increases in volume or power levels (measured in dB — decibels) are shown by the graph rising, and decreases by the pen trace going down. The distance between two low notes one octave apart is much less than with very high notes so that, for example, one octave above a 32Hz pedal organ note would be 64Hz, but the second harmonic of a percussive instrument whose fundamental might be 5kHz is 10kHz. In order to allow a pen chart to show variations in response of frequencies as we

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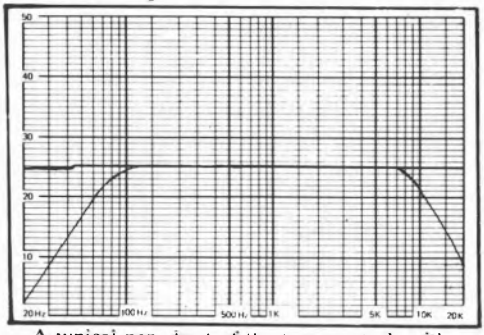
actually hear them, it is necessary to plot the logarythm of the frequency on the "x" axis, rather than linear frequencies. Thus, the distance between 20Hz and 200Hz becomes the same on the chart as 200Hz to 2kHz and 2kHz to 20kHz.

The ear is sensitive to percentage increases or decreases in volume, and so in order to show volume differences vertically on a chart, we plot decibels rather than volts vertically. A change of one decibel is approximately a change of 10% in voltage, a change of 6dB corresponds to double or half the voltage, whereas 20dB becomes ten times voltage etc. Decibels are thus a logarythmic ratio between two voltages, and dependent upon the amount of variation in level against frequency response. In the laboratory we choose the appropriate dB range for each graph, ie 1çdB, 25dB, or even 50dB between top and bottom.

To interpret the chart, look at the horizontal portion of the curve and note where it goes above or below the line at various frequencies. Deviations in the vertical position of the line from average are an indication of the amount of variation of the response. Fig 1 shows a typical chart of a tone control section with both rumble filters and treble filters switched in. Note that the chart falls below the flat response line at both ends of the audio spectrum, and the amount of variation will be seen to differ with the frequency. If you choose a point on the graph that you are interested in, look to the left or right at the end to see the amount of dB variation, and look vertically downwards to see the frequency corresponding to your chosen point.




A typical pen chart of the tone controls with rumble filter.

**Laboratory tests — tuner section**

**Front End Tests**

Two signal generators were used for all the tuner tests, a Sound Technology 1000A with an 1100A pre-emphasis unit, and a Hewlett Packard 8640B signal generator with digital frequency read out and calibrated attenuators. The Sound Technology is tunable over band 2 and can generate extremely high quality stereo signals with very low distortion and low noise. The Hewlett Packard generator has exceptionally good stability, and has the best signal to noise ratio of any generator I have yet tested, as well as having superb calibration. RF sensitivity in mono and stereo were noted using 50/75 ohm VHF transformers and suitable attenuators to develop the appropriate aerial signals at calibrated voltages. A Hewlett Packard radio frequency spectrum analyser, fitted with a very low capacity active probe was used to monitor levels on the aerial socket for calibration purposes. For the radio frequency intermodulation distortion tests, the outputs from the two generators were combined in a special hybrid transformer whose output fed the attenuator and impedance converter chains to the tuner. This transformer allowed each generator's output to feed through without having any effect on the other generator, to minimise any IM distortion that might otherwise be generated if the two signal sources were matched more conventionally. Image response, breakthrough of 10.7mHz IF, radiation of the local oscillator from the aerial socket, and various other RF tests were made on each receiver. Finally, limiting and muting thresholds and tuning dial frequency accuracy were checked.

**IF Tests**

The adjacent and alternate channel selectivities were measured using the two generators, by noting the points where a specified interference level was produced with the unwanted carrier spaced 200kHz and 400kHz either side of the main carrier respectively. If the selectivity curves were not similar either side, the test was repeated as a double-check on accuracy. The capture ratio was then checked with both generators on the same frequency by the usual method, and this incidentally is one of the most difficult tests to carry out accurately, and therefore was frequently repeated many times. We also checked AM rejection on at least two different RF levels.

**Discriminator, decoder and multiplex filter tests**

The signal to noise ratio, both weighted and unweighted, was measured in mono at 25$\mu$V and 1mV, and in stereo at 100$\mu$V, 1mV and 3mV (or at double these signal strengths for 300 ohm inputs). The tests were made on both output channels with an appropriate external laboratory multiplex filter employed, so that any pilot tone breakthrough would not interfere with the measurements. Individual hum components were measured, particularly if hum was noted in the subjective tests. Multiplex breakthrough at 19kHz and 38kHz was noted in stereo on both channels. All tuner measurements were normally taken on the tape output socket, but if this was found to be at an inappropriately low level, the measurements were repeated on the loudspeaker outputs at a suitable level setting. The amplifier gain was adjusted so that any tuner noise was far above any measured amplifier noise, and the loudspeaker outputs were loaded with 8 ohm resistors.

The frequency response was measured in mono, and on both stereo channels, and we looked for low frequency and high frequency cut-offs in addition to any anomalies in the audio spectrum. Rather surprisingly, a few tuners showed as much as 3.5dB bumps at around 5kHz, which showed bad de-emphasis and multiplex filtering design. Crosstalk was checked, both with filtered pink noise, and at discrete frequencies, and a note was made if the crosstalk improved when the receiver was re-tuned to give an optimum result.

Distortion was measured in mono and in stereo, figures being noted for left plus right, left and right only, and right minus left. A check was made to see if distortion could be improved by tuning away from the theoretically correct indicated position. If crosstalk and distortion improved when off-tuned, there was clearly a problem in the discriminator alignment, IF alignment, or indeed in the tuning indicator circuit. Some receivers improved dramatically when off-tuned, but in this position they were so good

that, after investigation we found that pre-sets were omitted which would have allowed the tuning meter to indicate correctly. Sometimes optimum performance was obtained almost at the point where the tuner was switching automatically to mono, or indeed muting.

Finally, the output levels on the tape feed sockets, resulting from full modulation through the tuner in mono and stereo, were checked to see if they were reasonable and compatible with tape recorder standards.

**Coding and Decoding**

In order to transmit what is in effect two separate channels of information on one frequency modulated carrier, a very elaborate system has to be employed and almost throughout the world the GE-Zenith multiplex system has been chosen for stereo broadcasting. In this system the sum channel, a signal obtained by adding the left and right signals together, is transmitted normally and is thus compatible as a monophonic broadcast, which would be picked up as such on a normal mono receiver, such as a transistor portable. The stereo width information which tells the sound where to come from at tens of thousands of times every second is transmitted on a sub-carrier of 38kHz, which is itself amplitude modulated with the difference channel information (R-L). This complete wave form has the 38kHz carrier subtracted from it by balancing it out at the transmitter, and this saves energy that can thus give a better signal to noise ratio in the receiver. In order for the receiver to replace the 38kHz carrier back again correctly before demodulation, a weak 19kHz pilot tone is transmitted all the time that the transmitter is in stereo, and thus in the receiver's decoder this "pilot tone" is picked out and doubled to 38kHz, and then re-inserted into the 38kHz side bands produced by the difference channel information in the transmission.

The difference information, together with its re-inserted 38kHz carrier, is then detected and added and subtracted from the main signal to give the left and right information channels in as close as possible a phase relationship to the signals which enter the transmitter's encoder. The actual process taking place in a stereo decoder, whether made of discrete components or one of the phase lock loop integrated circuit designs, is very complex, and for this book I hope it is sufficient to say that the decoder accepts a total bandwidth from 20Hz to 53kHz, and processes this to give stereo information, which is then de-emphasised to give an audio signal that is as flat as possible up to 15kHz, the approximate upper limit of stereo radio transmission.

Some integrated circuit discriminators and decoders unfortunately have in general an insufficient dynamic range, for their weighted noise performance is somewhat poorer than discrete circuits and better ICs, whilst high levels sent through them can produce considerable degrees of distortion. The choice of operating levels therefore, through the poorer ICs, has to be a compromise between poor hiss performance, and higher degrees of distortion, and it is quite clear that relatively few manufacturers have settled for the best compromise.

**Tuner background noise levels**

It is quite clear from my many years of dedicated listening that the BBC can put out stereo transmissions which have a wider dynamic range than most discs. Although the broadcasting organisations do sometimes transmit rather hissy or hummy programmes, the general noise level remains very low and the background noise performance of the complete system is largely dependent on the quality of the tuner's discriminator and decoder. Some produced an audible hiss behind a high quality broadcast, whereas others gave a fairly silent background. Usually when noise was present, hiss was audibly worse than hum, but some tuners were quite the reverse. A poor unweighted measurement was usually produced by a tuner having a bad hum level, whereas a poor weighted noise usually indicated a hiss problem. We were shocked to find that there was about 15dB difference in noise produced by the best and worst tuners in the survey, and clearly this requires investigation by the manufacturers who produced the noisier tuners.

In 1975 I carried out some exhaustive tests on BBC transmissions, measuring distortion and noise of the entire chain from the continuity suite in Broadcasting House through the pulse code modulated distribution

system to Wrotham, then through their radio 3 transmitter into the reference tuner at my home, and thence to elaborate test equipment. I felt it important to establish the maximum available quality that could be obtained from the entire system in order to ascertain the level of required performance of a tuner that would not show audible programme degradation. The distortion at peak level measured remarkably well at 0.2% and the unweighted noise was surprisingly low at 67dB below peak modulation level, the CCIR weighted measurement being —63.5dB. Clearly when a source was fed through to the continuity suite the noise and distortion performance would be marginally inferior at best and so a typical best operational practical measurement would be 0.3% distortion at peak, an unweighted signal to noise ratio of 65dB, and a weighted signal to noise of 62.5dB. A tuner introducing noise of the same magnitude as that produced on the broadcast would sound 3dB worse since the noise powers add and thus to show no noticeable degradation a tuner should not have an inherent noise that is inferior to 4dB better than the last typical figures mentioned ie 69dB unweighted and 66.5dB CCIR weighted.

This is not quite all the story, however, since an unweighted noise measuring a few dB inferior to that stated might be inaudible in practice if it is only due to the presence of 50Hz hum. Thus a better indication of subjective noise annoyance will be found in the CCIR weighted figures, which is after all the justification for using a weighting curve anyway. All the noise measurements were taken with a laboratory multiplex filter incorporated into the test equipment, so that tuners having poor filtering would not give a bad noise figure if they had a poor pilot tone breakthrough, which is inaudible to the majority of listeners.

Almost all the noise figures were measured on the tape recorder feed socket and if this feed was a high impedance one, the measurement was taken across a 10k ohm resistor representing a DIN tape recorder load, or the loudspeaker output was checked if this could produce a better figure. Clearly, the better the tape recorder with respect to noise, the more relevant is the weighted noise performance of the tuner, for the majority of receivers will not show significant degradation of noise performance on many cassette recorders that do not possess noise reduction, since so much noise is introduced by the recorder itself. A reel to reel recorder incorporating a Dolby B system, however, is capable of recording programmes with a considerably better dynamic range than is available on the vast majority of receivers tested.

Naturally weaker received stations will be audibly more noisy than strong ones, but on a good system stereo and mono broadcasts should not audibly show a change in the noise level if the received signal is relatively strong.

**The FM VHF broadcast band and capture ratio**

There is only a limited amount of space on band 2 for public broadcasting and the situation is even more difficult because of the intrusion since World War 2 of many public utility services including fire, ambulance and police in the same band at the higher frequency end. Despite an international recommendation that band 2 should be adopted for public broadcasting over a frequency range of approximately 88mHz to 108mHz and in some countries to only 100 or 104mHz. The top 10mHz of the band are used in the UK for public utilities etc (ie half the band). This is frankly most unfortunate since it means that the enture United Kingdom coverage of BBC and IBA broadcasting stations have to be squeezed in a 10mHz band and quite clearly many transmitters have to share similar frequencies. The Home Office in co-operation with the BBC and IBA have attempted to keep shared frequency transmissions well apart in distance, so that the minimum amount of interference is caused, but even so in many localities two stations on the same or close frequencies can be received and by rotating an aerial either one can be favoured but not always to the complete exclusion of the other. Some tuners suffer less interference from a weaker station on the same frequency as a strong one than some others and a measurement which gives a rating for this is termed capture ratio. Two signal generators are tuned on to exactly the same frequency, one of them modulated fully whilst the other is transmitting a quiet carrier.

One generator is altered in level with respect to the other and the difference in dB output noted between the point at which the blank carrier reduces the audio output from the receiver by 1dB and the point by which the output is reduced by 30dB. The capture ratio is defined as being half the dB difference between these two points. One tuner may require 4dB change of interference signal to change the audio output from —1dB to —30dB and thus the capture ratio would be 2dB.

If two stations are on the same frequency such as for example the BBC main network transmitter and a French network transmitter, some tuners will pick up more interference than others in the form of burbling noises in the backgound. Usually the problem is not too serious even in the worst cases when mono programmes are received, but interference becomes much more severe when two stereo programmes are received on or close to the same frequency. Whereas under normal conditions you may not have any trouble at all, under tropospheric ducting conditions, when it becomes possible to receive stations at a great distance due to atmospheric refraction, the interference can also become severe. Receivers with capture ratios better than 1.5dB should give appreciably better freedom from this interference than receivers having capture ratios inferior to 3dB. Fortunately almost all the receivers tested were at worst good in this respect.

**Pre-emphasis and de-emphasis**

When FM broadcasting was first introduced over 20 years ago, a treble boost was incorporated in the transmitters, so that a treble cut bringing the response back to flat could be introduced in all FM receivers. This cut substantially reduced the hiss on the output of the tuner, which was regarded as especially important, so that the main area of coverage for an acceptable signal to noise ratio could be extended. The amount of boost and cut is 10dB at 10kHz, thus improving the weighted signal to noise ratio of the system, other things being equal, by about 8dB. When the amount of de-emphasis was originally decided, microphone techniques were in general much more distant than they are now and even more important, the frequency response above 8kHz of many of the microphones used was considerably more limited than it is today. The original pre-emphasis then did not cause severe peaking problems at high frequencies, since their intensity was so much lower on average than today. Now, however, today's very high quality capacitor microphones are creating serious problems with their high frequency peak energies, some having a flat response to 15kHz at least, with the tendency for microphones to be used closer to instruments, and thus more of them being used to obtain an average balance. In order to preserve a reasonably flat power response, the BBC used to hold down the maximum deviation at middle frequencies to 3 or 4dB below the peak level permitted but more recently in order to give a better signal to noise ratio on receivers and particularly for those in poor signal strength areas, a novel form of device has been introduced known as a pre-emphasis limiter. This reduces the maximum energy at high frequencies without affecting peaks at middle or low ones. Studio managers are now encouraged to peak at somewhat higher levels than before and so programmes usually sound a little louder than they used to for a similar setting of a receiver's volume control. This naturally improves the overall signal to noise ratio of the FM stereo system.

De-emphasis is introduced after the decoder and immediately before the signal reaches the input selector switches, and thus cuts a certain amount of the hiss generated in the decoder. We found in the laboratory that many tuners have the correct de-emphasis but the extreme top (12kHz to 15kHz) was frequently falling off rather rapidly. This is almost always due to poor multiplex filter design.

**Tuner circuit alignment**

Most of the amplification of the radio signal is carried out in the intermediate frequency stages and virtually all FM tuners have 10.7mHz as the centre frequency of this section. It is extremely important that the total bandwidth required by the FM transmission should be flat in response and in phase in order to achieve low distortion and good separation in stereo at all frequencies. In the front end section of the tuner the local oscillator is tuned to mix with the incoming

radio signal thus producing a difference frequency of 10.7mHz, and this intermediate frequency is then amplified very considerably and then passed through a stage called a limiter, which should provide a consistent output to the discriminator for all levels of RF input signal. The IF passband has to be wider than the full frequency swing of the broadcast to avoid distortion, and most good tuners have a linear passband of at least 250kHz. In order to achieve a good capture ratio it is normally understood that the discriminator has to have a considerably wider passband than the IF section usually of the order of at least 600kHz, and often as much as 1mHz bandwidth.

The output of the discriminator is in effect a variable DC voltage around a centre zero, which is precisely proportional to the FM deviation of the input carrier, and this varying voltage then passes through a capacitor to block off the DC, which then allows the changing DC levels to pass into the decoder. When a good tuner is correctly tuned, the average DC output level of the discriminator is at zero potential in some models and this voltage is fed to a tuning meter, so that when it registers at centre zero, it indicates that the tuner is tuned to the centre of the carrier. The discriminator transformer usually incorporates tuning slugs or capacitors on both the primary and secondary and these must be tuned very precisely so that the output of the discriminator is linear with deviation. If the varying DC voltage begins to go non linear in proportion to the deviation, either near maximum positive or negative, distortion will result, and the effect can usually be noted if the tuner sounds and measures better when optimum results are obtained with the tuning meter clearly to the left or right of centre zero. This was noticed on many of the receivers, showing their poor quality control.

On some tuners we noticed that the circuits were peaked at one edge of the ceramic filter's passband rather than in the centre, and once again this contributed to distortion. The correct alignment of an FM tuner is a very skilled job and should not be undertaken lightly without the correct test equipment and the appropriate experience.

**Stereo separation and crosstalk**

If in a transmission system programme is applied to one channel only, the system should not produce a noticeable output on the other channel. If some "spillage" occurs somewhere (usually in the decoder or IF stages), the crosstalk is said to be poor and this will result either in a stereo image becoming narrower or in some cases actually becoming wider. The stereo separation then is changed from the original when crosstalk is present. Sometimes the crosstalk signal contains more distortion than the main channel's signal, and it is this that is far more objectionable than perhaps a marginal reduction of stereo width.

In the laboratory we measured as crosstalk all the signals present in the crosstalk channel, and thus the measurements include any harmonic distortion present. However, the importance of the subjective testing is undoubtedly considerable, since it is after all the subjective effect of unsatisfactory performance that must be the final criterion.

**Pick-up pre-amplifier section**

All the pick-up pre-amplifier inputs were tested using Bruel & Kjaer oscillators and intermodulation test equipment driving through an inverse RIAA passive attenuator which presented a 600 ohm source. Pen chart recordings were taken of the overall responses, and any significant deviations from a flat response received individual comments. Sensitivity and clipping were measured using a Bruel & Kjaer oscillator driving directly into the input, and having established this, input noise was checked, both weighted and unweighted, using a Shure cartridge inserted and sealed with wax into a mumental can with screened leads which could then be plugged into the equipment as a source. Impedance was measured in two ways, the first one being a straight measurement of resistive capacitance measured with a Wayne Kerr B862 bridge at 1592Hz, and the second method measured the voltage across the input when an oscillator was manually swept across the audio range through a high value resistor. This showed up any impedance variations due to feed back anomalies found in a few receivers. Pick-up input tests were monitored on the highest level tape output socket, or on the loudspeaker output at a suitable level, if the tape output

level was inadequate. Intermodulation distortion tests were carried out with both a Bruel & Kjaer 2010/1902 combination and an Amcron intermodulation analyser, products also being monitored on a Hewlett Packard 3580 spectrum analyser.

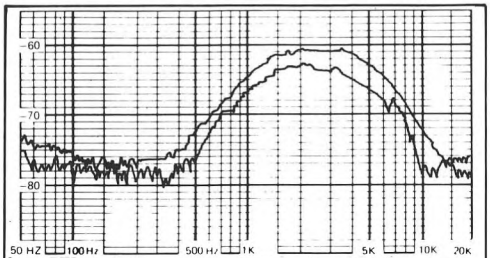
**General pre-amplifier section**
Microphone, auxiliary and tape input/output sensitivities, impedances and response were all checked with appropriate laboratory equipment. Tone control, balance control and volume control tracking were checked with a Hewlett Packard 3575A gain phase meter, whilst pen charts were made of responses both with the equipment set nominally flat and with different positions of tone controls. Amplifier response was checked up to 200kHz. Filter responses were also pen charted in every case. Clipping margins were tested with a Gould Advance OS 4000 storage oscilloscope, and in certain instances distortion was measured well below clipping when a problem was detected.

**The power amplifier sections**
For all these tests, external oscillators were interconnected with either the auxiliary, tuner, or tape replay sockets, and the outputs were connected to appropriate loads, across which various pieces of laboratory test equipment were bridged. The point at which 1% total harmonic distortion occurred was noted on each channel separately, and when both were driven, into 8 ohm and 4 ohm loads. A tone burst signal of 4mS, at a frequency of 1kHz, was then passed through the system every few seconds, and a digital storage oscilloscope was triggered to start scanning just before the pulse came through. We noted the point at which clipping was observable, and calculated the RMS power given during the tone burst. This test was carried out under various load conditions, but because of their complexity, only 8 ohm and 4 ohm resistive load results are actually quoted in the tables. Harmonic distortion was measured at 1dB and 3dB below the 1% distortion point, notes being taken of all relevant harmonics. A swept IM distortion plot was taken separately for second and third order tests at various levels. We also checked several amplifiers to measure second harmonic distortion during a long tone burst, and occasionally found that the distortion took some while to fall after the beginning of the pulse. Damping factor was measured at 40Hz by noting the output impedance of the amplifier. Switch on/off thumps and transients were measured by connecting the outputs to the storage oscilloscope, but continuous DC offsets on the output terminals were measured conventionally. Output noise measurements were taken, both CCIR weighted and unweighted, and individual hum components noted, if these were relevant. These tests were repeated in order to find the worst noise position of the volume control with 10k ohm screened resistors plugged into the appropriate input. In order to give a clearer indication of subjective dynamic range potential, I have evolved my own hum weighting curve, and have shown calculated AMF weighted maximum signal to noise ratios for all the latest receivers tested. The headphone outputs were checked into 8 ohms and 600 ohms for maximum output level without clipping. 8 ohm headphones would almost always work well, but most receivers gave a relatively poorer performance into 600 ohms models, but receivers having a lower inherent output noise always worked better than noisier ones when connected with high impedance headphones.

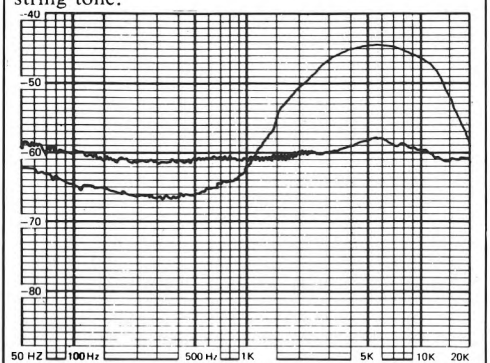
Many other tests were tried where appropriate, and virtually all the outputs were monitored on a storage oscilloscope and on a Hewlett Packard digital storage spectrum analyser having over 90dB dynamic range, and resolution bandwidths settable between 1Hz and 300Hz as required. Crossover distortion was noted by examining the output of a Hewlett Packard distortion analyser connected to an oscilloscope, thus allowing the distortion products to be continually visually monitored. Any problem areas encountered were always investigated as deeply as was practical, and contact with manufacturers was quite frequent, many agreeing immediately to rectify various trouble spots (see reviews).

In the past, reviews used to contain only harmonic distortion measurements taken at various levels but, approximately 3½ years ago, intermodulations distortion measurements had become commonplace. It has already been realised by electronic engineers that harmonic distortion is fairly irrelevant,

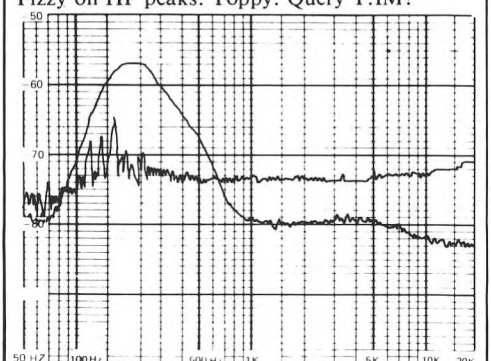
although its measurement can be a minor pointer to the performance characteristics of an amplifier. Music and speech contain primarily harmonic distortion, in fact varying between a minimum of 40% and a maximum of 90% and this may be somewhat of a shock to some readers. When a piano note is struck hard, for example, much of the power of the note is in the harmonics rather than the fundamental frequency of the particular piano string being hit. A clear example of a musical instrument containing mainly harmonics rather than fundamental tone would be a muted brass instrument such as a trombone or trumpet especially when blown hard. Thus, if an amplifier had even 1% harmonic distortion, the actual ratio of the different harmonics to the fundamental would not be changed subjectively. However, distortion created by the mixing products of two different musical notes may well be very audible. Consider for example a church organ pipe creating a note of 64Hz and mixtures creating combinations of frequencies between 2kHz and 5kHz. The 64Hz fundamental would add and subtract with the mixtures and create additional frequencies not harmonically related to those in the original instrument and it is these unpleasant intermodulation sounds that are clearly audible when reproduced by a poor amplifier. Harmonically related distortion is nowhere near so audible as unharmonically related distortion and whereas an amplifier might produce 1% harmonic distortion which would be inaudible, the same amount of intermodulation distortion would be clearly audible. What makes matters worse, though, is that intermodulation distortion of a transient nature is more audible still and can assume alarming proportions. Such transient intermodulation distortion is extremely difficult to measure, although its presence and approximate order of magnitude can be estimated. In such circumstances though the human ear is much more sensitive than even quite elaborate test equipment and as a check on this we carried out some extremely complicated testing on about 30 of the original receivers and all the new ones, to check correlation between various forms of distortion and remarks are made about the subjective listening tests. Three typical amplifiers' plots are shown below, together with the subjective comments which were made several weeks previously. Fortunately we were able to prove satisfactorily that our subjective comments were always pretty accurate.




Slightly brittle and lacking clarity. Brittle on string tone.




Fizzy on HF peaks. Toppy. Query T.IM?




Lumpy bass.

Half-power intermodulation distortion measured on three power amplifiers, with subjective comments.

**Subjective testing**

During the subjective tests on each tuner section and audio amplifier sections, very high quality master tapes were used. Each receiver's performance was compared with that of a very high quality standard which had itself been compared with many other alternatives. Standard tuners were the Yamaha CT-7000 and Accuphase T-100, and pre-amplifiers included the JVC JP-S7 and Technics 9600. Power amplifiers included a Crown DC-300A, and Quad 405, a Technics 9600 a Naim Audio, and the amplifier section of a Sansui 9090 receiver. Loudspeakers used included Yamaha 1000M, Chartwell 450 with passive crossovers, Quad electrostatics, Spendor BC1s, KEF 103 and the 4 ohm Yamaha NS 645s. A Technics SP10 Mk II turntable fitted with an AKG 8 ES cartridge, or a Shure CD4 cartridge, was used for testing pick-up inputs. At least one of my colleagues, and usually two, were with me for all the subjective tests, comments being dictated individually. If any serious difficulty was heard, everybody in my lab was requested to listen jointly. Whilst at times minor deficiencies were more marked to some listeners than others, major ones were found objectionable to all. It is of great interest though that many of the receivers sounded surprisingly good, and were only marginally different to the standard.

Output levels to the loudspeakers were also monitored by a Technics SH 9020M peak power meter, a Bruel & Kjaer peak reading volt meter and an oscilloscope. The output monitoring equipment was used to set identical output levels between the standard set up and the receiver under test to ensure that minor level differences would not contribute to subjective differences.

The carefully prepared test tape, representing virtually all types of music is copied direct from master tapes. Items on the tape included a quiet passage from Stravinsky's 'Petrushka', recorded in the Royal Festival Hall, involving some quiet percussive triangle and glockenspiel sounds, together with quiet orchestral backing; a piano recording made in the Queen Elizabeth Hall; an Elton John pop track; a recording of Boulez conducting 'The Rite of Spring' in the Festival Hall; a Welsh miner's choir with organ accompaniement, and percussion recorded in an anechoic chamber (as used in 'Hi-Fi Choice: Loudspeakers'); a recording of madrigals made in a church; part of the final movement of Bartok's 'Music for Strings, Percussion and Celelste'; a Country and Western style group playing on banjos, bass, percussion etc.; and finally a carefully made recording of jingling keys.

# Aiwa AX-7500

Aiwa Sales & Service (UK) Ltd., 31-32 Westwood Park Trading Est. Acton, London W3. 01-993 1673


This model gives an output power of 34W (both channels driven). It has provision for connecting two tape recorders (with monitoring), but dubbing is possible only from 2 to 1. Pick-up, auxiliary and tape inputs/outputs are on phono sockets but 5-pole DIN sockets are also provided for tape connections (tape 2 on the front panel). The smooth volume control is complemented by a centre indented balance control having a good law, and both bass and treble controls have 11 very uneven stepped positions. An additional mic input pot allows mixing in (front panel jack provided). Provision is made for switching either of two pairs of loudspeaker outputs or headphone only. A stereo jack socket for the latter and spring loaded clamps for speakers 1 and DIN sockets for speakers 2 are fitted. The casework is metal and is thus well screened whilst the front panel is most attractively designed and feels extremely smooth, having various functions lighting up where appropriate. Switchable rumble filter (6dB per octave below 50Hz) and loudness controls are available but unfortunately there is no treble filter. Other buttons include AFC and a stereo tuner muting. The mains lead is only 2-core, but an earth terminal is provided. The aerial connections are terminals and a ferrite rod antenna is at the back, which can be angled with difficulty, provides a reasonable signal for AM.

The amplifier section was pleasant to use, but distortion became very marked if the amplifier was driven even slightly over its limit and generally it tended to be rather bright and stereo positioning at high frequencies was very slightly fuzzy, particularly when loud. Some crossover distortion was noted, particularly at low levels, but a later sample was completely satisfactory. The intermodulation distortion measures fairly well at high levels and the harmonic distortion performance was fairly good and the power bandwidth excellent, half power being maintained to above the limit of audibility. The tone and volume controls were very well ganged and the output noise was very low indeed, so that almost no background noise would be noted if headphones were used. All the input and output levels and impedance presented no problems but the mic input clipped at only 14mV (which would be inadequate for any P A applications) The pick-up input response was very good, but in general the amplifier had a very inadequate range of tone control adjustment at 50Hz and 10kHz. Some higher harmonic hum was noted on the auxiliary input at high volume settings, although the pick-up pre-amplifier noise measured well.

The tuner's RF input sensitivities were excellent, RFIM just adequate, but image response was very poor. IF breakthrough and alternate selectivity were both very good, with adjacent selectivity reasonable. Capture ratio, limiting threshold and AM rejection all measured very well. While signal to noise ratios were superb, frequency response tailed off sharply above 14kHz. Crosstalk was reasonable at middle frequencies, but poor at high ones. The original sample gave poor distortion measurements but a second sample measured very well. The multiplex filter was excellent and the tuning knob felt very smooth and was much liked. The tuning frequency indication was quite accurate. The mute control only works on the stereo position with automatic switching. Medium wave reception was satisfactory but had too narrow a bandwidth.

This is a well laid out receiver which is easy to operate, but the hum problem on the auxiliary input

is most annoying at higher level settings. The latest production samples are clearly better than the original one in the first book, but I can only recommend its purchase with a degree of caution. Reasonable value for money.

**Amplifier Section**

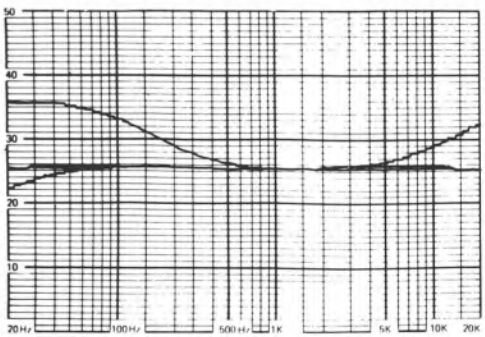
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 34W |
| Av. power o/p single ch. driven 8Ω | 39W |
| Av. power o/p single ch. driven tone burst 8Ω | 37W |
| Av. power o/p single ch. driven 4Ω | N/A |
| Av. power o/p single ch. driven tone burst 4Ω | N/A |
| Idle DC output worst ch. | 7mV |
| Turn on/off max. DC swing worst case | 65mV |
| Damping factor 8Ω | 31 |
| X-over distortion | — |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | N/A |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | N/A |
| IM dist. 10W av. | 0.06% |
| IM dist. RIAA/rec. out | 0.004% |
| ½ power bandwidth (old method 0.1%) | 25Hz-31kHz |
| Av. RIAA impedance | 54.5kΩ |
| Av. RIAA sensitivity | 2mV |
| Av. RIAA clipping | 248mV |
| Av. RIAA capacitance | 220pF |
| Av. aux. impedance | 52kΩ |
| Av. aux. sensitivity | 118mV |
| Av. tape impedance | 52kΩ |
| Av. tape sensitivity | 118mV |
| Mic impedance | 4.7kΩ |
| Mic. sensitivity | 800μV |
| Mic. clipping | 14.5mV |
| Max. level from tuner-rec. out | 420mV |
| Max. level from RIAA-rec. out | 397mV |
| Rec. out impedance DIN av. | 79.5kΩ |
| Rec. out impedance phono av. | 3.7kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 79dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 73.5dB |
| Amp. hum zero vol. AMF weighted av. | N/A |
| Amp. noise zero vol. CCIR s/n av. | 97dB |
| Amp. noise worst vol. CCIR s/n av. | 83dB |
| Amp. noise zero vol. unw. 20/20kHz | 200μV |
| Volume control tracking worst error | 1.3dB |

**Tuner Section**

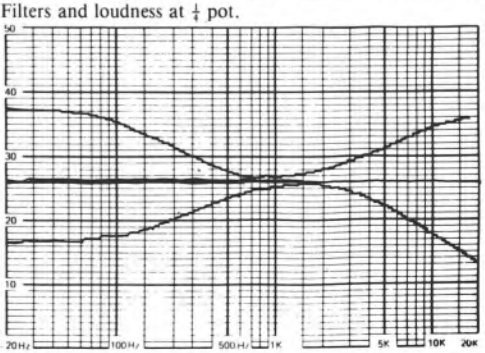
| | |
|---|---|
| Mono RF sens. 30dB IHF | 0.9μV |
| Mono RF sens. 50dB IHF | 1.5μV |
| Stereo RF sens. 50dB | 23μV |
| RFIM | 67dB |
| Adj. ch. av | 6dB |
| Alt. ch. av. | >70dB |
| Image resp | 53dB |
| Capture ratio | 1dB |
| AM reject | 63dB |
| Mono dist. 100% centre tune worst ch. | 0.3% |
| Mono dist. 100% op. tune av. | 0.29% |
| St. L = —R50% centre tune av. | 0.35% |
| St. single ch. 100% centre tune worst ch. | 0.32% |
| MPX reject 19kHz worst ch. | 61dB |
| MPX reject 38kHz worst ch. | >80dB |
| X-talk 1kHz centre tune worst ch. | 38dB |
| X-talk 10kHz centre tune worst ch. | 26.5dB |
| X-talk 1kHz op. tune av. | 48dB |
| Freq. resp. St. —3dB L/R<10Hz/14.5kHz—<10Hz/14.2kHz | |
| Freq. resp. St. 15kHz L/R | —4.5dB/—6dB |
| Limit threshold | 0.7μV |
| Muting threshold | 6.4μV |
| St. s/n CCIR 100μV/1mV av. | 55.5dB—73.5dB |
| Mono s/n 1mV av. CCIR | 79.5dB |

**General Data**

| | |
|---|---|
| Dimensions | 450 x 160 x 360mm |
| Weight | 11kgs |
| Typical selling price including VAT | £210.00 |




Filters and loudness at ¼ pot.

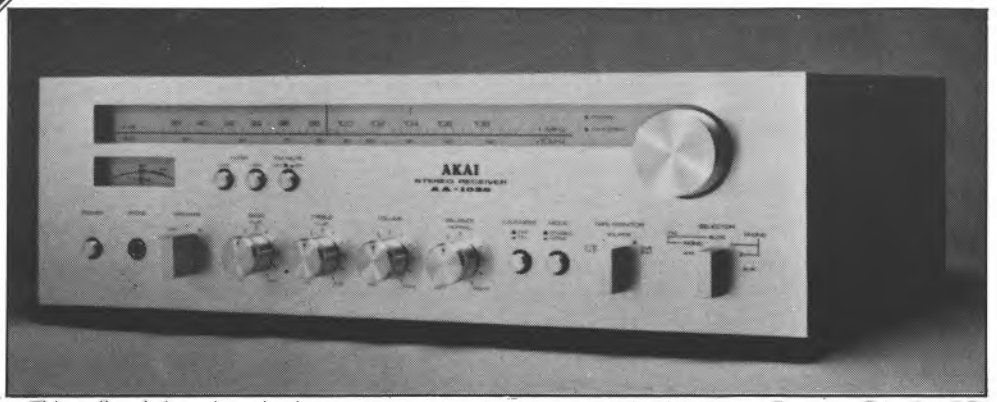



Tone controls.

BEST BUY

# Akai AA-1020

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




This well styled receiver, having an output power of 28W on both channels, includes provision for connecting two separate pick-ups and two independent tape recorders. The latter can also be interconnected for dubbing and either can be monitored. The treble and bass controls have 11 quite evenly stepped positions. The balance control had a good law but no centre indent. As with all the knobs the volume control one pulled off rather easily but was very smooth. Front panel switches include tape recording/dubbing selector, input selector and loudspeakers A/B and headphone only switch. Rumble and treble roll off buttons were complemented by loudness control, stereo/mono and FM mute.

Spring-loaded clamps on the rear are provided for speaker connections (2 pairs) and whilst all normal inputs are phono, a 5-pole DIN socket allows interconnection with DIN recorders in addition to separate phono sockets with appropriate impedances. The case is mainly high quality plywood covered with a woodgrain fabric finish and includes a wide ventilation panel on the left hand side of the top. A 3-core heavy duty mains lead feeds through a grommet into the rear and one switched AC outlet is provided with an independent chassis earth terminal.

Within its power limitation the amplifier was very well liked and sounded well on all inputs. The SMPTE IM, distortion measured well even at low levels but we noticed that the half-power bandwidth reached only approximatcly 10kHz. The tone controls were excellent but the bass filter started cutting too high (see pen chart). The treble "filter", only 6dB per octave, commenced cutting above 3kHz. The DIN tape output levels were well compatible for DIN recorders, and thus satisfactory for all normal recorder interconnections. The phono input and output levels were also very compatible. The amplifier section was found very pleasant to use and no problems were experienced in general operation. One unfortunate problem was noted when the equipment was switched off and this was a loud bonk from the speaker produced by an 8.5V DC pulse continuing for half a second. This could strain the bass units of some smaller loudspeakers if other samples were appreciably worse in this respect. The damping factor measured excellently. We noted that the main volume control did not track particularly well, 2.5dB swing being noted between full volume and —30dB and this could cause a discernable image shift.

The tuner section behaved very well on medium and strong signals, but was rather poor on weak mono, and noisy on weak stereo ones. The distortion performance was extremely good, and all the subjective listening tests proved this. The crosstalk was adequate at all frequencies, and the tuner was well aligned, having a centre stereo tuning meter. The tuning scale, illuminated green when the receiver is switched on, was slightly inaccurate, an error of 200kHz being noted. The image response measured badly, and some IF interference might be troublesome near a commercial or military short wave transmitting station operating near 10.7mHz. The RF intermodulation performance was fairly good, whilst the adjacent and alternate channel measurements were reasonable. The response falls rather rapidly above 13.5kHz, but this is not regarded as too serious, but unfortunate. 75 and 300 ohm aerial input terminals are provided and also a

BEST BUY

ferrite rod for medium wave reception.

This receiver is considered good value for money, especially since it offers some useful ergonomic features at reasonable cost. Its styling is most attractive. Its main good points are the excellent sound quality on stronger FM stations, and the generally good quality sound produced by the amplifier. Its main criticisms are the poor weak signal strength performance (rather noisy), and the susceptibility to image pick-up. Nevertheless still one of the best buys.

**Amplifier Section**

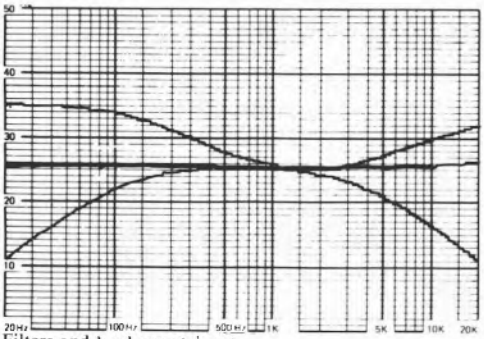
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 28W |
| Av. power o/p single ch. driven 8Ω | 32W |
| Av. power o/p single ch. driven tone burst 8Ω | 36W |
| Av. power o/p single ch. driven 4Ω | N/A |
| Av. power o/p single ch. driven tone burst 4Ω | N/A |
| Idle DC output worst ch. | 1mV |
| Turn on/off max. DC swing worst case | 8.5V |
| Damping factor 8Ω | 46 |
| X-over distortion | N/A |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | N/A |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | N/A |
| IM dist. 10W av. | 0.065% |
| IM dist. RIAA/rec. out | 0.007% |
| ½ power bandwidth (old method 0.1%) | <10Hz-10kHz |
| Av. RIAA impedance | 48kΩ |
| Av. RIAA sensitivity | 3.45mV |
| Av. RIAA clipping | 119mV |
| Av. RIAA capacitance | 156pF |
| Av. aux. impedance | 37.5kΩ |
| Av. aux. sensitivity | 176mV |
| Av. tape impedance | 85.5kΩ |
| Av. tape sensitivity | 176mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 360mV |
| Max. level from RIAA-rec. out | 375mV |
| Rec. out impedance DIN av. | 31.5kΩ |
| Rec. out impedance phono av. | 1.5Ω |
| Av. RIAA noise ref 8mV—rec. out unw. | 75dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 71dB |
| Amp. hum zero vol. AMF weighted av. | N/A |
| Amp. noise zero vol. CCIR s/n av. | 92dB |
| Amp. noise worst vol. CCIR s/n av. | 79dB |
| Amp. noise zero vol. unw. 20/20kHz | 655μV |
| Volume control tracking worst error | 2.5dB |

**Tuner Section**

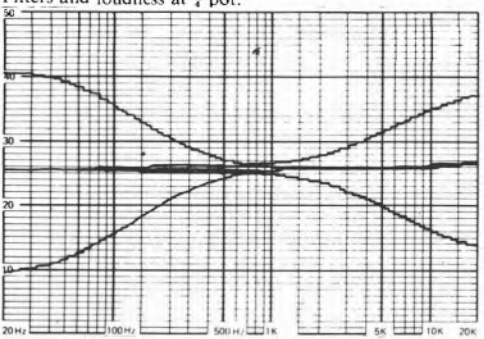
| | |
|---|---|
| Mono RF sens. 30dB IHF | 2.4μV |
| Mono RF sens. 50dB IHF | 4μV |
| Stereo RF sens. 50dB | 51μV |
| RFIM | 69.5dB |
| Adj. ch. av. | 2.5dB |
| Alt. ch. av. | 49dB |
| Image resp | 52.5dB |
| Capture ratio | 1.25dB |
| AM reject | 56dB |
| Mono dist. 100% centre tune worst ch. | 0.17% |
| Mono dist. 100% op. tune av. | 0.17% |
| St. L = —R 50% centre tune av. | 0.09% |
| St. single ch. 100% centre tune worst ch. | 0.18% |
| MPX reject 19kHz worst ch. | 51dB |
| MPX reject 38kHz worst ch. | >80dB |
| X-talk 1kHz centre tune worst ch. | 34dB |
| X-talk 10kHz centre tune worst ch. | 33dB |
| X-talk 1kHz op. tune av. | 35.5dB |
| Freq. resp. St. —3dB L/R 6Hz/14kHz—6Hz/14.1kHz | |
| Freq. resp. St. 15kHz L/R | —6dB/—5dB |
| Limit threshold | 1.5μV |
| Muting threshold | 6μV |
| St. s/n CCIR 100μV/1mV av. | 46.5dB—62dB |
| Mono s/n 1mV av. CCIR | 68.5dB |

**General Data**

| | |
|---|---|
| Dimensions | 440 x 140 x 350mm |
| Weight | 10.3kgs |
| Typical selling price including VAT | £145.00 |



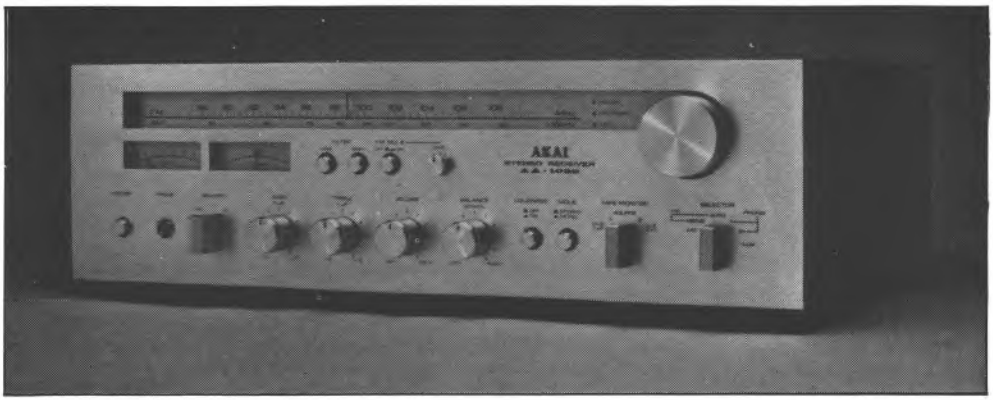
Filters and loudness at ¼ pot.



Tone controls.

# Akai AA-1030

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




The Akai model AA-1030 is similar but more powerful than the AA-1020, giving 47W per channel (both driven). A heavy duty 3-core mains lead is complemented by one switched mains outlet socket and a separate earth terminal. A ferrite rod is supplied for AM and 75 and 300 ohm terminals are incorporated for FM aerials. The volume and balance controls are smooth but the latter does not have a centre indent. Bass and treble controls each have 11 evenly stepped positions, but unfortunately all these knobs can pull off rather too easily. Interconnection with and dubbing beween two tape machines is possible. A front panel switch selects auxiliary, two pick-up inputs, auto stereo FM, mono FM and medium wave inputs. The tuning scale (illuminated green on switch on) is driven by a very smooth tuning knob with no backlash. Two selectable loudspeaker outputs (sliding clamps) are complemented by a stereo headphone jack. Rumble and treble roll-off buttons and an FM mute with a variable threshold control complete the main front panel controls. The receiver is housed in a wooden case having a ventilation strip in the top. A metal sheet underneath the chassis is also similarly ventilated. Whereas pick-up and auxiliary inputs are on phonos only, tape in/out includes DIN and phono sockets with appropriate impedances.

The amplifier worked well into BC3 speakers and had a pretty good IM performance at all levels. The amplifier noise was pretty low and input and output levels were compatible, with both DIN and phono standard recorders. Other input impedances were sensible and no clipping problems were experienced. All the controls were well ganged between channels except the volume control which showed a 2dB imbalance at one point. The treble and bass controls provided a good variation but the rumble filter started cutting a little too high. The treble roll-off cut from 4kHz but only at 6dB per octave. The loudness control worked well. We noted a rather high DC pulse on the output when the equipment was turned on or off and also a rather high permanent DC offset on the right channel (81mV). The general sound quality was liked and ergonomically the receiver is most pleasant.

The RF performance of the tuner was not altogether satisfactory, the sensitivity being slightly below average, although the adjacent and alternate channel response, and the RFIM and capture ratio all measured well. The image and IF reject were rather poorer, and problems could be experienced near aircraft flight paths. The tuner was rather noisy on weak signals in mono and stereo, although strong signals gave a fairly good signal to noise ratio. The distortion performance was excellent in mono and good in stereo, and the crosstalk measured well. Unfortunately the frequency response tailed off noticeably at the very high frequency end. The multiplex filter was adequate, but not good. A local/distant sensitivity switch on the rear can be used to reduce the sensitivity if the receiver is installed very close to a local FM transmitter, but its use severely degrades the performance on more distant stations. We noted that the limiting threshold was rather poor. The general feel of the tuning was excellent, and the dial accuracy was good.

The amplifier was generally liked, and the facilities offered are excellent. The tuner, however, seemed rather poor on weak signals, although very strong ones produced very good results. The manufacturers should attend to the limiter, discriminator and decoder sections to improve the

signal to noise ratio. The receiver can be recommended then for picking up local stations only, and for giving good reproduction from records.

**Amplifier Section**

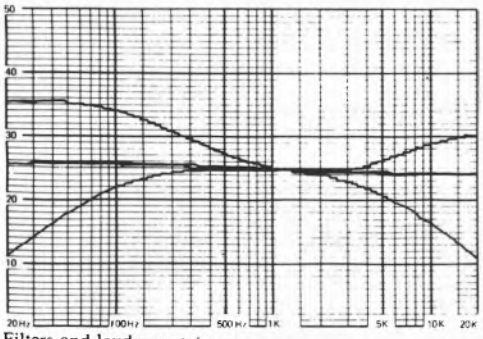
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 45W |
| Av. power o/p single ch. driven 8Ω | 52.5W |
| Av. power o/p single ch. driven tone burst 8Ω | 56W |
| Av. power o/p single ch. driven 4Ω | N/A |
| Av. power o/p single ch. driven tone burst 4Ω | N/A |
| Idle DC output worst ch. | 81mV |
| Turn on/off max. DC swing worst case | 15V |
| Damping factor 8Ω | 26 |
| X-over distortion | N/A |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | N/A |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | N/A |
| IM dist. 10W av. | 0.06% |
| IM dist. RIAA/rec. out | 0.018% |
| ½ power bandwidth (old method 0.1%) | <10Hz-26kHz |
| Av. RIAA impedance | 46kΩ |
| Av. RIAA sensitivity | 3.5mV |
| Av. RIAA clipping | 122mV |
| Av. RIAA capacitance | 35pF |
| Av. aux. impedance | 38.5kΩ |
| Av. aux. sensitivity | 171.5mV |
| Av. tape impedance | 90kΩ |
| Av. tape sensitivity | 171.5mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 290mV |
| Max. level from RIAA-rec. out | 345mV |
| Rec. out impedance DIN av. | 32kΩ |
| Rec. out impedance phono av. | 162Ω |
| Av. RIAA noise ref 8mV—rec. out unw. | 75dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 70dB |
| Amp. hum zero vol. AMF weighted av. | N/A |
| Amp. noise zero vol. CCIR s/n av. | 90dB |
| Amp. noise worst vol. CCIR s/n av. | 79dB |
| Amp. noise zero vol. unw. 20/20kHz | 450μV |
| Volume control tracking worst error | 2dB |

**Tuner Section**

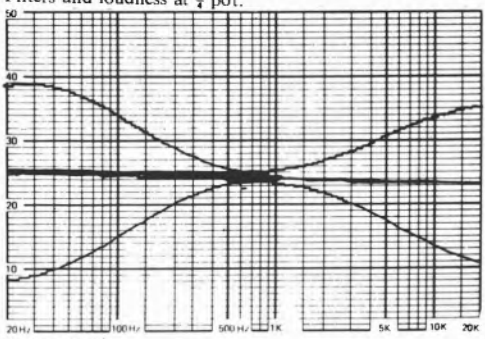
| | |
|---|---|
| Mono RF sens. 30dB IHF | 2.2μV |
| Mono RF sens. 50dB IHF | 5μV |
| Stereo RF sens. 50dB | 60μV |
| RFIM | 74dB |
| Adj. ch. av | 5dB |
| Alt. ch. av. | >70dB |
| Image resp | 53dB |
| Capture ratio | 1.5dB |
| AM reject | 56dB |
| Mono dist. 100% centre tune worst ch. | 0.19 |
| Mono dist. 100% op. tune av. | 0.17% |
| St. L = —R 50% centre tune av. | 0.11% |
| St. single ch. 100% centre tune worst ch. | 0.35% |
| MPX reject 19kHz worst ch. | 49dB |
| MPX reject 38kHz worst ch. | 56dB |
| X-talk 1kHz centre tune worst ch. | 40dB |
| X-talk 10kHz centre tune worst ch. | 36dB |
| X-talk 1kHz op. tune av. | 41.5dB |
| Freq. resp. St. —3dB L/R | 6Hz/14kHz—6Hz/13.8kHz |
| Freq. resp. St. 15kHz L/R | —5.5dB/—6dB |
| Limit threshold | 3μV |
| Muting threshold | 4.5μV-6μV |
| St. s/n CCIR 100μV/1mV av. | 46dB—61dB |
| Mono s/n 1mV av. CCIR | 66.5dB |

**General Data**

| | |
|---|---|
| Dimensions | 440 x 140 x 350mm |
| Weight | 13kgs |
| Typical selling price including VAT | £160.00 |



Filters and loudness at ½ pot.

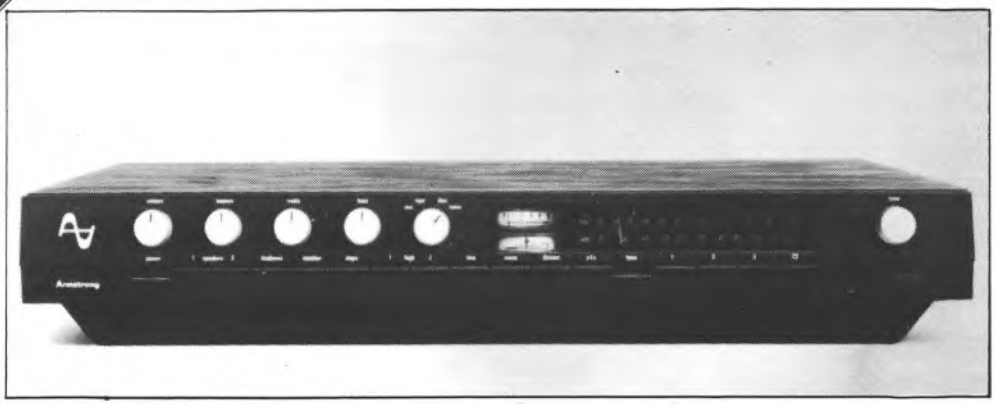


Tone controls.

RECOMMENDED

# Armstrong 626

Armstrong Audio Ltd., Warlters Rd., London N7 0RZ. 01-607 3213



Armstrong Audio have two receivers in their range, one FM only, and the other, reviewed here, FM and AM. An output power of 45W per channel was obtained into 8 ohms with both channels driven. All the input and output sockets including the loudspeaker connections are DIN type, and whilst the inputs include pick-up, auxiliary and tape, two separate pairs of loudspeakers can be selected at once if necessary with front panel switches. One mains outlet socket is complemented by an earth terminal, and the mains lead is 3-core. A 75 ohm RMA TV-type socket and a 300 ohm 2-pin socket are provided for FM aerial input and a swivellable ferrite rod for AM. All the rotary controls are small knobs, without centre indents. One is an input selector switch, whilst the others are volume, balance, bass and treble. 17 wide flat toggles operate all the different filters, outputs and tuner functions, including muting and AFC. A very small tuning knob is provided to complement the six pre-set stations (3 FM and 3 AM). A rumble filter is complemented by an elaborate treble filter system, in which a choice of two turnover frequencies is available, in addition to a choice of two cut-off slopes.

The basic amplifier section worked moderately well, and had a good damping factor and a reasonable transient power performance. It acquitted itself subjectively moderately well with a good bass performance, but slightly overbright treble. Although no crossover distortion was noticed, the IM distortion, reasonable at higher levels, crept up slightly at lower ones. The tone controls come before the record output feed, and thus the volume control is after them. The amplifier was very quiet indeed on the tape monitor input, but slight noise was introduced from the tone control circuit, which also had an inadequate clipping margin. Although the auxiliary input actually clipped at 4.5V, 0.1% THD was reached at 1V, virtually all second harmonic, this showing that this input could not accommodate many levels found in hi-fi equipment without audible roughness or distortion. Some hum was noticed on the pick-up input, and the input impedance here was a little low, but ideal for the Shure V15/111. Two phono input sensitivities are available and some IM distortion was noted in the pre-amplifier section, although an adequate clipping margin was available. Tape in/out levels were fully compatible with DIN or phono recorders (pre-sets provided for adjusting output level). The rumble filter was adequate, and the treble filters really excellent. When working hard the amplifier runs extremely hot.

The tuner's RF measurements showed a basic reasonable sensitivity with a rather average alternate channel selectivity, and a relatively poor weak stereo signal quality (rather noisy), which was still hissier than average even on stronger signals. The image response was not too good, but IF breakthrough was virtually undetectable. The centre zero tuning meter was clearly too insensitive for minimum received distortion to be set by eye since across the correct tuning area distortion varied from 0.6% to as low as 0.12%. The crosstalk was excellent at 1kHz and acceptable at 10kHz, although some distortion was noted. The multiplex filter was excellent, and the frequency response was good although this was just a little bright around 10kHz. The sound quality on local stations was good, and the pre-set stations were most useful. Medium wave (extending to long wave) worked well, but the bandwidth was much too sharp

RECOMMENDED

and some hum was present.

Whilst the amplifier section itself was satisfactory, the tone control area clearly needs some redesign to improve the distortion and noise performance. I would prefer to see phono sockets complementing DIN ones, and a much slower tuning rate. The tuning meter was also poor. The general performance has nevertheless improved markedly on this model in the last year. The FM only version has six pre-sets, which is rather more useful than the refiew sample's three on FM. However, the treble filters are outstanding.

**Amplifier Section**

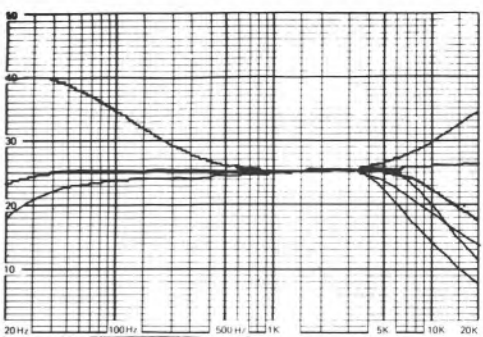
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 49W |
| Av. power o/p single ch. driven 8Ω | 58W |
| Av. power o/p single ch. driven tone burst 8Ω | 60W |
| Av. power o/p single ch. driven 4Ω | N/A |
| Av. power o/p single ch. driven tone burst 4Ω | N/A |
| Idle DC output worst ch. | <500μV |
| Turn on/off max. DC swing worst case | 2.8V |
| Damping factor 8Ω | 37 |
| X-over distortion | N/A |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | N/A |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | N/A |
| IM dist. 10W av. | 0.06% |
| IM dist. RIAA/rec. out | 0.1% |
| ½ power bandwidth (old method 0.1%) | <10Hz-13kHz |
| Av. RIAA impedance | 40.5kΩ |
| Av. RIAA sensitivity | 3.5mV-6.9mV |
| Av. RIAA clipping | 100mV-193mV |
| Av. RIAA capacitance | 40pF |
| Av. aux. impedance | 101kΩ |
| Av. aux. sensitivity | 152mV |
| Av. tape impedance | 90kΩ-27kΩ |
| Av. tape sensitivity | 319mV-268mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 640mV |
| Max. level from RIAA-rec. out | 300mV |
| Rec. out impedance DIN av. | 1kΩ |
| Rec. out impedance phono av. | — |
| Av. RIAA noise ref 8mV—rec. out unw. | 63.5dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 69dB |
| Amp. hum zero vol. AMF weighted av. | N/A |
| Amp. noise zero vol. CCIR s/n av. | 99dB |
| Amp. noise worst vol. CCIR s/n av. | 74.5dB |
| Amp. noise zero vol. unw. 20/20kHz | 600μV |
| Volume control tracking worst error | 2.6dB |

**Tuner Section**

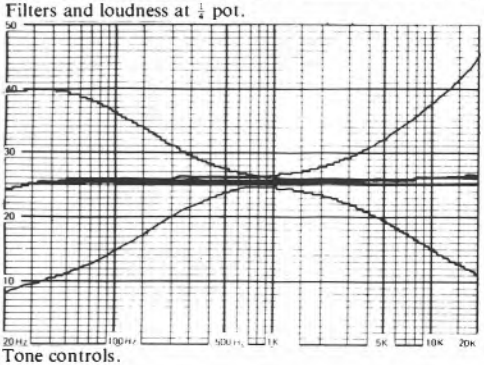
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.6μV |
| Mono RF sens. 50dB IHF | 4.2μV |
| Stereo RF sens. 50dB | 50μV |
| RFIM | 72dB |
| Adj. ch. av | 2dB |
| Alt. ch. av. | 46dB |
| Image resp | 63dB |
| Capture ratio | 2.25dB |
| AM reject | 42dB |
| Mono dist. 100% centre tune worst ch. | 0.6% |
| Mono dist. 100% op. tune av. | 0.12% |
| St. L = —R 50% centre tune av. | 0.38% |
| St. single ch. 100% centre tune worst ch. | 0.6% |
| MPX reject 19kHz worst ch. | 57dB |
| MPX reject 38kHz worst ch. | >80dB |
| X-talk 1kHz centre tune worst ch. | 42dB |
| X-talk 10kHz centre tune worst ch. | 31dB |
| X-talk 1kHz op. tune av. | 45dB |
| Freq. resp. St. —3dB L/R | 4Hz/15.4kHz—5Hz/15.7kHz |
| Freq. resp. St. 15kHz L/R | —1.75dB/—1.5dB |
| Limit threshold | 1.1μV |
| Muting threshold | 4.5μV |
| St. s/n CCIR 100μV/1mV av. | 49dB—60dB |
| Mono s/n 1mV av. CCIR | 68dB |

**General Data**

| | |
|---|---|
| Dimensions | 501 x 82 x 285mm |
| Weight | 6.8kgs |
| Typical selling price including VAT | £195.00 |



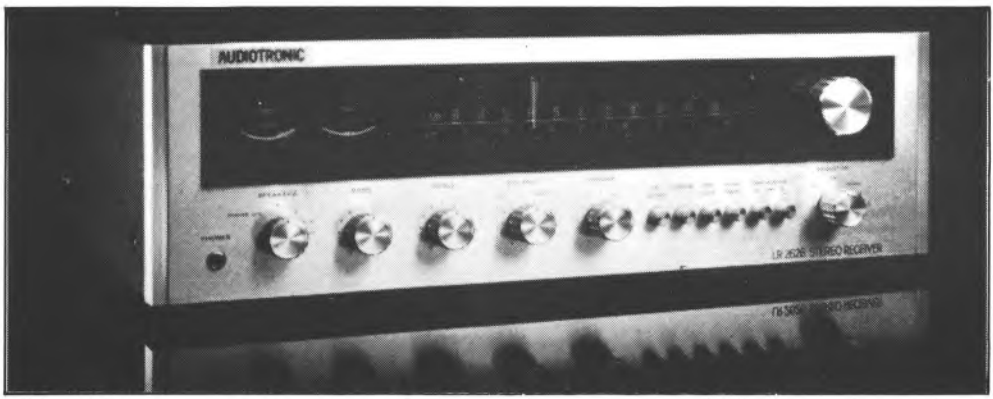
Filters and loudness at ½ pot.



Tone controls.

# Audiotronic LR-2626

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




This Audiotronics model, exclusively marketed by Laskeys, provides 30W per channel when both driven. Provision is made for interconnecting two tape recorders, and there are two extra auxiliary inputs. All these inputs and record outputs are phono, but a 5-pole DIN socket is also fitted for tape B. A front panel switch chooses speaker pairs A and/or B, or headphone only (stereo jack) and the loudspeaker connections are screw terminals on the rear. The mains lead is 3-core, and both a fuse and extra earth terminals are provided. Screw terminals are provided for 75 and 300 ohm VHF inputs.

The volume control felt smooth, and was complemented by a good balance control having a centre indent. The rotary bass and treble controls unfortunately did not have centre indents, but had a good usable range of adjustment. Buttons are provided for switching loudness control, FM muting, mono/stereo, treble roll-off and monitor tape A or B. If both the last two are pushed in, dubbing from A to B is switched through. The unit is housed in a wooden case, having a large ventilation gap in the top, incorporating a metal mesh.

The amplifier section sounded only reasonably good, and some slight blurriness was noted in the presence region, although the extreme top was clear. Low frequencies were not quite as well controlled as the standard. Signal to noise performances of the pre-amplifier and amplifier measured well, and all the controls were well ganged, although we did note a slight disparity at very low settings of the volume control. The IM distortion performance was generally good, and the half power bandwidth at 0.1% measured from below 10Hz to an average of 14.5kHz, which is pretty good in a budget amplifier. The clipping margin on the pickup input was adequate, and the impedance here was ideal. The sensitivities and levels throughout the amplifier were compatible with DIN and phono standards. Although the RF input sensitivities and signal to noise performance of the tuner were acceptable, some unfortunate failings were found in the general performances. Whilst one output channel had a pretty good top response, the other channel fell to nearly —6dB at 15kHz, in a gentle roll off starting below 10kHz. The multiplex filtering was poor on one output channel, and it is assumed that quality control was poor here. The phono socket output impedance from the tuner was rather high at 7.5k ohms. The image response was poor, but the alternate channel response was good, and the adjacent channel measurement showed the IF passband to be well aligned. The distortion performance was in general excellent, and the crosstalk was quite satisfactory. Some local oscillator radiation was noted on the aerial socket, which could cause problems to neighbours in some situations. Most impressive was the remarkably good RFIM figure, which shows that the tuner could be used fairly close to a stereo FM station without spurii being developed, but the capture ratio was very poor at 4.5dB. Although the performance on strong stations was good, weak stereo stations were reproduced rather noisily. The tuning knob bearings were slightly wobbly, and produced some backlash. A ferrite rod antenna is provided for MW reception.

This product would seem to be pretty good value for money, for the amplifier worked quite satisfactorily, but we would prefer to see better quality control on the tuner section with reference to the response and multiplex filtering, although our sample was a prototype. The RF input section

worked well, but higher Q circuits would improve image response and local oscillator radiation. Recommended, then, for its price, but check performance by asking for a demonstration, and listen for any inequality of response. In fact, this model will be discontinued a couple of months after publication, and will be replaced by a new range.

**Amplifier Section**

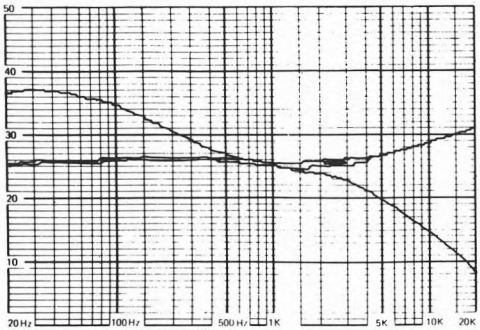
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 30W |
| Av. power o/p single ch. driven 8Ω | 36W |
| Av. power o/p single ch. driven tone burst 8Ω | 42W |
| Av. power o/p single ch. driven 4Ω | N/A |
| Av. power o/p single ch. driven tone burst 4Ω | N/A |
| Idle DC output worst ch. | 61mV |
| Turn on/off max. DC swing worst case | 1.75V |
| Damping factor 8Ω | 37 |
| X-over distortion | N/A |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | N/A |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | N/A |
| IM dist. 10W av. | 0.06% |
| IM dist. RIAA/rec. out | 0.004% |
| ½ power bandwidth(old method 0.1%) | <10Hz-14.5kHz |
| Av. RIAA impedance | 50kΩ |
| Av. RIAA sensitivity | 2.6mV |
| Av. RIAA clipping | 96mV |
| Av. RIAA capacitance | 75pF |
| Av. aux. impedance | 66kΩ |
| Av. aux. sensitivity | 167mV |
| Av. tape impedance | 66.5kΩ-79kΩ |
| Av. tape sensitivity | 167mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 550mV |
| Max. level from RIAA-rec. out | 435mV |
| Rec. out impedance DIN av. | 76kΩ |
| Rec. out impedance phono av. | 96Ω |
| Av. RIAA noise ref 8mV—rec. out unw. | 70dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 71.5dB |
| Amp. hum zero vol. AMF weighted av. | N/A |
| Amp. noise zero vol. CCIR s/n av. | 91dB |
| Amp. noise worst vol. CCIR s/n av. | 84dB |
| Amp. noise zero vol. unw. 20/20kHz | 460μV |
| Volume control tracking worst error | 1.9dB |

**Tuner Section**

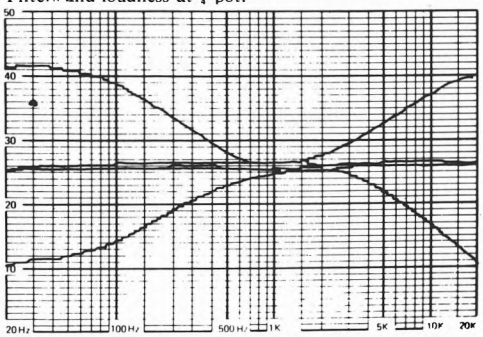
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.5μV |
| Mono RF sens. 50dB IHF | 3μV |
| Stereo RF sens. 50dB | 32μV |
| RFIM | 80.5dB |
| Adj. ch. av | 0dB |
| Alt. ch. av. | >70dB |
| Image resp. | 52.5dB |
| Capture ratio | 4.5dB |
| AM reject | 47dB |
| Mono dist. 100% centre tune worst ch. | 0.21% |
| Mono dist. 100% op. tune av. | 0.2% |
| St. L = —R50% centre tune av. | 0.15% |
| St. single ch. 100% centre tune worst ch. | 0.2% |
| MPX reject 19kHz worst ch. | 41.5dB |
| MPX reject 38kHz worst ch. | >80dB |
| X-talk 1kHz centre tune worst ch. | 33.5dB |
| X-talk 10kHz centre tune worst ch. | 33dB |
| X-talk 1kHz op. tune av. | 36dB |
| Freq. resp. St. —3dB L/R | 5Hz/12kHz—4Hz/16.8kHz |
| Freq. resp. St. 15kHz L/R | —5.5dB/—1.5dB |
| Limit threshold | 1μV |
| Muting threshold | 2.4μV |
| St. s/n CCIR 100μV/1mV av. | 49dB—62dB |
| Mono s/n 1mV av. CCIR | 67dB |

**General Data**

| | |
|---|---|
| Dimensions | 432 x 128 x 320mm |
| Weight | 8kgs |
| Typical selling price including VAT | £140.00 |



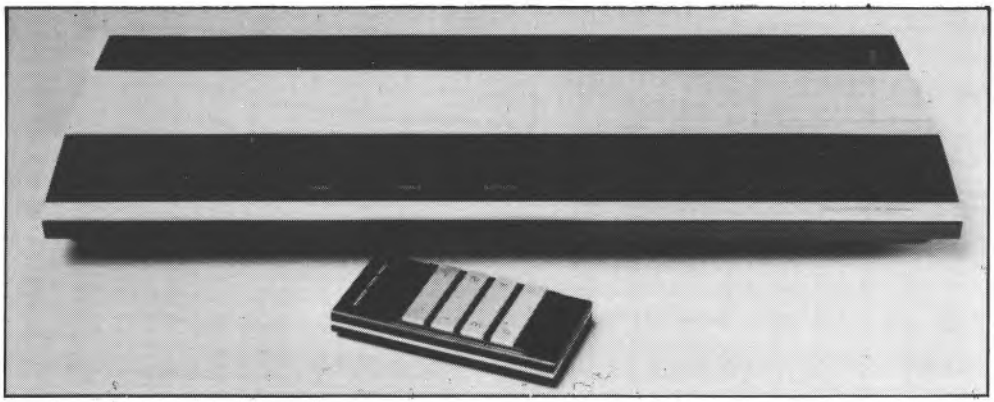
Filters and loudness at ¼ pot.



Tone controls.

# Beomaster 2400

Bang & Olufsen (UK) Ltd., Eastbrook Rd., Gloucester, GL4 7DE. 0452 21591.



This remarkable receiver with a remote control facility contains some very unusual features. In particular, the volume control is touch operated with internal circuitry automatically altering volume, either on the set itself or by remote control. The volume unfortunately continues to alter for a second or so after pressure is released, and so a panic mute button is provided!

Input facilities are also touch sensitive buttons, and include pick-up, tape, FM manual, and four pre-set FM stations. A hinged metal lid behind the touch panel exposes slider type bass, treble and balance controls (no centre indents) mono/stereo FM switching, loudness control and low, medium and high fixed volume settings (the latter being overridden by the main control). Four pre-set FM tuning wheels are provided with an indication of tuned frequency, and also a large horizontal wheel for manual tuning.

Loudspeaker connections (DIN sockets) together with 5 pole DIN sockets for tape and pick-up are in a countersunk panel underneath the receiver. 75 ohm coaxial and 300 ohm DIN aerial sockets are provided. An extension loudspeaker switch and a stereo headphone jack are mounted on the front panel.

The remote control works with supersonic pulses, and operates up to several yards away, but not through obstructions. (My cats reacted to it). Switching between the four pre-set stations and pick-up inputs is complemented by panic button and volume control, and the unit is battery operated.

The power amplifier provides 40W into 8 ohm and 60W into 4 ohm with a marginal increase on a tone burst. Distortion measured well, but the response extended to well above 100kHz, and I would have preferred it to roll off much lower. The swept IM charts were generally satisfactory, but obviously showed a problem above 100kHz. Output noise levels were extremely low and the sound quality excellent. If the equipment is switched off rather than temporarily turned off with the panic button a loud thump (14V) can be heard on the speakers (mains switch-on thumps — 19V).

Control tracking is good, but gimmickry is surely taken too far on this model, and I would have preferred a manual volume control on the set itself. No filters are provided, but the tone controls offered a very wide range of adjustment (see pen charts). The pick-up input stage had a permanent rumble cut off about 12dB per octave below 40Hz, and whilst the sensitivity was satisfactory the clipping margin was poor at 55mV. IM distortion measured rather poorly at 0.15%. Noise performance was reasonable, but the input impedance showed a severe reduction to a few thousand ohms at very low frequencies, showing incompatability with high impedance cartridges, eg Decca London. The DIN output socket gives an absurdly low level from records, and is only suitable for relatively few recorders, and hopelessly incompatible with phono line inputs.

The tuner's RF performance showed good sensitivity, and other parameters were acceptable, although selectivity was poorer than average. AM rejection was poor, but capture ratio adequate. The audio section showed an extremely flat response, but weighted noise levels were much poorer than average in mono, though reasonable in stereo. Crosstalk was excellent at middle frequencies, and otherwise reasonable. Subjectively the sound quality was excellent, with very low distortion, although our

first sample had hum on the right channel. The multiple filtering was excellent, and the tuning scale accuracy very good.

This receiver has such compatability problems, that I can only recommend it for specialised use, but whilst hi-fi fanatics will probably be annoyed with its ergonomics, some users will be attracted to its highly unique styling and presentation.

**Amplifier Section**

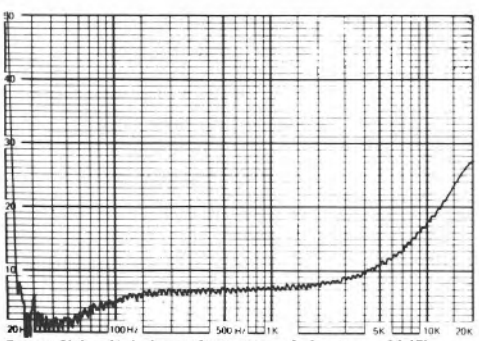
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 40W |
| Av. power o/p single ch. driven 8Ω | 40W |
| Av. power o/p single ch. driven tone burst 8Ω | 41W |
| Av. power o/p single ch. driven 4Ω | 60W |
| Av. power o/p single ch. driven tone burst 4Ω | 69W |
| Idle DC output worst ch. | 12mV |
| Turn on/off max. DC swing worst case | 1.5V |
| Damping factor 8Ω | 106 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.02% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.03% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.125% |
| Half power bandwidth | 3Hz-100kHz |
| Av. RIAA impedance | 58.8kΩ |
| Av. RIAA sensitivity | 4mV |
| Av. RIAA clipping | 55mV |
| Av. RIAA capacitance | 100pF |
| Av. aux. impedance | — |
| Av. aux. sensitivity | — |
| Av. tape impedance | 570kΩ |
| Av. tape sensitivity | 280mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 10.4mV |
| Max. level from RIAA-rec. out | 7mV |
| Rec. out impedance DIN av. | 88kΩ |
| Rec. out impedance phono av. | — |
| Av. RIAA noise ref 8mV—rec. out unw. | 71dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 72dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 102dB |
| Amp. noise zero vol. CCIR s/n av. | 102dB |
| Amp. noise worst vol. CCIR s/n av. | 80.5dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 0.5dB |

**Tuner Section**

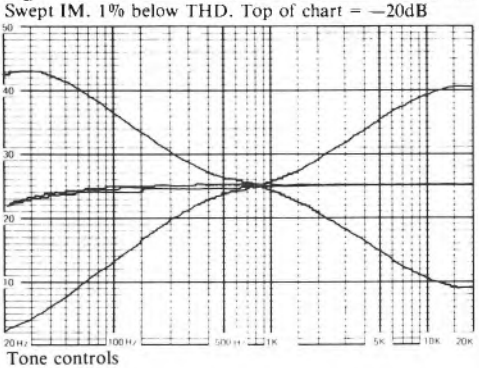
| | |
|---|---|
| Mono RF sens. 30dB IHF | 0.8μV |
| Mono RF sens. 50dB IHF | 4μV |
| Stereo RF sens. 50dB | 29μV |
| RFIM | 74dB |
| Adj. ch. av | 7dB |
| Alt. ch. av. | 58dB |
| Image resp | 72dB |
| Capture ratio | 1.5dB |
| AM reject | 49dB |
| Mono dist. 100% centre tune worst ch. | 0.24% |
| Mono dist. 100% op. tune av. | 0.24% |
| St. L = —R 50% centre tune av. | 0.06% |
| St. single ch. 100% centre tune worst ch. | 0.12% |
| MPX reject 19kHz worst ch. | 67dB |
| MPX reject 38kHz worst ch. | 71dB |
| X-talk 1kHz centre tune worst ch. | 44dB |
| X-talk 10kHz centre tune worst ch. | 31dB |
| X-talk 1kHz op. tune av. | 44.5dB |
| Freq. resp. St. —3dB L/R 6Hz/16.1kHz—6Hz/16.1kHz | |
| Freq. resp. St. 15kHz L/R | +0.8dB/—0.2dB |
| Limit threshold | 0.6μV |
| Muting threshold | |
| St. s/n CCIR 100μV/1mV av. | 53dB—62dB |
| Mono s/n 1mV av. CCIR | 63dB |

**General Data**

| | |
|---|---|
| Dimensions | 60 x 620 x 250mm |
| Weight | 7kgs |
| Typical selling price including VAT | £395.00 |



Swept IM. 1% below THD. Top of chart = —20dB

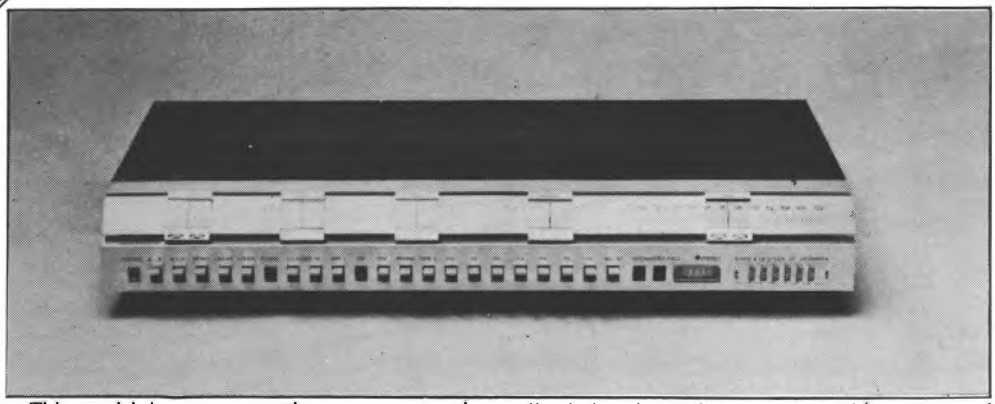


Tone controls

BEST BUY

# Beomaster 4400

Bang & Olufsen (UK) Ltd., Eastbrook Rd., Gloucester, GL4 7DE. 0452 21591.



This model is a very worthy successor to the model 4000, and includes six pre-set FM stations. The receiver is housed in an attractive flat case, having a sloping front panel, on which the sideways-acting controls for volume, balance, bass and treble are complemented by a slide-rule type tuning control. The audio controls do not have centre indents, but the tone controls, and filters, can be switched out with a lever, if desired. Below the slider is a row of levers switching various functions, including a choice of two loudspeaker outputs, mono/stereo, loudness control, rumble filter (12dB per octave below 60Hz), treble filter (12dB per octave cut above 8kHz), tape 1 (allowing monitoring), input selection from pick-up, tape 2, FM (manual tuning), six pre-set FM stations, and finally, automatic frequency control. Under a cover are the six small, and rather awkward wheels for adjusting pre-set stations.

A stereo jack-socket for headphones is provided, and also an amplifier overload light, tuning lights, a stereo light and an RF signal strength meter. On the rear panel, underneath the large heat sinks, are the DIN standard input and output sockets. The mains input lead is only 2-core, and no earth terminal is provided.

The power amplifer section gives a maximum continuous output of 57W per channel into 8 ohms, rising to 92W into 4 ohms (most creditable). The tone burst performance gave virtually identical results. The sound quality was extremely good, being open and transparent, and amplifier distortion levels measured very well. A switch-on transient of 23V was noted into an 8 ohm load, and this may prove rather annoying. Damping factor measured extremely well at 140 (40Hz). The tone controls were well designed, giving a reasonable range of adjustment, without their boosts increasing outside the audio range. Nevertheless, I found the faders a little bit sticky in operation but control tracking was reasonable.

Amplifier output noise was very low indeed, even when the volume control was advanced to flat out, thus providing excellent dynamic range on headphones. The pick-up input pre-amplifier performed far better than any previous B & O design, and no clipping problems should be experienced, pre-sets being provided for input sensitivity. The RIAA response was excellent, and the input impedance was quite reasonable, with low capacity, but at low frequencies it fell dramatically thus being incompatible with high impedance cartridges, (eg Decca London). Noise and distortion levels measured very well.

The tape recording 5-pole DIN sockets, whilst conforming to DIN standards, are totally incompatible with external phono standards, and present very low levels indeed from both records and tuner.

The FM tuner section generally operated well and had an excellent input sensitivity and was particularly good on weak stereo signals. Image response, IF breakthrough, RF IM and all measured very well indeed. The selectivity was reasonably good, and the capture ratio acceptable. The manual tuning rate was much too fast, but the dial accuracy, unfortunately, was appalling, (max error 600kHz) which B & O really must improve. The pre-set station facility was excellent, allowing great ease of use by the entire family.

The tuner's frequency response measured extremely well in all modes, and the weighted noise

BEST BUY

levels also measured well. Crosstalk measured well at middle frequencies, and adequately at high ones. Slight distortion was audible on very high deviation peaks, and tuning was very critical for optimum performance. Normal programmes sounded well. Distortions measured well generally, but rose to 0.6% on peak deviation on left or right only, confirming the subjective comments.

This is clearly the best receiver that B & O have yet designed, and it can be recommended, its good points being its excellent tuner RF performance, reasonably good tuner audio performance, and a generally excellent pre-amplifier and amplifier section. The pre-set station facility, and the excellent rumble and treble filters are specially commended.

**Amplifier Section**

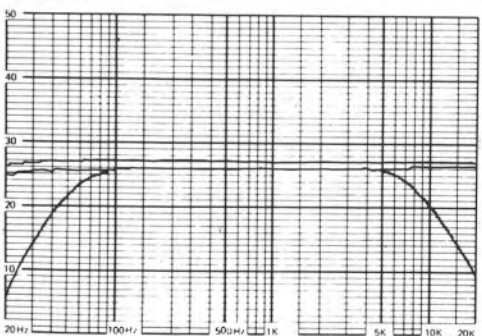
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 52.5W |
| Av. power o/p single ch. driven 8Ω | 57W |
| Av. power o/p single ch. driven tone burst 8Ω | 56.5W |
| Av. power o/p single ch. driven 4Ω | 91.5W |
| Av. power o/p single ch. driven tone burst 4Ω | 96.5W |
| Idle DC output worst ch. | 25mV |
| Turn on/off max. DC swing worst case | 23V |
| Damping factor 8Ω | 140 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.005% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.01% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.0015% |
| Half power bandwidth | 3Hz-100kHz |
| Av. RIAA impedance | 43.3kΩ |
| Av. RIAA sensitivity | 2.2mV/Zero |
| Av. RIAA clipping | 90mV |
| Av. RIAA capacitance | 30pF |
| Av. aux. impedance | — |
| Av. aux. sensitivity | — |
| Av. tape impedance | 465kΩ |
| Av. tape sensitivity | 190mV/Zero |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 10.8mV |
| Max. level from RIAA-rec. out | 13.5mV |
| Rec. out impedance DIN av. | 95kΩ |
| Rec. out impedance phono av. | — |
| Av. RIAA noise ref 8mV—rec. out unw. | 77.5dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 73.5dB |
| Amp. hum zero vol. AMF wtd. av. ref 1W 8Ω | —92dB |
| Amp. noise zero vol. CCIR s/n av. | 92dB |
| Amp. noise worst vol. CCIR s/n av. | 88dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1.5dB |

**Tuner Section**

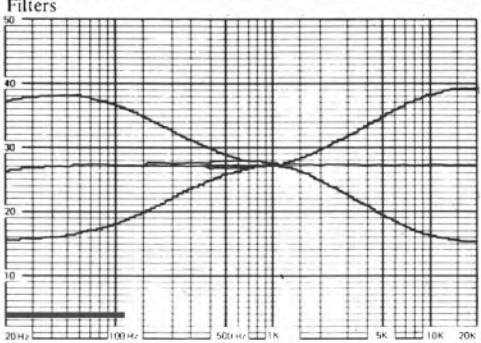
| | |
|---|---|
| Mono RF sens. 30dB IHF | 0.8μV |
| Mono RF sens. 50dB IHF | — |
| Stereo RF sens. 50dB | 30μV |
| RFIM | 76dB |
| Adj. ch. av | 10dB |
| Alt. ch. av. | 61.5dB |
| Image resp | 80dB |
| Capture ratio | 1.6dB |
| AM reject | 72dB |
| Mono dist. 100% centre tune worst ch. | 0.33% |
| Mono dist. 100% op. tune av. | 0.33% |
| St. L = —R 50% centre tune av. | 0.17% |
| St. single ch. 100% centre tune worst ch. | 0.64% |
| MPX reject 19kHz worst ch. | 67dB |
| MPX reject 38kHz worst ch. | >90dB |
| X-talk 1kHz centre tune worst ch. | 42dB |
| X-talk 10kHz centre tune worst ch. | 29dB |
| X-talk 1kHz op. tune av. | 43dB |
| Freq. resp. St. —3dB L/R <10Hz/15.8kHz/<10Hz/15.8kHz | FLAT |
| Freq. resp. St. 15kHz L/R | —0.8dB |
| Limit threshold | 0.5μV |
| Muting threshold | 7.5μV |
| St. s/n CCIR 100μV/1mV av. | 56.5dB/64.5dB |
| Mono s/n 1mV av. CCIR | 66.5dB |

**General Data**

| | |
|---|---|
| Dimensions | 575 x 95 x 280mm |
| Weight | 10kgs |
| Typical selling price including VAT | £395.00 |



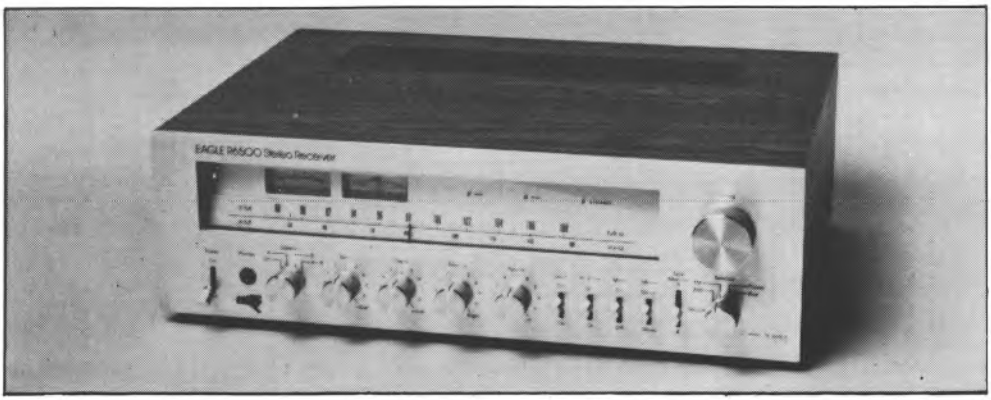
Filters



Tone controls.

# Eagle R-6500

Eagle International Ltd., Precision Centre, Heather Park Drive, Wembley, Middlesex. HA0 1SU. 01-902 8832



This receiver gave 60W output on each channel into 8 ohms, increasing to 90W into 4 ohms. Housed in a wooden case, with a metal base plate, it is fitted with a 41 stepped position volume control, a centre-indented balance control, and 11 position bass and treble controls. The front panel incorporates a switch selecting either or both loudspeaker pairs, a headphone jack socket (level too high and rather hissy), loudness control, treble filter (6dB/oct. above 5kHz), FM muting, stereo/mono, and tape monitor switch for use with two external machines. The input selector switch chooses AM, FM, phono or auxiliary inputs. On the back panel, aerial input terminals are provided for AM and 300 ohm FM, with a separate clamp terminal for 75 ohm unbalanced. A ferrite rod for AM can be swivelled horizontally or vertically, but is very floppy. Phono sockets are used for general interconnections, but the tape 'A' feed is also available on a compatible 5-pole DIN socket. 3.5 Amp loudspeaker fuses are provided for protection, and a 3-core mains lead is complemented by an earth tag for pick-up earthing. Loudspeaker connections are with spring-loaded clamps.

The amplifier section gave a good burst performance into 8 ohms, but transient output was limited into 4 ohms, presumably by over-protection. Unfortunately, the amplifier was rather noisy, and even with volume at minimum, hiss was audible a few feet away from sensitive speakers. A 20V switch-off transient will produce a loud thump on speakers. The volume control was well liked and tracked reasonably well. The tone controls had well-designed steps, but the bass boost continued excessively below 50Hz. The amplifier sounded slightly lifeless but many users might find it acceptable.

The damping factor was adequate, and the half-power bandwidth extended to 65kHz. The overall response cut 3dB at 30kHz, which is reasonably welcome. Amplifier harmonic distortion was acceptable up to just below clipping, and whilst no third order swept IM problems were noted, an increase of second order distortion was noted at very high frequencies, despite the amplifier roll-off. Input and output levels and impedances were all compatible with phono interconnection standards.

The RIAA input impedance was well optimised, and with average capacity, and sensitivity and clipping margins were both good. The input hiss level was marginally higher than average, but satisfactory. IM distortion was just a little high, but acceptable, whilst the RIAA response was generally flat, but with a built-in 6dB/octave rumble cut below 42Hz.

The FM tuner section was provided with a stable, but rather heavy, tuning knob. The dial accuracy was only fair. Whilst the RF sensitivity was reasonable, RFIM was poor. Local oscillator radiation was appalling, and this receiver could disturb other users. Image response and IF rejection were good. Adjacent channel selectivity was poor, but alternate very good. Capture ratio was also poor. Limiting, muting and stereo threshold were all satisfactory, and AM rejection excellent. The audio response was very good, and noise levels were better than average on strong signals — but average on weak ones. Unfortunately high level modulation was rather too distorted, just above 1% THD being noted in the worst cases. Subjectively, high deviation speech and HF transients produced spitch and slight cracks which could not be reduced by careful tuning. This lets down an otherwise reasonable budget

receiver, although crosstalk measured acceptably well.

If you want a fairly high power receiver at a modest cost, and can live with the ouput noise problem, the higher-than-average tuner distortion, and the poor RFIM performance (Eagle have promised to improve these), you may well find this model good value for money.

**Amplifier Section**

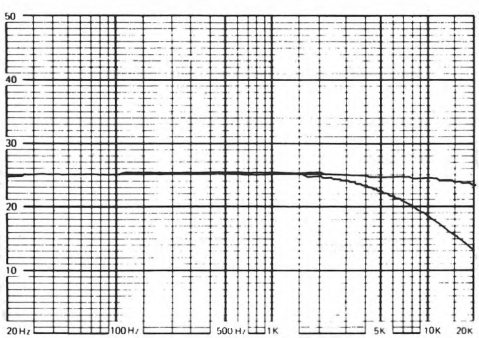
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 53.5W |
| Av. power o/p single ch. driven 8Ω | 60.5W |
| Av. power o/p single ch. driven tone burst 8Ω | 63W |
| Av. power o/p single ch. driven 4Ω | 89W |
| Av. power o/p single ch. driven tone burst 4Ω | 64.5W |
| Idle DC output worst ch. | 32mV |
| Turn on/off max. DC swing worst case | 20V |
| Damping factor 8Ω | 42 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.02% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.04% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.02% |
| Half power bandwidth | 2Hz-67kHz |
| Av. RIAA impedance | 47.2kΩ |
| Av. RIAA sensitivity | 3.1mV |
| Av. RIAA clipping | 105mV |
| Av. RIAA capacitance | 10pF |
| Av. aux. impedance | 87.6kΩ |
| Av. aux. sensitivity | 210mV |
| Av. tape impedance | 105kΩ |
| Av. tape sensitivity | 200mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 472mV |
| Max. level from RIAA-rec. out | 530mV |
| Rec. out impedance DIN av. | 79kΩ |
| Rec. out impedance phono av. | 3.3kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 75dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 71.25dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 79.5dB |
| Amp. noise zero vol. CCIR s/n av. | 81dB |
| Amp. noise worst vol. CCIR s/n av. | 80.5dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1.3dB |

**Tuner Section**

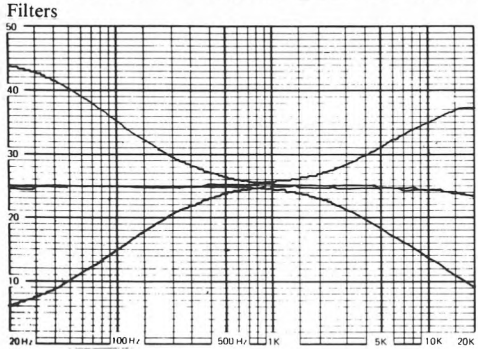
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.1μV |
| Mono RF sens. 50dB IHF | 13μV |
| Stereo RF sens. 50dB | 40μV |
| RFIM | 63dB |
| Adj. ch. av. | 3.5dB |
| Alt. ch. av. | >70dB |
| Image resp | 80dB |
| Capture ratio | 2.2dB |
| AM reject | 66dB |
| Mono dist. 100% centre tune worst ch. | 0.71% |
| Monodist. 100% op. tune av. | 0. 3% |
| St. L = —R50% centre tune av. | 0.1% |
| St. single ch. 100% centre tune worst ch. | 1.2% |
| MPX reject 19kHz worst ch. | 59dB |
| MPX reject 38kHz worst ch. | 86dB |
| X-talk 1kHz centre tune worst ch. | 41dB |
| X-talk 10kHz centre tune worst ch. | 39dB |
| X-talk 1kHz op. tune av. | 41dB |
| Freq. resp. St. —3dB L/R 5Hz/16.7kHz—5Hz/17kHz | |
| Freq. resp. St. 15kHz L/R | —Flat/+0.2dB |
| Limit threshold | 0.7μV |
| Muting threshold | 2.6μV |
| St. s/n CCIR 100μV/1mV av. | 52dB—64dB |
| Mono s/n 1mV av. CCIR | 68.5dB |

**General Data**

| | |
|---|---|
| Dimensions | 456 x 320 x 132mm |
| Weight | 8.4kgs |
| Typical selling price including VAT | £150.00 |



Filters

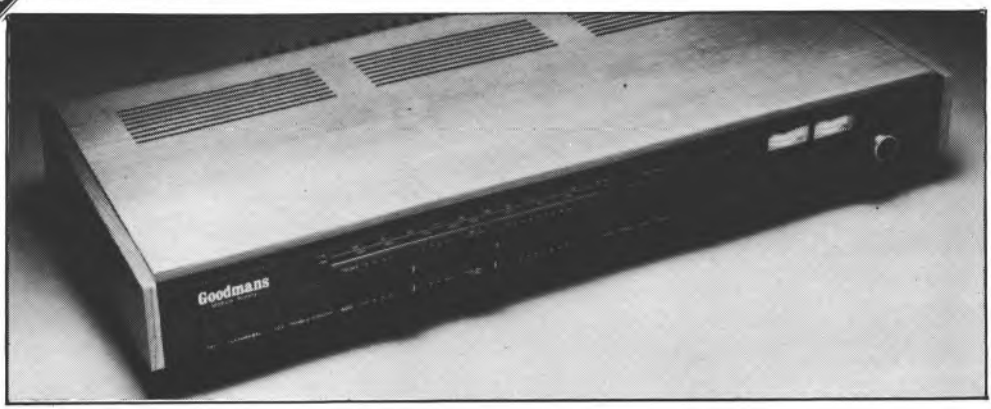


Tone controls.

RECOMMENDED

# Goodmans Module 90

Goodmans Loudspeakers Ltd., Downley Rd., Havant, Hants. 07012 6344




This reasonably priced receiver delivers 30W per channel into 8 ohms and two switchable pairs of loudspeakers can be plugged in. All the input and output sockets are DIN types and only DIN recorders etc. can be recommended for interconnection because of compatibility problems. Only a 300 ohm FM aerial socket is incorporated together with an AM one, no ferrite rod being fitted. Only pick-up and tape input/output and an auxiliary input are provided. A 3-core mains lead is complemented by one AC switched outlet and a separate earth terminal is located near the DIN audio sockets. Sideways acting sliders situated on the front panel provide bass, treble and independent volume adjustment for the two channels and all were rather stiff. No centre indents were incorporated in the tone controls. Two stereo headphone jacks were found useful. Square indented push buttons operate 4 pre-set stations, general FM and medium wave tuning, AFC, auxiliary, pick-up, tape monitor, mono/stereo, loudness, treble filter, rumble filter and loudspeaker switching.

Within its power limitation the sound quality seemed pretty good, although slightly bright, and the sound produced had a surprising transparent quality. The amplifier had an extremely good transient power capability allowing at least 50% overload on very short peaks and thus it was capable of giving quite a loud audible volume, although low frequencies were clearly limited. The IM distortion performance whilst being good at high levels reached orders of several percent at very low levels (crossover distortion). The harmonic distortion performance was quite reasonable, though. The general hiss levels of the pre-amp and amplifier were satisfactory.

A 20V DC pulse occurred when the receiver was switched on and this would be very dangerous for some smaller loudspeaker units.

The tone control variation was very wide. The rumble filter begins to cut (6dB per octave) from 80Hz, and the amplifier's normal response falls fairly sharply from 30Hz. The treble roll-off was 6dB per octave above 4.5kHz. The RIAA response was very good, and all the tone controls tracked very well. The law of the two volume control sliders was rather different, position 5 on one being equivalent to 6 on the other, and setting balance accurately is therefore rather difficult.

The auxiliary input, although quite sensitive, clipped at only 1.5V, which is most restrictive. Although the pick-up input impedance was satisfactory, the clipping margin was only adequate. The tuner's output level appearing on the DIN socket was clearly too high for complete DIN compatibility and some 4dB higher than the pick-up output which was reasonable. The damping factor was adequate and so the amplifier overall was regarded as fairly good at its price.

The RF sensitivity was only fair, but the IF rejection and RFIM measurements were very good. The capture ratio was particularly good at only 0.75dB. The limiting threshold however was extremely poor as was multiplex rejection. The frequency response peaked at treble frequencies (rather bright). The crosstalk performance was reasonable at middle frequencies but rather poor at high ones, although it improved if the tuner was "off tuned". The distortion performance was surprisingly good. The stereo hiss performance was rather average on strong signals, but significantly below average on weak ones. Correct tuning is indicated when a tuning lamp indicator ceases to

RECOMMENDED

glow.

This model seems to offer pretty good value for money, especially for the provision of pre-set FM stations, although the general performance was clearly not up to that found on receivers costing perhaps £25 more. A fairly good budget buy nevertheless, but try it before purchase.

**Amplifier Section**

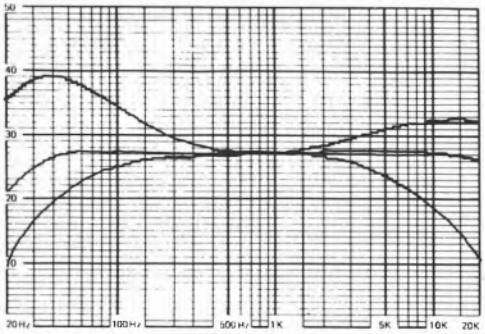
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 30W |
| Av. power o/p single ch. driven 8Ω | 33W |
| Av. power o/p single ch. driven tone burst 8Ω | 53W |
| Av. power o/p single ch. driven 4Ω | N/A |
| Av. power o/p single ch. driven tone burst 4Ω | N/A |
| Idle DC output worst ch. | 39mV |
| Turn on/off max. DC swing worst case | 20V |
| Damping factor 8Ω | 28 |
| X-over distortion | N/A |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | N/A |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | N/A |
| IM dist. 10W av. | 0.08% |
| IM dist. RIAA/rec. out | 0.03% |
| ½ power bandwidth (old method 0.1%) | 20Hz-9.7kHz |
| Av. RIAA impedance | 50kΩ |
| Av. RIAA sensitivity | 2.9mV |
| Av. RIAA clipping | 57mV |
| Av. RIAA capacitance | 55pF |
| Av. aux. impedance | 645kΩ |
| Av. aux. sensitivity | 94mV |
| Av. tape impedance | 37kΩ |
| Av. tape sensitivity | 237mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 110mV |
| Max. level from RIAA-rec. out | 60mV |
| Rec. out impedance DIN av. | 88kΩ |
| Rec. out impedance phono av. | — |
| Av. RIAA noise ref 8mV—rec. out unw. | 73.5dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 71.25dB |
| Amp. hum zero vol. AMF weighted av. | N/A |
| Amp. noise zero vol. CCIR s/n av. | 84.5dB |
| Amp. noise worst vol. CCIR s/n av. | 67dB |
| Amp. noise zero vol. unw. 20/20kHz | 680μV |
| Volume control tracking worst error | SEE REVIEW |

**Tuner Section**

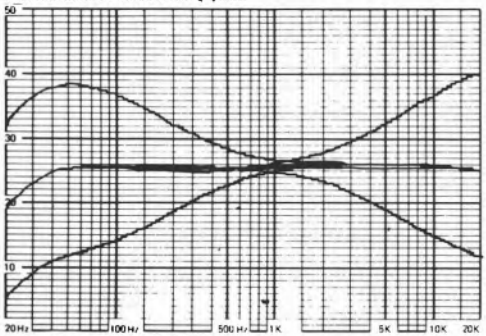
| | |
|---|---|
| Mono RF sens. 30dB IHF | 2.8μV |
| Mono RF sens. 50dB IHF | 7μV |
| Stereo RF sens. 50dB | 65μV |
| RFIM | 69.5dB |
| Adj. ch. av. | 4.5dB |
| Alt. ch. av. | 48dB |
| Image resp | 77dB |
| Capture ratio | 0.75dB |
| AM reject | 58dB |
| Mono dist. 100% centre tune worst ch. | 0.47% |
| Mono dist. 100% op. tune av. | 0.25% |
| St. L = —R 50% centre tune av. | 0.12% |
| N. B. Old Method | 0.12% |
| St. single ch. 100% centre tune worst ch. | 0.27% |
| MPX reject 19kHz worst ch. | 36.5dB |
| MPX reject 38kHz worst ch. | 60.5dB |
| X-talk 1kHz centre tune worst ch. | 35.5dB |
| X-talk 10kHz centre tune worst ch. | 22.5dB |
| X-talk 1kHz op. tune av. | 42dB |
| Freq. resp. St. —3dB L/R 6Hz/12.1kHz | —6Hz/12.3kHz |
| Freq. resp. St. 15kHz L/R | —6.5dB/6.5dB |
| Limit threshold | 6μV |
| Muting threshold | 5.5μV |
| St. s/n CCIR 100μV/1mV av. | 44dB—61dB |
| Mono s/n 1mV av. CCIR | 67dB |

**General Data**

| | |
|---|---|
| Dimensions | 614 x 318 x 100mm |
| Weight | 8.5kgs |
| Typical selling price including VAT | £140.00 |




Filters and loudness at ½ pot.




Tone controls.

# Goodmans 120

Goodmans Loudspeakers Ltd., Downley Rd., Havant, Hants. 07012 6344

Despite its relatively modest price, this receiver can deliver 40W per channel into 8 ohms (both driven). All the audio and loudspeaker inputs and outputs are on DIN sockets. Only a 2-core mains lead is fitted but a separate earth terminal is provided as is one switched AC outlet socket. A coaxial 75 ohm socket is complemented by a 300 ohm one for FM and an additional socket for connection of an external AM antenna (LW, MW and SW). Push buttons include AFC, FM mute, input selection including auxiliary, pick-up, tape monitor, mono/stereo, loudness, rumble and treble roll-offs, loudspeaker 1, loudspeaker 2 and headphones (2 stereo jacks inside a hinged cover on the left of the case). All the push buttons are particularly suitable for large thumbs! No centre indents are provided with the rotary tone or balance controls, and the balance control acted rather violently at the ends of its track. The ventilated case is coloured black and the general styling is frankly rather ugly in my opinion. Massive heat dissipation fins along the back allow fairly cool running. The tuning knob (enormous) is very wibbly-wobbly and clumsy and the tuning scale unconventionally runs opposite to normal (high to low on VHF). This receiver is only suitable for interconnection with recorders having DIN standard inputs.

The amplifier sound quality was very well liked and there was an ample reserve of power for normal applications. Although the intermodulation and harmonic distortion measurements were good, the half-power bandwidth was poor on one channel. The amplifier noise performance was reasonably good, although some hum was present on the pick-up input. The volume control tracking was very poor, particularly at low levels, but most of the other control trackings were satisfactory. The bass control allowed considerable variation. Particularly commendable were the rumble and treble filters, which approached cuts of 18dB per octave from 45Hz and 7.8kHz respectively (amongst the best tested). The pick-up input impedance was rather high, but the other impedances were all very compatible as were the general sensitivities. The RIAA response measured extremely well and the clipping margins were satisfactory throughout. No DC problems were experienced and the output damping factor was very good, assisting the amplifier's well damped and solid low frequency performance.

The signal to noise performance of the tuner section measured extremely well as far as hiss was concerned both on weak and on strong signals, but unfortunately some hum was introduced under all conditions which might affect listening pleasure with some loudspeaker systems. The distortion performance in stereo measured badly at the correct tuning positon but improved dramatically when tuned optimally, thus showing incorrect discriminator alignment (only a signal strength meter is provided). Crosstalk was good at 1kHz, but very poor at 10kHz. The frequency response measured very well. The pilot tone rejection was poor. Whilst the RF input sensitivities measured very well and the RFIM, IF breakthrough and image response were excellent, the adjacent and alternate channel response were just good. The capture ratio was poor and the local oscillator radiation very poor and the tuner could cause disturbance to others when in use. The muting did not work at all (bad factory adjustment) and the limiting threshold was very poor indeed, so that weak signals were

noticeably quieter than strong ones. The tuning can only be said to be clumsy but the sound quality at best was very good.

In general this receiver can produce an excellent sound quality and it is clear from the measurements that theoretically it could be very good indeed. Poor quality control in tuner factory adjustments, however, are letting it down. Many will be put off by its plasticy appearance and poor tuning dial assembly. Recommended with caution if you can bear with its poor ergonomics and appearance.

**Amplifier Section**

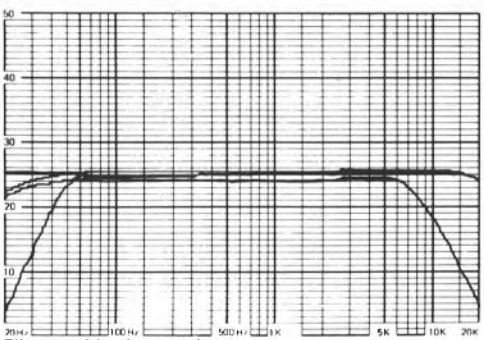
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 40.5W |
| Av. power o/p single ch. driven 8Ω | 45W |
| Av. power o/p single ch. driven tone burst 8Ω | 47.5W |
| Av. power o/p single ch. driven 4Ω | N/A |
| Av. power o/p single ch. driven tone burst 4Ω | N/A |
| Idle DC output worst ch. | 30mV |
| Turn on/off max. DC swing worst case | 6V |
| Damping factor 8Ω | 39 |
| X-over distortion | N/A |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | N/A |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | N/A |
| IM dist. 10W av. | 0.05% |
| IM dist. RIAA/rec. out | 0.04% |
| ½ power bandwidth (old method 0.1%) | 30Hz-15kHz |
| Av. RIAA impedance | 58kΩ |
| Av. RIAA sensitivity | 1.4mV |
| Av. RIAA clipping | 99mV |
| Av. RIAA capacitance | 90pF |
| Av. aux. impedance | 450kΩ |
| Av. aux. sensitivity | 88mV |
| Av. tape impedance | 101kΩ |
| Av. tape sensitivity | 88mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 74mV |
| Max. level from RIAA-rec. out | 60mV |
| Rec. out impedance DIN av. | 83kΩ |
| Rec. out impedance phono av. | — |
| Av. RIAA noise ref 8mV—rec. out unw. | 62dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 70dB |
| Amp. hum zero vol. AMF weighted av. | N/A |
| Amp. noise zero vol. CCIR s/n av. | 92dB |
| Amp. noise worst vol. CCIR s/n av. | 81dB |
| Amp. noise zero vol. unw. 20/20kHz | 1.6mV |
| Volume control tracking worst error | 3dB |

**Tuner Section**

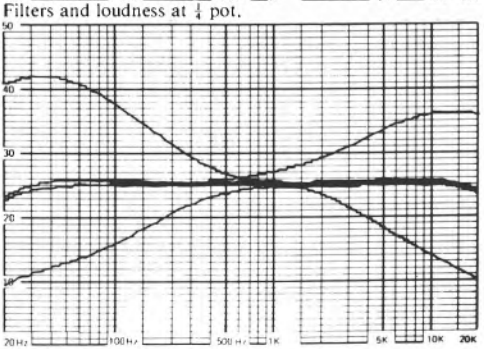
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.5μV |
| Mono RF sens. 50dB IHF | 6.2μV |
| Stereo RF sens. 50dB | 30μV |
| RFIM | 76.5dB |
| Adj. ch. av | 4dB |
| Alt. ch. av. | 50dB |
| Image resp | 74.5dB |
| Capture ratio | 3.75dB |
| AM reject | 47.5dB |
| Mono dist. 100% centre tune worst ch. | 0.25% |
| Mono dist. 100% op. tune av. | 0.22% |
| St. L = —R 50% centre tune av. | 0.3% |
| St. single ch. 100% centre tune worst ch. | 1% |
| MPX reject 19kHz worst ch. | 37dB |
| MPX reject 38kHz worst ch. | 60dB |
| X-talk 1kHz centre tune worst ch. | 34.5dB |
| X-talk 10kHz centre tune worst ch. | 19dB |
| X-talk 1kHz op. tune av. | 37dB |
| Freq. resp. St. —3dB L/R | 12Hz/17.3kHz—22Hz/15.5kHz |
| Freq. resp. St. 15kHz L/R | —1.5dB/—2.8dB |
| Limit threshold | 6μV |
| Muting threshold | — |
| St. s/n CCIR 100μV/1mV av. | 52dB—67.75dB |
| Mono s/n 1mV av. CCIR | 70dB |

**General Data**

| | |
|---|---|
| Dimensions | 584 x 305 x 115mm |
| Weight | 10.8kgs |
| Typical selling price including VAT | £155.00 |



Filters and loudness at ¼ pot.



Tone controls.

BEST BUY

# Goodmans 150

Goodmans Loudspeakers Ltd., Downley Rd., Havant, Hants. 07012 6344


This high powered receiver gave a continuous output of nearly 75W on both channels. 7 preset FM stations are provided, together with continuous tuning of FM, medium and long wave AM. Only a two core mains lead is provided, but a separate mains earth terminal allows an external connection. Two AC specially shuttered three way outlet sockets are fitted. All input and output sockets are DIN type, although the tape also has phono sockets for use with appropriate equipment. Other inputs include pick-up and auxiliary. None of the controls has centre indents, and the volume control had an unusual hop off characteristic before the end of its travel. The auxiliary DIN socket also had tape record feeds on it and can thus be used for interconnection with a two head recorder which can then be dubbed through to the normal machine having a monitoring facility. The two 5-pole DIN tape record sockets allow either high or low level sources to meet European and Japanese DIN conventions, whilst the phono sockets provide normal interconnection for non DIN equipment. Switches are provided for FM mute (labelled "distant"), AFC tuning, lock, mono/stereo and loudness controls. Two quarter inch stereo jack sockets are provided for headphones. The amplifier runs at a fairly high temperature, but this is reasonable considering it high power.

The intermodulation distortion per-formance was most unusual, being totally inconsistent between the channels at 10W. There was clearly a transient tone burst problem, but Goodmans have now rectified this. The loudspeakers were protected by relay switching. The damping factor measured quite well. The main amplifier was just slightly noisier than average but the general high available sensitivities, of course, cause considerable hiss to be heard at high volume settings. The tone controls provided adequate variation. The rumble and treble filters, having 3dB points at 45Hz/7kHz respectively, fell off at nearly 18dB per octave, which is extremely good. The pick-up input measured very flat indeed, and its input impedance was about optimum. Compatibility was excellent on the appropriate recorder feed socket. Unfortunately the auxiliary input clipped at 4V which might present a problem. The RIAA pre-amplifier introduced virtually no audible noise. All the controls tracked well between channels.

The tuner section of the first sample was very hissy, but a second one was far better and quite adequate in this respect. The distortion measurements were fairly good, but when the tuner was tuned for optimum results if fared better. The crosstalk figures at middle frequencies were excellent, but poor at high ones, but what is more important is that there was virtually no distortion audible in the crosstalk at all, thus contributing to the generally clean sound quality. The limiting threshold was excellent. The RF sensitivity was extremely good, and a commendable surprise was the stereo 50dB signal to noise ratio (unweighted) of 22$\mu$V. The adjacent and alternate channel selectivities were very good, and even the RFIM performance measured incredibly well. The tuning was good in general, but the tuning knob was large, and slightly rattly in its bearings. The tuning dial and a separate frequency meter indicated up to 300kHz out, which is rather poor. The second sample had a very fine tuner section indeed, but Goodmans must continue to watch their quality control on the decoder chip (ref. hiss level). The frequency

# Goodmans 150

BEST BUY

response and multiplex filtering were excellent. The pre-set stations worked very well, and were most useful.

This receiver has clearly some very good points, offering a very good tuner and high power amplifier, and is remarkably good value for money. Although it has rather unusual styling, it could appeal to some.

**Amplifier Section**

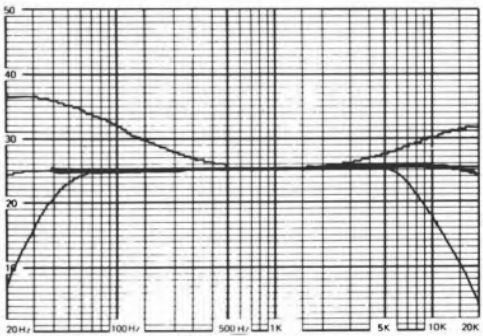
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 74.5W |
| Av. power o/p single ch. driven 8Ω | 77.5W |
| Av. power o/p single ch. driven tone burst 8Ω | 81W |
| Av. power o/p single ch. driven 4Ω | N/A |
| Av. power o/p single ch. driven tone burst 4Ω | N/A |
| Idle DC output worst ch. | 5mV |
| Turn on/off max. DC swing worst case | NONE |
| Damping factor 8Ω | 33 |
| X-over distortion | N/A |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | N/A |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | N/A |
| IM dist. 10W av. | 0.2% |
| IM dist. RIAA/rec. out | 0.007% |
| ½ power bandwidth (old method 0.1%) | <10Hz-22kHz |
| Av. RIAA impedance | 50kΩ |
| Av. RIAA sensitivity | 2mV |
| Av. RIAA clipping | 175mV |
| Av. RIAA capacitance | 175pF |
| Av. aux. impedance | 553kΩ |
| Av. aux. sensitivity | 46mV |
| Av. tape impedance | 61kΩ |
| Av. tape sensitivity | 102mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 670mV |
| Max. level from RIAA-rec. out | 405mV |
| Rec. out impedance DIN av. | 43kΩ |
| Rec. out impedance phono av. | 10.3kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 70dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 71dB |
| Amp. hum zero vol. AMF weighted av. | N/A |
| Amp. noise zero vol. CCIR s/n av. | 89dB |
| Amp. noise worst vol. CCIR s/n av. | 76dB |
| Amp. noise zero vol. unw. 20/20kHz | 1.3mV |
| Volume control tracking worst error | 1dB |

**Tuner Section**

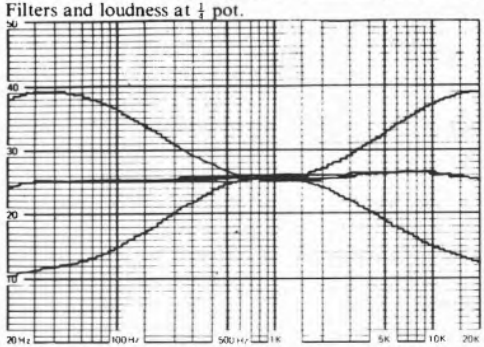
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1μV |
| Mono RF sens. 50dB IHF | 2.3μV |
| Stereo RF sens. 50dB | 22μV |
| RFIM | 81dB |
| Adj. ch. av | 7dB |
| Alt. ch. av. | >70dB |
| Image resp | 80dB |
| Capture ratio | 1.5dB |
| AM reject | 51.5dB |
| Mono dist. 100% centre tune worst ch. | 0.39% |
| Mono dist. 100% op. tune av. | 0.29% |
| St. L = —R 50% centre tune av. | 0.17% |
| St. single ch. 100% centre tune worst ch. | 0.24% |
| MPX reject 19kHz worst ch. | 70dB |
| MPX reject 38kHz worst ch. | 76dB |
| X-talk 1kHz centre tune worst ch. | 39dB |
| X-talk 10kHz centre tune worst ch. | 24.5dB |
| X-talk 1kHz op. tune av. | 44dB |
| Freq. resp. St. —3dB L/R 17Hz/16.1kHz—17Hz/16.1kHz | |
| Freq. resp. St. 15kHz L/R | +1dB/+0.5dB |
| Limit threshold | 0.7μV |
| Muting threshold | 1μV |
| St. s/n CCIR 100μV/1mV av. | 55dB—61.5dB |
| Mono s/n 1mV av. CCIR | 64dB |

**General Data**

| | |
|---|---|
| Dimensions | 540 x 360 x 200mm |
| Weight | 18kgs |
| Typical selling price including VAT | £240.00 |



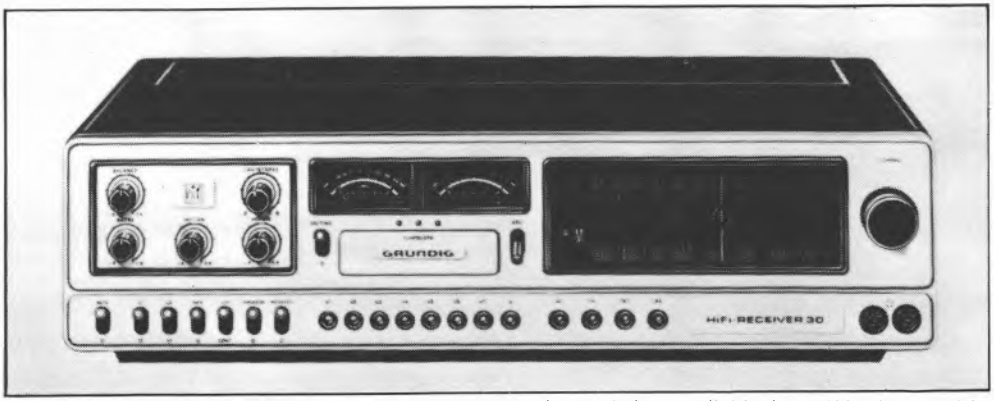
Filters and loudness at ½ pot.



Tone controls.

# Grundig Receiver 30

Grundig International Ltd., 42 Newlands Park, London SE26 5NQ. 01-659 2468




This entirely metal-cased DIN standardised German receiver also has DIN interconnection sockets for line inputs/outputs from non DIN recorders. In addition to manual tuning (incorporating medium wave) up to seven pre-set stations are provided.

Input selection, including pick-up and outputs from either of two tape recorders, is with touch sensitive switches. Lever switches select on/off, loudspeakers 1 and 2, FM stereo/mono, loudness control, treble filter (very steep above 6kHz), tape monitor, FM tuner AFC and FM muting. Bass, mid, treble and balance controls are very small non-indented knobs, found crude and a little stiff. The volume control is ridiculously small and feels rather rough: its tracking was only fair. All the rear sockets are DIN, and the FM antenna is for 300 ohm balanced inputs only. An internal ferrite rod is fitted for AM. No earth terminals are provided; the mains lead is only 2-core.

The power output measured only 29W per channel into 8 ohms, but 45W into 4 ohms, tonebursting revealing a marginal power increase into 4 ohms only. Amplifier output noise was very low, but distortion was generally high. However, the swept IM charts were reasonably satisfactory at high and low levels. The half-power bandwidth measured satisfactorily. The turn-on pulse reached 14V, but was of short duration. The damping factor was satisfactory. The sound quality of the power amplifier section was surprisingly reasonable, despite the high measured distortion. Whilst the tone controls offered a very wide range of adjustment, it was difficult to set them for a flat response. The headphone output levels (awkward special DIN sockets here), were more compatible than usual, 9V maximum being available into 600 ohm models. Although the DIN sockets are to DIN convention, the tape record source impedance is ridiculously high at 1M ohm, and the level from disc is too low for comfort even into DIN equipment, although levels are satisfactory on the additional high level output socket. The pick-up input circuitry had a reasonably optimised impedance, with fairly high capacity. The noise performance was poor, especially on the right channel. The frequency response showed a gradual fall-off below 25Hz (welcome), but the IM distortion measured a little high. Clipping was reached at 48mV, which is not really sufficient. All the external inputs clip at about 5V, which might present an occasional problem. Tape and monitor input impedances are very high at 0.5M ohm, and sensitivity is adequate.

The provision of 7 pre-set stations is highly commendable, but manual tuning had slight backlash. The RF input sensitivity was acceptable on 300 ohm, but a 75 ohm aerial directly connected would be badly mis-matched. RFIM was very poor on a compatible aerial. Image response was very poor, but IF rejection good and selectivity outstandingly good. Capture ratio was below average, but limiting threshold good. Muting was too insensitive, but rejection was excellent. The tuner's audio response was 3dB at 15kHz — just tolerable, but multiplex filtering was excellent. Noise levels were excellent on strong signals, but average on weak ones. Distortion was acceptable up to fairly loud levels, but pea higher than average at full deviation. Crosstalk was generally reasonable. The sound quality was satisfactory, except at very high deviations, with some spitch, or very slight transient cracking noted in the crosstalk. The tuning

indication was slightly inaccurate (green and red light emitting diodes), and scale accuracy was poor.

Apart from the small rotary controls, the ergonomics are basically good, but very different from the usual receiver concept. This model has some very good points, particularly the astonishing FM selectivity, and tuner signal to noise ratios, and an excellent treble filter. Medium wave reception was excellent, and one of the best. However, the noisy pick-up input stage (possibly poor transistor samples), the above average tuner distortion, and low output power, together with the rather high price, must unfortunately cause a recommendation to be withheld. Grundig must look at testing standards other than DIN.

**Amplifier Section**

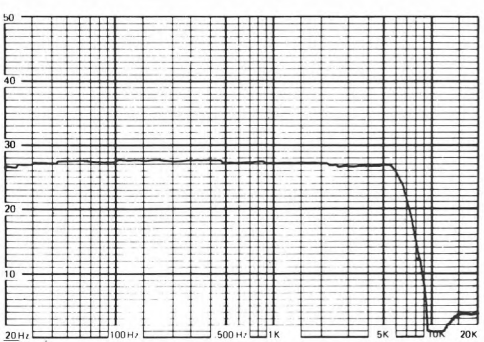
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 26.5W |
| Av. power o/p single ch. driven 8Ω | 29W |
| Av. power o/p single ch. driven tone burst 8Ω | 30W |
| Av. power o/p single ch. driven 4Ω | 45W |
| Av. power o/p single ch. driven tone burst 4Ω | 50W |
| Idle DC output worst ch. | 28mV |
| Turn on/off max. DC swing worst case | 14V |
| Damping factor 8Ω | 62 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.07% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.09% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.08% |
| Half power bandwidth | 3Hz-100kHz |
| Av. RIAA impedance | 51kΩ |
| Av. RIAA sensitivity | 1.8mV |
| Av. RIAA clipping | 48mV |
| Av. RIAA capacitance | 120pF |
| Av. aux. impedance | 490kΩ |
| Av. aux. sensitivity | 205mV |
| Av. tape impedance | 568kΩ |
| Av. tape sensitivity | 190mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 920mV |
| Max. level from RIAA-rec. out | 900mV |
| Rec. out impedance DIN av. | 971kΩ |
| Rec. out impedance DIN line av. | 5.6kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 70dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 65dB |
| Amp. hum zero vol. AMF wtd. av. ref 1W 8Ω | 98.5dB |
| Amp. noise zero vol. CCIR s/n av. | 96dB |
| Amp. noise worst vol. CCIR s/n av. | 84dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 2dB |

**Tuner Section**

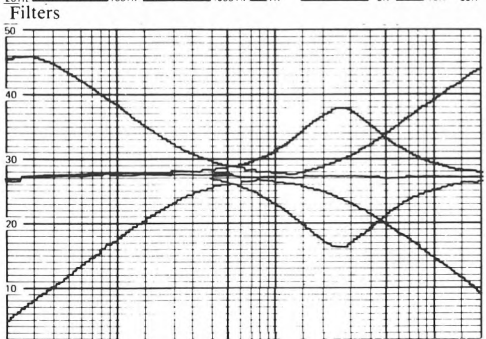
| | |
|---|---|
| Mono RF sens. 30dB IHF | 3μV |
| Mono RF sens. 50dB IHF | 29μV |
| Stereo RF sens. 50dB | — |
| RFIM | 58dB |
| Adj. ch. av | 16dB |
| Alt. ch. av. | >70dB |
| Image resp | 50dB |
| Capture ratio | 1.8dB |
| AM reject | 68dB |
| Mono dist. 100% centre tune worst ch. | 0.63% |
| Mono dist. 100% op. tune av. | 0.4% |
| St. L = —R 50% centre tune av. | 0.12% |
| St. single ch. 100% centre tune worst ch. | 0.47% |
| MPX reject 19kHz worst ch. | 65dB |
| MPX reject 38kHz worst ch. | 73dB |
| X-talk 1kHz centre tune worst ch. | 38dB |
| X-talk 10kHz centre tune worst ch. | 32dB |
| X-talk 1kHz op. tune av. | 40.5dB |
| Freq. resp. St. —3dB L/R 12Hz/15kHz—12Hz/15.1kHz | |
| Freq. resp. St. 15kHz L/R | —2.9dB/—2.9dB |
| Limit threshold | 1.7μV |
| Muting threshold | 9.5μV |
| St. s/n CCIR 100μV/1mV av. | 50dB—68dB |
| Mono s/n 1mV av. CCIR | 75dB |

**General Data**

| | |
|---|---|
| Dimensions | 540 x 150 x 320mm |
| Weight | 12kgs |
| Typical selling price including VAT | £330.00 |



Filters

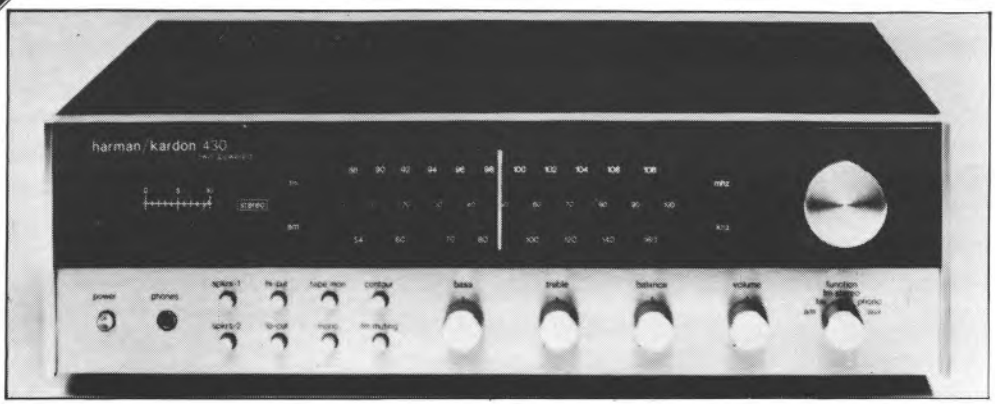


Tone controls.

RECOMMENDED

# Harman Kardon 430

Harman (UK), St John's Rd., Tylers Green, High Wycombe, Bucks. 049 481 5221.




This receiver gives up to 28W per channel (both driven) into either or both of two loudspeaker pairs. Loudspeaker connections are by a push lock. A three core mains lead is now supplied and is complemented by a spare earth terminal. Inputs include pick-up, auxiliary and tape, the last being available on phonos or 5-pole DIN and the other inputs being phono sockets. Front panel controls include a rotary selector switch, volume, balance, bass and treble controls, all without centre indents, but working well. Rumble and treble roll-off switches are provided with turnovers at 90Hz, and 4kHz respectively at rates of 6dB per octave. Push buttons switch on FM muting, automatic loudness compensation, loudspeaker feeds, tape monitor and stereo/mono. A hinged ferrite rod for AM can be pointed in any horizontal direction. Only 300 ohm screw terminals are provided for FM aerials, which is unfortunate. One line and two loudspeaker fuses on the rear panel afford reasonable protection.

The dual power supply allows both channels to give optimum performance simultaneously. Distortion performance was very good indeed, remaining low up to just before clipping on both the amplifier and pick-up pre-amplifier. The amplifier sounded extremely well on all inputs, and input and output impedances were all quite reasonable, as were the sensitivities, although the pick-up pre-amplifier gave rather a low output onto the tape recorder feed. All the controls were very well ganged, and gave no trouble. The half-power bandwidth was excellent. The loudspeaker output stage was rather hissy, and this will be noticed on headphones.

The 300 ohm aerial input will not work too well with the more usual 75 ohm coaxial installation (but see section on aerials). Assuming then a 300 ohm ribbon, the input sensitivity was good, although the alternate channel measurements were only fair, and the adjacent selectivity was poor. RFIM and image were acceptable, and IF break through was very low. The distortion performance was very good, and the frequency response good. The crosstalk performance was reasonable, but improved dramatically when tuned slightly off centre, which showed slight misalignment. Tuning dial accuracy was good. Capture ratio and limiting threshold were good, and the multiplex, filter was reasonable. A muting pre-set allows setting at any desired level. The tuning knob felt very smooth, and the general audio quality was very good indeed, particularly on stronger stations.

This is clearly a pretty high quality product, and is therefore not cheap. It provided generally very good quality, but unfortunately will only give its best FM performance with a 300 ohm aerial feed, or with a special 75/300 ohm input transformer. It gave a welcome clarity of reproduction, and generally had good signal to noise ratios, although the output might be a little hissy into headphones.

Many facilities found in other receivers are lacking here, but its simplicity may well attract purchasers. Recommended then, but rather expensive for the power output.

# Harman Kardon 430

RECOMMENDED

**Amplifier Section**

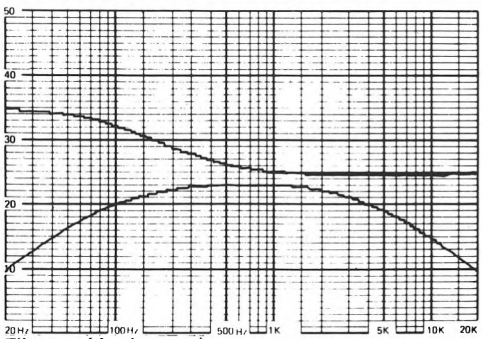
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 28W |
| Av. power o/p single ch. driven 8Ω | 28W |
| Av. power o/p single ch. driven tone burst 8Ω | 36W |
| Av. power o/p single ch. driven 4Ω | N/A |
| Av. power o/p single ch. driven tone burst 4Ω | N/A |
| Idle DC output worst ch. | 3mV |
| Turn on/off max. DC swing worst case | 1.2V |
| Damping factor 8Ω | 34 |
| X-over distortion | N/A |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | N/A |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | N/A |
| IM dist. 10W av. | 0.14% |
| IM dist. RIAA/rec. out | 0.012% |
| ½ power bandwidth (old method 0.1%) | 10Hz-20.5kHz |
| Av. RIAA impedance | 50kΩ |
| Av. RIAA sensitivity | 2.8mV |
| Av. RIAA clipping | 88mV |
| Av. RIAA capacitance | 20pF |
| Av. aux. impedance | 43kΩ |
| Av. aux. sensitivity | 136mV |
| Av. tape impedance | 43kΩ |
| Av. tape sensitivity | 136mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 600mV |
| Max. level from RIAA-rec. out | 360mV |
| Rec. out impedance DIN av. | 470kΩ |
| Rec. out impedance phono av. | 1.1kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 74.5dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 71dB |
| Amp. hum zero vol. AMF weighted av. | N/A |
| Amp. noise zero vol. CCIR s/n av. | 82dB |
| Amp. noise worst vol. CCIR s/n av. | 80dB |
| Amp. noise zero vol. unw. 20/20kHz | 900μV |
| Volume control tracking worst error | 1dB |

**Tuner Section**

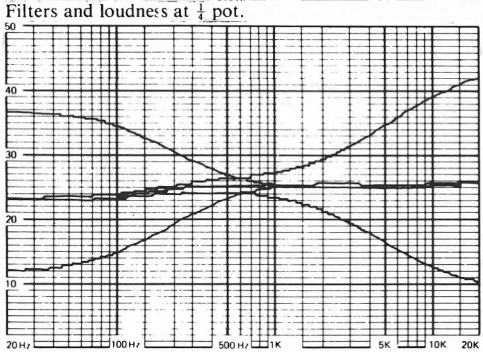
| | |
|---|---|
| Mono RF sens. 30dB IHF | 2.7μV |
| Mono RF sens. 50dB IHF | 5.2μV |
| Stereo RF sens. 50dB | 60μV |
| RFIM | 63.5dB |
| Adj. ch. av | 2dB |
| Alt. ch. av. | 40dB |
| Image resp. | 60.5dB |
| Capture ratio | 1.5dB |
| AM reject | 58dB |
| Mono dist. 100% centre tune worst ch. | 0.24% |
| Monodist. 100% op. tune av. | 0.07% |
| St. L = —R 50% centre tune av. | 0.05% |
| St. single ch. 100% centre tune worst ch. | 0.19% |
| MPX reject 19kHz worst ch. | 50dB |
| MPX reject 38kHz worst ch. | 68dB |
| X-talk 1kHz centre tune worst ch. | 36dB |
| X-talk 10kHz centre tune worst ch. | 30dB |
| X-talk 1kHz op. tune av. | 43dB |
| Freq. resp. St. —3dB L/R 9Hz/15.4kHz | —9Hz/15.8kHz |
| Freq. resp. St. 15kHz L/R | —2dB/—1.25dB |
| Limit threshold | 1.5μV |
| Muting threshold | VAR.* |
| St. s/n CCIR 100μV/1mV av. | 46dB—65dB |
| Mono s/n 1mV av. CCIR | 81dB |

**General Data**

| | |
|---|---|
| Dimensions | 432 x 368 x 140mm |
| Weight | 10.9kgs |
| Typical selling price including VAT | £195.00 |



Filters and loudness at ¼ pot.

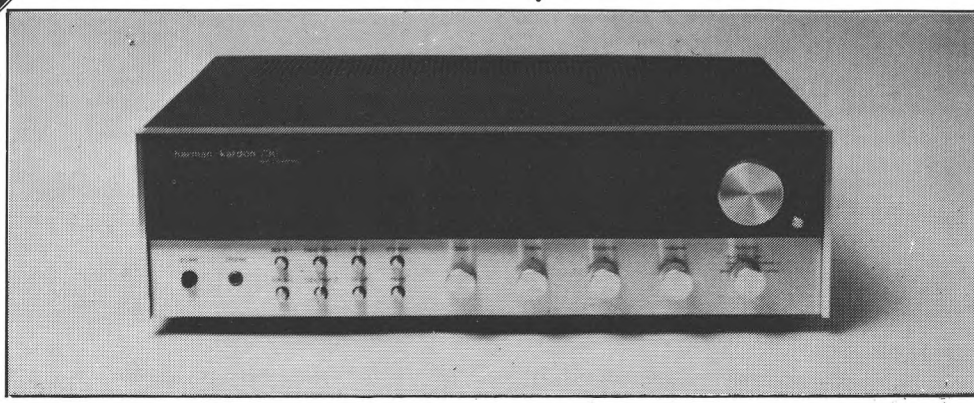


Tone controls.

RECOMMENDED

# Harman Kardon 730

Harman (UK), St John's Rd., Tylers Green, High Wycombe, Bucks. 049 481 5221.



This model is metal-encased and includes power amplifiers capable of 58W per channel into 8 ohms and 76W into 4 ohms. It includes a medium wave section and has an excellent rotatable ferrite rod on the rear, giving better than average AM reception. A 3-core mains lead is fitted, and an earth terminal is provided close by the input/output phono sockets, a 5-pole DIN one being also fitted for one of the two tape interconnections. Phono break points are provided for inserting external equipment in between the pre-amp and amplifier sections. A separate AM antenna terminal is fitted alongside the 300 ohm balanced FM terminals, but we found that a 75 ohm antenna works quite well when connected to one 300 ohm and earth.

All the rotary controls work smoothly, but none had steps or centre indents. The input switch selects AM, FM, auxiliary 1 and 2, and pick-up 1 and 2. Front panel switches operate power on/off, speakers 1 and 2, tape monitor 1 and 2, rumble filter (12dB/octave below 70Hz), treble filter (6dB per octave above 4kHz), loudness control (boosts bass only), mono/stereo, and FM muting. A stereo headphone jack socket gives a good performance into 8 ohm models, but too high a level and a faint hiss into 600 ohm ones.

The tone burst performance revealed a noticeably higher level available on transients into 8 ohms, and considerably higher at 100W into 4 ohms, which is commendable. The amplifier sounded well, but marginally toppy. (Damping factor reasonable.) Distortion measurements were all very good indeed, although the swept IM charts revealed a very steep increase in distortion above 50kHz, due undoubtedly to the unnecessary extension of frequency response to at least 200kHz (misplaced specmanship!). Output noise measured reasonably well but became just a little hissy when the volume control was at two o'clock. Half-power bandwidth extended to 65kHz, and automatic resettable cut-outs are provided for loudspeaker and amplifier protection. Volume control tracking was excellent, and the balance control worked well. The tone controls gave a reasonable amount of variation, particularly at high frequencies, but unfortunately the rise continued well above 20kHz. Phono standard inputs and outputs were all well optimised, but the 5-pole DIN socket gives an inadequate level and has a ridiculously high source impedance of 470K ohms.

The pick-up inputs had a well optimised impedance, with very low input capacity. IM distortion measured acceptably well, and signal to noise ratios and clipping margins excellent. The frequency response was very flat showing a sensible subsonic roll-off.

The tuner's RF sensitivity measured very well at 2$\mu$V (300 ohms), equivalent to 1$\mu$V for 75 ohms. RFIM measured adequately, and image and IF breakthroughs excellent. The selectivity was very lopsided, but satisfactory. Capture ratio, limit threshold and AM rejection were all excellent, and muting could be varied as required with a pre-set on the back. The audio response and multiplex breakthroughs measured extremely well, and tuner weighted noise levels were quite remarkably good. Distortion levels measured well at medium deviations, but were just a little high at maximum deviation, although crosstalk was none too good at high frequencies. Some slight spitch in the crosstalk from speech at a high level was noted, but on normal programmes the sound quality was generally good.

RECOMMENDED

Tuning scale accuracy was excellent. Tuning was a little spongy with some backlash, but the knob ran smoothly.

Basically, this receiver has been extremely well-designed. The tuner worked so well, apart from the strange adjacent selectivity imbalance and possibly the distortion would have measured much better if greater care had been taken in quality control. Although the absence of centre indents on the controls is tiresome, the general ergonomics are pretty good, and the receiver can be recommended, although it is fairly expensive. Incidentally, the tuning meter was slightly inaccurate, and optimum tuning is very critical.

**Amplifier Section**

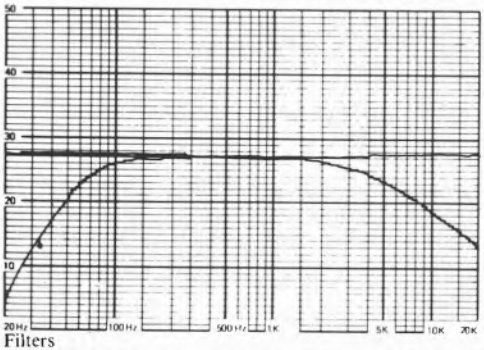
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 56.5W |
| Av. power o/p single ch. driven 8Ω | 58W |
| Av. power o/p single ch. driven tone burst 8Ω | 68W |
| Av. power o/p single ch. driven 4Ω | 76W |
| Av. power o/p single ch. driven tone burst 4Ω | 68W |
| Idle DC output worst ch. | 22mV |
| Turn on/off max. DC swing worst case | 6V |
| Damping factor 8Ω | 53 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.01% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.01% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.018% |
| Half power bandwidth | 2Hz-65kHz |
| Av. RIAA impedance | 50kΩ |
| Av. RIAA sensitivity | 2.3mV |
| Av. RIAA clipping | 103mV |
| Av. RIAA capacitance | 31pF |
| Av. aux. impedance | 43.3kΩ |
| Av. aux. sensitivity | 150mV |
| Av. tape impedance | 43.3kH |
| Av. tape sensitivity | 150mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 524mV |
| Max. level from RIAA-rec. out | 500mV |
| Rec. out impedance DIN av. | 460kΩ |
| Rec. out impedance phono av. | 300Ω |
| Av. RIAA noise ref 8mV—rec. out unw. | 79dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 74½dB |
| Amp. hum zero vol. AMF wtd. av. ref 1W 8Ω | 93dB |
| Amp. noise zero vol. CCIR s/n av. | 91dB |
| Amp. noise worst vol. CCIR s/n av. | 85dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 0.8dB |

**Tuner Section**

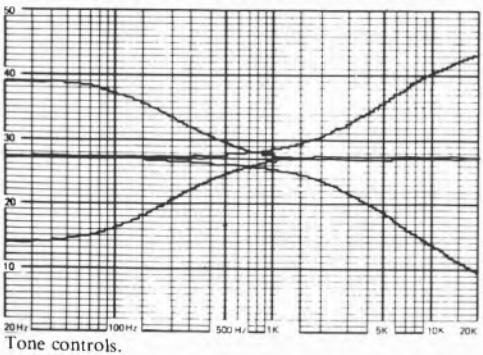
| | |
|---|---|
| Mono RF sens. 30dB IHF | 2μV |
| Mono RF sens. 50dB IHF | 6μV |
| Stereo RF sens. 50dB | 100μV |
| RFIM | 70dB |
| Adj. ch. av. | 7.5dB |
| Alt. ch. av. | 64dB |
| Image resp | 91dB |
| Capture ratio | 1dB |
| AM reject | 68dB |
| Mono dist. 100% centre tune worst ch. | 0.45% |
| Monodist. 100% op. tune av. | 0.28% |
| St. L = —R 50% centre tune av. | 0.17% |
| St. single ch. 100% centre tune worst ch. | 0.47% |
| MPX reject 19kHz worst ch. | 66dB |
| MPX reject 38kHz worst ch. | 97dB |
| X-talk 1kHz centre tune worst ch. | 41dB |
| X-talk 10kHz centre tune worst ch. | 30dB |
| X-talk 1kHz op. tune av. | 44dB |
| Freq. resp. St. —3dB L/R 14Hz/16.5kHz | —15Hz/16.6kHz |
| Freq. resp. St. 15kHz L/R. | —0.7dB/—0.7dB |
| Limit threshold | 1.2μV |
| Muting threshold. | 0/300μV |
| St. s/n CCIR 100μV/1mV av. | 55dB—74dB |
| Mono s/n 1mV av. CCIR | 79dB |

**General Data**

| | |
|---|---|
| Dimensions | 432 x 368 x 140mm |
| Weight | 13.7kgs |
| Typical selling price including VAT | £300.00 |



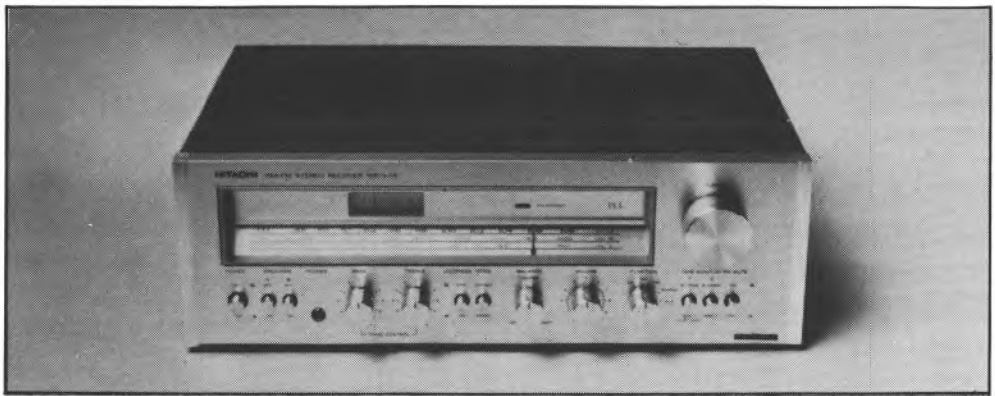
Filters



Tone controls.

# Hitachi SR-503L

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



This medium-powered model delivers 39W per channel into 8 ohms, and only 45W per channel into 4 ohms, the output current being severely limited by a rather inadequate power supply. When both channels are driven, output is reduced to 30W per channel. The back of the receiver is rather unconventional, inputs and outputs being connected on to a horizontal shelf, except for the aerial inputs (AM terminal, 300 ohms balanced terminals and normal coaxial socket for 75 ohms). Spring-loaded press lock terminals are fitted for loudspeaker interconnections, and the 3-core mains lead feeds its earth through to a chassis earth terminal.

The volume control has 41 reasonably optimised steps, but the centre-indented balance control operated rather suddenly towards its ends. The bass and treble controls have 11 stepped positions — very gradual across the centre, and too sudden at the extremities. Push buttons provide on/off, loudspeaker selection (two pairs), loudness control, mono/stereo, tape 1/2 monitoring, and FM muting, and an input selector switches to long wave, medium wave, FM, pick-up, and auxiliary inputs. The first sample arrived with a cracked ferrite rod, but the second one was fully satisfactory on long wave and medium wave. Phono sockets are provided on the rear for interconnections, but also a 5-pole DIN type is provided additionally for tape 1.

The main amplifier gave a rather odd tone burst performance showing crosstalk particularly on transients, or when at high power. Harmonic distortion was higher than average near clipping, and subjectively climaxes seemed fuzzy, and pulled towards the centre. Output noise levels measured well, and the stereo headphone socket worked well but gave rather a high level into high impedance models. The tone controls operate around the power amplifier's negative feedback circuit, which is surely not very good practice. The damping factory at worst measured only 20, which is barely adequate. The swept IM charts were satisfactory, and the half power bandwidth quite reasonable. No rumble or treble filters are provided. Input and output levels and impedances were all well optimised, but note that the DIN replay sensitivity is some 7dB lower than the phono tape input. The basic amplifier response attenuated above 35kHz, which is welcome.

The pick-up input pre-amplifier performance showed rather a poor hiss level. The frequency response was reasonably flat, but showed no fall off at 20Hz, which is inadvisable, especially since no rumble filter is fitted. The input impedance showed a very high capacity, which will be unsuitable for some types of cartridge, but the clipping margin was satisfactory. Distortion on this input measured extremely well.

The tuner's RF input sensitivity was rather poor at 1.8$\mu$V, and RF intermodulation distortion was very poor. The image response was very poor, but IF breakthrough was good. Selectivity was uneven, being poor on one side, and alternate channel selectivity was considerably below average. Capture ratio and limiting threshold measured very well, and muting was well optimised. AM rejection was particularly good. The frequency response tailed off badly, showing 3dB fall offs at 50Hz and 12.5kHz averaging —8.5dB. Multiplex breakthrough was acceptably low. Strong signals reproduced with a good dynamic range, and low hiss, but weak ones were a little noisy. Distortion levels were generally extremely low, but high frequencies at high

deviations produced slight edginess and roughness, though this was not too serious. Crosstalk was reasonable, but some roughness was noted subjectively on very high deviations. The tuning scale accuracy was very poor, the worst error being 420kHz. Tuning, however, was smooth and stable, and the ergonomics excellent.

This model does not seem suitable for speakers of less than 8 ohms impedances. Although it generally has some good points, the tuner's poor response and the amplifier's transient performance leave a lot to be desired, and at its price I must regard it as poor value for money.

**Amplifier Section**

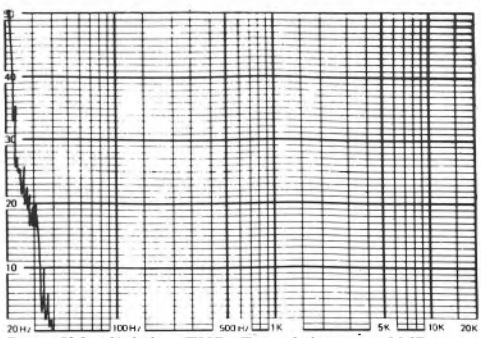
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 30.5W |
| Av. power o/p single ch. driven 8Ω | 39W |
| Av. power o/p single ch. driven tone burst 8Ω | 47.5W |
| Av. power o/p single ch. driven 4Ω | 45.5W |
| Av. power o/p single ch. driven tone burst 4Ω | 43.5W |
| Idle DC output worst ch. | 2.5mV |
| Turn on/off max. DC swing worst case | 1.75V |
| Damping factor 8Ω | 26 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.02% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.04% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.002% |
| Half power bandwidth | 2Hz-75kHz |
| Av. RIAA impedance | 44kΩ |
| Av. RIAA sensitivity | 3.3mV |
| Av. RIAA clipping | 103mV |
| Av. RIAA capacitance | 476pF |
| Av. aux. impedance | 69.8kΩ |
| Av. aux. sensitivity | 265mV |
| Av. tape impedance | 81.4kΩ |
| Av. tape sensitivity | 265mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 696mV |
| Max. level from RIAA-rec. out | 665mV |
| Rec. out impedance DIN av. | 80.2kΩ |
| Rec. out impedance phono av. | 3.3kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 73.5dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 68.5dB |
| Amp. hum zero vol. AMF wtd. av. ref 1W 8Ω | 91dB |
| Amp. noise zero vol. CCIR s/n av. | 98.5dB |
| Amp. noise worst vol. CCIR s/n av. | 88dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1.3dB |

**Tuner Section**

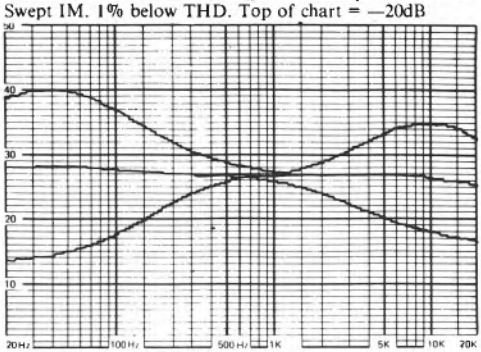
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.8μV |
| Mono RF sens. 50dB IHF | 4.1μV |
| Stereo RF sens. 50dB | 35μV |
| RFIM | 57dB |
| Adj. ch. av | 7dB |
| Alt. ch. av. | 45dB |
| Image resp | 49dB |
| Capture ratio | 0.8dB |
| AM reject | 66dB |
| Monodist. 100% centre tune worst ch. | 0.07% |
| Monodist. 100% op. tune av. | 0.07% |
| St. L = —R 50% centre tune av. | 0.07% |
| St. single ch. 100% centre tune worst ch. | 0.18% |
| MPX reject 19kHz worst ch. | 59dB |
| MPX reject 38kHz worst ch. | 62dB |
| X-talk 1kHz centre tune worst ch. | 41dB |
| X-talk 10kHz centre tune worst ch. | 31dB |
| X-talk 1kHz op. tune av. | 42dB |
| Freq. resp. St. —3dB L/R 55Hz/13.1kHz | —50Hz/12.4kHz |
| Freq. resp. St. 15kHz L/R | —7.5dB/—9.6dB |
| Limit threshold | 1μV |
| Muting threshold | 6.5μV |
| St. s/n CCIR 100μV/1mV av. | 50dB—64dB |
| Mono s/n 1mV av. CCIR | 69.5dB |

**General Data**

| | |
|---|---|
| Dimensions | 435 x 134 x 359mm |
| Weight | 7.6kgs |
| Typical selling price including VAT | £155.00 |



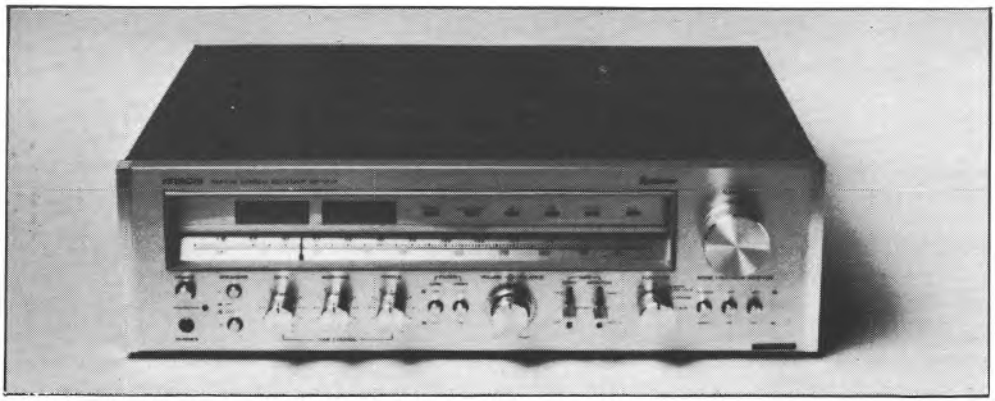
Swept IM. 1% below THD. Top of chart = —20dB



Tone controls.

# Hitachi SR-903

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



This high power model can deliver 140W on each channel into 8 ohms, but only 120W into 4 ohms, a similar power being available in 8 ohms when both channels are driven, showing the power supply to be a little inadequate. The receiver also incorporates a medium wave section, and has a ferrite rod at the rear which unfortunately cannot be swivelled out. The basic wooden cabinet incorporates a metal base plate and the heavy duty 3-core mains lead is accompanied by an earth tag at the rear. Spring-loaded press loudspeaker connections are provided for two pairs. The main interconnections are with phono sockets, but a 5-pole DIN one is also provided for tape 1. A 75 ohm unbalanced FM aerial coax socket complements 300 ohm balanced terminals, and separate AM input terminals.

The 41 stepped position volume control has a centre indented balance control behind it, which shows too rapid a change either side of centre. Very smooth 11 step controls for bass, mid and treble adjustment provide an excellent tonal balance range, and press buttons are provided to operate loudspeaker switching, rumble filter (cutting at 6dB per octave below 120Hz — rather too high), treble filter (6dB per octave above 5kHz), stereo/mono, loudness compensation and external adaptor in/out. Two three-position switches are provided for monitoring or dubbing to and from two external recorders. A rotary switch selects MW, mono FM, FM mute/auto stereo, pick-up and auxiliary inputs. A very long and reasonably accurate tuning scale looks good, and the large tuning knob rotates smoothly, having an excellent flywheel action with no backlash.

The tone burst performance of the amplifier section into 8 ohms showed a slight power increase, but was poor into 4 ohms. The harmonic distortion performance showed a rather high figure of 0.1% odd harmonics at 1db below clipping, which is not too good, and was not much better when measured 2dB lower. The swept IM pen charts revealed a slight rise at 50kHz. Since the response was 3dB down by 45kHz, the swept IM was a little surprising and disappointing. The half-power bandwith also extended to only 55kHz. Amplifier output noise was acceptable, but not good, and the stereo headphone jack would present some hiss to high impedance headphones, which could also be driven to destruction if the volume was inadvertently raised much too far. Damping was adequate, but not good. Input and output interconnection levels and impedances were well optimised on the phono and DIN sockets. The pick-up input has a slightly low impedance with a high effective capacity of 150pF. The clipping margin was just adequate, but the RIAA response was very flat, though showing a usefully slow roll-off below 30Hz. The noise performance was adequate, but slightly below average. The pick-up output on all record sockets was some 2.5dB too high for compatability with the tuner's ouput.

The FM tuner's RF sensitivities were all excellent, but the RF IM performance was poor. Image response and IF breakthrough however measures well. Adjacent channel selectivity was only average, but alternate selectivity good. Capture ratio and limiting threshold measured well, but AM rejection was only fair on weaker signals. Muting level was set rather high at 8$\mu$V. Frequency response measured well, and multiplex filtering excellently. Background noise level was only rather average, and distortion peaked at around 0.54% at worst, but improved

when tuned off the meter's theoretical correct position. Tuning for optimum performance was very critical, and even so, slight spitch was noted in a crosstalk channel at high deviations. Roughness on speech peaks was occasionally suspected.

Although the performance was reasonably good throughout, it failed to live up to it's price, although users will be impressed with its available power into 8 ohms. I cannot recommend it though for use with 4 ohm loudspeakers. We were not over enthusiastic with the amplifier's subjective sound quality, finding it a little brittle at times, and bass occasionally lacked body.

**Amplifier Section**

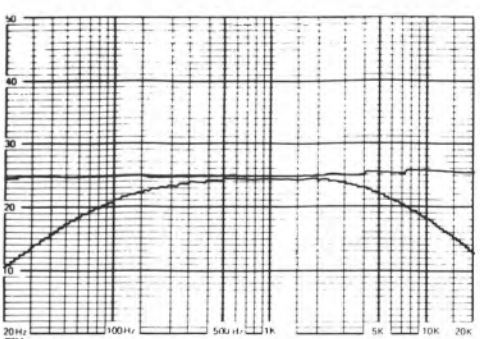
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 120W |
| Av. power o/p single ch. driven 8Ω | 140W |
| Av. power o/p single ch. driven tone burst 8Ω | 162W |
| Av. power o/p single ch. driven 4Ω | 125W |
| Av. power o/p single ch. driven tone burst 4Ω | 107W |
| Idle DC output worst ch. | 25mV |
| Turn on/off max. DC swing worst case | Zero |
| Damping factor 8Ω | 48 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.04% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.07% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.03% |
| Half power bandwidth | 3Hz-55kHz |
| Av. RIAA impedance | 41.5kΩ |
| Av. RIAA sensitivity | 3.4mV |
| Av. RIAA clipping | 92mV |
| Av. RIAA capacitance | 150pF |
| Av. aux. impedance | 49kΩ |
| Av. aux. sensitivity | 280mV |
| Av. tape impedance | 55kΩ |
| Av. tape sensitivity | 270mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 456mV |
| Max. level from RIAA-rec. out | 630mV |
| Rec. out impedance DIN av. | 73kΩ |
| Rec. out impedance phono av. | 1kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 74dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 70dB |
| Amp. hum zero vol. AMF wtd. av. 1W 8Ω | 78dB |
| Amp. noise zero vol. CCIR s/n av. | 92dB |
| Amp. noise worst vol. CCIR s/n av. | 87dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 0.7dB |

**Tuner Section**

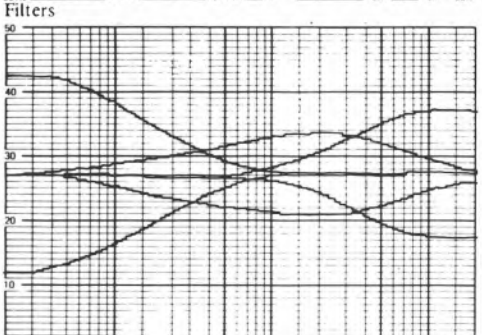
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1μV |
| Mono RF sens. 50dB IHF | 2μV |
| Stereo RF sens. 50dB | 30μV |
| RFIM | 62dB |
| Adj. ch. av | 6dB |
| Alt. ch. av. | >70dB |
| Image resp | 97dB |
| Capture ratio | 0.75dB |
| AM reject | 67dB |
| Mono dist. 100% centre tune worst ch. | 0.33% |
| Mono dist. 100% op. tune av. | 0.16% |
| St. L = —R 50% centre tune av. | 0.23% |
| St. single ch. 100% centre tune worst ch. | 0.54% |
| MPX reject 19kHz worst ch. | 78dB |
| MPX reject 38kHz worst ch. | 79dB |
| X-talk 1kHz centre tune worst ch. | 43dB |
| X-talk 10kHz centre tune worst ch. | 38dB |
| X-talk 1kHz op. tune av. | 47dB |
| Freq. resp. St. —3dB L/R 5Hz/15.4kHz—6Hz/15.4kHz | |
| Freq. resp. St. 15kHz L/R | —1dB/—1.1dB |
| Limit threshold | 0.7μV |
| Muting threshold | 8μV |
| St. s/n CCIR 100μV/1mV av. | 51dB—61dB |
| Mono s/n 1mV av. CCIR | 67.5dB |

**General Data**

| | |
|---|---|
| Dimensions | 490 x 144 x 400mm |
| Weight | 13.5kgs |
| Typical selling price including VAT | £335.00 |



Filters

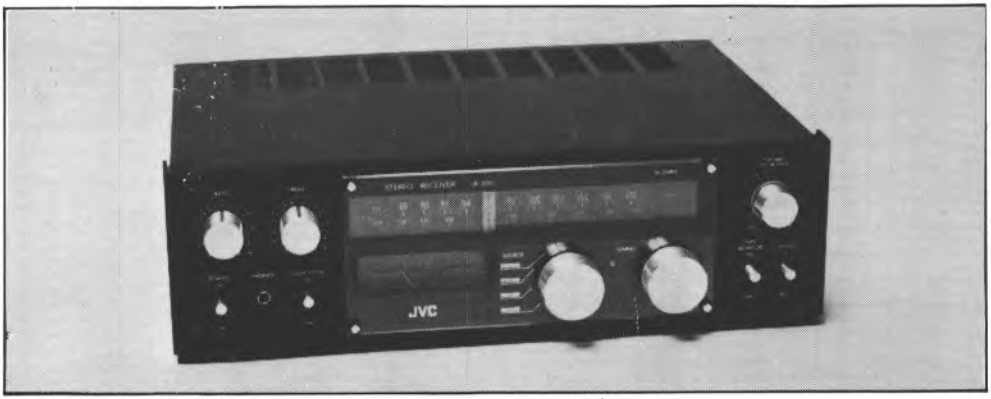


Tone controls.

BEST BUY

# JVC JR-S50

JVC (UK) Ltd., Eldonwall Trading Est., Staples Corner, 6/8 Priestley Way, London NW2 7AF. 01-450 2621.




This very modestly priced model, giving just 23W into 8 ohms, is housed in a metal cabinet, containing slightly more air than components, and is thus very light. Only a 2 core mains lead is provided, but an earth terminal gives adequate earthing on the back chassis. Clearly made down to a price, the input selector switches only to MW, FM, FM mute or pick-up. A lever switch operates single tape monitor, loudness control and a treble filter (6dB per octave above 6kHz). I intensely disliked the friction locked volume control, which also has to do for balance adjustment — with great awkwardness. It would be preferable to have separate balance and volume controls and sacrifice the loudness switch. 11 stepped position bass and treble controls give approximately 10dB boost and cut at 60Hz and 15kHz, but the steps were quite reasonable.

The amplifier section gave a useful increase to 32W into 4 ohms, and tone burst tests showed a further 10% increase on transients. Distortion was just below 0.1% near clipping, but fell reasonably at lower levels. The half-power bandwidth was excellent, but the response extended flat up to 70kHz, and this is undesirable on a budget model, in this case showing a large increase in the swept IM tests above 50kHz. Damping factor was rather average, and subjectively some bass reproduced a little boomily, but generally the quality was reasonable, provided the amplifier was not driven into clipping. The stereo headphone jack gave a reasonable quality, but was a little hissy into 600 ohm models. No DC switch on/off problems were noted. The tape sockets were compatible with DIN and phono standards, but the pick-up output was some 2.5dB higher than the equivalent tuner one — annoying, but not important.

The RIAA pick-up input had a well optimised input impedance, and no clipping problem was encountered. The response was very flat indeed, but I would have preferred a built in rumble cut below 35Hz or so since no switchable rumble filter is provided. Input noise measured very well, and no problems were experienced at all on the pick-up input, IM distortion also being reasonably low. The MW section was quite good subjectively, with a better than average performance, and the FM input sensitivity measured surprisingly well at 1$\mu$V. RFIM and image response measured acceptably for a budget receiver, and IF break through was excellent. Selectivity, though, was rather poor. The limiting threshold and capture ratio were both very good. AM rejection was good on weak signals, but a little below average on strong ones. The frequency response let the tuner down rather, measuring —5dB at 15kHz, but reasonably flat to 12kHz. Multiplex filtering was adequate, and signal to noise ratios were reasonable. The tuning meter indicated rather vaguely, and distortion was thus measured at optimum, being generally surprisingly much better than many much more expensive models. Tuning scale accuracy was excellent, and tuning ergonomics simple and effective, with a very smoothly operating control. Crosstalk measured and sounded at a low level when carefully tuned, and the general sound quality was actually better than average, although the very high frequency roll off was clearly noticeable.

This is quite clearly excellent value for money, and despite the awkward volume control I can definitely recommend the model if you only require very basic facilities, and are content with its rather low power output capability. JVC have shown significant

# JVC JR-S50

BEST BUY

advances in their receiver design since the first edition of Hi-Fi Choice on Receivers. This model is a credit to its designers, and should prove very popular in the market. Clearly one of the best buys.

**Amplifier Section**

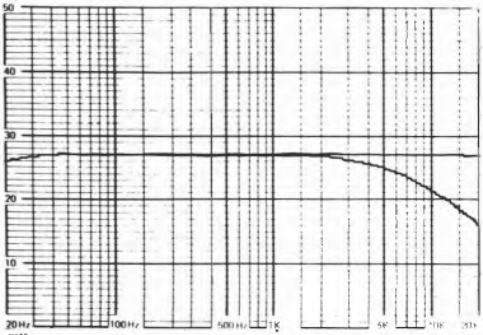
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 21W |
| Av. power o/p single ch. driven 8Ω | 23.5W |
| Av. power o/p single ch. driven tone burst 8Ω | 23.5W |
| Av. power o/p single ch. driven 4Ω | 32.5W |
| Av. power o/p single ch. driven tone burst 4Ω | 35W |
| Idle DC output worst ch. | 13mV |
| Turn on/off max. DC swing worst case | 1.2V |
| Damping factor 8Ω | 34 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.05% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.08% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.01% |
| Half power bandwidth | 2Hz-100kHz |
| Av. RIAA impedance | 49kΩ |
| Av. RIAA sensitivity | 2.3mV |
| Av. RIAA clipping | 100mV |
| Av. RIAA capacitance | 80pF |
| Av. aux. impedance | — |
| Av. aux. sensitivity | — |
| Av. tape impedance | 132kΩ |
| Av. tape sensitivity | 275mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 404mV |
| Max. level from RIAA-rec. out | 620mV |
| Rec. out impedance DIN av. | 74.6kΩ |
| Rec. out impedance phono av. | 2.3kΩ |
| Av. RIAA noise ref 8mV— rec. out unw. | 77.5dB |
| Av. RIAA noise ref 8mV— rec. out CCIR | 73dB |
| Amp. hum zero vol. AMF wtd. av. ref 1W 8Ω | —89dB |
| Amp. noise zero vol. CCIR s/n av. | 85.5dB |
| Amp. noise worst vol. CCIR s/n av. | 83dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 0.9dB |

**Tuner Section**

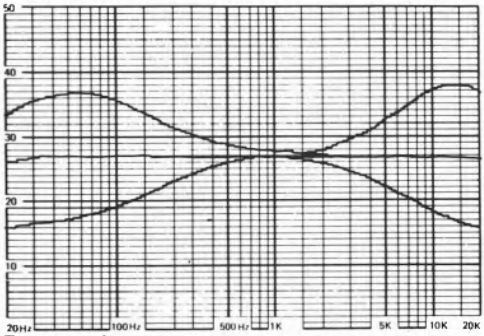
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1μV |
| Mono RF sens. 50dB IHF | 2.9μV |
| Stereo RF sens. 50dB | 32μV |
| RFIM | 66dB |
| Adj. ch. av. | 2.5dB |
| Alt. ch. av. | 52.5dB |
| Image resp | 64dB |
| Capture ratio | 1dB |
| AM reject | 50dB |
| Mono dist. 100% centre tune worst ch. | 0.18% |
| Mono dist. 100% op. tune av. | 0.18% |
| St. L = —R 50% centre tune av. | 0.08% |
| St. single ch. 100% centre tune worst ch. | 0.17% |
| MPX reject 19kHz worst ch. | 55dB |
| MPX reject 38kHz worst ch. | 76dB |
| X-talk 1kHz centre tune worst ch. | 39dB |
| X-talk 10kHz centre tune worst ch. | 30dB |
| X-talk 1kHz op. tune av. | 47dB |
| Freq. resp. St. —3dB L/R 7Hz/14.1kHz | —7Hz/14.7kHz |
| Freq. resp. St. 15kHz L/R | —6.3dB/—4dB |
| Limit threshold | 0.7μV |
| Muting threshold | 1.4μV |
| St. s/n CCIR 100μV/1mV av. | 51dB—62dB |
| Mono s/n 1mV av. CCIR | 67dB |

**General Data**

| | |
|---|---|
| Dimensions | 130 x 430 x 359mm |
| Weight | 6.6kgs |
| Typical selling price including VAT | £90.00 |



Filters



Tone controls.

# JVC JR-S200L

JVC (UK) Ltd., Eldonwall Trading Est., Staples Corner, 6/8 Priestley Way, London NW2 7AF. 01-450 2621.


Although this receiver gives just an average output of 55W into 8 ohms, it can deliver 90W tone burst into 4 ohms, which is both very welcome and good design. Five 13 click step graphic faders are incorporated for tone control, their action operating around 40Hz, 250Hz, 1kHz, 5kHz and 15kHz. This allows a very comprehensive range of adjustment, but no filters are employed, since the two extreme ends can be filtered reasonably with the graphic controls. The volume control is a sideways acting very smooth lever, under which is a centre indented horizontal slider for balance, having a good rate of swing. A heavy duty 3-core mains lead is provided, and an earth terminal will be found useful. A 75 ohm coax socket for FM aerial is complemented by 300 ohm balanced terminals, and two additional ones for an external AM antenna, an attached non-directable ferrite rod normally giving a good signal though. Medium wave reception was reasonable with quite a wide audio bandwidth, but selectivity was only adequate.

A row of neat push buttons select power on/off, speakers 1 and 2, pick-up, auxiliary, FM, MW and LW input selection, tape monitor, FM mute/mono switching and loudness compensation. On the rear panel low level inputs and outputs are on phono sockets, a 5 pole DIN socket also being available to duplicate the phono tape feeds. Break points are provided for insertion of external equipment before the main amplifier. Rather nasty small terminals are provided for loudspeaker connection, rather than spring lock ones. The receiver is well presented.

The tone burst performance was very satisfactory showing a good current capability on transients. The harmonic distortion was a little high at 1dB below clipping, but significantly better at 3dB below. The swept IM curves showed an increase in distortion above 70kHz, clearly due to an excessive frequency response measuring only 3dB down at 100kHz, and also the frequency of the half-power bandwidth point.

The subjective sound quality was good, but not quite up to that of the very best receivers, and a slight tendency to harshness was noted. The output noise levels measured extremely well, and headphones connected to the stereo jack socket provided good quality with no audible hiss, even on high impedance models, but the output level capability was excessive on the latter. The ouput damping factor measured well. All input and output tape interconnections have compatible levels and impedances, and no trouble should be experienced.

The RIAA pick-up input had a well optimised input impedance, and an excellent clipping margin. The signal to noise ratio was also very good, and the response sensibly flat, showing a slight roll-off below 20Hz. IM distortion measured satisfactorily and this input should give no problems.

Although the RF sensitivities and RFIM performance measured extremely well, the image response was not really adequate, the local oscillator running below band 11 istead of above. Radio amateurs transmitting on the 4 meter band close to this receiver will cause chaos, and it won't be their fault! IF breakthrough was poor, and selectivity rather below average. Capture ratio was adequate, but limiting good, whilst AM rejection was very poor on weak signals. Muting was good, though frequency response was poor, measuring 7dB down at 15kHz, not good enough in a medium priced receiver. Multiplex filtering measured well, but signal to noise ratios were just adequate. Although

crosstalk measured well, some spitch was noticed at very high deviations, and distortion levels at high deviations were a little higher than average. Subjectively the poor EHF response lets the tuner down, but in other respects it could be said to be average. Tuning accuracy was adequate, tuning being achieved with an edgwise wheel, and being rather too critical especially in stereo.

The graphic equaliser and general audio performance are quite good, and the tuner's performance varies from excellent to poor. A little more attention to design in the problem areas could have made it a best buy, but it can only be recommended if you must have graphic equalisation at modest cost.

**Amplifier Section**

| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 48.5W |
| Av. power o/p single ch. driven 8Ω | 55W |
| Av. power o/p single ch. driven tone burst 8Ω | 56W |
| Av. power o/p single ch. driven 4Ω | 78W |
| Av. power o/p single ch. driven tone burst 4Ω | 90W |
| Idle DC output worst ch. | 10mV |
| Turn on/off max. DC swing worst case | 40mV |
| Damping factor 8Ω | 54 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.05% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.07% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.01% |
| Half power bandwidth | 3Hz-100kHz |
| Av. RIAA impedance | 49kΩ |
| Av. RIAA sensitivity | 2.4mV |
| Av. RIAA clipping | 175mV |
| Av. RIAA capacitance | 20pF |
| Av. aux. impedance | 72kΩ |
| Av. aux. sensitivity | 175mV |
| Av. tape impedance | 86kΩ |
| Av. tape sensitivity | 175mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 500mV |
| Max. level from RIAA-rec. out | 565mV |
| Rec. out impedance DIN av. | 76kΩ |
| Rec. out impedance phono av. | 3.5kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 76dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 73dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 95dB |
| Amp. noise zero vol. CCIR s/n av. | 99dB |
| Amp. noise worst vol. CCIR s/n av. | 90dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 0.6dB |

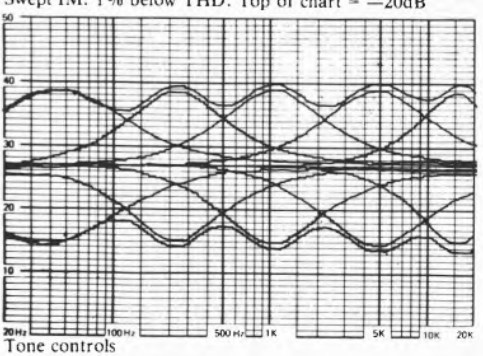
**Tuner Section**

| | |
|---|---|
| Mono RF sens. 30dB IHF | 1μV |
| Mono RF sens. 50dB IHF | 240μV |
| Stereo RF sens. 50dB | 240μV |
| RFIM | 79dB |
| Adj. ch. av. | 4.5dB |
| Alt. ch. av. | 55dB |
| Image resp | 63dB |
| Capture ratio | 1.5dB |
| AM reject | 59dB |
| Mono dist. 100% centre tune worst ch. | 0.57% |
| Mono dist. 100% op. tune av. | 0.33% |
| St. L = —R50% centre tune av. | 0.13% |
| St. single ch. 100% centre tune worst ch. | 0.18% |
| MPX reject 19kHz worst ch. | 65dB |
| MPX reject 38kHz worst ch. | 58dB |
| X-talk 1kHz centre tune worst ch. | 45dB |
| X-talk 10kHz centre tune worst ch. | 38dB |
| X-talk 1kHz op. tune av. | 47.5dB |
| Freq. resp. St. —3dB L/R 30Hz/14.4kHz—29Hz/14kHz | |
| Freq. resp. St. 15kHz L/R | —5.6dB/—8dB |
| Limit threshold | 0.6μV |
| Muting threshold | 3μV |
| St. s/n CCIR 100μV/1mV av. | 49dB—61dB |
| Mono s/n 1mV av. CCIR | 64dB |

**General Data**

| | |
|---|---|
| Dimensions | 500 x 160 x 335mm |
| Weight | 9.8kgs |
| Typical selling price including VAT | £210.00 |

Swept IM. 1% below THD. Top of chart = —20dB

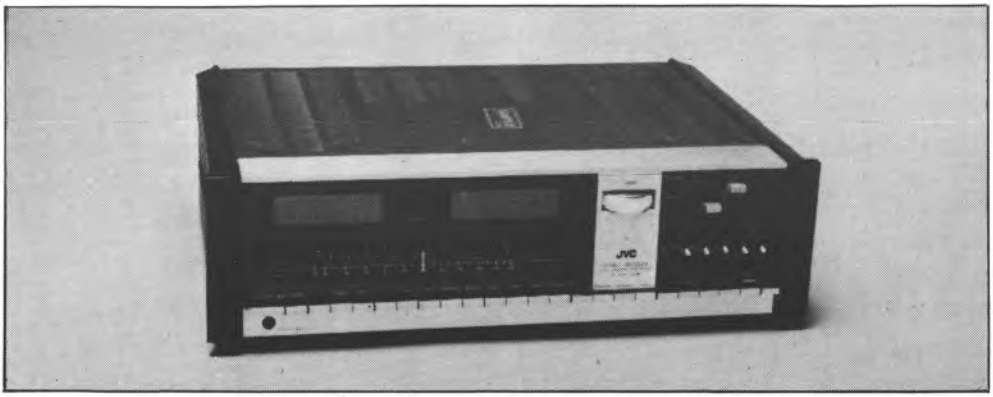


Tone controls

BEST BUY

# JVC JR-S600 mk 11

JVC (UK) Ltd., Eldonwall Trading Est., Staples Corner, 6/8 Priestley Way, London NW2 7AF. 01-450 2621.



This large and heavy receiver is capable of the very high output power of 170W into 8 ohms, rising to 260W into 4 ohms, and incorporates the useful and well-designed JVC graphic equaliser. Five vertical operating levers each have thirteen steps and operate at 40 Hz, 250Hz, 1kHz, 5kHz and 15kHz. These allow an extremely wide range of tonal balance adjustment. A very smooth sideways-acting long-throw fader is provided for volume control and has excellent tracking. Below this is a centre-indented sideways-acting lever for balance, changing slowly across the centre and very suddenly at the ends. Across the entire width of the bottom of the front panel is a row of neat push buttons providing mains on/off, speaker 1/2 selection, input selection for AM, FM, pick-ups 1 and 2, auxiliary, tape 1 and 2 monitoring dubbing, FM mute, audio mute, mono/stereo, loudness control, rumble filter (cutting at 6dB per octave below 150Hz, ridiculously high), treble filter (6dB per octave above 4kHz), and finally a switch allowing the graphic equaliser to be used in the tape recording feed. Tuning is achieved with an edgewise wheel which works very smoothly, but is a little critical for tuning stero signals optimally.

On the rear panel, the mains lead is heavy duty 3-core, and ample earth terminals are provided. Inputs and outputs are generally on phono sockets, tape 2 being duplicated on a 5-pole DIN, which has good compatibility. Break points are supplied with 'U' links for insertion of external equipment before the main amplifier. Loudspeaker terminals are easy to use spring-loaded types, and aerial terminals are provided for 75 and 300 ohm FM and external AM, internal FM and a swivel type ferrite rod antennae being supplied. A switch selects the internal FM antenna.

The tone burst performance of the main amplifier section was excellent, showing the power supply to be well stabilised, the output levels on transients being identical to the continuous ratings. Harmonic distortion measured well but some crossover distortion was originally noticed, which completely cleared when we reset an internal pre-set (careless quality control?). The swept IM pen charts showed a marked rise of distortion above 65kHz. The amplifier response was only 3dB down at 80kHz, also the point for half-power bandwidth. The output noise measured quite well, but the stereo headphone jack gives much too high a level into high impedance headphones, and their destruction could be caused by excessive volume. Damping factor was acceptable, but not good. Inputs and outputs were all well compatible and impedances sensible.

The RIAA pick-up pre-amplifier had a well optimised input impedance and an excellent clipping margin, and signal to noise ratio. IM distortion was low, and the frequency response very flat indeed.

The FM tuner section had a good input sensitivity, with reasonable RFIM performance. Other RF parameters measured quite reasonably, with alternate channel selectivity and AM rejection being extremely good. The audio responses were excellent, and the multiplex filter worked extremely well. Signal to noise ratios were all good, but not exceptional. Distortion measurements were good, and crosstalk very good. Subjectively, the audio performance was superb, no criticisms of any kind being made. Tuning scale accuracy was excellent, thus proving the tuner section to be well above average generally.

Since no bad points were found on this receiver, it

BEST BUY

can be recommended with safety, although its price is high. Medium wave reception was particularly good, with sharp selectivity and lower than average distortion. If you require the very comprehensive and excellent graphic equalisation facilities, and are prepared to pay the price, you should be very happy with it.

**Amplifier Section**

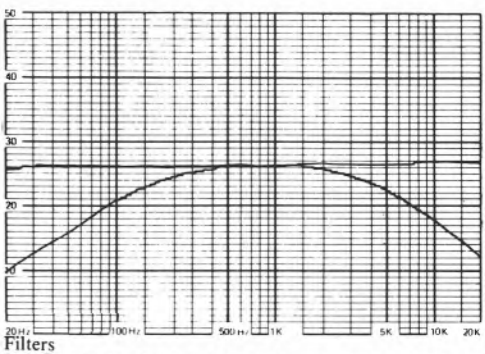
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 153W |
| Av. power o/p single ch. driven 8Ω | 171W |
| Av. power o/p single ch. driven tone burst 8Ω | 169W |
| Av. power o/p single ch. driven 4Ω | 264W |
| Av. power o/p single ch. driven tone burst 4Ω | 267W |
| Idle DC output worst ch. | 5mV |
| Turn on/off max. DC swing worst case | 200mV |
| Damping factor 8Ω | 40 |
| X-over distortion | Yes R CH. |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.01% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.01% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.008% |
| Half power bandwidth | 4Hz-90kHz |
| Av. RIAA impedance | 50kΩ |
| Av. RIAA sensitivity | 3mV |
| Av. RIAA clipping | 310mV |
| Av. RIAA capacitance | 100pF |
| Av. aux. impedance | 63kΩ |
| Av. aux. sensitivity | 285mV |
| Av. tape impedance | 64kΩ |
| Av. tape sensitivity | 285mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 656mV |
| Max. level from RIAA-rec. out | 775mV |
| Rec. out impedance DIN av. | 78kΩ |
| Rec. out impedance phono av. | 4.8kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 76dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 73dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | —98dB |
| Amp. noise zero vol. CCIR s/n av. | 99dB |
| Amp. noise worst vol. CCIR s/n av. | 91dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 0.6dB |

**Tuner Section**

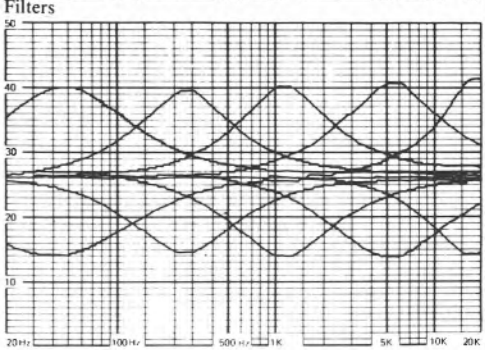
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.1μV |
| Mono RF sens. 50dB IHF | 7μV |
| Stereo RF sens. 50dB | 35μV |
| RFIM | 73dB |
| Adj. ch. av | 6dB |
| Alt. ch. av. | >70dB |
| Image resp | 83dB |
| Capture ratio | 1.45dB |
| AM reject | 63dB |
| Mono dist. 100% centre tune worst ch. | 0.16% |
| Mono dist. 100% op. tune av. | 0.12% |
| St. L = —R50% centre tune av. | 0.12% |
| St. single ch. 100% centre tune worst ch. | 0.26% |
| MPX reject 19kHz worst ch. | 76dB |
| MPX reject 38kHz worst ch. | 101dB |
| X-talk 1kHz centre tune worst ch. | 39dB |
| X-talk 10kHz centre tune worst ch. | 38dB |
| X-talk 1kHz op. tune av. | 39dB |
| Freq. resp. St. —3dB L/R 23Hz/15.6kHz—27Hz/15.6kHz | |
| Freq. resp. St. 15kHz L/R | —0.7dB/—0.5dB |
| Limit threshold | 0.7μV |
| Muting threshold | 3.5μV |
| St. s/n CCIR 100μV/1mV av. | 53dB—62.5dB |
| Mono s/n 1mV av. CCIR | 68.5dB |

**General Data**

| | |
|---|---|
| Dimensions | 560 x 169 x 431mm |
| Weight | 19.2kgs |
| Typical selling price including VAT | £440.00 |



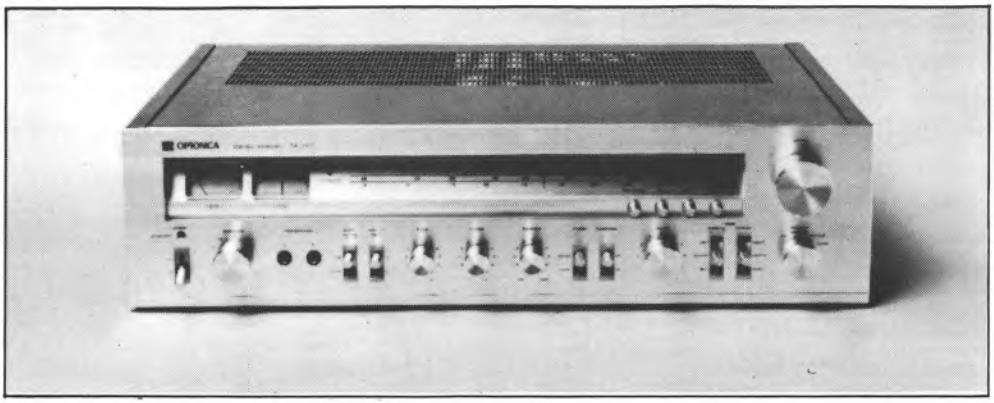
Filters



Tone controls.

# Optonica SA-2121

Sharp Electronics Ltd., Sharp House, 107 Hulme Hall Lane, Manchester M10 8NL. 061 205 7321



Optonica is a section of the Sharp company, and this model is their first one to be made available under their new hi-fi brand name. It delivers 52W into 8 ohms and 81W into 4 ohms. It is very well styled and incorporates an AM section with a ferrite rod at the rear, and aerial inputs for 75 and 300 ohm antennae are fitted. Auxiliary and tape inputs/ouputs are on phono sockets, but 5-pole DIN sockets are also supplied duplicating tape 1/2 interconnections. Lever switches are provided for mains on/off, audio muting, rumble filter (—3dB at 25Hz), stereo/mono, loudness, tape dubbing in either direction, and monitor tape 1/2, whilst rotaries provide loudspeaker switching for two pairs, and input selection to auxiliary, pick-up 1/2 and tuner section. Push buttons select FM muting, FM auto, medium wave and long wave reception. The styling is attractive, the receiver being encased in metal, with wooden side cheeks. The review sample was an early prototype, and minor improvements will be made in production samples. Small loudspeaker screw terminals were found rather fiddly. The bass and treble controls had 11 rather unequal steps, but the balance conrol was centre-indented and generally excellent. The smooth volume control tracked quite well.

Tone bursts revealed the power supply to be reasonably stable, almost identical outputs being available on transients, as for the continuous ratings. Frequency response extended to 120kHz, and this is excessive, and unfortunately produced some distortion in the swept IM curves at very high frequencies. Half-power bandwidth was at 130kHz, and we would prefer to see a roll-off introduced before the power amplifier to curtail response. Damping factor was satisfactory, and no DC switching problems were encountered. Harmonic distortion measured quite well and was predominantly second harmonic, and output noise was minimal, a stereo headphone jack providing good quality into headphones, but a rather excessive voltage into high impedance models.

Input and output impedances on the phono sockets were all compatible but, whilst the pick-up output levels to tape were reasonable, the tuner level was rather too low, but this is being increased to a reasonable level on the production line for Europe.

The RIAA pick-up input stage had a rather low impedance of 40k ohms, and a fairly high capacity, but most cartridges will perform satisfactorily. Clipping margins were excellent, and distortion extremely low. Furthermore, input noise was better than average. The frequency response also measured very flat.

The tuner's RF input sensitivity measured quite well in mono and stereo, but RFIM distortion was rather poor. Image response and IF breakthrough both measured extremely well, however. Selectivity was only fair, but AM rejection good. Limiting threshold and capture ratio measured excellently, but muting was too sensitive. The audio responses were all extremely good, and multiplex filtering excellent. Mono weighted noise figures were good, but stereo ones just adequate. Harmonic distortion measurements were all excellent, and crosstalk figures satisfactory. The subjective quality was above average, but I would have preferred a quieter stereo background noise level. Tuning scale accuracy was quite satisfactory, and whilst the tuning was smooth, slight backlash was noted. AM performance was better than average, with no whistle on Brookmans Park Radio 4, and the long

wave facility will be useful, although R2 produces a slight whistle.

Whilst the amplifier section performed generally well, and the operating ergonomics were good, the tuner performace was only average, the areas requiring improvement being RFIM and weighted signal to noise ratios. The sound quality through will be good on intermediate strength signals, but be careful to avoid overloading the aerial input. Reasonable value for money, but not quite recommended as a best buy, although a good starter for a new range.

**Amplifier Section**

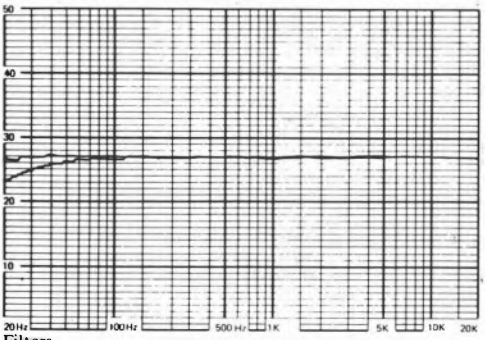
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 47.5W |
| Av. power o/p single ch. driven 8Ω | 52.5W |
| Av. power o/p single ch. driven tone burst 8Ω | 52.5W |
| Av. power o/p single ch. driven 4Ω | 81W |
| Av. power o/p single ch. driven tone burst 4Ω | 84W |
| Idle DC output worst ch. | 5mV |
| Turn on/off max. DC swing worst case | 10mV |
| Damping factor 8Ω | 40 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.03% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.04% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.002% |
| Half power bandwidth | 2Hz-100kHz |
| Av. RIAA impedance | 40kΩ |
| Av. RIAA sensitivity | 3.8mV |
| Av. RIAA clipping | 160mV |
| Av. RIAA capacitance | 150pF |
| Av. aux. impedance | 58kΩ |
| Av. aux. sensitivity | 215mV |
| Av. tape impedance | 75kΩ |
| Av. tape sensitivity | 215mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 258mV |
| Max. level from RIAA-rec. out | 485mV |
| Rec. out impedance DIN av. | 79kΩ |
| Rec. out impedance phono av. | 2.6kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 72dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 73dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 85dB |
| Amp. noise zero vol. CCIR s/n av. | 94dB |
| Amp. noise worst vol. CCIR s/n av. | 89dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1.2dB |

**Tuner Section**

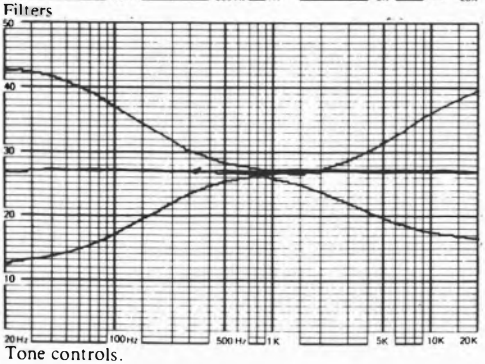
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.1μV |
| Mono RF sens. 50dB IHF | 2.6μV |
| Stereo RF sens. 50dB | 33μV |
| RFIM | 61dB |
| Adj. ch. av. | 5.5dB |
| Alt. ch. av. | 55dB |
| Image resp | 83dB |
| Capture ratio | 1dB |
| AM reject | 60dB |
| Mono dist. 100% centre tune worst ch. | 0.12% |
| Mono dist. 100% op. tune av. | 0.07% |
| St. L = —R50% centre tune av. | 0.11% |
| N.B. Old method | 0.22% |
| St. single ch. 100% centre tune worst ch. | 0.22% |
| MPX reject 19kHz worst ch. | 64dB |
| MPX reject 38kHz worst ch. | 100dB |
| X-talk 1kHz centre tune worst ch. | 41dB |
| X-talk 10kHz centre tune worst ch. | 31dB |
| X-talk 1kHz op. tune av. | 49dB |
| Freq. resp. St. —3dB L/R | 5Hz/16.8kHz—5Hz/17kHz |
| Freq. resp. St. 15kHz L/R | Flat-Flat |
| Limit threshold | 0.7μV |
| Muting threshold | 1.1μV |
| St. s/n CCIR 100μV/1mV av. | 52dB—61dB |
| Mono s/n 1mV av. CCIR | 66dB |

**General Data**

| | |
|---|---|
| Dimensions | 550 x 142 x 390mm |
| Weight | 14.5kgs |
| Typical selling price including VAT | £240.00 |



Filters



Tone controls.

RECOMMENDED

# Pioneer SX-550

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

The SX-550 is the cheapest in Pioneer's submitted range, and delivers 34W into 8 ohms, increasing to 45W into 4 ohms. A selector switch chooses either or both of two pairs of speakers, which can be interconnected with spring-loaded connectors along the horizontal back platform which also contains the phono input/output sockets for two tape-recorders, pick-up and auxiliary, a 5-pole DIN socket also being provided for tape 2 interconnection. An IEC mains socket is provided, together with an earth terminal, and both 300 ohm and AM terminals are fitted, 75 ohm FM aerials being catered for with a TV-type coaxial socket. A very sensible ferrite rod which can be swivelled in any direction is mounted on the rear panel, and I consider it by far the best type encountered.

Controls with 11 steps are provided for bass and treble, but the steps were rather uneven, and the range of adjustment only just adequate. The balance control had a centre indent, but operated rather rapidly across the centre. The rotary volume control was rather small. Push buttons operate FM muting, mono/stereo, loudness compensation and tape monitors 1/2, there being no rumble or treble filters. An input selector switches to AM, FM, phono or auxiliary/mic. inputs, microphones being plugged into a stereo jack socket on the front panel (input sensitivity very poor though). The receiver is most attractively designed, with wooden side cheeks, but metal top and bottom plates, and ergonomics were excellent, including the tuning assembly which was also very accurately aligned for frequency read-out.

Tone bursts revealed a well-stabilised power supply, and harmonic distortion on the power amplifier was better than average. The swept IM pen charts showed extremely bad distortion above 100kHz, the actual frequency response extending flat to at least 200kHz, which again is misplaced specmanship and quite ridiculous. Half-power bandwidth measured well at 100kHz at HF. Output amplifier noise measured extremely well, and the stereo headphone jack provided good headphone quality without hiss, but too high a level into high impedance phones. The damping factor at 40Hz was only 22, thus confirming the subjective comments of slackness and boominess at very low frequencies. Otherwise the subjective quality was above average. Phono tape and auxiliary inputs and outputs all had sensible sensitivities and impedances, but the 5-pole DIN socket produced rather a low level into an external DIN load.

The RIAA input stage had a well optimised impedance and a very good clipping margin. Noise levels measured well, and the frequency response was extremely flat, but surely a steep rumble cut below 40Hz would be desirable here. IM distortion measured extremely well.

FM input sensitivities all measured reasonably well, but slight RFIM was produced by strong aerial signals. Other RF measurements were satisfactory. Selectivity, however, was rather poor. Capture ratio and limiting threshold measured very well indeed, but muting was too sensitive. AM rejection was poor on weak signals. Whilst the frequency response was quite good, multiplex filtering was virtually non-existent, and some older tape recorders might produce whistles on tape. Noise levels measured reasonably well. Distortion figures were all fairly low, and crosstalk measurements were exceptionally good. The subjective quality was also very good, although optimum tuning was right of centre, showing the tuning meter to be slightly inaccurate.

RECOMMENDED

AM reception was better than average, but with a sharp selectivity. However, a whistle was heard on Radio 4 Brookmans Park.

Provided that you only require to listen regularly to stronger stations on FM, and your tape recorder has its own built-in multiplex filter, I can safely recommend this receiver. It seems good value for money and will undoubtedly attract many purchasers, but it cannot be recommended if you wish to receive distant stations.

**Amplifier Section**

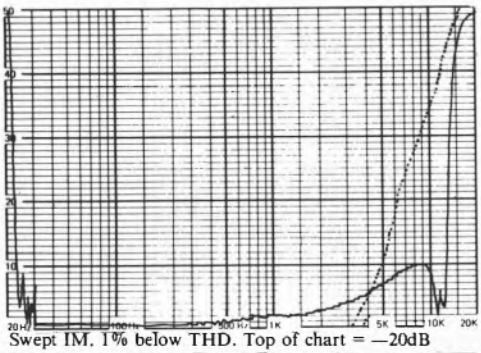
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 28.5W |
| Av. power o/p single ch. driven 8Ω | 34W |
| Av. power o/p single ch. driven tone burst 8Ω | 30W |
| Av. power o/p single ch. driven 4Ω | 45W |
| Av. power o/p single ch. driven tone burst 4Ω | 47.5W |
| Idle DC output worst ch. | 12mV |
| Turn on/off max. DC swing worst case | 4V |
| Damping factor 8Ω | 24 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.03% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.03% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.002% |
| Half power bandwidth | 2Hz-100kHz |
| Av. RIAA impedance | 50.5kΩ |
| Av. RIAA sensitivity | 2.8mV |
| Av. RIAA clipping | 235mV |
| Av. RIAA capacitance | 100pF |
| Av. aux. impedance | 51kΩ |
| Av. aux. sensitivity | 170mV |
| Av. tape impedance | 62.4kΩ |
| Av. tape sensitivity | 170mV |
| Mic impedance | 60kΩ |
| Mic. sensitivity | 6mV |
| Mic. clipping | 280mV |
| Max. level from tuner-rec. out | 384mV |
| Max. level from RIAA-rec. out | 475mV |
| Rec. out impedance DIN av. | 79kΩ |
| Rec. out impedance phono av. | 6.7kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 73dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 72.5dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 90dB |
| Amp. noise zero vol. CCIR s/n av. | 97dB |
| Amp. noise worst vol. CCIR s/n av. | 91dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1dB |

**Tuner Section**

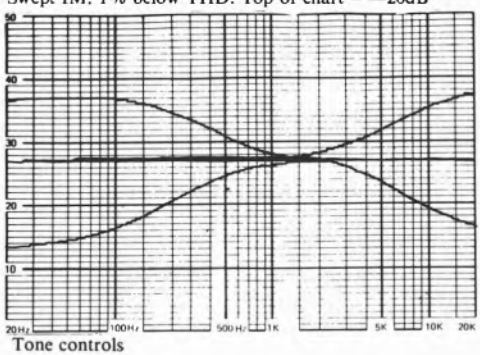
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1μV |
| Mono RF sens. 50dB IHF | 18μV |
| Stereo RF sens. 50dB | 40μV |
| RFIM | 65dB |
| Adj. ch. av | 3dB |
| Alt. ch. av. | 50dB |
| Image resp | 71dB |
| Capture ratio | 1dB |
| AM reject | 68dB |
| Mono dist. 100% centre tune worst ch. | 0.19% |
| Mono dist. 100% op. tune av. | 0.12% |
| St. L = —R 50% centre tune av. | 0.08% |
| St. single ch. 100% centre tune worst ch. | 0.33% |
| MPX reject 19kHz worst ch. | 36dB |
| MPX reject 38kHz worst ch. | 54dB |
| X-talk 1kHz centre tune worst ch. | 46dB |
| X-talk 10kHz centre tune worst ch. | 42dB |
| X-talk 1kHz op. tune av. | 47dB |
| Freq. resp. St. —3dB L/R | 11Hz/16.7kHz—11Hz/17.4kHz |
| Freq. resp. St. 15kHz L/R | —1.7dB/—1.3dB |
| Limit threshold | 0.5μV |
| Muting threshold | 0.8μV |
| St. s/n CCIR 100μV/1mV av. | 52.5dB—63dB |
| Mono s/n 1mV av. CCIR | 67.5dB |

**General Data**

| | |
|---|---|
| Dimensions | 448 x 141 x 301mm |
| Weight | 9.4kgs |
| Typical selling price including VAT | £150.00 |



Swept IM. 1% below THD. Top of chart = —20dB

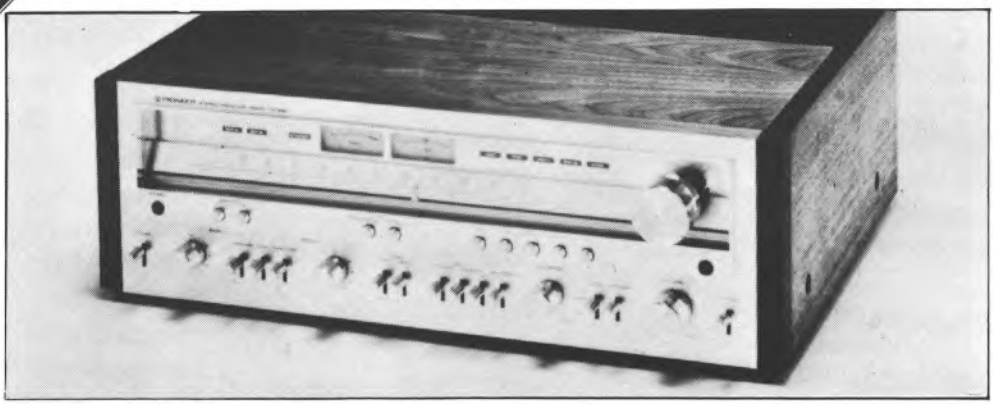


Tone controls

RECOMMENDED

# Pioneer SX-850

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



The model SX-850 is quite a powerful receiver, supplying up to 108W per channel into 8 ohms and a massive 170W into 4 ohms, two pairs of loudspeakers being switchable on push buttons on the front panel. Loudspeaker connections are on spring loaded push clamps, and an IEC mains input socket is provided together with ample earthing terminals. As with the SX-550, the AM ferrite rod antenna can be swivelled into almost any direction, and was well designed. A 75 ohm coax socket is fitted for FM, and also 300 ohm terminals, additional ones being mounted for an external AM aerial. Phono sockets are provided for external interconnections to auxiliary, phono 1/2 and two tape recorders, tape 2 also being available on a 5 pole standardised DIN socket. In addition to U-linked break points between pre-amplifier and amplifier sections, additional switchable by-pass phono sockets are provided for insertion of external equipment in the pre-amplifier section.

Tone controls with 11 very even steps are provided for bass and treble, each having switchable turnover frequencies of 200Hz/400Hz, and 2.5kHz/5kHz respectively. A tone control cancel switch is also conveniently provided. Further lever type switches provide rumble filtering (6dB per octave below 30Hz) and treble filtering (6dB per octave above 5kHz), tape dubbing, tape 1/2 monitoring adaptor insert, stereo/mono, loudness compensation and audio muting (—20dB). Push buttons select loudspeaker pairs, stereo FM high frequency blend, FM muting, AM, MW, FM, phono 1/2 (the latter also being used for stereo mix insert on a jack socket), and auxiliary. The receiver is very handsomely styled, and very heavy, and its ergonomics are excellent including a very good tuning assembly.

The tone burst performance showed the amplifier's power supply to be very good and well regulated, and power amplifier distortion measured very well. Whilst the half-power bandwidth extended to just 55kHz, the frequency response extended to 100kHz, which is most unwise, and thus the swept intermodulation pen charts started climbing above 20kHz, peaking at around 150kHz to around 6%, which is indicative of bad design. Nevertheless, the subjective sound quality was very good. Particularly good was the high current available, and well designed protection circuits. The damping factor measured well, and the sound quality was open, with the bass end particularly tight. Output noise levels were rather average, and some hiss might be noted on high impedance headphones — a grossly excessive voltage being available, which could damage high impedance models. The volume control tracked well, and the centre indented balance control had an even rate of change. Phono input and output interconnections were all well optimised, but the 5 pole DIN socket gave slightly too low a level for comfort. The RIAA stage was well optimised for impedance, and clipping and noise levels, and IM all measured well. Frequency response was extremely flat with a sensible subsonic roll-off.

All the tuner front end measurements were excellent, but adjacent selectivity was rather poor. Muting was much too sensitive, but AM rejection reasonable. Frequency responses were reasonably flat, with multiplex filtering satisfactory. Weak signals were reproduced with less background noise than usual, strong ones having about an average background noise content. When optimally tuned

RECOMMENDED

left of centre, distortion figures were very low, but the tuning meter indicated incorrectly. Subjectively the sound quality was good, though not exceptional. Tuning scale accuracy and ergonomics were excellent.

Whilst the general performance of this model was very good, its fairly high price should allow for a better adjacent channel performance and strong stereo signal noise performances and better output noise performance. It can be recommended though, particularly if you want its extensive facilities, since it also has excellent features. The MW reception was also good, but a slight whistle was heard on Radio 4 Brookmans Park. Fairly reasonable value for money.

**Amplifier Section**

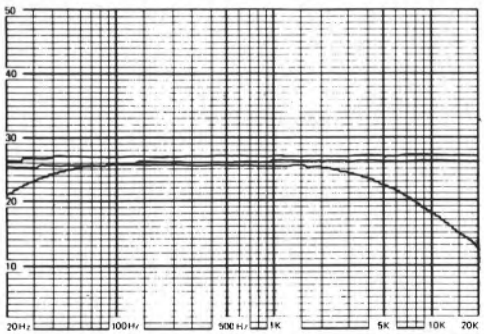
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 97W |
| Av. power o/p single ch. driven 8Ω | 107.5W |
| Av. power o/p single ch. driven tone burst 8Ω | 110.5W |
| Av. power o/p single ch. driven 4Ω | 169W |
| Av. power o/p single ch. driven tone burst 4Ω | 186W |
| Idle DC output worst ch. | 2mV |
| Turn on/off max. DC swing worst case | 175mV |
| Damping factor 8Ω | 73 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.02% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.03% |
| IM dist. 10W av. | N/A% |
| IM dist. RIAA/rec. out | 0.008% |
| Half power bandwidth | 3Hz-55kHz |
| Av. RIAA impedance | 51.5kΩ |
| Av. RIAA sensitivity | 2.8mV |
| Av. RIAA clipping | 230mV |
| Av. RIAA capacitance | 80pF |
| Av. aux. impedance | 44kΩ |
| Av. aux. sensitivity | 180mV |
| Av. tape impedance | 48kΩ |
| Av. tape sensitivity | 180mV |
| Mic impedance | 56kΩ |
| Mic. sensitivity | 8.5mV |
| Mic. clipping | 750mV |
| Max. level from tuner-rec. out | 512mV |
| Max. level from RIAA-rec. out | 490mV |
| Rec. out impedance DIN av. | 80kΩ |
| Rec. out impedance phono av. | 2.5kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 74dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 72dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 98.5dB |
| Amp. noise zero vol. CCIR s/n av. | 91.5dB |
| Amp. noise worst vol. CCIR s/n av. | 83dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1dB |

**Tuner Section**

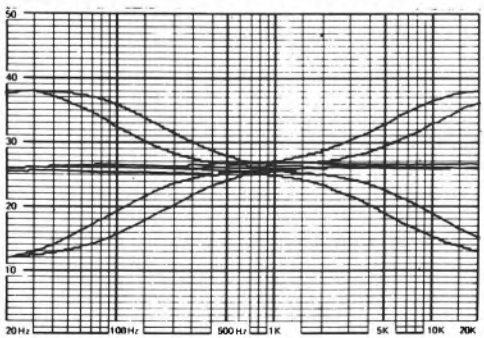
| | |
|---|---|
| Mono RF sens. 30dB IHF | 0.8μV |
| Mono RF sens. 50dB IHF | 1.7μV |
| Stereo RF sens. 50dB | 20μV |
| RFIM | 76dB |
| Adj. ch. av. | 2.5dB |
| Alt. ch. av. | 62dB |
| Image resp | 88dB |
| Capture ratio | 1.4dB |
| AM reject | 63dB |
| Mono dist. 100% centre tune worst ch. | 0.11% |
| Mono dist. 100% op. tune av. | 0.08% |
| St. L = —R 50% centre tune av. | 0.07% |
| St. single ch. 100% centre tune worst ch. | 0.52% |
| MPX reject 19kHz worst ch. | 62dB |
| MPX reject 38kHz worst ch. | >100dB |
| X-talk 1kHz centre tune worst ch. | 39dB |
| X-talk 10kHz centre tune worst ch. | 37dB |
| X-talk 1kHz op. tune av. | 40dB |
| Freq. resp. St. —3dB L/R 16Hz/15.5kHz | —17Hz/15.7kHz |
| Freq. resp. St. 15kHz L/R | —1.3dB/—0.9dB |
| Limit threshold | 0.4μV |
| Muting threshold | 0.6μV |
| St. s/n CCIR 100μV/1mV av. | 54dB—62dB |
| Mono s/n 1mV av. CCIR | 67dB |

**General Data**

| | |
|---|---|
| Dimensions | 526 x 173 x 411mm |
| Weight | 19.1kgs |
| Typical selling price including VAT | £330.00 |



Filters

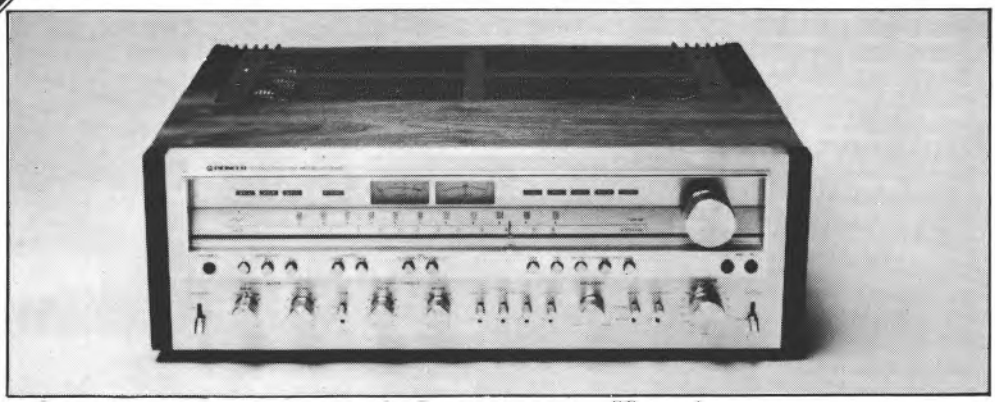


Tone controls.

BEST BUY

# Pioneer SX-1250

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



If you want a good receiver capable of delivering 220W per channel into 8 ohms and an incredible 335W per channel into 4 ohms, this one should certainly fill the bill. One of the heaviest in the survey, the SX-1250 is the top end of the Pioneer range, and incorporates very extensive facilities, including 11 stepped positions upper bass and lower treble tone controls, with additional 5 step positions low bass and upper treble ones, a tone cancel switch also being provided. The main volume control has 32 smooth and very even steps with excellent tracking, but more steps would be preferable. A large tuning scale with meters for tuning and signal strength runs right across the front of the receiver, and the tuning knob and ergonomics are superb.

Lever switches are provided for mains on/off, tape copying, tape monitor 1/2, insert of external adaptor etc., stereo/mono, loudness compensation and audio —20dB mute. Push buttons operate a choice of three pairs of speakers, rumble and treble filters (cut 6dB per octave below 30Hz and above 8kHz respectively), FM muting, multipath indication, input selectivity for AM, MW, FM, pick-up 1, pick-up 2/Mic (mic input on two mono insensitive jack inputs) and auxiliary.

Inputs/outputs are on phono sockets, but tape 2 is duplicated on a compatible 5 pole DIN one. Loudspeaker connections are on spring-loaded clamp levers that were simple to operate, and the mains connection is on an IEC socket, earth terminals also being provided. A swivel type ferrite rod antenna is supplied for MW, but also separate terminals for external antenna connections. A 75 ohm TV-type coax socket is complemented by 300 ohm terminals for FM antennae. Break points are available with U-links between the pre-amplifier and power amplifier sections.

Although the main amplifier sounded extremely good, the half power bandwidth extended to only 60kHz, and yet the response did not tail off until well above 120kHz, and the swept IM charts showed a dramatic increase of distortion above 50kHz. I think a bandwidth limitation cutting above 35kHz or so would have been preferable. Harmonic distortion however measured extremely well, but the damping factor was average. Output noise levels were also average. Headphones could be driven far too hard, and high impedance phones could be driven to well over 1W! No output DC switching problems were encountered. Inputs and outputs were all well compatible with phono and DIN standards.

The RIAA input stage had an extremely flat response and an excellent noise performance, and a sensible input impedance. IM distortion was low, and no problems should be encountered with any conventional pick-up interconnection.

The FM tuner section had good input sensitivities and excellent RF IM, image and IF rejection measurements. Selectivity was extremely good, and well compromised against distortion. Limit threshold was excellent, but muting too sensitive. AM reject was adequate. Frequency response and multiplex filtering were exemplary. Weighted noise levels also measured superbly, the tuner being one of the quietest. Distortion figures were generally excellent, although left or right only at high deviations were just good. Crosstalk measurements were also exceptionally good, and the overall sound quality produced was one of the best in the survey, particularly remarkable considering the very tight IF bandwidth which allows distant stations to be received very close to very strong ones. Tuning scale

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accuracy was good, and MW reception was adequate.

Although this receiver it very expensive, if offers an incredible tuner performance with very comprehensive pre-amplifier facilities. The sound quality can hardly be faulted, but I wish paper specmanship about supersonic frequency response could be a little more sensible. This model is strongly recommended if you can possibly afford it — good value for money even at the price, and far better value than equivalent separates.

**Amplifier Section**

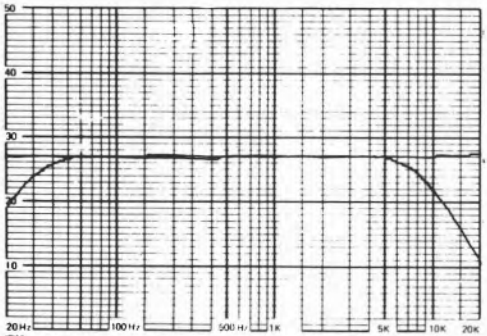
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 210W |
| Av. power o/p single ch. driven 8Ω | 220W |
| Av. power o/p single ch. driven tone burst 8Ω | 210W |
| Av. power o/p single ch. driven 4Ω | 333W |
| Av. power o/p single ch. driven tone burst 4Ω | 342W |
| Idle DC output worst ch. | 5mV |
| Turn on/off max. DC swing worst case | 12mV |
| Damping factor 8Ω | 44 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.01% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.01% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.002% |
| Half power bandwidth | 3Hz-60kHz |
| Av. RIAA impedance | 51kΩ |
| Av. RIAA sensitivity | 2.5mV |
| Av. RIAA clipping | 540mV |
| Av. RIAA capacitance | 120pF |
| Av. aux. impedance | 54.5mV |
| Av. aux. sensitivity | 157mV |
| Av. tape impedance | 61kΩ |
| Av. tape sensitivity | 157mV |
| Mic impedance | 59kΩ |
| Mic. sensitivity | 5.3mV |
| Mic. clipping | 1.15V |
| Max. level from tuner-rec. out | 577mV |
| Max. level from RIAA-rec. out | 520mV |
| Rec. out impedance DIN av. | 81kΩ |
| Rec. out impedance phono av. | 2.4kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 69dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 72.5dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 96dB |
| Amp. noise zero vol. CCIR s/n av. | 97dB |
| Amp. noise worst vol. CCIR s/n av. | 87dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 0.5dB |

**Tuner Section**

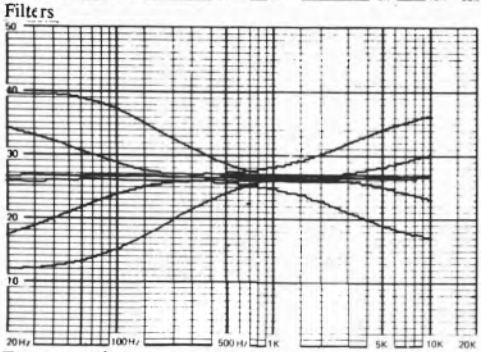
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.1μV |
| Mono RF sens. 50dB IHF | 3.8μV |
| Stereo RF sens. 50dB | 25μV |
| RFIM | 79dB |
| Adj. ch. av | 12dB |
| Alt. ch. av. | 63dB |
| Image resp | >100dB |
| Capture ratio | 1.7dB |
| AM reject | 61dB |
| Mono dist. 100% centre tune worst ch. | 0.2% |
| Mono dist. 100% op. tune av. | 0.2% |
| St. L = —R 50% centre tune av. | 0.14% |
| St. single ch. 100% centre tune worst ch. | 0.28% |
| MPX reject 19kHz worst ch. | —78dB |
| MPX reject 38kHz worst ch. | —106dB |
| X-talk 1kHz centre tune worst ch. | 50dB |
| X-talk 10kHz centre tune worst ch. | 39dB |
| X-talk 1kHz op. tune av. | 50dB |
| Freq. resp. St. —3dB L/R 19Hz/16.8kHz—19Hz/17.1kHz | |
| Freq. resp. St. 15kHz L/R | Flat/Flat |
| Limit threshold | 0.5μV |
| Muting threshold | 0.8μV |
| St. s/n CCIR 100μV/1mV av. | 54dB—68dB |
| Mono s/n 1mV av. CCIR | 74dB |

**General Data**

| | |
|---|---|
| Dimensions | 556 x 186 x 464m |
| Weight | 29.2kgs |
| Typical selling price including VAT | £550.00 |



Filters

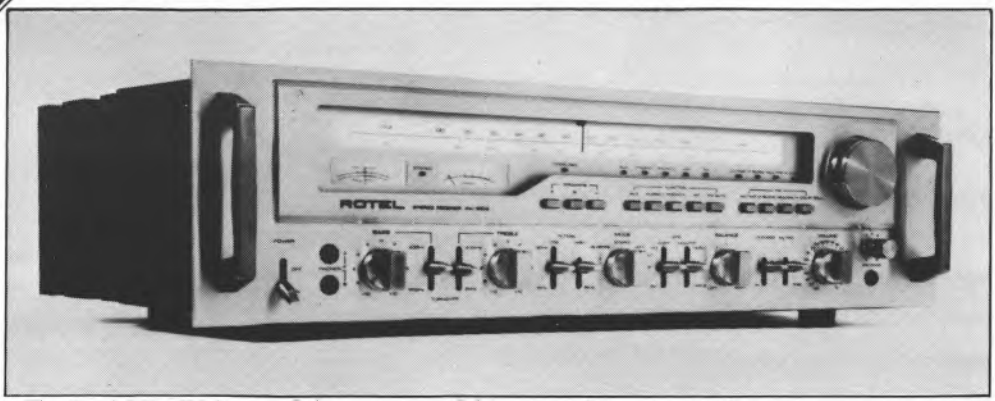


Tone controls.

BEST BUY

# Rotel RX-1603

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




The Rotel RX-1603 is one of the most powerful receivers in the survey, delivering 250W per channel into 8 ohms but only 240W average continuous power into 4 ohms, the latter being current protected with a relay. Three pairs of loudspeakers can be interconnected, and are individually selectable. The tone controls are 11 even stepped position types with switchable turnovers at 200/400Hz and 2.5 and 5kHz respectively. No mid frequency control was provided. The volume control had 41 even steps with good tracking, and worked very smoothly. The centre indented balance control also worked very smoothly and evenly. A ferrite rod was supplied for AM and gave acceptable reception, FM external antennae being connected with terminals for 300 and 75 ohms, the latter being duplicated on a TV-type coax socket.

Two tape recorders can be interconnected on phono sockets, one being duplicated on a 5-pole DIN compatible one. Two pick-up inputs on phono sockets are provided, one being duplicated on a 5-pole DIN. Lever type switches operate mains on/off, bass and treble turnover frequencies, rumble filter (6dB per octave below 30Hz or 15kHz), treble filter (steep above 9kHz), tape copying and monitoring, loudness compensation and 15dB muting. A rotary switch selects stereo/reverse stero/mono etc. Input selection is with push buttons, choosing pick-up 1/2, auxiliary, AM, MW and FM auto. Push buttons operate muting, high frequency blend, multipath indication and Dolby 25$\mu$sec de-emphasis. A microphone input is available on a stereo jack socket (very insensitive), and has its own volume control.

The tone burst performance of the amplifier section showed a considerable power increase over the continuous rating, but was very uneven on the two channels (310W and 380W on left and right). This suggests poor quality control in setting up. Harmonic distortion measurements came out quite well, but the swept IM pen charts revealed a frequency response extending far too high above the half-power bandwidth's 55kHz limit. Distortion reached nearly 10% at 100kHz, again misplaced specmanship. No switch on/off problems were noted, and the output noise level measured well, but peaked at 2 o'clock on the volume control. A ludicrous 32V was available on each of two headphone sockets when connected to high impedance models. The damping factor was excellent, and sound reproduced was crisp and generally excellent, although at times thought slightly brittle. The 41 step volume control had excellent tracking, and was much liked. Auxiliary and tape monitor inputs averaged 40K ohms input impedance, which is perhaps a little low, but sensitivities were adequate. The 5-pole DIN socket provided slightly too high a level from phono, but if the latter was switched to low sensitivity the available level was then much too low. The output level from the tuner was quite compatible with that from the pick-up pre-amplifier. The RIAA inputs had a higher than average capacity but very good noise and distortion performance. The frequency response was very flat.

The tuner's general RF performance was excellent, but adjacent channel selectivity just good. Muting was too sensitive, and capture ratio average. Frequency response and noise performances were excellent, and crosstalk good, with subjective quality as one of the best. Dial accuracy and tuning ergonomics were excellent.

# Rotel RX-1603

BEST BUY

Whilst this receiver is very expensive, its general performance was very good indeed, and in particular the tuner section is excellent. It can be recommended then, and is reasonably good value for money, despite its high cost. It offers very comprehensive facilities, and was a delight to use.

**Amplifier Section**

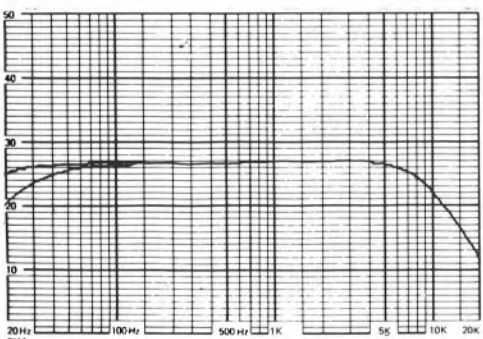
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 228W |
| Av. power o/p single ch. driven 8Ω | 249W |
| Av. power o/p single ch. driven tone burst 8Ω | 273W |
| Av. power o/p single ch. driven 4Ω | 240W |
| Av. power o/p single ch. driven tone burst 4Ω | 346W |
| Idle DC output worst ch. | 2.5mV |
| Turn on/off max. DC swing worst case | 140V |
| Damping factor 8Ω | 105 |
| X-over distortion | No |
| Harmonic dist. —3 dB ref 1% 1kHz 8Ω av. | 0.02% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.03% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.002% |
| Half power bandwidth | 2Hz-57kHz |
| Av. RIAA impedance | 49.5kΩ |
| Av. RIAA sensitivity | 2.4mV-6.5mV |
| Av. RIAA clipping | 350mV-950mV |
| Av. RIAA capacitance | 176pF |
| Av. aux. impedance | 38.8kΩ |
| Av. aux. sensitivity | 155mV |
| Av. tape impedance | 43.3kΩ |
| Av. tape sensitivity | 155mV |
| Mic impedance | 44.6kΩ |
| Mic. sensitivity | 5.7mV |
| Mic. clipping | >10V |
| Max. level from tuner-rec. out | 376mV |
| Max. level from RIAA-rec. out | 182-495mV |
| Rec. out impedance DIN av. | 90kΩ |
| Rec. out impedance phono av. | 2kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 76dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 72dB |
| Amp. hum zero vol. AMF wtd. av. ref 1W 8Ω | 100dB |
| Amp. noise zero vol. CCIR s/n av. | 107dB |
| Amp. noise worst vol. CCIR s/n av. | 85dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1dB |

**Tuner Section**

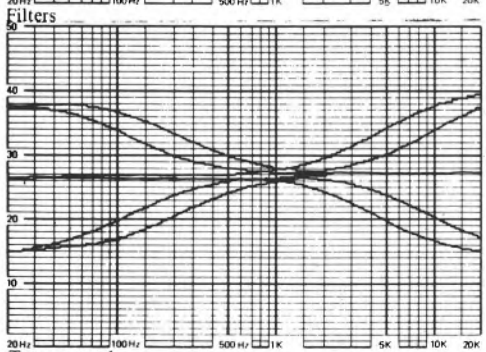
| | |
|---|---|
| Mono RF sens. 30dB IHF | 0.7μV |
| Mono RF sens. 50dB IHF | 1.8μV |
| Stereo RF sens. 50dB | 17μV |
| RFIM | 82dB |
| Adj. ch. av | 8dB |
| Alt. ch. av. | >70dB |
| Image resp. | — |
| Capture ratio | 1.5dB |
| AM reject | 69dB |
| Mono dist. 100% centre tune worst ch. | 0.22% |
| Mono dist. 100% op. tune av. | 0.21% |
| St. L = —R 50% centre tune av. | 0.11% |
| St. single ch. 100% centre tune worst ch. | 0.06% |
| MPX reject 19kHz worst ch. | 54dB |
| MPX reject 38kHz worst ch. | 82dB |
| X-talk 1kHz centre tune worst ch. | 42dB |
| X-talk 10kHz centre tune worst ch. | 35dB |
| X-talk 1kHz op. tune av. | 46dB |
| Freq. resp. St. —3dB L/R 27Hz/17.2kHz—23Hz/17.1kHz | |
| Freq. resp. St. 15kHz L/R | Flat/Flat |
| Limit threshold | 0.4μV |
| Muting threshold | 1μV |
| St. s/n CCIR 100μV/1mV av. | 57dB—68dB |
| Mono s/n 1mV av. CCIR | 67dB |

**General Data**

| | |
|---|---|
| Dimensions | 600 x 180 x 480mm |
| Weight | 33kgs |
| Typical selling price including VAT | £530.00 |



Filters

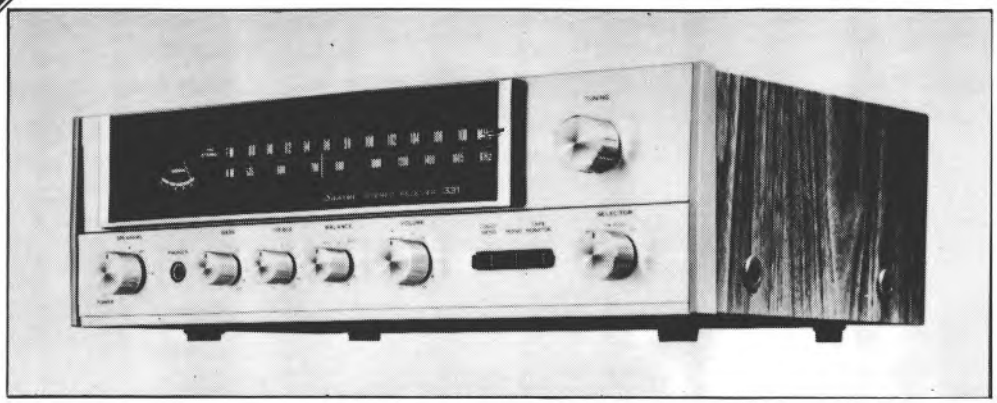


Tone controls.

BEST BUY

# Sansui 331

Sansui London Showroom, 39/41 Maple Str., London W1P 5FU. 01-568 5353.



This budget amplifier gives 14W per channel (both driven) and includes only basic facilities. It has switched outputs to two pairs of loudspeakers (spring loaded connectors). The 2-core mains lead is complemented by a separate spring lock earth terminal. Pick-up, auxiliary and tape in and out sockets are phono, although tape is also duplicated on a 5-pole DIN socket. 75 and 300 ohm FM aerial spring-lock connectors are fitted, with an AM one complemented by a ferrite rod, mounted internally for medium wave reception. The case is very well finished wood, with a metal base plate. An input switch selects pick-up, auxiliary, FM auto and AM functions. Bass, treble, and balance controls unfortunately omit centre indents, but, together with the volume control, worked very smoothly. Three front panel push buttons provide mono/stereo, loudness and tape monitor functions. No bass or treble roll-offs are provided.

Surprisingly, the amplifier gave virtually a 50% transient power output increase, and thus sounded louder than measurements would normally suggest with its continuous rating. The general amplifier sound quality was very good, within its rating, but a tendency to "woofiness" in the bass was confirmed by the poor measured damping factor. The half power band width did not measure too well. The IM distortion performance was reasonably good. No output DC problems were encountered. The signal to noise ratios measured relatively well, although some noise was introduced when the volume control was increased to its flat out position. The bass and volume controls tracked extremely well, but the treble control was not at all well ganged, since it showed a maximum swing of 4dB at worst. The loudness control was satisfactory. The pick-up input impedance measured admirably, as did the clipping margin. On the record output socket we noticed that the pick-up output level was approximately 5dB lower than the equivalent tuner output level, and this might be annoying. The DIN tape socket will be found compatible with most DIN input sockets on associated DIN standard recorders.

The tuner's signal to noise performance was amazingly good on stereo, and frankly as good as most of the very highly priced receivers. The frequency response was quite remarkably flat, but the pilot tone filtering was virtually ineffective, thus making it almost essential to have a multiplex filter in any interconnected recorder. The distortion performance measured well, and is particularly remarkable on such an inexpensive receiver. the crosstalk measured rather poorly, but in context will almost certainly be found adequate, and in any case better than the average pick-up cartridge, since relatively low distortion was noted in the crosstalk signal, which is more important than an excellent crosstalk figure. The RF input sensitivities were all remarkably good for a budget tuner. The adjacent and alternate channel selectivities were very good, as were the IF rejection and local oscillator radiation measurements. The image response was very bad (only —45dB), and thus some problems could be experienced by users near aircraft flight paths (eg near Heathrow Airport). A single RF strength meter is provided, which has to serve for a tuning indicator, and the tuning dial was reasonably accurate. The tuning knob ran smoothly and had no backlash.

Despite a few poor measurements this receiver was very well liked, producing excellent stereo radio signals. It is very simple to use, and can be

BEST BUY

recommended strongly as a budget buy which despite its minor failings shows up some of its more expensive competition. Excellent value for money, then, particularly for the amazingly good tuner performance. Still a "best buy".

**Amplifier Section**

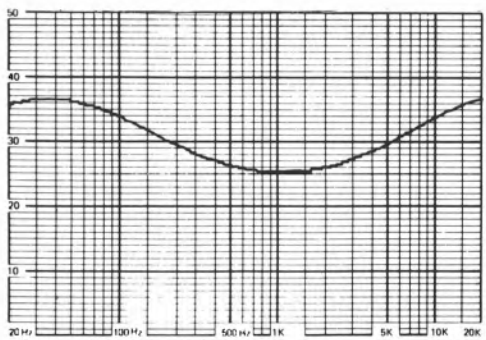
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 14W |
| Av. power o/p single ch. driven 8Ω | 16.5W |
| Av. power o/p single ch. driven tone burst 8Ω | 20.5W |
| Av. power o/p single ch. driven 4Ω | N/A |
| Av. power o/p single ch. driven tone burst 4Ω | N/A |
| Idle DC output worst ch. | — |
| Turn on/off max. DC swing worst case | 3.2V |
| Damping factor 8Ω | 14 |
| X-over distortion | N/A |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | N/A |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | N/A |
| IM dist. 10W av. | 2.2% |
| IM dist. RIAA/rec. out | 0.004% |
| ½ power bandwidth (old method 0.1%) | 20Hz-10kHz |
| Av. RIAA impedance | 46kΩ |
| Av. RIAA sensitivity | 2.1mV |
| Av. RIAA clipping | 110mV |
| Av. RIAA capacitance | 160pF |
| Av. aux. impedance | 109kΩ |
| Av. aux. sensitivity | 115mV |
| Av. tape impedance | 140kΩ |
| Av. tape sensitivity | 115mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 900mV |
| Max. level from RIAA-rec. out | 390mV |
| Rec. out impedance DIN av. | 80kΩ |
| Rec. out impedance phono av. | 836Ω |
| Av. RIAA noise ref 8mV—rec. out unw. | 75dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 71dB |
| Amp. hum zero vol. AMF weighted av. | N/A |
| Amp. noise zero vol. CCIR s/n av. | 89dB |
| Amp. noise worst vol. CCIR s/n av. | 68dB |
| Amp. noise zero vol. unw. 20/20kHz | 700μV |
| Volume control tracking worst error | 1dB |

**Tuner Section**

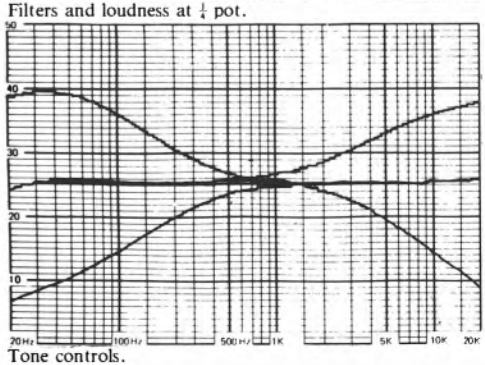
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.5μV |
| Mono RF sens. 50dB IHF | 3.2μV |
| Stereo RF sens. 50dB | 23μV |
| RFIM | 70.5dB |
| Adj. ch. av. | 5.5dB |
| Alt. ch. av. | 56dB |
| Image resp | 45dB |
| Capture ratio | 3dB |
| AM reject | 53dB |
| Mono dist. 100% centre tune worst ch. | 0.32% |
| Mono dist. 100% op. tune av. | 0.32% |
| St. L = —R 50% centre tune av. | 0.11% |
| St. single ch. 100% centre tune worst ch. | 0.28% |
| MPX reject 19kHz worst ch. | 36.5dB |
| MPX reject 38kHz worst ch. | 77dB |
| X-talk 1kHz centre tune worst ch. | 26dB |
| X-talk 10kHz centre tune worst ch. | 30dB |
| X-talk 1kHz op. tune av. | 32dB |
| Freq. resp. St. —3dB L/R | 3Hz/18kHz—3Hz/18.1kHz |
| Freq. resp. St. 15kHz L/R | —1.25dB/—1.25dB |
| Limit threshold | 1.1μV |
| Muting threshold | NONE |
| St. s/n CCIR 100μV/1mV av. | 51.5dB—70dB |
| Mono s/n 1mV av. CCIR | 75dB |

**General Data**

| | |
|---|---|
| Dimensions | 424 x 125 x 266mm |
| Weight | 5.7kgs |
| Typical selling price including VAT | £110.00 |



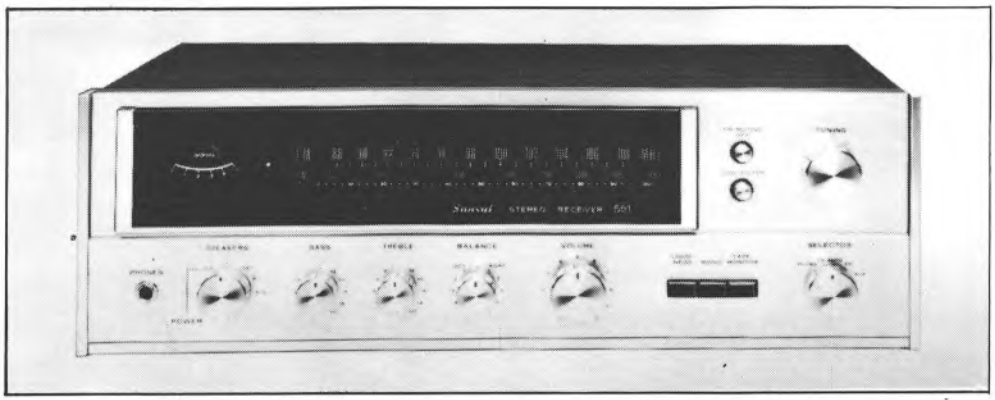
Filters and loudness at ¼ pot.



Tone controls.

# Sansui 551

Sansui London Showroom, 39/41 Maple Str., London W1P 5FU. 01-568 5353.



The Sansui 551 (similar to the model 331), has 22W per channel (both driven) into either or both main and remote speakers (switchable). Screw terminals are provided for their connection. The headphone socket on the front panel gives adequate drive for all normal headphones. Pick-up, auxiliary, and tape in/out sockets are phono, but tape is also duplicated on a 5-pole DIN (compatible). Bass, treble and balance controls are all rotary, but without centre indents. The balance control tended to shift the image rather rapidly in the centre of its travel, but the volume control was well liked and very smooth. Loudness, mono/stereo, FM mute, treble roll off and tape monitor buttons are provided on the front panel, and the input selector switches between auxiliary, pick-up, FM auto and AM (MW). A ferrite rod on a pull out lever is provided for AM reception, and terminals allow connection of external 75 and 300 ohm FM or AM aerials. Only a signal strength meter is included, which has to be used for tuning optimally.

This amplifier sounded surprisingly good at the HF end, although bright, but the bass end tended to be rather woolly and lacked punch, and this was confirmed by the poor damping factor measurements and also unfortunately the restricted half power bandwidth at the low frequency end. This, however, was measured for 0.1%, and undoubtedly the measurements would have been better for 1%. The intermodulation distortion measurements showed a clear increase at lower levels (slight crossover distortion). The harmonic distortion measured well at middle frequencies. No DC problems were experienced on the output. The general noise levels of the amplifier measured quite well, and in particular, the pick-up pre-amp was very quiet indeed. It also had in ideal input impedance, and excellent clipping margin and extremely low measured intermod distortion. Auxiliary and phono tape in and out levels and impedances were optimum. The tracking of the bass, treble and volume controls was only just satisfactory, although the treble roll-off cutting 6dB per octave from 3kHz was adequate. Bass and treble controls had an acceptable range. The amplifier was found very simple to use, and easy to connect with external recorders.

The tuner's signal to noise ratio on stronger stereo signals and all mono ones was really excellent, and up to the high standards of the best tuners. However, weak stereo signals were rather hissy. The mono distortion levels were all very low, but in stereo the measurements were somewhat higher, although subjectively they were certainly not serious. The general sound quality was clean and bright. Slight traces of spitch were noticed in the crosstalk when speech was transmitted on one channel only, although the general speech quality was very good. The frequency response, whilst being good at the high frequency end, was —3dB at 35Hz (not serious). All the crosstalk figures were very good, especially for a budget receiver. The mono RF sensitivity was excellent, but the stereo one was rather average. The adjacent and alternate channel selectivities were lop-sided. The image response was poor and the capture ratio just adequate. Surprisingly, the 551 front end was not quite as good as on the 331, but possibly this is due to sample variation. The dial accuracy was adequate.

This is of course a budget receiver, and so I must not be too hard on its failings, for the good points are strong indeed, in particular the excellent signal to

noise ratio of the tuner on local signals, and the generally good sound performance on such signals. Although I rate the unit as fairly good value for money, it was a slight disappointment. The 331 seemed better in many respects, although its output power is lower. A recommended buy, then, but look at its competition.

**Amplifier Section**

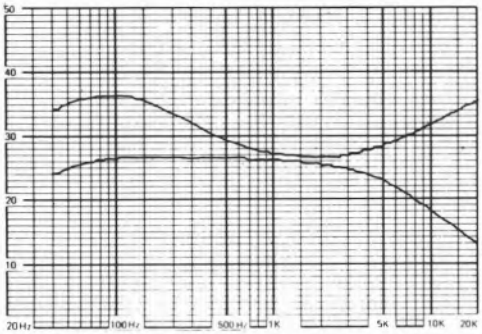
Av. power o/p both chs. driven 8Ω . . . . . 21.5W
Av. power o/p single ch. driven 8Ω . . . . . 24.5W
Av. power o/p single ch. driven tone burst 8Ω . . . . . 26W
Av. power o/p single ch. driven 4Ω . . . . . N/A
Av. power o/p single ch. driven tone burst 4Ω . . . . . N/A
Idle DC output worst ch. . . . . <100μV
Turn on/off max. DC swing worst case . . . . . 800mV
Damping factor 8Ω . . . . . 12
X-over distortion . . . . . N/A
Harmonic dist. —3dB ref 1% 1kHz 8Ω av. . . . . N/A
Harmonic dist. —1dB ref 1% 1kHz 8Ω av. . . . . N/A
IM dist. 10W av. . . . . 0.19%
IM dist. RIAA/rec. out . . . . . 0.005%
½ power bandwidth (old method 0.1%) . . . . . 85Hz-16kHz
Av. RIAA impedance . . . . . 52.5kΩ
Av. RIAA sensitivity . . . . . 1.85mV
Av. RIAA clipping . . . . . 128mV
Av. RIAA capacitance . . . . . 12pF
Av. aux. impedance . . . . . 116kΩ
Av. aux. sensitivity . . . . . 119mV
Av. tape impedance . . . . . 153kΩ
Av. tape sensitivity . . . . . 119mV
Mic impedance . . . . . —
Mic. sensitivity . . . . . —
Mic. clipping . . . . . —
Max. level from tuner-rec. out . . . . . 710mV
Max. level from RIAA-rec. out . . . . . 435mV
Rec. out impedance DIN av. . . . . 79kΩ
Rec. out impedance phono av. . . . . 590Ω
Av. RIAA noise ref 8mV—rec. out unw. . . . . 75dB
Av. RIAA noise ref 8mV—rec. out CCIR . . . . . 72dB
Amp. hum zero vol. AMF weighted av. . . . . N/A
Amp. noise zero vol. CCIR s/n av. . . . . 85dB
Amp. noise worst vol. CCIR s/n av. . . . . 79dB
Amp. noise zero vol. unw. 20/20kHz . . . . . 350μV
Volume control tracking worst error. . . . . 1dB

**Tuner Section**

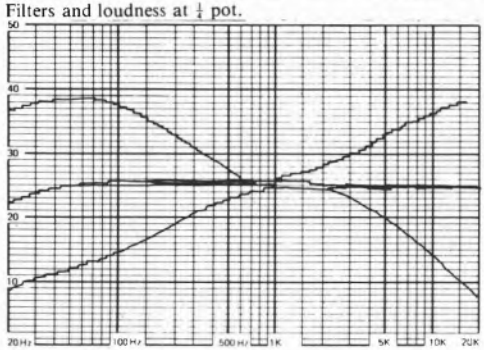
Mono RF sens. 30dB IHF . . . . . 1.1μV
Mono RF sens. 50dB IHF . . . . . 2.5μV
Stereo RF sens. 50dB . . . . . 32μV
RFIM . . . . . 71dB
Adj. ch. av . . . . . 9dB
Alt. ch. av. . . . . 34dB
Image resp . . . . . 59dB
Capture ratio . . . . . 3.5dB
AM reject . . . . . 54dB
Mono dist. 100% centre tune worst ch. . . . . 0.29%
Mono dist. 100% op. tune av. . . . . 0.25%
St. L = —R 50% centre tune av. . . . . 0.22%
St. single ch. 100% centre tune worst ch. . . . . 0.62%
MPX reject 19kHz worst ch. . . . . 57.5dB
MPX reject 38kHz worst ch. . . . . 47.5dB
X-talk 1kHz centre tune worst ch. . . . . 38dB
X-talk 10kHz centre tune worst ch. . . . . 37dB
X-talk 1kHz op. tune av. . . . . 39dB
Freq. resp. St. —3dB L/R 37Hz/15.2kHz—34Hz/15.1kHz
Freq. resp. St. 15kHz L/R. . . . . −2.5dB/—2.5dB
Limit threshold . . . . . 0.9μV
Muting threshold . . . . . 13μV
St. s/n CCIR 100μV/1mV av. . . . . 49dB—67dB
Mono s/n 1mV av. CCIR . . . . . 70.5dB

**General Data**

Dimensions . . . . . 424 x 135 x 285mm
Weight . . . . . 8.6kgs
Typical selling price including VAT . . . . . £145.00



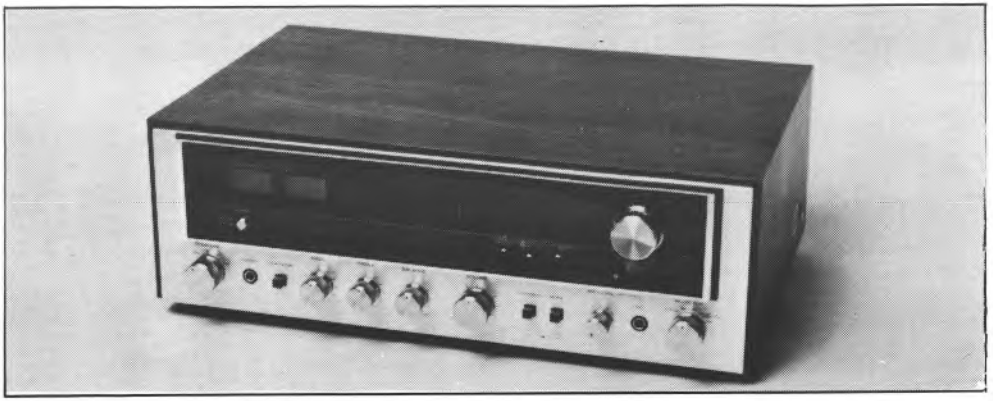
Filters and loudness at ½ pot.



Tone controls.

# Sansui 5050

Sansui London Showroom, 39/41 Maple Str., London W1P 5FU. 01-568 5353.



In the first edition, the 9090 was regarded as one of the best buys, and this new model has been introduced quite recently in the same series. Maximum output power is 49W per channel into 8 ohms, rising to 70W per channel into 4 ohms. Attractively designed, and housed in a wooden cabinet with metal base plate, it offers switching to two pairs of loudspeakers, and interconnection with just one external recorder. The tuner section has FM and AM, a ferrite rod being supplied for the latter, which can be pulled out but not rotated. A three core mains lead together with earth terminals are fitted. Terminals are supplied for external AM and 300 ohm FM inputs, and a clamp terminal for 75 ohm unbalanced FM.

Audio interconnections are on phono sockets, and tape is duplicated on a compatible 5-pole DIN socket. Bass and treble controls each have 11 rather uneven steps, but the balance control had a good law and was centre indented. The main rotary volume control had excellent tracking, and felt quite smooth. A separate mic gain control (with stereo input jack) is provided with a rather poor sensitivity, but sufficient for PA. Push buttons operate treble filter (6dB per octave above 3kHz — too low) loudness control, stereo/mono, power on/off, tape monitoring, external adaptor by-pass and FM mute.

The power amplifier's tone burst performance measured very well, showing 75W transient power available in to 4 ohms. Whilst frequency response extended to 90kHz, half-power bandwidth extended to 100kHz. Swept IM pen charts looked well, but showed a rise at 150kHz, which is not serious. The damping factor measured well, and the sound quality was considered good. Whilst output noise was low with available control at minimum, two higher than average peaks were noted at 10 o'clock and 3 o'clock, caused by the loudness control circuitry, and this is a little unfortunate. No switch on/off problems were noted, and headphone quality was quite good from the stereo jack socket, but available levels a little high into 600 ohm models. Harmonic distortion measured very well even at 1dB below clipping. The tone controls offered an average performance, and the 1kHz response was slightly affected. Input and output levels on auxiliary and tape sockets were all compatible with DIN and phono standards.

The RIAA pick-up input had a well optimised impedance characteristic, but showed a marginal impedance drop at very low frequencies. The response was very flat, which is unfortunate since no rumble filter is provided, and I would have preferred a bass droop below 35Hz. Noise and distortion performance measured well.

Whilst sensitivities were reasonable, RFIM was rather average, and image response poor. Selectivity measured quite well, as did capture ratio and limit threshold. Muting was fairly insensitive, but AM rejection was adequate. Frequency response was poor, measuring —7.5dB at 15kHz, clearly due to the multiplex filter design, which did, however, give excellent rejection. This should have been sacrificed a bit for the sake of improved response. Signal to noise ratio was rather poorer than average, particularly on strong stereo signals. The original sample had a misaligned discriminator, but the second sample gave very good harmonic distortion measurements, which were much better than average. Crosstalk measurements were all good. The subjective quality was generally very good, but a little noisy, and transients were audibly down

compared with those from our standard system. AM rejection was fairly good, but the response very limited. Frequency scale accuracy was very good and tuning ergonomics good.

I must confess to being disappointed with the tuner section, and Sansui will have to improve the audio recovery level from the discriminator to improve hiss levels. Furthermore, the tuner's response was poor, since the multiplex filter affected it too greatly. The amplifier section, however, was well liked. The power amplifier was well designed, but this receiver can only be recommended if you can overlook the tuner's deficiences.

**Amplifier Section**

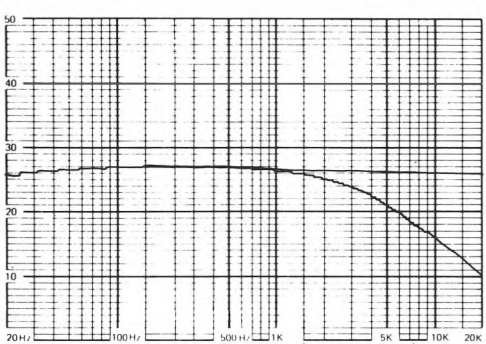
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 40.5W |
| Av. power o/p single ch. driven 8Ω | 49W |
| Av. power o/p single ch. driven tone burst 8Ω | 54W |
| Av. power o/p single ch. driven 4Ω | 70W |
| Av. power o/p single ch. driven tone burst 4Ω | 95W |
| Idle DC output worst ch. | 45mV |
| Turn on/off max. DC swing worst case | 750mV |
| Damping factor 8Ω | 73 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.01% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.02% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.013% |
| Half power bandwidth | 2Hz-100kHz |
| Av. RIAA impedance | 47.7kΩ |
| Av. RIAA sensitivity | 3.2mV |
| Av. RIAA clipping | 205mV |
| Av. RIAA capacitance | 10pF |
| Av. aux. impedance | 57.5kΩ |
| Av. aux. sensitivity | 195mV |
| Av. tape impedance | 66.7kΩ |
| Av. tape sensitivity | 195mV |
| Mic impedance | 18.6kΩ |
| Mic. sensitivity | 5.5mV |
| Mic. clipping | >10V |
| Max. level from tuner-rec. out | 492mV |
| Max. level from RIAA-rec. out | 480mV |
| Rec. out impedance DIN av. | 74.3kΩ |
| Rec. out impedance phono av. | 350Ω |
| Av. RIAA noise ref 8mV—rec. out unw. | 76.5dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 72dB |
| Amp. hum zero vol. AMF wtd. av. ref 1W 8Ω | 85dB |
| Amp. noise zero vol. CCIR s/n av. | 92dB |
| Amp. noise worst vol. CCIR s/n av. | 87dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 0.7dB |

**Tuner Section**

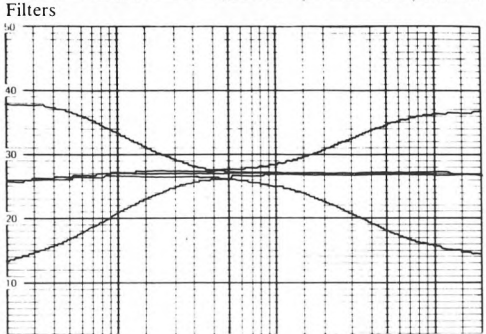
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.3μV |
| Mono RF sens. 50dB IHF | 3.1μV |
| Stereo RF sens. 50dB | 40μV |
| RFIM | 64dB |
| Adj. ch. av | 8dB |
| Alt. ch. av. | >70dB |
| Image resp | 50dB |
| Capture ratio. | 1.1dB |
| AM reject | 66dB |
| Mono dist. 100% centre tune worst ch. | 0.18% |
| Mono dist. 100% op. tune av. | 0.12% |
| St. L = —R 50% centre tune av. | 0.13% |
| St. single ch. 100% centre tune worst ch. | 0.22% |
| MPX reject 19kHz worst ch. | 72dB |
| MPX reject 38kHz worst ch. | 53dB |
| X-talk 1kHz centre tune worst ch. | 38dB |
| X-talk 10kHz centre tune worst ch. | 34dB |
| X-talk 1kHz op. tune av. | 44dB |
| Freq. resp. St. —3dB L/R 14Hz/13.3kHz—14Hz/13.5kHz | |
| Freq. resp. St. 15kHz L/R | —7.8dB/—7.3dB |
| Limit threshold | 0.8μV |
| Muting threshold | 8μV |
| St. s/n CCIR 100μV/1mV av. | 50dB—60dB |
| Mono s/n 1mV av. CCIR | 65dB |

**General Data**

| | |
|---|---|
| Dimensions | 462 x 146 x 299mm |
| Weight | 10.1kgs |
| Typical selling price including VAT | £195.00 |



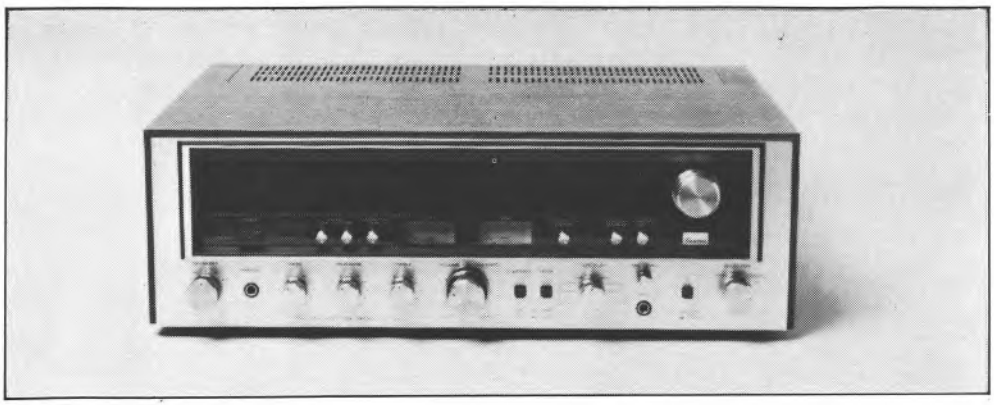
Filters



Tone controls.

# Sansui 7070

Sansui London Showroom, 39/41 Maple Str., London W1P 5FU. 01-568 5353.



Similarly styled to the other models in the latest Sansui series, this one is capable of 88W into 8 ohms, but only 72W into 4 ohms. Bass, middle and treble controls are provided with 11 reasonably even steps, thus allowing a wide range of adjustment. The volume control is concentrically mounted with the centre-indented balance control behind it, and both operated well with good tracking. Medium wave AM reception had a very sharp selectivity, severely limiting response; a swivellable ferrite rod complements an AM external aerial terminal, FM antennae being interconnected with 300 ohm terminals, or a clamp-type 75 ohm one. A 3-core mains lead and adequate earthing are fitted.

Two tape recorders can be interconnected with phono sockets, tape 1 being duplicated on a 5-pole DIN socket. Two pairs of speakers can be switched and interconnected with clamp-type connectors. Push switches select loudness compensation, stereo/mono, pick-up 1/2, power on/off, rumble filter (6dB per octave below 170Hz — too high), treble filter (6dB per octave above 3.5kHz — too low), 20dB audio muting, external adaptor insert, FM stereo high blend, and FM muting. A rotary switch selects pick-up, FM auto, external Dolby FM adaptor, AM and auxiliary inputs. A separate microphone control complements a stereo jack socket which is rather insensitive.

The power amplifier's tone burst performance revealed too much protection, particularly into 4 ohms. Distortion measurements were satisfactory, and the swept IM charts were very satisfactory. The half-power bandwidth was sensibly extended to 100kHz, whilst the actual response tailed off above 60kHz, which is welcome. Damping factor measured well, and the sound quality seemed better than average and showed a welcome transparency. Output noise was satisfactory, but background hiss might be noticed when high impedance headphones are connected (too much level available here). No switch on/off problems were noted. All inputs and outputs on auxiliary and tape were well optimised for DIN and phono standards.

The RIAA input had a higher than average capacity and above average input impedance. The clipping margin was excellent though, and noise and distortion performance good. The frequency response was also very flat.

Although the tuner's RF sensitivity measured well, RFIM was rather poor. Other RF measurements were satisfactory, but selectivity particularly good. Limiting and muting worked well, but AM rejection was poor on strong signals. Capture ratio was a little disappointing at 2dB. Frequency response was just adequate, but signal to noise ratios rather poor. The multiplex filter, however, worked well. Distortion performance was very well optimised, rising to just over 0.3% at worst, and this is good considering the good adjacent channel selectivity. The subjective sound quality was very good indeed, but optimum tuning was slightly right of centre. Crosstalk also measured well. Dial accuracy was adequate, but tuning ergonomics generally good.

Although this receiver was liked, the tuner's RFIM and signal to noise performances rather let it down. The amplifier works well into 8 ohms, but cannot be recommended for use with 4 ohm speakers. Reasonable value for money, but its competition is too strong, and so just a lukewarm recommendation.

**Amplifier Section**

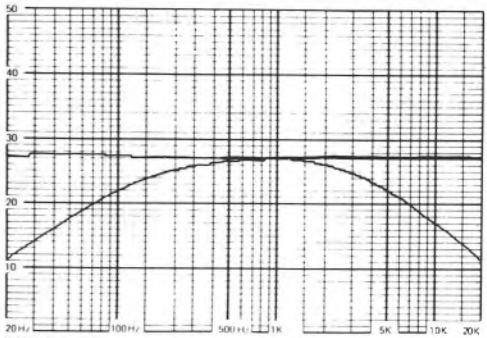
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 83W |
| Av. power o/p single ch. driven 8Ω | 88W |
| Av. power o/p single ch. driven tone burst 8Ω | 77W |
| Av. power o/p single ch. driven 4Ω | 72W |
| Av. power o/p single ch. driven tone burst 4Ω | 62W |
| Idle DC output worst ch. | 12mV |
| Turn on/off max. DC swing worst case | 80mV |
| Damping factor 8Ω | 67 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.02% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.03% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.002% |
| Half power bandwidth | 2Hz-100kHz |
| Av. RIAA impedance | 55kΩ |
| Av. RIAA sensitivity | 2.4mV |
| Av. RIAA clipping | 190mV |
| Av. RIAA capacitance | 160pF |
| Av. aux. impedance | 56kΩ |
| Av. aux. sensitivity | 145mV |
| Av. tape impedance | 64kΩ |
| Av. tape sensitivity | 145mV |
| Mic impedance | 14.6kΩ |
| Mic. sensitivity | 3.4mV |
| Mic. clipping | 350mV |
| Max. level from tuner-rec. out | 428mV |
| Max. level from RIAA-rec. out | 485mV |
| Rec. out impedance DIN av. | 74.5kΩ |
| Rec. out impedance phono av. | 1.5Ω |
| Av. RIAA noise ref 8mV—rec. out unw. | 75.5dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 72dB |
| Amp. hum zero vol. AMF wtd. av. ref 1W 8Ω | 80dB |
| Amp. noise zero vol. CCIR s/n av. | 91.5dB |
| Amp. noise worst vol. CCIR s/n av. | 79dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 0.7dB |

**Tuner Section**

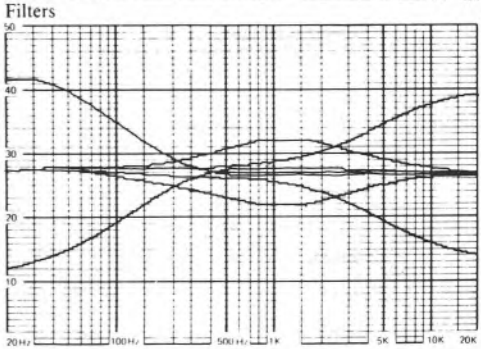
| | |
|---|---|
| Mono RF sens. 30dB IHF | 0.9μV |
| Mono RF sens. 50dB IHF | 2.8μV |
| Stereo RF sens. 50dB | 29μV |
| RFIM | 62dB |
| Adj. ch. av. | 10.5dB |
| Alt. ch. av. | >70dB |
| Image resp | 66dB |
| Capture ratio | 2dB |
| AM reject | 51dB |
| Mono dist. 100% centre tune worst ch. | 0.17% |
| Mono dist. 100% op. tune av. | 0.13% |
| St. L = —R50% centre tune av. | 0.1% |
| St. single ch. 100% centre tune worst ch. | 0.34% |
| MPX reject 19kHz worst ch. | 66dB |
| MPX reject 38kHz worst ch. | 91dB |
| X-talk 1kHz centre tune worst ch. | 50dB |
| X-talk 10kHz centre tune worst ch. | 34dB |
| X-talk 1kHz op. tune av. | 51dB |
| Freq. resp. St. —3dB L/R 15Hz/15.1kHz—15Hz/15.1kHz | |
| Freq. resp. St. 15kHz L/R | —2.7dB/—2.6dB |
| Limit threshold | 0.5μV |
| Muting threshold | 4.5μV |
| St. s/n CCIR 100μV/1mV av. | 53dB—59dB |
| Mono s/n 1mV av. CCIR | 65dB |

**General Data**

| | |
|---|---|
| Dimensions | 502 x 156 x 371mm |
| Weight | 16.6kgs |
| Typical selling price including VAT | £310.00 |



Filters



Tone controls

RECOMMENDED

# Sansui 8080

Sansui London Showroom, 39/41 Maple Str., London W1P 5FU. 01-568 5353.

This receiver gives up to 95W per channel (both driven) into main and either of two remote pairs of loudspeakers (switchable). The 8080 is very similar to the 9090, but the bass and treble controls having 11 stepped positions do not have switched turnover frequencies, although a similar stepped mid control is also provided. Inputs include pick-up, auxiliary, and two tape recorders, which with their outputs are on phono sockets, tape 2 also being duplicated on a 5-pole DIN socket. A swivellable ferrite rod is provided together with a separate AM aerial terminal, and 75 and 300 ohm FM aerial inputs. Volume and balance controls are concentric, the latter having a centre indent. A rotary switch selects pick-up, auxiliary, FM auto, AM or external Dolby FM adaptor. Levers or push buttons control mono/stereo, loudness, FM mute, Dolby noise reduction/4 channel adaptor (external), audio mute, rumble and treble roll-offs, and power on/off. A tape selector/monitor control allows monitoring from either recorder, and also permits dubbing in either direction. A separate microphone input gain control permits mixing from an appropriate input jack socket, which is complemented by a headphone jack. All the controls felt very smooth, and the receiver was easy to use, with the tuning ergonomics also good.

Whilst the intermodulation and harmonic distortion performance of the amplifier was very good at higher levels, some slight crossover distortion was noticed at very quiet levels. The sound quality was on the bright side, although generally very good, but the half power band width only extended (for 0.1%) to 13kHz. The damping factor measured well. A slight hiss was audible on the output, if the treble control was fully advanced. Headphones might sound a little hissy. All the controls worked well. The tone controls offered adequate variation, but failed to give a sufficient range of adjustment at the ends of the audio spectrum. The mid control was useful, varying 1.5kHz by ±5dB. The rumble and treble rolls offs cut at 6dB per octave from 150Hz (too high) and 3kHz (too low) respectively. The RIAA input had a rather low impedance, which would suit cartridges such as the Shure V15/111, although some others might show a slight amount of top cut. The RIAA clipping margin and noise level were excellent, and the tuner outputs were compatible in level on the record output sockets. The auxiliary and tape in/out impedances and sensitivities measured well, and the microphone input was more sensitive than average, and thus just adequate (most others are hopeless).

The signal to noise ratios on the tuner section were excellent. The frequency response was very good, on one channel, whilst the other channel showed an odd 1dB shelf down from 3.6kHz upwards, but only 3dB down at 15kHz (not too noticeable in practice). The distortion performance was fairly good, and the crosstalk very good at middle frequencies, but average at high ones. The multiplex filter was excellent, as was the tuning accuracy. The RF input sensitivities all measured very well. The adjacent and alternate channel selectivities were excellent, as were all the other RF measurements, although the intermod performance was just good.

Although this receiver performed generally very well, it is clearly outclassed by the Sansui 9090, which now costs about 20% more. However, it is only fair to say that I still consider it reasonable value for money, and it can be recommended, although the 9090 is a far better buy.

# Sansui 8080

RECOMMENDED

**Amplifier Section**

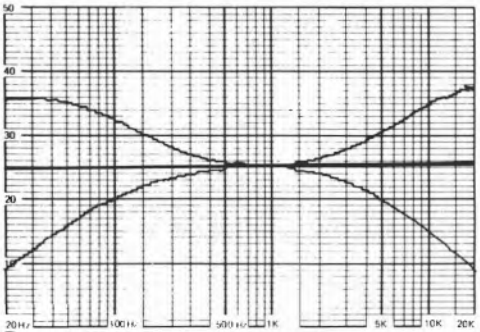
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 95W |
| Av. power o/p single ch. driven 8Ω | 105W |
| Av. power o/p single ch. driven tone burst 8Ω | 121W |
| Av. power o/p single ch. driven 4Ω | N/A |
| Av. power o/p single ch. driven tone burst 4Ω | N/A |
| Idle DC output worst ch. | NONE |
| Turn on/off max. DC swing worst case | 100mV |
| Damping factor 8Ω | 46 |
| X-over distortion | N/A |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | N/A |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | N/A |
| IM dist. 10W av. | 0.04% |
| IM dist. RIAA/rec. out | 0.015% |
| ½ power bandwidth (old method 0.1%) | <10Hz-13kHz |
| Av. RIAA impedance | 34.5kΩ |
| Av. RIAA sensitivity | 2.75mV |
| Av. RIAA clipping | 245mV |
| Av. RIAA capacitance | 45pF |
| Av. aux. impedance | 51kΩ |
| Av. aux. sensitivity | 96mV |
| Av. tape impedance | 65kΩ |
| Av. tape sensitivity | 96mV |
| Mic impedance | 15kΩ |
| Mic. sensitivity | 2.75mV |
| Mic. clipping | 320mV |
| Max. level from tuner-rec. out | 320mV |
| Max. level from RIAA-rec. out | 247mV |
| Rec. out impedance DIN av. | 65kΩ |
| Rec. out impedance phono av. | 300Ω |
| Av. RIAA noise ref 8mV—rec. out unw. | 73.5dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 71dB |
| Amp. hum zero vol. AMF weighted av. | N/A |
| Amp. noise zero vol. CCIR s/n av. | 87dB |
| Amp. noise worst vol. CCIR s/n av. | 87dB |
| Amp. noise zero vol. unw. 20/20kHz | 700μV |
| Volume control tracking worst error | 1.4dB |

**Tuner Section**

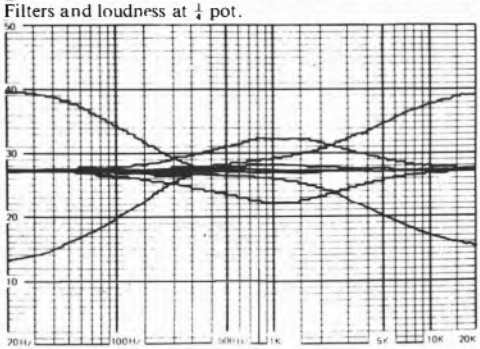
| | |
|---|---|
| Mono RF sens. 30dB IHF | 0.9μV |
| Mono RF sens. 50dB IHF | 1.7μV |
| Stereo RF sens. 50dB | 20μV |
| RFIM | 76dB |
| Adj. ch. av | 10dB |
| Alt. ch. av. | >70dB |
| Image resp | 84dB |
| Capture ratio | 1.25dB |
| AM reject | 59.5dB |
| Mono dist. 100% centre tune worst ch. | 0.21% |
| Mono dist. 100% op. tune av. | 0.2% |
| St. L = —R 50% centre tune av. | 0.09% |
| St. single ch. 100% centre tune worst ch. | 0.46% |
| MPX reject 19kHz worst ch. | 61dB |
| MPX reject 38kHz worst ch. | >80dB |
| X-talk 1kHz centre tune worst ch. | 40dB |
| X-talk 10kHz centre tune worst ch. | 30.5dB |
| X-talk 1kHz op. tune av. | 50dB |
| Freq. resp. St. —3dB L/R 18Hz/15.1kHz—20Hz/15.7kHz | |
| Freq. resp. St. 15kHz L/R | —3dB/—1.75dB |
| Limit threshold | 0.6μV |
| Muting threshold | 16μV |
| St. s/n CCIR 100μV/1mV av. | 55dB—68dB |
| Mono s/n 1mV av. CCIR | 67.5dB |

**General Data**

| | |
|---|---|
| Dimensions | 540 x 182 x 397mm |
| Weight | 20.9kgs |
| Typical selling price including VAT | £360.00 |



Filters and loudness at ¼ pot.



Tone controls.

BEST BUY

# Sansui 9090

Sansui London Showroom, 39/41 Maple Str., London W1P 5FU. 01-568 5353.

With a power output of 144W per channel into 8 ohms, three pairs of loudspeakers can be connected, using spring loaded lever clamps (up to two pairs at a time selectable). Two stereo headphone jacks are included. The volume control is concentrically mounted with the balance control, which has a centre indent. Mid, bass and treble controls, with eleven even steps, are provided, the latter two having a choice of two turnover frequencies available, and with a tone cancel position. Rumble and treble roll-offs are provided, but only at 6dB per octave. The amplifier section incorporates phono break points for external equipment, and also the facility of adding an external Dolby B adaptor/quadraphonic adaptor which can be switched in to either FM radio or general processing, if fitted. Mono/stereo and loudness lever switches are provided, complemented by push buttons for mains on/off, 20dB audio mute, FM muting, multiplex filter and meter selector. A dubbing switch controls two external tape recorders if required, permitting dubbing in either direction with appropriate monitoring. A separate microphone input can be mixed in to the main system. The input selector switch chooses pick-up, auxiliary, Dolby FM adaptor, FM auto, and AM (MW) for which a swivellable ferrite rod antenna is provided at the back. All inputs and tape recorder connections are on phonos, with tape 2 duplicated on a 5-pole DIN. The receiver is very heavy, but runs comparatively cool.

Not only did the amplifier section produce the most amazingly good transparent sound quality, but very extensive tests revealed it to be virtually beyond reproach, even into highly reactive loads, including dummy crossovers etc. The IM distortion performance was very good, and the harmonic distortion performance was so good that the 0.1% THD point was measured only 6.15W below the 1% point! When one channel only was driven the available output reached 162W, a transient tone burst showing 170W. LF to HF swept 20Hz separated two tone tests revealed extremely low IM throughout into both 8 ohms and highly reactive loads. The output noise performance was satisfactory. 70mV DC offset was noted on one channel (internal pre-set error). All the other tone controls and filters tracked extremely well. Towards the bottom of its travel the volume control went very marginally out of step, and slight hiss was introduced at the eleven o'clock setting. All the input and tape out levels and impedances were very compatible, although the RIAA input was a little low, but would suit the Shure V15/111 very well. This input was remarkably quiet, and yet very sensitive.

The audio performance of the tuner section was excellent, with very low distortion and exceptionally low noise. Middle frequency crosstalk measured very well, but was poorer at high frequencies, although adequate. The response showed a 1dB shelf down above 4.5kHz, but 15kHz was —2.75dB. The RF performance was virtually exemplary, having excellent sensitivities and IF bandwidth shape, and good rejections. Subjectively, the tuner was clearly one of the very best. The tuning knob had a slight backlash, although it was smooth. The dial accuracy was excellent.

This remarkable receiver is quite costly, but it is nevertheless very good value for money. Those concerned with exceptional sound quality should find it most attractive since it offers excellent facilities, though none that might be superfluous.

# Sansui 9090

BEST BUY

Still a favourite and a best buy.

**Amplifier Section**

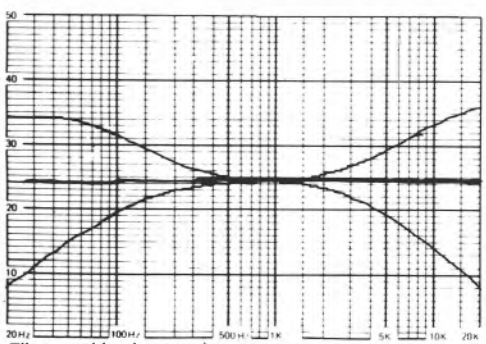
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 162W |
| Av. power o/p single ch. driven 8Ω | 180W |
| Av. power o/p single ch. driven tone burst 8Ω | 265W |
| Av. power o/p single ch. driven 4Ω | N/A |
| Av. power o/p single ch. driven tone burst 4Ω | 265W |
| Idle DC output worst ch. | 70mV |
| Turn on/off max. DC swing worst case | 200mV |
| Damping factor 8Ω | 42 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.02% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.04% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.03% |
| ½ power bandwidth (old method 0.1%) | 5Hz-64kHz |
| Av. RIAA impedance | 34kΩ |
| Av. RIAA sensitivity | 3.3mV |
| Av. RIAA clipping | 240mV |
| Av. RIAA capacitance | 50pF |
| Av. aux. impedance | 52kΩ |
| Av. aux. sensitivity | 132mV |
| Av. tape impedance | 65kΩ |
| Av. tape sensitivity | 132mV |
| Mic impedance | 14.7kΩ |
| Mic. sensitivity | 3.4mV |
| Mic. clipping | 200mV |
| Max. level from tuner-rec. out | 310mV |
| Max. level from RIAA-rec. out | 240mV |
| Rec. out impedance DIN av. | 65kΩ |
| Rec. out impedance phono av. | 330Ω |
| Av. RIAA noise ref 8mV—rec. out unw. | 74.5dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 73dB |
| Amp. hum zero vol. AMF weighted av. | 85dB |
| Amp. noise zero vol. CCIR s/n av. | 89dB |
| Amp. noise worst vol. CCIR s/n av. | 81dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1.8dB |

**Tuner Section**

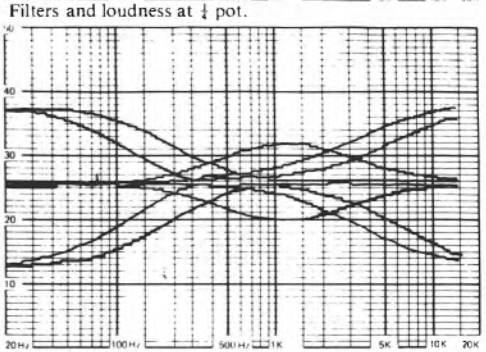
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.1μV |
| Mono RF sens. 50dB IHF | 1.9μV |
| Stereo RF sens. 50dB | 22μV |
| RFIM | 72dB |
| Adj. ch. av. | 11.5dB |
| Alt. ch. av. | >70dB |
| Image resp | 83dB |
| Capture ratio | 1.5dB |
| AM reject | 35.5dB |
| Mono dist. 100% centre tune worst ch. | 0.14% |
| Mono dist. 100% op. tune av. | 0.09% |
| St. L = —R50% centre tune av. | 0.075% |
| St. single ch. 100% centre tune worst ch. | 0.22% |
| MPX reject 19kHz worst ch. | 64dB |
| MPX reject 38kHz worst ch. | 74dB |
| X-talk 1kHz centre tune worst ch. | 40dB |
| X-talk 10kHz centre tune worst ch. | 30dB |
| X-talk 1kHz op. tune av. | 52dB |
| Freq. resp. St. —3dB L/R | 18Hz/15.5kHz—18Hz/15kHz |
| Freq. resp. St. 15kHz L/R | —2.5dB/—3dB |
| Limit threshold | 0.7μV |
| Muting threshold | 4.5μV |
| St. s/n CCIR 100μV/1mV av. | 59dB—73dB |
| Mono s/n 1mV av. CCIR | 73.5dB |

**General Data**

| | |
|---|---|
| Dimensions | 540 x 182 x 397mm |
| Weight | 23.3kgs |
| Typical selling price including VAT | £435.00 |



Filters and loudness at ½ pot.

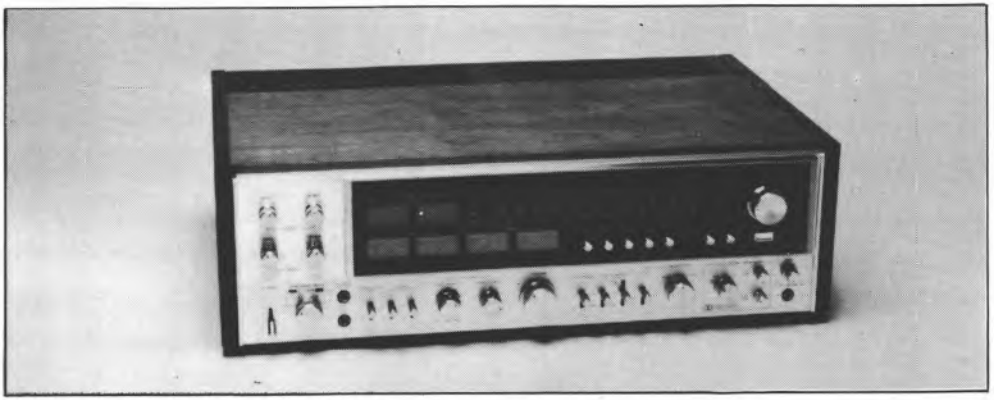


Tone controls.

Updated from 'Hi-Fi Choice: Receivers' 1976 

# Sansui QRX-9001

Sansui London Showroom, 39/41 Maple Str., London W1P 5FU. 01-568 5353.



The UK version of this model incorporates a modification which uses one of the two tape replay monitors for Matrix H decoding. Incorporating four output amplifiers and with the provision of driving two four-channel systems, it can decode CD4, SQ, and QS discs, the last also being used when matrix H is switched in. The four amplifiers can be switched to give higher power for stereo, but normally gives 100W per channel into 8 ohms, but only 70W continuous into 4 ohms.

Centre indented balance controls are provided for front and back channels, and also front/back ratio. The quadraphonic volume control tracked moderately well, with greatest errors diagonally. Bass and treble controls with 11 stepped positions and a rather uneven law provided independant adjustment for front and back. A Dolby B switchable encoder/decoder is available which can be inserted into tape recorder feeds, or into any stereo input before decoding. Switches provide quad/stereo selection, Dolby B operation, loudness compensation, 20dB audio muting, rumble and treble filters (6dB per octave and inappropriate turnovers), tape monitoring and auxiliary input. (No stereo/mono switch). Push buttons select QS synthesiser, hall or surround, normal QS, SQ, CD4/discrete 4 channel, FM muting and Dolby level indication meter.

Four separate meters are provided for output power level indications. Two more meters provide RF signal strength and tuning indications. A stereo mic input is available with volume and balance controls. Rotary switches operate Dolby FM, Dolby play back, Dolby off and Dolby record, and a further switch operates input selection from pick-up, FM auto, FM mono and AM. Audio connections are on phono sockets at the rear, a 5-pole DIN one duplicating tape 1. A ferrite rod complements the external AM terminal, and terminals are provided for 300 and 75 ohm antennae. The receiver is very large, and complex, but ergonomically excellent.

The tone burst performance, whilst being reasonable into 8 ohms, showed a poor transient capability into 4 ohms. The high power mode produced 160W into 8 ohms, but actually lower power than normal mode into 4 ohms (only 53W). The protection circuit seemed to be over protective, and should be better. Output noise was acceptable, but slightly hissy. Swept IM pen charts seemed far better than average, and the half-power bandwidth extended to 90kHz, but the response was sensibly curtailed above 50kHz. Damping factor measured well, and the subjective sound quality into 8 ohm speakers was well above average, and particularly transparent at HF.

Auxiliary and tape inputs had adequate sensitivity, but tape feed levels from disc and tuner were rather low on the phono sockets, but DIN compatability was satisfactory. The RIAA pick-up input measured extremely well and the input impedance was a little high at middle frequencies, but fell sharply below 20Hz, which should become quite an effective low rumble filter. The RF sensitivities all measured very well, but RF IM performance was barely adequate. Other RF measurements were good. Selectivity measured very well and other IF measurements were all very good. Response measured reasonably, and multiplex filtering was excellent. Distortion measurements were extremely good on the second sample, especially considering the sharp selectivity. However the first sample gave poor figures on centre tuning,

but good ones considerably off tune, and it seems the tuning meter circuitry could be better designed. Unfortunately, signal to noise performance was rather disappointing on strong signals, but relatively good on weak ones. Crosstalk and subjective sound quality were excellent, except for background noise. MW performance was rather poor.

This amazing receiver had a good overall audio performance with excellent facilities, but the tuner's RF IM and noise performances need improvement. In other ways, though, the tuner was excellent, and Sansui are likely to improve the criticised areas. CD4 discs reproduced particularly well, using a Shure CD4 cartridge.

**Amplifier Section**
**N.B. Norm/High Power**

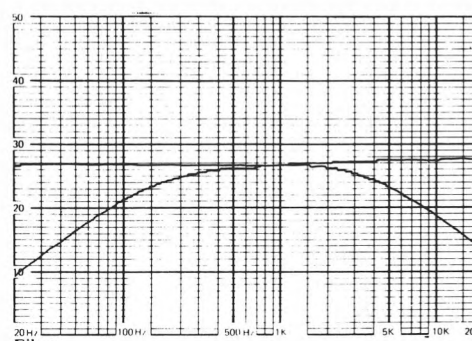
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 94W/136W |
| Av. power o/p single ch. driven 8Ω | 101W/136W |
| Av. power o/p single ch. driven tone burst 8Ω | 100W/121W |
| Av. power o/p single ch. driven 4Ω | 69W/49W |
| Av. power o/p single ch. driven tone burst 4Ω | 56W/41W |
| Idle DC output worst ch. | 25mV |
| Turn on/off max. DC swing worst case | 120mV |
| Damping factor 8Ω | 48/35 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.03/0.01% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.05/0.1% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.002% |
| Half power bandwidth | 2Hz-90kHz/2Hz-95kHz |
| Av. RIAA impedance | 61.2kΩ |
| Av. RIAA sensitivity | 2.5mV/3.2mV |
| Av. RIAA clipping | 180mV |
| Av. RIAA capacitance | 60pF |
| Av. aux. impedance | 37.6kΩ |
| Av. aux. sensitivity | 85mV/110mv |
| Av. tape impedance | 64.5kΩ |
| Av. tape sensitivity | 85mV/110mV |
| Mic impedance | 14kΩ |
| Mic. sensitivity | 3.8mV |
| Mic. clipping | 350mV |
| Max. level from tuner-rec. out | 256mV |
| Max. level from RIAA-rec. out | 302mV |
| Rec. out impedance DIN av. | 69kΩ |
| Rec. out impedance phono av. | 1.5kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 77dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 73dB |
| Amp. hum zero vol. AMF wtd. av. ref 1W 8Ω | 96dB/95dB |
| Amp. noise zero vol. CCIR s/n av. | 90dB/87dB |
| Amp. noise worst vol. CCIR s/n av. | 82dB/88dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 0.9dB |

**Tuner Section**

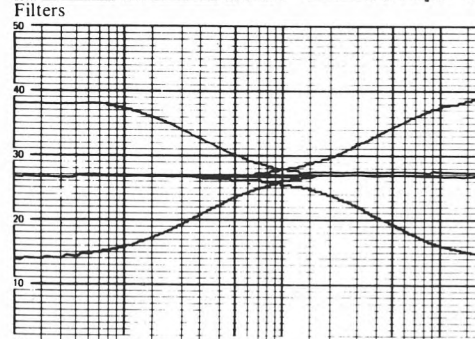
| | |
|---|---|
| Mono RF sens. 30dB IHF | 0.9μV |
| Mono RF sens. 50dB IHF | 2μV |
| Stereo RF sens. 50dB | 30μV |
| RFIM | 65dB |
| Adj. ch. av | 13dB |
| Alt. ch. av. | 60dB |
| Image resp | 79dB |
| Capture ratio | 1.3dB |
| AM reject | 60dB |
| Mono dist. 100% centre tune worst ch. | 0.21% |
| Mono dist. 100% op. tune av. | 0.19% |
| St. L = —R 50% centre tune av. | 0.1% |
| St. single ch. 100% centre tune worst ch. | 0.32% |
| MPX reject 19kHz worst ch. | 69dB |
| MPX reject 38kHz worst ch. | 94dB |
| X-talk 1kHz centre tune worst ch. | 48dB |
| X-talk 10kHz centre tune worst ch. | 34dB |
| X-talk 1kHz op. tune av. | 50dB |
| Freq. resp. St. —3dB L/R 17Hz/15.2kHz—17Hz/15.7kHz | |
| Freq. resp. St. 15kHz L/R | —2.6dB/—2dB |
| Limit threshold | 0.5μV |
| Muting threshold | 6μV |
| St. s/n CCIR 100μV/1mV av. | 53dB—60dB |
| Mono s/n 1mV av. CCIR | 65dB |

**General Data**

| | |
|---|---|
| Dimensions | 600 x 174 x 415mm |
| Weight | 23kgs |
| Typical selling price including VAT | £730.00 |



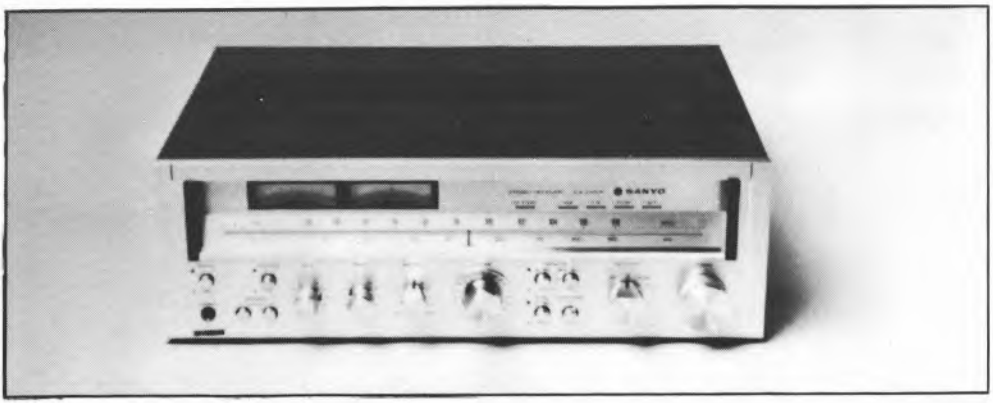
Filters



Tone controls.

# Sanyo JCX-2300K

Sanyo Marubeni (UK) Ltd., 8 Greycaine Rd., Watford, Herts. Watford 46363



A brand new model in the Sanyo range, the JCX-2300K gives 38W per channel into 8 ohms rising to 52W into 4 ohms. Two pairs of speakers can be selected on push buttons, and are interconnected with spring-loaded push clamps which were easy to use. An internal ferrite rod is complemented by an exernal AM aerial terminal, and 300 or 75 ohm FM antennae also connect on terminals. Auxiliary, pick-up and two tape recorders interconnections are on to phonosockets (no 5-pole DIN).

The volume control has 41 steps, and was very well liked. The balance control is centre indented and had a good law, and bass and treble controls each have 11 steps, though 1 and 11 are almost identical to 2 and 10 respectively. No rumble/treble filters are provided. Push buttons give mains on/off, loudness compensation, tape monitors 1/2, stereo/mono and FM muting. The input selector switches to MW, FM, pick-up or auxiliary. The knobs are rather unusual, having a large flat cut out in the centre of which is a small pointer, making them easy to grasp, and also particularly easy to use for blind people. The main case work is plastic covered wood, with a metal under chassis.

The amplifier tone bust tests produced approximately 10% more power than the continuous readings into 8 and 4 ohms, and thus transients are reasonably well handled. The swept IM charts were reasonable, but not as good as some, and half-power bandwidth extended to 75kHz, with frequency response tailing off at about the same frequency. Harmonic distortion, whilst measuring reasonably well, was almost entirely second harmonic. Whilst damping factor measured adequately, bass frequencies sounded flabby and boomy and the treble end seemed to slightly lack focus. In several respects, though, the quality was generally good. However, output noise measured and sounded very poorly, even with volume at minimum. Headphones interconnected with a stereo jack socket had a discernable background hiss if high impedance, but reasonable levels were available. A slight thump was audible on switch on/off, but this should not damage loudspeakers. Idle DC offsets were very poor, a fixed 100mV being measured on one channel with no programme.

Auxiliary and tape input impedances were a little low, but quite compatible, but output levels were reasonable. The RIAA input had a reasonable impedance characteristic at mid and high frequencies, but showed a considerable impedance drop below 60Hz, reaching only around 5 ohms by 20Hz or so. This should not affect most pick-ups, though. Distortion and input noise measured very well. Frequency response showed a slow roll-off subsonically. The clipping margin was very good.

Whilst FM RF sensitivities all measured well, the image response was below average, and RFIM poor. IF rejection was excellent though, and selectivity measured quite well. Limit threshold and muting were good, but capture ratio and AM rejection average. Frequency response measured extremely well with adequate, but not good, multiplex rejection. Signal to noise ratios were acceptable. Distortion measured reasonably well, and crosstalk was adequate. Some spitch and roughness were noted in the crosstalk on maximum deviation programme tests, and the sound quality was rated rather average. Tuning scale accuracy was excellent, and tuning ergonomics good. AM reception was quite good, but some RFIM was noted here.

Unfortunately on the aerial test a very annoying

twittering noise was audible on Radio 3, caused by the receiver's poor RF IM performance, which also produced spurious carriers (12dB aerial attenuator helps if added, but reduces sensitivity). If you are interested in receiving only your local stations, and your aerial signals are not over strong, you will probably find the sound quality quite adequate, and the price asked makes this model quite reasonable value for money. But, it cannot be recommended for sensitive speakers or headphones because of the output noise problem.

**Amplifier Section**

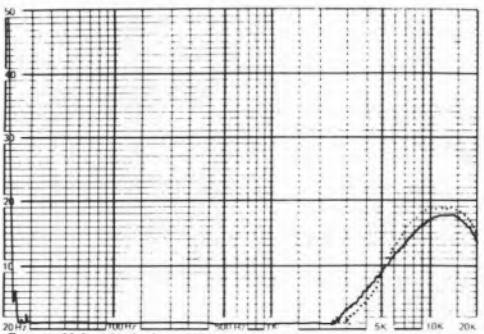
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 33W |
| Av. power o/p single ch. driven 8Ω | 38W |
| Av. power o/p single ch. driven tone burst 8Ω | 42W |
| Av. power o/p single ch. driven 4Ω | 52W |
| Av. power o/p single ch. driven tone burst 4Ω | 60.5W |
| Idle DC output worst ch | 100mV |
| Turn on/off max. DC swing worst case | 7.2V |
| Damping factor 8Ω | 43 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av | 0.02% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av | 0.02% |
| IM dist. 10W av | N/A |
| IM dist. RIAA/rec. out | 0.002% |
| Half power bandwidth | 2Hz-75kHz |
| Av. RIAA impedance | 51.8kΩ |
| Av. RIAA sensitivity | 2.9mV |
| Av. RIAA clipping | 150mV |
| Av. RIAA capacitance | 110pF |
| Av. aux. impedance | 40kΩ |
| Av. aux. sensitivity | 175mV |
| Av. tape impedance | 40kΩ |
| Av. tape sensitivity | 175mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 464mV |
| Max. level from RIAA-rec. out | 475mV |
| Rec. out impedance DIN av | — |
| Rec. out impedance phono av | 2.6kΩ |
| Av. RIAA noise ref 8mV—rec. out unw | —73dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | —71.75dB |
| Amp. hum zero vol. AMF weighted av | —89dB |
| Ref 1W | 8kΩ |
| Amp. noise zero vol. CCIR s/n av | —77.5dB |
| Amp. noise worst vol. CCIR s/n av | 76dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1dB |

**Tuner Section**

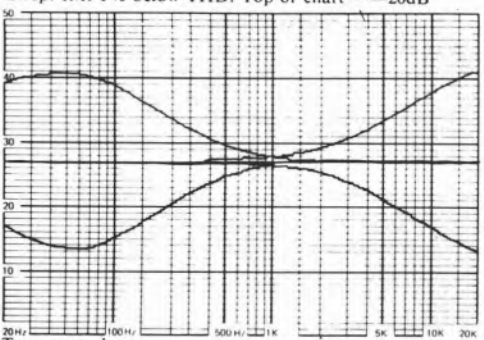
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1μV |
| Mono RF sens. 50dB IHF | 3μV |
| Stereo RF sens. 50dB | 35μV |
| RFIM | 63dB |
| Adj. ch. av | 7dB |
| Alt. ch. av | >70dB |
| Image resp | 60dB |
| Capture ratio | 1.4dB |
| AM reject | 59dB |
| Mono dist. 100% centre tune worst ch | 0.22% |
| Mono dist. 100% op. tune av | 0.22% |
| St. L = —R 50% centre tune av | 0.15% |
| St. single ch. 100% centre tune worst ch | 0.32% |
| MPX reject 19kHz worst ch | 55dB |
| MPX reject 38kHz worst ch | 60dB |
| X-talk 1kHz centre tune worst ch | 37dB |
| X-talk 10kHz centre tune worst ch | 31dB |
| X-talk 1kHz op. tuneav | 39dB |
| Freq. resp. St. —3dB L/R 9Hz/17.1kHz—9Hz/17kHz | |
| Freq. resp. St. 15kHz L/R | —0.2dB/Flat |
| Limit threshold | 0.5μV |
| Muting threshold | 2.5μV |
| St. s/n CCIR 100μV/1mV av | 53dB—62dB |
| Monos/n 1mV av. CCIR | 68dB |

**General Data**

| | |
|---|---|
| Dimensions | 440 x 146 x 330mm |
| Weight | 9kgs |
| Typical selling price including VAT | £150.00 |



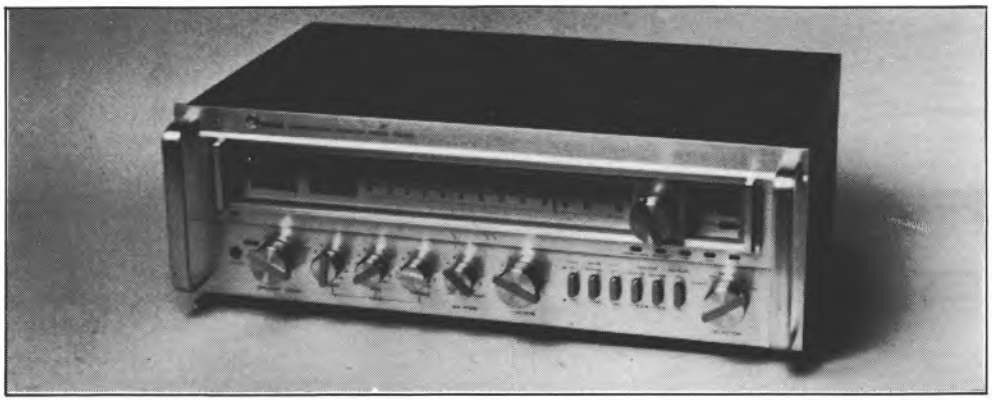
Swept IM. 1% below THD. Top of chart = —20dB



Tone controls

# Setton RS-220

Lewin-Adams Marketing Ltd., Clarke Rd., Mount Farm, Milton Keynes, Bucks. 0908 75764.



Setton is a new French company subcontracting manufacture to Japan, and the model RS-220 is the lowest power receiver in their range, delivering 63W into 8 ohms rising to 87W into 4 ohms. Two pairs of speakers can be interconnected with spring loaded clamps, and independently switchable. The volume control has 41 evenly stepped positions, and is both smooth and well tracking, and the balance control is centre indented with a good law. Controls with 11-stepped positions for bass, mid and treble offer a wide range of adjustment. A ferrite rod is provided for AM, and terminals for 75 and 300 ohm FM and AM external antennae. An IEC mains socket is provided, and also adequate earthing terminals. Interconnection with two external tape recorders is possible, and an input selector switch to pick-up, FM, FM with high frequency stereo narrowing, AM, and auxiliary. Push buttons provide loudness compensation, stereo/mono, treble filter (6dB per octave above 3.5kHz — too low) tape monitors 1/2 and FM muting. Lights are provided for many indications, including protection circuitry in operation, and overloading. The styling is unusual with all rotary controls, including tuning, having protrusions each side of the knob.

The tone burst performance of the amplifier section showed a good power reserve for transients, especially into 4 ohms, and although the swept IM curves were generally good, some slight crossover distortion was noted at very high frequencies at 29dB below 1kHz clipping. Harmonic distortion though measured well, and the sound quality was generally very good. Output noise consisted mainly of more than average high harmonic content hum, hiss being very low. A stereo headphone jack socket worked reasonably into 8 ohms, but high impedance headphones might emphasis the same hum problem. The damping factor measured well. Tape input and output levels and impedances were all reasonably compatible on both phono and DIN sockets. The tuner's output level, though, was far above that from discs.

The RIAA input stage had switchable sensitivities and good impedance and clipping characteristics. distortion and noise measured very well, but whilst frequency response was very flat, unfortunately no rumble filter is fitted.

The FM RF sensitivities were generally rather poor, and the image response of —40dB is very bad indeed. RF IM was also very poor. Local oscillator radiation could also prove a nuisance to neighbours. Selectivity was good, but rather lopsided. Capture ratio and limiting were good, but muting threshold was far too sensitive. AM rejection of weak signals was rather poor. Frequency response was excellent, and multiplex filtering better than average. Noise performance however was only fair. Distortion was rather average on centre tuning, but reasonable when optimally tuned way off centre indication (tuning meter poor). At its best sound quality was excellent, but just a little noisy. Crosstalk measured well and was superb on optimum tuning. Dial accuracy and tuning ergonomics were good, but the protruberances on the tuning knob were a little annoying. MW reception was quite good, but the ferrite rod only pivoted horizontally.

Unfortunately this receiver would seem to be rather overpriced, and considering its disappointing front end and below average signal to noise performance, it cannot really be recommended. Despite this, it is capable of some very good quality on reasonably strong local stations, and with the

**Amplifier Section**

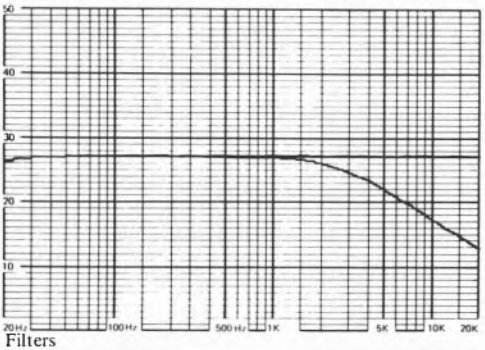
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 54W |
| Av. power o/p single ch. driven 8Ω | 63W |
| Av. power o/p single ch. driven tone burst 8Ω | 68W |
| Av. power o/p single ch. driven 4Ω | 87W |
| Av. power o/p single ch. driven tone burst 4Ω | 106W |
| Idle DC output worst ch. | 20mV |
| Turn on/off max. DC swing worst case | 500mV |
| Damping factor 8Ω | 44 |
| X-over distortion | Yes |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.02% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.03% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.002% |
| Half power bandwidth | 3Hz-95kHz |
| Av. RIAA impedance | 50kΩ |
| Av. RIAA sensitivity | 3mV-5.75mV |
| Av. RIAA clipping | 185mV-360mV |
| Av. RIAA capacitance | 15pF |
| Av. aux. impedance | 88.5kΩ |
| Av. aux. sensitivity | 185mV |
| Av. tape impedance | 88.5kΩ |
| Av. tape sensitivity | 185mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 712mV |
| Max. level from RIAA-rec. out | 270/532mV |
| Rec. out impedance DIN av. | 80kΩ |
| Rec. out impedance phono av. | 4.6Ω |
| Av. RIAA noise ref 8mV—rec. out unw. | 72.5B |
| Av. RIAA noise ref 8mV—rec. out CCIR | 72dB |
| Amp. hum zero vol. AMF wtd. av. ref 1W 8Ω | —74dB |
| Amp. noise zero vol. CCIR s/n av. | 90dB |
| Amp. noise worst vol. CCIR s/n av. | 86dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 0.9dB |

**Tuner Section**

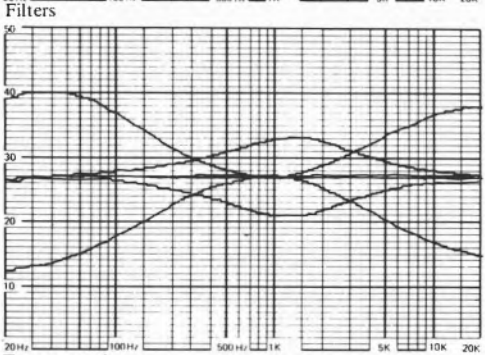
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.8μV |
| Mono RF sens. 50dB IHF | 20μV |
| Stereo RF sens. 50dB. | — |
| RFIM | 62dB |
| Adj. ch. av. | 6.5dB |
| Alt. ch. av. | 69dB |
| Image resp | 40dB |
| Capture ratio | 1.2dB |
| AM reject | 62dB |
| Mono dist. 100% centre tune worst ch. | 0.6% |
| Mono dist. 100% op. tune av. | 0.25% |
| St. L = —R 50% centre tune av. | 0.13% |
| St. single ch. 100% centre tune worst ch. | 0.5% |
| MPX reject 19kHz worst ch. | 61dB |
| MPX reject 38kHz worst ch. | >100dB |
| X-talk 1kHz centre tune worst ch. | 43dB |
| X-talk 10kHz centre tune worst ch. | 34dB |
| X-talk 1kHz op. tune av. | 45dB |
| Freq. resp. St. —3dB L/R 20Hz/16.7kHz—120Hz/16.6kHz | |
| Freq. resp. St. 15kHz L/R | Flat/Flat |
| Limit threshold | 0.7μV |
| Muting threshold | 1.2μV |
| St. s/n CCIR 100μV/1mV av. | 52dB—61dB |
| Mono s/n 1mV av. CCIR | 66dB |

**General Data**

| | |
|---|---|
| Dimensions | 540 x 170 x 300mm |
| Weight | 16kgs |
| Typical selling price including VAT | £300.00 |



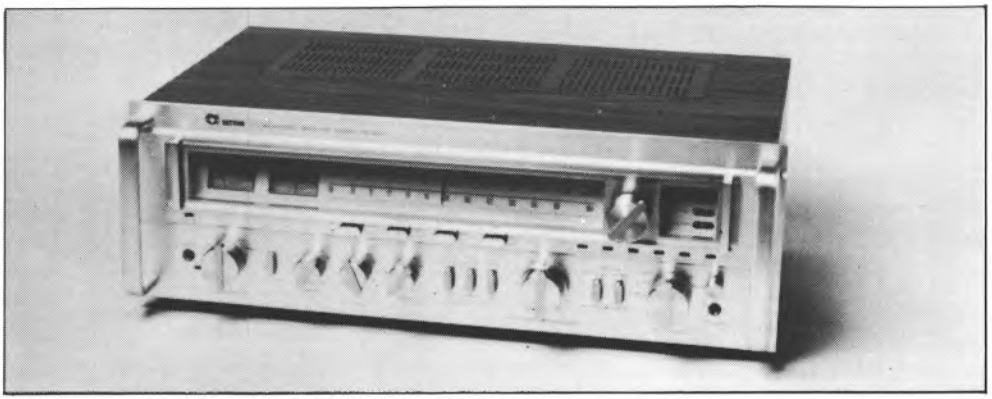
Filters



Tone controls.

## Setton RS-440

Lewin-Adams Marketing Ltd., Clarke Rd., Mount Farm, Milton Keynes, Bucks. 0908 75764.



This rather highly-priced receiver gives 85W into 8 ohms and 123W into 4 ohms, and allows three pairs of loudspeakers to be interconnected on spring-loaded clamps. Only two pairs of speakers can be selected at once though. Styled similarly to the RS-220, with similar knobs, it can be interconnected with two external tape recorders on phono sockets, with tape 2 also on a 5-pole DIN one. The 41 step volume control tracked reasonably, and the centre-indented balance control behind it worked well. Bass, mid and treble controls had 11 even steps, and gave a wide range of adjustment. Push buttons are provided for bass control turnover frequency (250Hz or 500Hz), treble control turnover (2.5kHz or 5kHz), audio mute, FM mute, tone control cancel, stereo/mono, loudness compensation, tape monitors 1/2 and treble filter (6dB per octave above 3kHz — far too low). An input selector chooses pick-up, FM, FM stereo narrowing, AM and auxiliary 1 and 2. A stereo microphone input with volume control is provided on a stereo jack socket, but its input sensitivity was poor. Antenna terminals for 75 and 300 ohm FM complement an AM one, and a ferrite rod swivels horizontally only. An IEC mains socket and earth terminals are provided. Front panel lights include clipping and overload protection indications.

Tone burst tests revealed transient power outputs available some 15% above continuous levels. Harmonic distortion measurements were excellent. Whilst half-power bandwidth extended to 70kHz, frequency response was far too extended above this, and not surprisingly, the swept IM curves showed an increase in distortion above 100kHz, but nevertheless better than expected. The subjective sound quality was excellent, although the original sample had a hum problem when tone controls were in use. A later sample checked showed the problem to be improved, but slight hum was still noticed. Some noise might be noted on headphones interconnected with the stereo jack socket. Damping factor was good, and no problems were noted when switched on or off. Tape input and output levels and sensitivities were all reasonably compatible.

The RIAA input stage had a well optimised impedance, with particularly low capacitance, and an excellent clipping margin. Input noise and distortion were both better than average. Frequency response was very flat, but no rumble filter was provided, which is unfortunate. FM input sensitivities were slightly below average, but RFIM performance was very good. Image response and IF breakthroughs also measured very well. Local oscillator radiation was very poor. Selectivity was well balanced, and reasonably good, with alternate channel rejection excellent. Limiting threshold and capture ratio were only fair, and muting was far too sensitive. AM rejection was below average, particularly on strong signals. Frequency response was excellent, with multiplex filtering very good. Signal to noise ratios were only fair, and should be better for the price asked. Distortion measured very well, and the sound quality very good indeed, but hiss obtruded in quiet passages. Crosstalk measured and sounded at a very low level. Tuning scale accuracy was excellent, but the tuning knob was disliked, though working smoothly. AM reception was quite good, but the audio response severely attenuated.

Whilst this receiver had some excellent points, the very high comparative price asked should allow a quieter discriminator/decoder tuner section. The

overall performance though was much better than that from the RS-220. It is certainly worth considering if you like its features and styling, but cannot be classed a best buy.

**Amplifier Section**

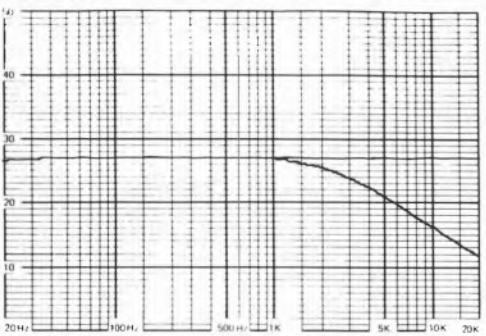
Av. power o/p both chs. driven 8Ω . . . . . 74W
Av. power o/p single ch. driven 8Ω . . . . . 85W
Av. power o/p single ch. driven tone burst 8Ω . . . . . 95W
Av. power o/p single ch. driven 4Ω . . . . . 123W
Av. power o/p single ch. driven tone burst 4Ω . . . . . 153W
Idle DC output worst ch. . . . . 25mV
Turn on/off max. DC swing worst case . . . . . 180mV
Damping factor 8Ω . . . . . 73
X-over distortion . . . . . No
Harmonic dist. —3dB ref 1% 1kHz 8Ω av. . . . . 0.01%
Harmonic dist. —1dB ref 1% 1kHz 8Ω av. . . . . 0.01%
IM dist. 10W av. . . . . N/A
IM dist. RIAA/rec. out . . . . . 0.004%
Half power bandwidth . . . . . 3Hz-77kHz
Av. RIAA impedance . . . . . 50kΩ
Av. RIAA sensitivity . . . . . 3mV-6mV
Av. RIAA clipping . . . . . 200mV-390mV
Av. RIAA capacitance . . . . . 22pF
Av. aux. impedance . . . . . 68kΩ
Av. aux. sensitivity . . . . . 190mV
Av. tape impedance . . . . . 68kΩ
Av. tape sensitivity . . . . . 190mV
Mic impedance . . . . . 8.7kΩ
Mic. sensitivity . . . . . 7mV
Mic. clipping . . . . . >10V
Max. level from tuner-rec. out . . . . . 644mV
Max. level from RIAA-rec. out . . . . . 272/540mV
Rec. out impedance DIN av. . . . . 82kΩ
Rec. out impedance phono av. . . . . 4.7kΩ
Av. RIAA noise ref 8mV—rec. out unw. . . . . 72dB
Av. RIAA noise ref 8mV—rec. out CCIR . . . . . 72.75dB
Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω . . . . . 85dB
Ref 1W . . . . . 8Ω
Amp. noise zero vol. CCIR s/n av. . . . . 92dB
Amp. noise worst vol. CCIR s/n av. . . . . 84.5dB
Amp. noise zero vol. unw. 20/20kHz . . . . . N/A
Volume control tracking worst error . . . . . 1.3dB

**Tuner Section**

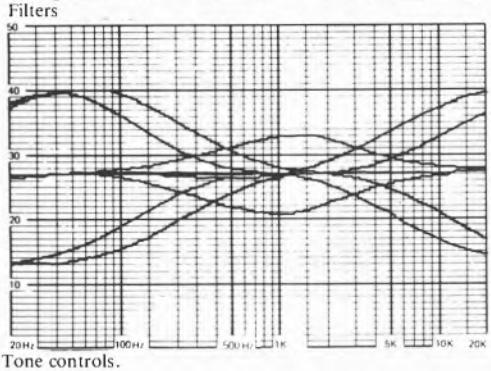
Mono RF sens. 30dB IHF . . . . . 1.3μV
Mono RF sens. 50dB IHF . . . . . 2.9μV
Stereo RF sens. 50dB . . . . . 65μV
RFIM . . . . . 75dB
Adj. ch. av . . . . . 8dB
Alt. ch. av. . . . . >70dB
Image resp . . . . . 78dB
Capture ratio. . . . . 1.5dB
AM reject . . . . . 53dB
Mono dist. 100% centre tune worst ch. . . . . 0.11%
Mono dist. 100% op. tune av. . . . . 0.07%
St. L = —R50% centre tune av. . . . . 0.11%
St. single ch. 100% centre tune worst ch. . . . . 0.25%
MPX reject 19kHz worst ch. . . . . 60dB
MPX reject 38kHz worst ch. . . . . >100dB
X-talk 1kHz centre tune worst ch. . . . . 42dB
X-talk 10kHz centre tune worst ch. . . . . 32dB
X-talk 1kHz op. tune av. . . . . 43dB
Freq. resp. St. —3dB L/R 25Hz/16.8kHz—25Hz/16.8kHz
Freq. resp. St. 15kHz L/R . . . . . Flat/Flat
Limit threshold . . . . . 1.2μV
Muting threshold . . . . . 1.4μV
St. s/n CCIR 100μV/1mV av. . . . . 51.5dB—60.5dB
Mono s/n 1mV av. CCIR . . . . . 66dB

**General Data**

Dimensions . . . . . 540 x 170 x 300mm
Weight . . . . . 17kgs
Typical selling price including VAT . . . . . £360.00



Filters



Tone controls.

# Sony STR-2800

Sony (UK) Ltd., 134 Regent St., London W1R 0DJ. 01-439 3874.


The cheapest of the Sony models reviewed in this book, this model incorporates long wave and medium wave AM, as well as the usual basic facilities. It is capable of producing 35W into 8 ohms and 45W into 4 ohms, two pairs of loudspeakers being selectable with a rotary switch. Rather crude screw terminals are provided for speaker connections. An IEC mains socket is provided, together with earth terminals. Only one tape unit can be interconnected on either phono sockets or a 5-pole DIN one. A swivellable ferrite rod is provided for AM, but an external AM antenna can be switched in when connected to a terminal. Terminals are also provided for 75 and 300 ohm FM aerial inputs. Bass and treble controls, each with 11 even steps, are complemented by a centre-indented balance control, also having a good law. The volume control tracked extremely well and was considerably larger than the other audio control knobs, all of which were much liked. An input switch selects pick-up, FM, long wave or medium wave. Push buttons are provided for power on/off, loudness compensation, mono/stereo, FM muting and tape monitoring. No filters are provided. The receiver is housed in a basic metal cabinet with wooden side cheeks, and is well presented.

Tone burst tests on the power amplifier revealed a good margin for music transients, especially into 4 ohms. Harmonic distortion at half power and near clipping measured rather poorly and much worse than average, generally around 0.1%. Swept IM charts, however, whilst showing rather more than average distortion across the audio band, showed almost no rise at all supersonically, and this is creditable. Half-power bandwidth extended to 70kHz, but response was curtailed just below this point, thus providing better IM curves. Sound quality was reasonable, but output noise measured a little inferior to average, peaking when the volume control was at two o' clock. A stereo headphone jack was clearly optimised for 8 ohm headphones, and high impedance models might be a little hissy. Damping factor measured adequately. The tape input sensitivity was a little low, and the phono output level to tape averaged some 3dB higher than the equivalent level from the tuner, which is unfortunate. The DIN socket though gave reasonably compatible levels.

The pick-up input stage had a very compatible input impedance, with a low capacity, and the clipping margin was adequate. Distortion was reasonable, and noise levels very satisfactory. The frequency response was reasonably flat and showed a useful subsonic roll-off, but at just 6dB per octave below 20Hz, and I would have preferred this a little higher and steeper since no rumble filter is fitted.

The FM tuner's input sensitivities were adequate, but RFIM performance, image response (—46dB), and IF selectivity were all very poor, making it impossible to separate weak stations even fairly close to strong ones. Whilst capture ratio measured well, AM rejection on weak stations was poor, and muting too sensitive. Frequency response measured well, but multiplex filtering diabolical, one of my colleagues actually hearing pilot tone breakthrough. Signal to noise ratios in stereo were rather poor comparatively, and Sony should be able to do better than this. Distortion was not too good, but improved considerably when optimally tuned right of centre indication (tuning meter rather inaccurate). The sound quality was reasonable, but optimum tuning very critical, and some slight distortion and

spitch on transients was noted in the crosstalk. Tuning scale accuracy was excellent and ergonomics good. The AM sound quality on long wave and medium wave was quite acceptable, although the filter was very sharp, cutting audio response well below the transmitted maximum. Some RFIM was noted on MW.

Although the audio section of this receiver sounded and performed quite well, the poor RFIM performance, the poorer than average noise, and the inaccurate tuning meter, cause a recommendation to be with-held. If you are only interested in receiving local stations, however, you may find the sound quality quite acceptable, but you may notice more hiss than average on a wide dynamic range programme and note multiplex breakthrough.

**Amplifier Section**

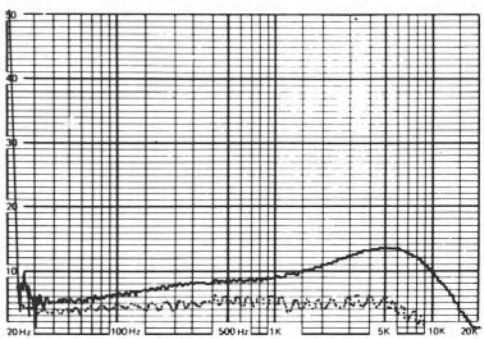
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 29W |
| Av. power o/p single ch. driven 8Ω | 35W |
| Av. power o/p single ch. driven tone burst 8Ω | 39W |
| Av. power o/p single ch. driven 4Ω | 46W |
| Av. power o/p single ch. driven tone burst 4Ω | 60.5W |
| Idle DC output worst ch. | 18mV |
| Turn on/off max. DC swing worst case | 2.25mV |
| Damping factor 8Ω | 36 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.09% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.13% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.026% |
| Half power bandwidth | 3Hz-70kHz |
| Av. RIAA impedance | 49.5kΩ |
| Av. RIAA sensitivity | 2.5mV |
| Av. RIAA clipping | 100mV |
| Av. RIAA capacitance | 43pF |
| Av. aux. impedance | — |
| Av. aux. sensitivity | — |
| Av. tape impedance | 99kΩ |
| Av. tape sensitivity | 255mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 512mV |
| Max. level from RIAA-rec. out | 830mV |
| Rec. out impedance DIN av. | 67kΩ |
| Rec. out impedance phono av. | 7kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 76dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 72dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 92dB |
| Amp. noise zero vol. CCIR s/n av. | 86dB |
| Amp. noise worst vol. CCIR s/n av. | 81dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 0.8dB |

**Tuner Section**

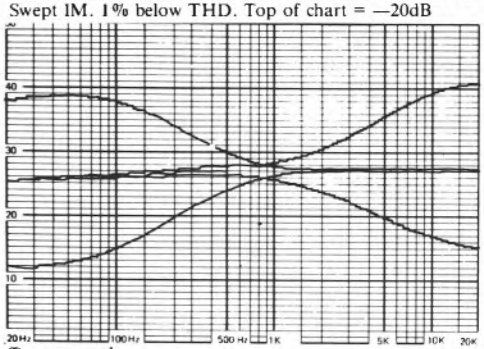
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.2μV |
| Mono RF sens. 50dB IHF | 5.5μV |
| Stereo RF sens. 50dB | 35μV |
| RFIM | 61dB |
| Adj. ch. av. | 6.5dB |
| Alt. ch. av. | 45dB |
| Image resp | 46dB |
| Capture ratio | 1dB |
| AM reject | 67dB |
| Mono dist. 100% centre tune worst ch. | 0.25% |
| Mono dist. 100% op. tune av. | 0.11% |
| St. L = —R 50% centre tune av. | 0.19% |
| St. single ch. 100% centre tune worst ch. | 0.55% |
| MPX reject 19kHz worst ch. | 35dB |
| MPX reject 38kHz worst ch. | 71dB |
| X-talk 1kHz centre tune worst ch. | 36dB |
| X-talk 10kHz centre tune worst ch. | 36dB |
| X-talk 1kHz op. tune av. | 42dB |
| Freq. resp. St. —3dB L/R 9Hz/18.4kHz—9Hz/19.9kHz | |
| Freq. resp. St. 15kHz L/R | —1.4dB/—0.7dB |
| Limit threshold | 0.7μV |
| Muting threshold | 1.2μV |
| St. s/n CCIR 100μV/1mV av. | 51dB—60dB |
| Mono s/n 1mV av. CCIR | 65.5dB |

**General Data**

| | |
|---|---|
| Dimensions | 485 x 145 x 375mm |
| Weight | 9.5kgs |
| Typical selling price including VAT | £150.00 |



Swept IM. 1% below THD. Top of chart = —20dB



Tone controls

# Sony STR-3800

Sony (UK) Ltd., 134 Regent St., London W1R 0DJ. 01-439 3874.


This model is virtually identical in appearance and facilities to the model 2800, the only difference being the provision of interconnection and monitoring from a second tape recorder (please see 2800 review for basic details). However, the available power output of the model 3800 is somewhat higher, 43W into 8 ohms, but only 15W continuous into 4 ohms, the protection circuit cutting out above this level. Transient tone burst testing, however, revealed a good amplifier performance, peaking up to 66W into 4 ohms, which is quite satisfactory.

The swept IM pen charts were again almost identical and showed the amplifier to be well-designed in this area with an HF roll-off occurring just before the half power bandwidth limit of 75kHz. The harmonic distortion measurements were on the high side, not far short of 0.1% near clipping, and not much better at half power. IM distortion was around 0.05% at audio frequencies, rather higher than most competitive models, but at least consistent up to very high frequencies.

The subjective sound quality was frankly disappointing, comments being made by several listeners that the amplifier lacked transparency, and occasionally losing detail. Bass frequencies seemed to lack body, and yet the damping factor measured adequately. Notwithstanding the quality criticisms, many users will find it quite acceptable, but unfortunately other models actually do sound better.

A slight thump will be noticed on turn on, but it will not be harmful. Output noise was a little higher than average (mainly hiss), and a stereo jack socket will produce some hiss into high impedance headphones, but low impedance models should be satisfactory. As with the 2800, tape inputs were a little insensitive, and the output levels from disc are considerably higher than those typically from the tuner. The DIN socket, however, should be compatible with external DIN equipment.

The RIAA pick-up input stage had a reasonably optimised input impedance, and the clipping margin was adequate. Signal to noise ratio was good, and distortion satisfactory, whilst frequency response was reasonable, showing identical characteristics to the model 2800.

The tuner's FM RF sensitivities were similar to those of the 2800, but RFIM was even worse. Image response was again bad, but IF rejection good. Some local oscillator radiation was noted on the aerial socket, but this was not too bad. Selectivity was not aerial socket, but this was not too bad. Selectivity was not too good, but better than that of the model 2800. AM rejection was again poor on weak signals, and other measurements were again similar to the model 2800. Frequency response was excellent, but again, multiplex filtering was virtually non-existent, pilot tone again being noted by one of my colleagues. The weighted signal to noise ratios were rather poor, and a high pitched hum could just be discerned in the background. The distortion characteristics showed exactly the same tendency as the model 2800, the tuning meter being similarly inaccurate. Crosstalk measured very well, and the subjective quality was rather better than that from the model 2800, no spitch or transient distortion being noted. Tuning, however, was critical, but dial accuracy excellent, and I particularly liked the tuning ergonomics. A swivellable ferrite rod is supplied for AM reception, together with a switchable external AM antenna terminal. The IF passband on AM was very sharp, but reception was

quite good, no whistle being audible on Radio 4, Brookmans Park.

Since this receiver is more expensive than the model 2800, and its qualities generally very similar, and criticism generally the same, it cannot really be recommended, particularly since the amplifier's audio quality was noticeably inferior to average. I can only regard it as very average value for money, and you will find many better value receivers in this book. It may sound reasonably good though on local stations if you are not too critical. Sony should have provided more facilities and a better tuner for the extra £20 or so.

**Amplifier Section**

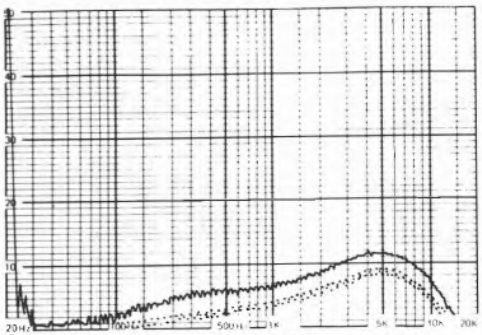
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 37W |
| Av. power o/p single ch. driven 8Ω | 43W |
| Av. power o/p single ch. driven tone burst 8Ω | 46W |
| Av. power o/p single ch. driven 4Ω | 15W |
| Av. power o/p single ch. driven tone burst 4Ω | 66W |
| Idle DC output worst ch. | 18mV |
| Turn on/off max. DC swing worst case | 9V |
| Damping factor 8Ω | 36 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.07% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.09% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.02% |
| Half power bandwidth | 2Hz-75kHz |
| Av. RIAA impedance | 49.5kΩ |
| Av. RIAA sensitivity | 2.6mV |
| Av. RIAA clipping | 95mV |
| Av. RIAA capacitance | 150pF |
| Av. aux. impedance | — |
| Av. aux. sensitivity | — |
| Av. tape impedance | 86.7kΩ |
| Av. tape sensitivity | 280mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 544mV |
| Max. level from RIAA-rec. out | 855mV |
| Rec. out impedance DIN av. | 67.8kΩ |
| Rec. out impedance phono av. | 7kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 76.5dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 72.5dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 93.5dB |
| Amp. noise zero vol. CCIR s/n av. | 87dB |
| Amp. noise worst vol. CCIR s/n av. | 82dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1.7dB |

**Tuner Section**

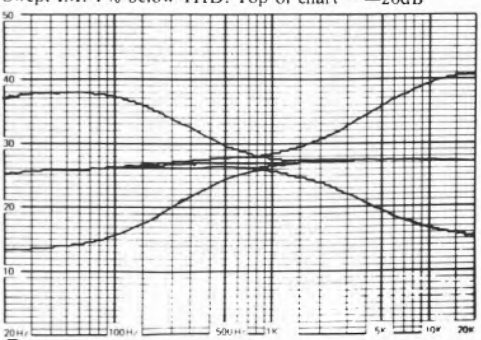
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.1μV |
| Mono RF sens. 50dB IHF | 4.8μV |
| Stereo RF sens. 50dB | 43μV |
| RFIM | 60dB |
| Adj. ch. av. | 55dB |
| Alt. ch. av. | 59dB |
| Image resp | 47dB |
| Capture ratio | 1.4dB |
| AM reject | 62dB |
| Mono dist. 100% centre tune worst ch. | 0.35% |
| Mono dist. 100% op. tune av. | 0.14% |
| St. L = —R 50% centre tune av. | 0.16% |
| St. single ch. 100% centre tune worst ch. | 0.63% |
| MPX reject 19kHz worst ch. | 35dB |
| MPX reject 38kHz worst ch. | 59dB |
| X-talk 1kHz centre tune worst ch. | 42dB |
| X-talk 10kHz centre tune worst ch. | 40dB |
| X-talk 1kHz op. tune av. | 48dB |
| Freq. resp. St. —3dB L/R 8Hz/flat—8Hz/flat | |
| Freq. resp. St. 15kHz L/R | —0.7dB/—0.8dB |
| Limit threshold | 0.7μV |
| Muting threshold | 1.2μV |
| St. s/n CCIR 100μV/1mV av. | 51dB—60dB |
| Mono s/n 1mV av. CCIR | 66dB |

**General Data**

| | |
|---|---|
| Dimensions | 485 x 145 x 375mm |
| Weight | 10.5kgs |
| Typical selling price including VAT | £175.00 |



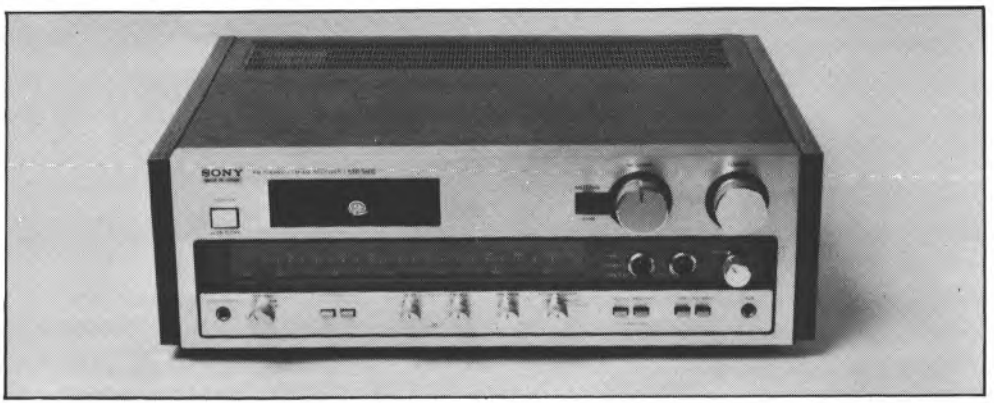
Swept IM. 1% below THD. Top of chart = —20dB



Tone controls

# Sony STR-5800

Sony (UK) Ltd., 134 Regent St., London W1R 0DJ. 01-439 3874.




This model is similarly styled to the two other Sony ones reviewed in this book, but many additional facilities are provided. The output stage can provide up to 87W into 8 ohms, rising to 130W into 4 ohms. Three switchable pairs of loudspeakers can be interconnected with spring clamp connectors, but only two pairs can be used at one time, switchable on a rotary. Friction-locked bass and treble controls are centre-indented rotaries with independent variation (with difficulty) for each channel. The centre-indented balance control had a good law, as did the tone controls, but all were rather small and a little stiff. The much larger volume control only tracked moderately well, but was nice to use. A switch entitled 'Acoustic Compensation' enabled loudness control to be selected to operate at either low frequencies only, or low and high, or alternatively a presence lift could be switched in. This control was much liked, although I would not personally use it much.

Push buttons provide power on/off, rumble filter (6dB per octave below 45Hz), treble filter (6dB per octave above 6kHz), FM muting, multipath indication, mono/stereo, and external adaptor insertion. Lever switches operate 20dB audio muting, tape copying in either direction, and tape monitoring 1 or 2. A 'function' switch selects pick-up, FM, AM (medium wave only), or auxiliary (duplicated on front panel stereo jack). The audio interconnections on the rear panel are with phono sockets, but tape 1 is duplicated on a 5-pole DIN. Antenna connections are identical to the other models, but no switch is provided for the AM antenna. An IEC socket is mounted for mains connection, and an easy to use spring-loaded earth terminal will be found useful.

Tone burst tests on the amplifier showed a marginal power increase. Harmonic distortion measurements were all good, and the swept IM charts better than average, although peaking up a little at 70kHz. The half-power bandwidth of the power amplifier was sensibly set higher than the frequency response limit of —3dB at 55kHz. The weighted ouput noise measured reasonably well, but was at its maximum when the volume control was at three o'clock. Sound quality was fairly reasonable, and headphones connected to a stereo jack socket worked well. Damping factor measured adequately, but a DC off-set on one channel of 40mV was considered not too good. Auxiliary and tape inputs were slightly less sensitive than average, but probably adequate for most users. Output levels were moderately well optimised.

The RIAA pick-up input stage had a well optimised input impedance. Clipping margins are adequate, and noise levels slightly better than average. IM distortion measured well, and the response was very flat. Whilst the RF sensitivities of the FM tuner section measured well, RFIM was rather poor, a few spurii being noted in the aerial test. Image and IF breakthroughs measured well. Adjacent channel selectivity was lop-sided and rather poor. Capture ratio, limiting threshold and AM rejection were all excellent but muting, was too sensitive. Frequency response was adequate averaging —2.5dB at 15kHz. Multiplex filtering was excellent. Weighted signal to noise ratios were reasonably satisfactory and about average at high levels, and good on weak signals. Subjective sound quality was quite good, but optimum sound quality required very critical tuning slightly left of centre indication, at which point distortion measured

reasonably well overall. Crosstalk measured extremely well at middle and high frequencies. Tuning dial accuracy was reasonably good, and tuning ergonomics were well liked. Medium wave reception was better than average with good sensitivity, and no whistles were noted on Radio 4 Brookmans Park.

Whilst this model included a tuner section that was clearly better than the other Sony models, at double the price of the model 2800 it still leaves quite a lot to be desired, particularly in the RFIM and selectivity performances. Not good value for money because of the high price.

**Amplifier Section**

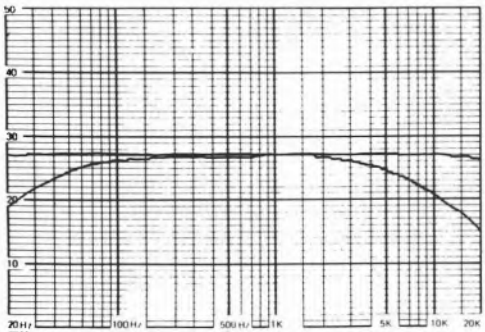
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 76.5W |
| Av. power o/p single ch. driven 8Ω | 87W |
| Av. power o/p single ch. driven tone burst 8Ω | 90.5W |
| Av. power o/p single ch. driven 4Ω | 129.5W |
| Av. power o/p single ch. driven tone burst 4Ω | 144W |
| Idle DC output worst ch. | 40mV |
| Turn on/off max. DC swing worst case | 300mV |
| Damping factor 8Ω | 40 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.01% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.01% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.017% |
| Half power bandwidth | 2Hz-70kHz |
| Av. RIAA impedance | 45kΩ |
| Av. RIAA sensitivity | 3mV |
| Av. RIAA clipping | 95mV |
| Av. RIAA capacitance | 70pF |
| Av. aux. impedance | 107kΩ |
| Av. aux. sensitivity | 285mV |
| Av. tape impedance | 140kΩ |
| Av. tape sensitivity | 300mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 576mV |
| Max. level from RIAA-rec. out | 760mV |
| Rec. out impedance DIN av. | 67kΩ |
| Rec. out impedance phono av. | 7kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 79dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 73.5dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 95.5dB |
| Amp. noise zero vol. CCIR s/n av. | 94dB |
| Amp. noise worst vol. CCIR s/n av. | 87.5dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1.3dB |

**Tuner Section**

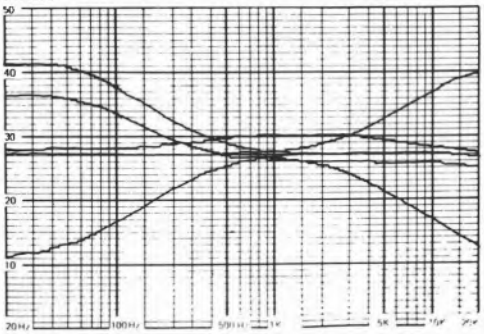
| | |
|---|---|
| Mono RF sens. 30dB IHF | 0.9μV |
| Mono RF sens. 50dB IHF | 2.6μV |
| Stereo RF sens. 50dB | 28μV |
| RFIM | 65dB |
| Adj. ch. av | 4dB |
| Alt. ch. av. | 62dB |
| Image resp | 73dB |
| Capture ratio | 1dB |
| AM reject | 68dB |
| Mono dist. 100% centre tune worst ch. | 0.19% |
| Mono dist. 100% op. tune av. | 0.18% |
| St. L = —R 50% centre tune av. | 0.1% |
| St. single ch. 100% centre tune worst ch. | 0.4% |
| MPX reject 19kHz worst ch. | 67dB |
| MPX reject 38kHz worst ch. | 99dB |
| X-talk 1kHz centre tune worst ch. | 44dB |
| X-talk 10kHz centre tune worst ch. | 39dB |
| X-talk 1kHz op. tune av. | 54dB |
| Freq. resp. St. —3dB L/R 10Hz/15.1kHz—10Hz/15.6kHz | |
| Freq. resp. St. 15kHz L/R | —2.7dB/—2.1dB |
| Limit threshold | 0.5μV |
| Muting threshold | 1.3μV |
| St. s/n CCIR 100μV/1mV av. | 53dB—62dB |
| Mono s/n 1mV av. CCIR | 67dB |

**General Data**

| | |
|---|---|
| Dimensions | 490 x 170 x 415mm |
| Weight | 15.4kgs |
| Typical selling price including VAT | £250.00 |



Filters

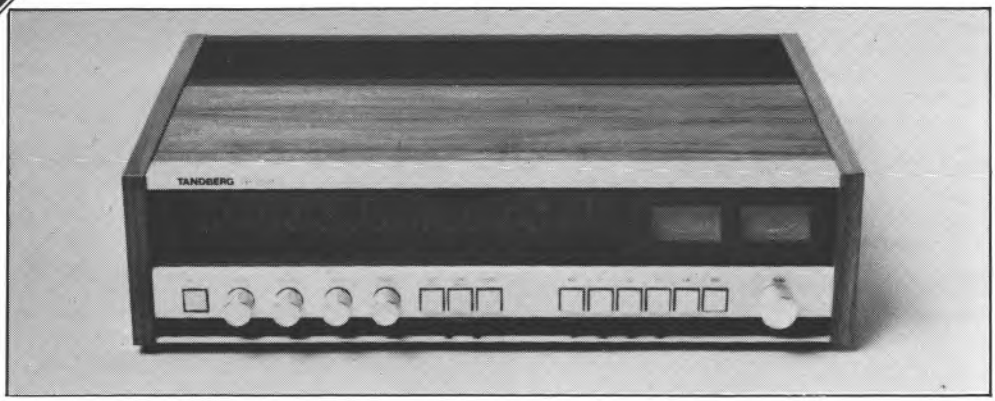


Tone controls.

BEST BUY

# Tandberg TR-2025

Tandberg (UK) Ltd., Farnell House, 81 Kirkstall Rd., Leeds LS3 1HR. 0532 35111.




This new model incorporates MW, LW and three pre-set stations on FM, in addition to manual tuning. Up to 45W is available into 8 ohms and 65W continuous into 4 ohms. Two switchable pairs of loudspeakers can be interconnected on DIN sockets, and all audio low level signals for pick-up and two tape recorders are on 5-pole DIN connectors. 75 ohm TV-type coax and DIN 300 ohm and AM aerial sockets are provided. The mains lead is only 2-core, and no earth terminals are provided. Treble and bass controls were rotaries having no centre indents, but providing a wide range of adjustment. The balance control worked well, but was also not centre indented. The rotary volume control tracked well. Large push buttons select tape monitors 1/2, pick-up, FM, MW or LW. Smaller push buttons provide loudness control, mono/stereo, rumble filter (excellent 12dB per octave cut off below 60Hz), treble filter (well over 12dB per octave above 10kHz — excellent) and FM muting. Three miniature potentiometers are supplied for setting the pre-set stations. Ergonomics were very good.

The toneburst tests showed the original circuit to be overprotected in output current, and as a result, Tandberg have totally modified this circuit, now giving adequate transient power into both 4 and 8 ohm speakers. However, no trouble was experienced into 8 ohms. Harmonic distortion measurements were good, and half-power bandwidth extended to 100kHz, but response curtailed above 90kHz, which is very wise. The swept IM pen charts showed low distortion throughout, even up to 200kHz, which is excellent. Noise levels measured quite well, and the ¼" stereo jack, slightly difficult to use being rather stiff and awkward, worked reasonably, but gave too high a level into high impedance models.

The subjective sound quality was very good, and no problems were encountered. The tape inputs had rather a low input impedance, and output levels, whilst being well optimised for many Japanese and Tandberg decks, are not really compatible with DIN standards, but this is of course almost an advantage, although the tuner level was much higher than that from discs. The RIAA input stage had an adequate clipping margin, and noise performance, and whilst the input impedance was quite reasonable, it will be incompatible at low frequencies for higher impedance cartridges, such as the Decca London. The response fell 3dB at 20Hz, which is welcome, but was otherwise flat. Distortion was just a little higher than average.

The entire performance of the FM RF section was excellent, no problems of any kind being encountered. Adjacent selectivity measured quite well, and alternate extremely well. Capture ratio was adequate, but limiting threshold and muting excellent. AM rejection was adequate. Frequency response and multiplex filtering measured extremely well. Signal to noise ratios were quite reasonable. Distortion measured quite well, and particularly well for left or right only. Crosstalk measured and sounded good. The sound quality was very good, and the noise levels acceptable. Dial accuracy was reasonably good. Tuning ergonomics, including the use of pre-set stations, was very good. AM quality on medium and long wave was well above average.

I particularly liked this model, finding the tuner section generally very good indeed. This model will work well on weak and strong stations, and has obviously been very well designed. If you like pre-set station facilities, I can strongly recommend it. One of the better buys.

# Tandberg TR-2025

BEST BUY

Tandberg hope to provide a service in which they will modify the existing protection circuit, without charge, equipment purchased before November 1st, provided the guarantee is valid and the equipment has not been misused. Models purchased before this date should already have the modified circuitry. This applies to the entire 2000 receiver range.

**Amplifier Section**

| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 45W |
| Av. power o/p single ch. driven 8Ω | 45W |
| Av. power o/p single ch. driven tone burst 8Ω | 49W |
| Av. power o/p single ch. driven 4Ω | 65*W |
| Av. power o/p single ch. driven tone burst 4Ω | 14*W |
| Idle DC output worst ch. | 2mV |
| Turn on/off max. DC swing worst case | 40mV |
| Damping factor 8Ω | 35 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.01% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.02% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.06% |
| Half power bandwidth | 2Hz-100kHz |
| Av. RIAA impedance | 47kΩ |
| Av. RIAA sensitivity | 3.1mV |
| Av. RIAA clipping | 100mV |
| Av. RIAA capacitance | 30pF |
| Av. aux. impedance | — |
| Av. aux. sensitivity | |
| Av. tape impedance | 24.7kΩ |
| Av. tape sensitivity | 200mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 50mV |
| Max. level from RIAA-rec. out | 27.5mV |
| Rec. out impedance DIN av. | 35.8kΩ |
| Rec. out impedance phono av. | — |
| Av. RIAA noise ref 8mV—rec. out unw. | 73dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 71dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 94dB |
| Amp. noise zero vol. CCIR s/n av. | 91dB |
| Amp. noise worst vol. CCIR s/n av. | 86dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1dB |

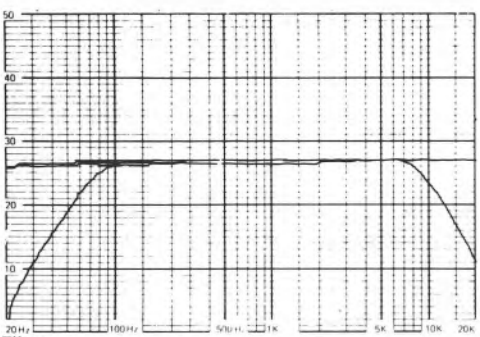
**Tuner Section**

| | |
|---|---|
| Mono RF sens. 30dB IHF | 0.9μV |
| Mono RF sens. 50dB IHF | 3.5μV |
| Stereo RF sens. 50dB | 30μV |
| RFIM | 76dB |
| Adj. ch. av | 9dB |
| Alt. ch. av. | >70dB |
| Image resp | 87dB |
| Capture ratio | 1.8dB |
| AM reject | 58dB |
| Mono dist. 100% centre tune worst ch. | 0.34% |
| Mono dist. 100% op. tune av. | 0.27% |
| St. L = —R50% centre tune av. | 0.13% |
| St. single ch. 100% centre tune worst ch. | 0.18% |
| MPX reject 19kHz worst ch. | 62dB |
| MPX reject 38kHz worst ch. | 63dB |
| X-talk 1kHz centre tune worst ch. | 43dB |
| X-talk 10kHz centre tune worst ch. | 34dB |
| X-talk 1kHz op. tune av. | 43dB |
| Freq. resp. St. —3dB L/R 17Hz/15.7kHz | —18Hz/15.7kHz |
| Freq. resp. St. 15kHz L/R | —0.2dB/—0.4dB |
| Limit threshold | 0.5μV |
| Muting threshold | 4μV |
| St. s/n CCIR 100μV/1mV av. | 50dB—62dB |
| Mono s/n 1mV av. CCIR | 68dB |

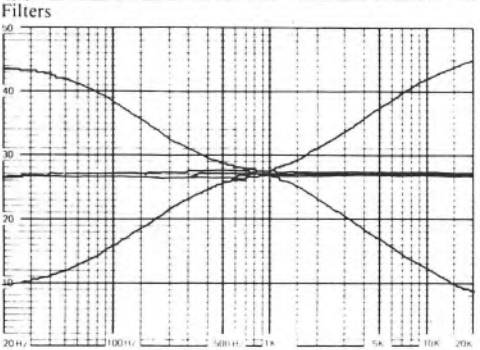
**General Data**

| | |
|---|---|
| Dimensions | 515 x 143 x 320mm |
| Weight | 8.3kgs |
| Typical selling price including VAT | £245.00 |

*See text



Filters

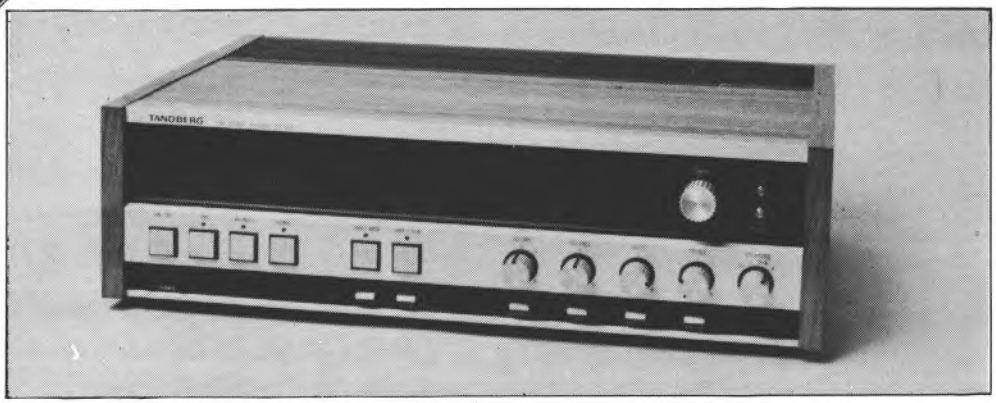


Tone controls

RECOMMENDED

# Tandberg TR-2055

Tandberg (UK) Ltd., Farnell House, 81 Kirkstall Rd., Leeds LS3 1HR. 0532 35111.




This model is in the middle of the new Tandberg range, and delivers a maximum of 66W into 8 ohms and 92W continuous into 4 ohms, but the protection circuitry on the original review sample cuts the latter down to only 12W on tone bursts due to transient current limiting (now modified and satisfactory). Two pick-up inputs are provided, one with a sensitivity pre-set, and also interconnections for two tape recorders, pre-set gains again being fitted. Inputs and outputs are on phono sockets, all duplicated with 5-pole DIN ones, which is most useful. A 75 ohm TV-type coax socket is provided for FM aerials, but also standard DIN 300 ohm and AM sockets are provided. Two switchable pairs of loudspeakers can be interconnected on slightly crude screw terminals, but note comments on 4 ohm performance. Rotary bass and treble controls provide a virtually excessive range of adjustment, but did not have centre indents. Unfortunately, they also affect the middle frequency response. The centre indented balance control had a smooth law. The volume control tracked well. Large push buttons operate mains on/off, FM. pick-up 1/2 and tape 1/2 monitoring. Smaller buttons operate tape dubbing facilities in both directions, loudness control, mono/stereo, rumble filter (12dB per octave below 90Hz) and treble filter (more than 12dB per octave above 10kHz). Small push buttons operate a 25$\mu$ sec tuner de-emphasis and FM muting.

Tone burst tests into 8 ohms were completely satisfactory and the new Tandberg protection circuit now being put into production should provide good performance into 4 ohms. Harmonic distortion measured very well, and was predominantly second harmonic. Half-power bandwidth extended to 100kHz, and frequency response unfortunately to 150kHz (this should have been curtailed at least one octave lower). Swept IM charts showed a considerable rise in distortion above 50kHz. Whilst damping factor measured extremely well, low frequencies sounded very slightly flabby and high frequencies occasionally a little brittle. Output noise levels measured extremely well, and an awkward $\frac{1}{4}$" jack socket provided reasonable quality into headphones, but too high a level is available into high impedance models. A stereo jack socket is also provided for feeding a tape recorder with an equalised signal. Tape input impedances were fairly low, and sensitivities variable and well optimised. (Adjust pre-sets carefully to avoid clipping). Output levels on the tape sockets were all compatible with DIN and phono standards.

The RIAA input stage had a pre-settable gain control on pick-up 1 only, and gave a good clipping margin and noise performance, provided the pre-set was appropriately adjusted. The input impedance was well optimised, at middle and high frequencies, but falls rapidly at low frequencies, thus making it incompatible with higher impedance cartridges, such as the Decca London. At maximum pre-set gain distortion was high, but improved considerably at lower settings, whilst frequency response showed a slight valley of 0.75dB at high frequencies.

The FM section input sensitivities measured reasonably well, with an acceptable RF IM performance. Image response was adequate, but IF rejection excellent. Adjacent and alternate selectivities were both excellent. Limiting and AM rejection were good, but capture ratio just average. Muting was too sensitive. The frequency response was excellent, and multiplex filtering good. Weighted signal to noise ratios all measured very

RECOMMENDED

well indeed. All distortion figures at maximum deviation measured below 0.1%, which is amazingly good. Crosstalk also measured phonomenally well at middle and high frequencies. The sound quality was very good, and tuning, bearing in mind the sharp IF filters used, gave excellent distant station reception. Dial accuracy was reasonable. AM quality was quite satisfactory.

Despite the tuners excellent performance, the price is rather high for the output power. The original protection circuit was poor but it has by now been completely satisfactorily modified for both 8 and 4 ohm speakers. Recommended, but only moderate value for money.

**Amplifier Section**

| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 64W |
| Av. power o/p single ch. driven 8Ω | 67W |
| Av. power o/p single ch. driven tone burst 8Ω | 86W |
| Av. power o/p single ch. driven 4Ω | 92W* |
| Av. power o/p single ch. driven tone burst 4Ω | 12W* |
| Idle DC output worst ch. | 7.5mV |
| Turn on/off max. DC swing worst case | 100mV |
| Damping factor 8Ω | 77 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.01% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.01% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.14% |
| Half power bandwidth | 3Hz-100kHz |
| Av. RIAA impedance | 47kΩ |
| Av. RIAA sensitivity | 2.2mV—9.5mV |
| Av. RIAA clipping | 70mV—300mV |
| Av. RIAA capacitance | 34pF |
| Av. aux. impedance | — |
| Av. aux. sensitivity | |
| Av. tape impedance | 26kΩ |
| Av. tape sensitivity | 155mV-675mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 608mV |
| Max. level from RIAA-rec. out | 570mV |
| Rec. out impedance DIN av. | 36kΩ |
| Rec. out impedance phono av. | 1kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 78.5dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 73dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 98dB |
| Amp. noise zero vol. CCIR s/n av. | 92dB |
| Amp. noise worst vol. CCIR s/n av. | 86dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1dB |

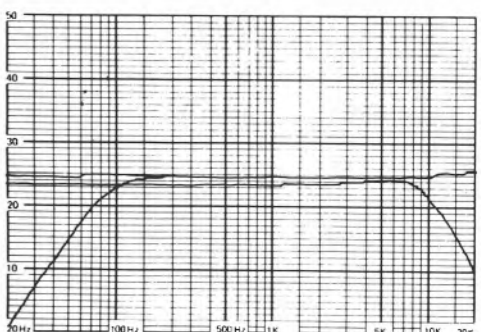
**Tuner Section**

| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.1μV |
| Mono RF sens. 50dB IHF | 2.2μV |
| Stereo RF sens. 50dB | 25μV |
| RFIM | 71dB |
| Adj. ch. av | 10dB |
| Alt. ch. av. | 70dB |
| Image resp | 63dB |
| Capture ratio | 1.5dB |
| AM reject | 66dB |
| Mono dist. 100% centre tune worst ch. | 0.06% |
| Monodist. 100% op. tune av. | 0.06% |
| St. L = —R 50% centre tune av. | 0.07% |
| St. single ch. 100% centre tune worst ch. | 0.08% |
| MPX reject 19kHz worst ch. | 69dB |
| MPX reject 38kHz worst ch. | 58dB |
| X-talk 1kHz centre tune worst ch. | 61dB |
| X-talk 10kHz centre tune worst ch. | 47dB |
| X-talk 1kHz op. tune av. | 61dB |
| Freq. resp. St. —3dB L/R 19Hz/15.9kHz—19Hz/15.9kHz | |
| Freq. resp. St. 15kHz L/R | Flat/Flat |
| Limit threshold | 0.8μV |
| Muting threshold | 1.3μV |
| St. s/n CCIR 100μV/1mV av. | 54dB—67dB |
| Mono s/n 1mV av. CCIR | 72.5dB |

**General Data**

| | |
|---|---|
| Dimensions | 510 x 153 x 353mm |
| Weight | 13kgs |
| Typical selling price including VAT | £340.00 |

*See text

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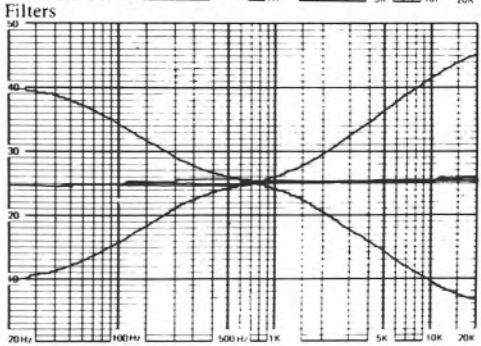
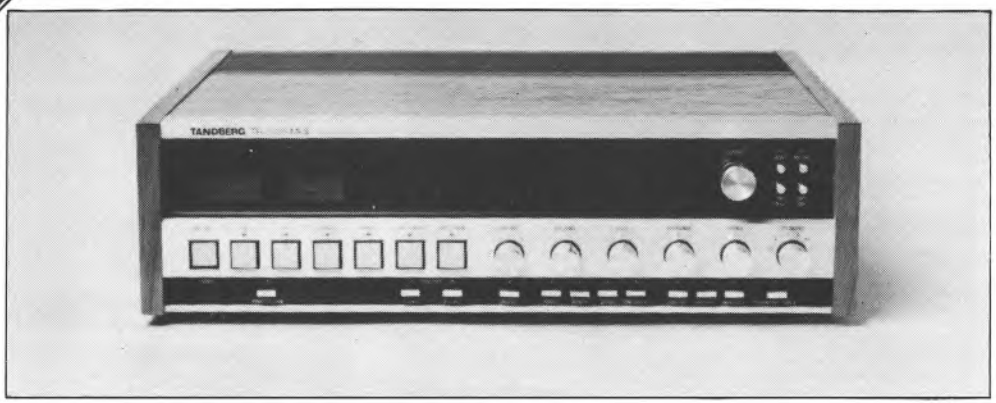



Tone controls.

BEST BUY

## Tandberg TR-2075 mk II

Tandberg (UK) Ltd., Farnell House, 81 Kirkstall Rd., Leeds LS3 1HR. 0532 35111.




The Mk II version will have completely superseded the original model by the time this book is published, and all tests have been carried out on pre-production models. The first sample was rejected as the RF front end became misaligned in transit from Oslo. The largest model in the range, it can deliver 100W into 8 ohms continuous, and 150W into 4 ohms. Large push buttons provide input switching from pick-up 1/2, FM, AM and tape monitoring 1 and 2 in either direction between two interconnected recorders. Inputs and outputs are on phono sockets, and all are duplicated on 5-pole DIN ones. A 75 ohm TV-type coax socket is complemented by a 300 ohm and AM DIN types and a swivellable ferrite rod is also supplied. Three pairs of loudspeakers are catered for with rather awkward small screw terminals, a rotary switch selecting up to two pairs at once. The tuning and signal strength meters can be switched to read output power. Additional push buttons operate loudness compensation, stereo/mono etc routing, tone control cancel, rumble filter (12dB per octave below 35Hz), treble filters 1/2 (switchable together or separately with 6dB or greater than 12dB per octave above approximately 8kHz), and a button inserting tone controls into the tape record feeds. The volume control did not track too well at high levels, but the centre indented balance control worked well. Bass, mid and treble controls offered an extremely wide range of adjustment, and were split concentric types allowing separate adjustment of the two channels. Their centre indents though were insufficiently positive.

Tone burst tests into 8 ohms were very satisfactory, but subjective and transient tests showed that the first review sample was very poor into 4 ohms. The original protection circuit was clearly unsatisfactory but Tandberg entirely modified it to my total satisfaction, just before the review was completed, and up to 120W into 8 ohms and 160W into 4 ohms are now available on transients. Harmonic distortion measurements peaked around 0.01% and were thus good, but second harmonic did not decrease much between 1dB and 3dB below clipping. Half-power bandwidth extended to just 55kHz, but frequency response went up to 130kHz, which is not really advisable. Swept IM charts thus showed a considerable rise above 60kHz.

Output noise levels measured well, and two $\frac{1}{4}$" stereo headphone jacks provided good quality, but awkward voltages, into high impedance models. The sound quality subjectively was very good, and no problems were encountered into 8 ohm speakers. The damping factor measured very well. The pre-settable tape input levels gave a good range of adjustment, but were medium impedance, averaging 25k ohms. Output levels on the DIN and phono sockets were all reasonably compatible. The RIAA pick-up input circuitry had a reasonable input impedance, which fell rapidly however at low frequencies, and will not be compatible with high impedance cartridges such as the Decca London. Noise and overload performances were good, and response reasonable, but humping just 1dB over the entire mid frequency band.

The FM input sensitivities measured extremely well, as did RF IM image response and IF rejection. Selectivity also measured extremely well, making the receiver ideal for both distant and local station reception. Limiting and muting were both excellent, but capture ratio was only fair. AM rejection was

BEST BUY

also excellent. Frequency response and multiplex filtering were all excellent. Weighted signal to noise ratios were amongst the best in the survey. Distortion and crosstalk measurements were extremely good, especially considering the excellent selectivity. AM reception was satisfactory, making this tuner section one of the best in the survey. Tuning dial accuracy was very poor on the second sample, but strangely quite good on the first one.

I liked this receiver a lot, particularly the superb tuner section. I strongly recommend it, and Tandberg will be attending to the protection circuit problem on all their 2000 receiver range as a result of our original findings.

**Amplifier Section**

| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 101W |
| Av. power o/p single ch. driven 8Ω | 101W |
| Av. power o/p single ch. driven tone burst 8Ω | 116W |
| Av. power o/p single ch. driven 4Ω | 132W* |
| Av. power o/p single ch. driven tone burst 4Ω | 9W* |
| Idle DC output worst ch. | 2.5mV |
| Turn on/off max. DC swing worst case | 120mV |
| Damping factor 8Ω | 78 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.02% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.01% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.04% |
| Half power bandwidth | 2Hz-55kHz |
| Av. RIAA impedance | 47kΩ |
| Av. RIAA sensitivity | 2.8mV—11mV |
| Av. RIAA clipping | 120mV—440mV |
| Av. RIAA capacitance | 20pF |
| Av. aux. impedance | — |
| Av. aux. sensitivity | — |
| Av. tape impedance | 21kΩ |
| Av. tape sensitivity | 150mV-660mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 496mV |
| Max. level from RIAA-rec. out | 150/560mV |
| Rec. out impedance DIN av. | 36kΩ |
| Rec. out impedance phono av. | 1kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 78dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 74dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 96dB |
| Amp. noise zero vol. CCIR s/n av. | 96dB |
| Amp. noise worst vol. CCIR s/n av. | 81dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 2.1dB |

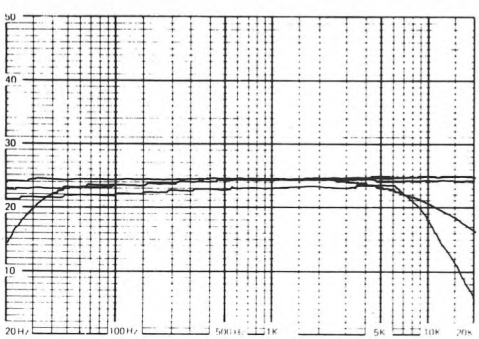
**Tuner Section**

| | |
|---|---|
| Mono RF sens. 30dB IHF | 0.8μV |
| Mono RF sens. 50dB IHF | 4μV |
| Stereo RF sens. 50dB | 22μV |
| RFIM | 75 dB |
| Adj. ch. av | 11dB |
| Alt. ch. av. | >70dB |
| Image resp | >100dB |
| Capture ratio | 1.8dB |
| AM reject | 66dB |
| Mono dist. 100% centre tune worst ch. | 0.07% |
| Mono dist. 100% op. tune av. | 0.06% |
| St. L = —R 50% centre tune av. | 0.13% |
| St. single ch. 100% centre tune worst ch. | 0.32% |
| MPX reject 19kHz worst ch. | 70dB |
| MPX reject 38kHz worst ch. | 57dB |
| X-talk 1kHz centre tune worst ch. | 47dB |
| X-talk 10kHz centre tune worst ch. | 45dB |
| X-talk 1kHz op. tune av. | 51dB |
| Freq. resp. St. —3dB L/R 17Hz/15.9kHz—16Hz/16.1kHz | |
| Freq. resp. St. 15kHz L/R | —0.3dB/+0.4dB |
| Limit threshold | 0.5μV |
| Muting threshold | 2.2μV |
| St. s/n CCIR 100μV/1mV av. | 54dB—68dB |
| Mono s/n 1mV av. CCIR | 73dB |

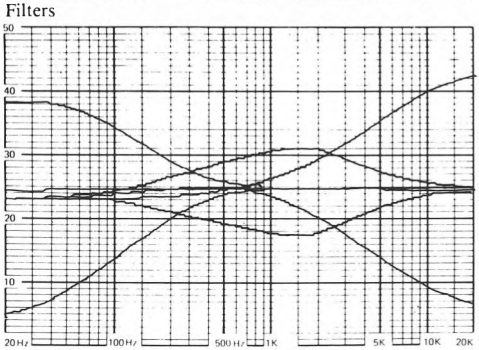
**General Data**

| | |
|---|---|
| Dimensions | 510 x 153 x 353mm |
| Weight | 12.5kgs |
| Typical selling price including VAT | £450.00 |

*See text



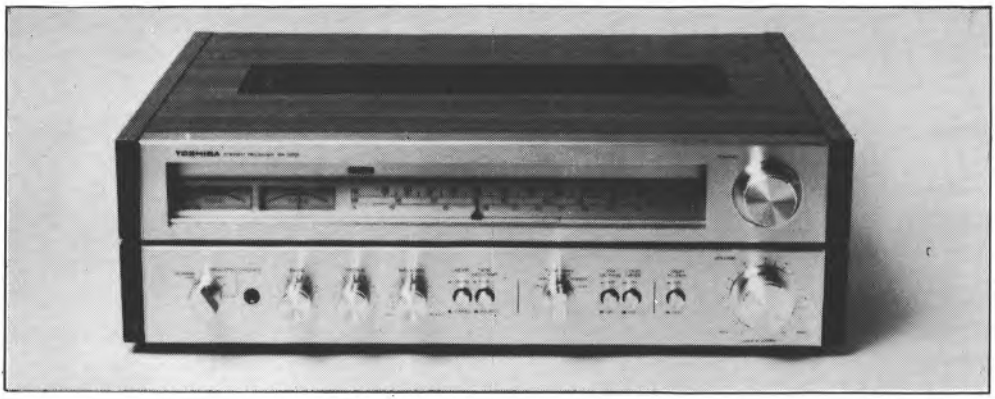
Filters



Tone controls

## Toshiba SA-320

Toshiba (UK) Ltd., Toshiba House, Great South West Rd., Feltham, Middlesex.
01-751 1281



The lowest-powered of the reviewed Toshiba range, this receiver gives 26W into 8 ohm and 38W into 4 ohms. A function switch selects long wave, medium wave, FM auto, pick-up and auxiliary inputs. A tape monitor button is provided and phonos and a 5-pole DIN socket are supplied for interconnection with a recorder. The mains lead is 2-core, but a ground terminal is provided. 75 and 300 ohm FM aerial terminals are fitted, together with an AM one, and an internal ferrite rod is provided. Two pairs of loudspeakers can be switched through and connected on rather poor quality screw terminals. The rotary bass and treble controls had no centre indent, but worked quite well. The balance control is centre-indented and has a smooth rate of change. The large, smooth rotary volume control tracked rather poorly at low volume settings. Push buttons switch stereo/mono, tape monitor, FM muting, loudness compensation and treble filter (6dB per octave above 7kHz). The receiver is reasonably well styled for the price, and whilst the main case is wooden, the base plate is metallic.

The power amplifier's tone burst performance showed no increase in transient power over the continuous ratings. Whilst distortion measurements were fairly good, the subjective sound quality was described in the tests as rather coloured at mid frequencies. Reproduction was slightly confused and well below average, audible differences between this model and our standard being very clear to us. The half-power bandwidth extended to only 40kHz for visible distortion, and yet the response was allowed to extend to 110kHz, which is ridiculous. This effect contributed to rather poor swept IM charts above 20kHz. Output noise measured and sounded at a very low level, which is creditable. Headphone levels from a stereo jack socket were quite well optimised. A slight thump was noticed when switched on or off. Auxiliary and tape interconnections were all well optimised.

The RIAA input circuitry had a rather high input impedance, which dropped fairly dramatically below 50Hz. Noise and distortion measured very well, and the clipping margin was excellent. The response humped up to +1.5dB at 250Hz, but was otherwise satisfactory.

The RF front end generally measured rather poorly, with poor sensitivity, mediocre RFIM, very poor image response, and poor selectivity. Capture ratio measured very well, but AM rejection was poor on weak signals. Muting was too sensitive, but limiting satisfactory. The frequency response was quite ridiculous, averaging +3.5dB at 5kHz, +1.5dB at 10kHz and +2.5dB at 15kHz. Very poor multiplex filter matching and de-emphasis circuits were responsible for this. Multiplex filtering itself was good though. Signal to noise performance was very poor, and distortion on left or right alone, measured and sounded very poor. Crosstalk was worse than average. Dial accuracy was good. Tuning ergonomics were very good. AM reception was very clothy, and strong signals produced an audible modulation hum.

I am sorry that I can, in no way, recommend this receiver. The tuner section was very poor indeed, and an amplifier which actually sounds inferior is surely bad. A considerable time was spent investigating the peculiar response, and by changing three resistors and re-routing the de-emphasis component, the response was made extremely flat, and the noise improved by nearly 2dB. Toshiba are recommended to adopt this modification, but even

so, a recommendation would still be withheld, despite the modest price.

**Amplifier Section**

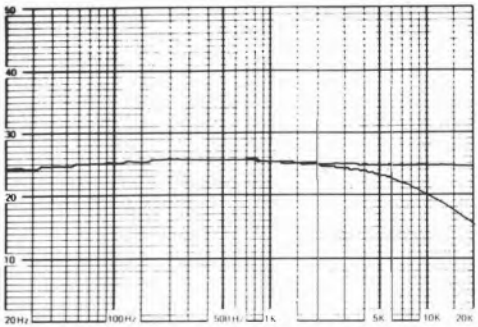
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 24.5W |
| Av. power o/p single ch. driven 8Ω | 26.5W |
| Av. power o/p single ch. driven tone burst 8Ω | 25W |
| Av. power o/p single ch. driven 4Ω | 38W |
| Av. power o/p single ch. driven tone burst 4Ω | 38W |
| Idle DC output worst ch. | 40mV |
| Turn on/off max. DC swing worst case | 3V |
| Damping factor 8Ω | 39 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.03% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.05% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.01% |
| Half power bandwidth | 2Hz-40kHz |
| Av. RIAA impedance | 60kΩ |
| AV. RIAA sensitivity | 2.7mV |
| Av. RIAA clipping | 150mV |
| Av. RIAA capacitance | 80pF |
| Av. aux. impedance | 87kΩ |
| Av. aux. sensitivity | 200mV |
| Av. tape impedance | 110kΩ |
| Av. tape sensitivity | 200mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 384mV |
| Max. level from RIAA-rec. out | 560mV |
| Rec. out impedance DIN av. | 65.3kΩ |
| Rec. out impedance phono av. | 3kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 72dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 74dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 81.5dB |
| Amp. noise zero vol. CCIR s/n av. | 94.5dB |
| Amp. noise worst vol. CCIR s/n av. | 80dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 2dB |

**Tuner Section**

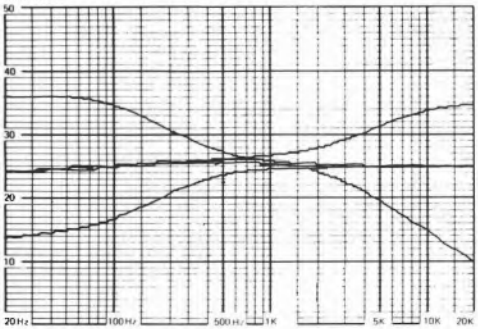
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.8μV |
| Mono RF sens. 50dB IHF | 5.5μV |
| Stereo RF sens. 50dB | 60μV |
| RFIM | 65dB |
| Adj. ch. av. | 1.5dB |
| Alt. ch. av. | 47dB |
| Image resp | 45dB |
| Capture ratio | 0.9dB |
| AM reject | 66dB |
| Mono dist. 100% centre tune worst ch. | 0.32% |
| Mono dist. 100% op. tune av. | 0.3% |
| St. L = —R 50% centre tune av. | 0.18% |
| St. single ch. 100% centre tune worst ch. | 1.2% |
| MPX reject 19kHz worst ch. | 65dB |
| MPX reject 38kHz worst ch. | 96dB |
| X-talk 1kHz centre tune worst ch. | 31dB |
| X-talk 10kHz centre tune worst ch. | 31dB |
| X-talk 1kHz op. tune av. | 33dB |
| Freq. resp. St. —3dB L/R 9Hz/16.6kHz—8Hz/16.5kHz | |
| Freq. resp. St. 15kHz L/R | +2.1dB/+1.8dB |
| Limit threshold | 1.1μV |
| Muting threshold | 1.8μV |
| St. s/n CCIR 100μV/1mV av. | 47dB—59.5dB |
| Mono s/n 1mV av. CCIR | 65dB |

**General Data**

| | |
|---|---|
| Dimensions | 500 x 158 x 435mm |
| Weight | 11kgs |
| Typical selling price including VAT | £140.00 |




Filters



# Toshiba SA-520

Toshiba (UK) Ltd., Toshiba House, Great South West Rd., Feltham, Middlesex.
01-751 1281

This model can deliver 52W into 8 ohms and 77W into 4 ohms. Two pairs of loudspeakers can be interconnected on spring-loaded clamps. 75 and 300 ohm FM aerial terminals are complemented by an AM one, but a ferrite rod, which can be only lifted up and down, is provided for normal AM reception. Phono sockets provide the push button switched inputs for pick-up 1/2, auxiliary and two tape recorder interconnections, one of these being duplicated on a 5-pole DIN socket. Treble and bass controls are 11 position horizontal sliders, which give a wide range of adjustment. The balance control was also a horizontal slider with a centre indent, but changed position too rapidly across the centre. The stepped volume control had only 22 positions, which is inadequate, but nevertheless it was quite liked, although most users would prefer a rotary, if not more steps. Many push button switches are provided, but which unfortunately resemble a row of false teeth, since they were ragged and wobbly. They controlled mains on/off, speaker selection, FM muting, rumble filter (6dB per octave below 70Hz), treble filter (6dB per octave above 9kHz), loudness compensation, mono/stereo, tape monitors 1/2 and input selection (AM, FM auto, pick-up 1/2 and auxiliary). The mains lead is 3-core, and two earth terminals are provided.

The tone burst tests on the power amplifier revealed approximately the same transient power available as continuous. Harmonic distortion was only just below 0.1%, which is rather poor, and whilst the power bandwidth extended to just 60kHz, the response was maintained to 140kHz, which is misplaced specmanship. The swept IM charts were inferior to average at 10kHz and above. When driven fairly hard on speech, reproduction seemed slightly coloured and rather hard in the presence region. Bass frequencies seemed rather slack, and reproduction was sometimes brittle. Output noise measured very well, and headphones connected to a stereo jack socket on the front were reasonably compatible. Input and output levels to tape were quite compatible, but the tuner's output level was rather low, particularly on the DIN socket. The RIAA pick-up input had a reasonably optimised impedance which fell sharply subsonically. Clipping margin and noise performance were very good. Frequency response and distortion measured well.

The RF sensitivity of the FM section measured well, and RFIM performance was quite good. Image response and IF rejection measured well. Adjacent selectivity was very poor, but alternate channel fair. Capture ratio and limiting threshold were both good. AM rejection was particularly poor, and muting too sensitive. As with the model SA-320, the frequency response was ridiculous, showing the same problems and cause. The multiplex filtering though was good. Signal to noise ratios were also very poor. Harmonic distortion measured quite well, but at peak deviation, slight roughnes was audible in the crosstalk, particularly at high frequencies. Crosstalk levels, however, were inferior to average. Dial accuracy was only fair, but tuning ergonomics excellent. Medium wave reception was adequate.

The tuner's response and noise problems, together with the amplifier's below average sound quality, cause a recommendation to be witheld. A three position de-emphasis switch gave an incorrect response in all positions, and Toshiba must be encouraged to put right the multiplex filter loading and de-emphasis problems which are identical to those in the other two Toshiba models.

**Amplifier Section**

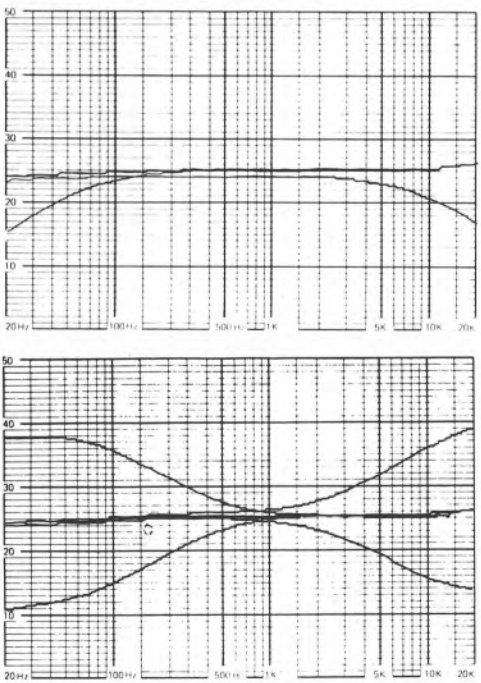
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 50W |
| Av. power o/p single ch. driven 8Ω | 52.5W |
| Av. power o/p single ch. driven tone burst 8Ω | 53W |
| Av. power o/p single ch. driven 4Ω | 77W |
| Av. power o/p single ch. driven tone burst 4Ω | 81W |
| Idle DC output worst ch. | 10mV |
| Turn on/off max. DC swing worst case | 750mV |
| Damping factor 8Ω | 61 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.06% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.07% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.004% |
| Half power bandwidth | 3Hz-60kHz |
| Av. RIAA impedance | 52kΩ |
| Av. RIAA sensitivity | 2.9mV |
| Av. RIAA clipping | 142mV |
| Av. RIAA capacitance | 100pF |
| Av. aux. impedance | 94kΩ |
| Av. aux. sensitivity | 185mV |
| Av. tape impedance | 94kΩ |
| Av. tape sensitivity | 185mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 360mV |
| Max. level from RIAA-rec. out | 530mV |
| Rec. out impedance DIN av. | 79kΩ |
| Rec. out impedance phono av. | 3kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 76dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 72dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 86.5dB |
| Amp. noise zero vol. CCIR s/n av. | 91.5dB |
| Amp. noise worst vol. CCIR s/n av. | 84.5dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 0.7dB |

**Tuner Section**

| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.1μV |
| Mono RF sens. 50dB IHF | — |
| Stereo RF sens. 50dB | 45μV |
| RFIM | 73dB |
| Adj. ch. av | 0dB |
| Alt. ch. av. | 59dB |
| Image resp | 80dB |
| Capture ratio | 1dB |
| AM reject | 41dB |
| Mono dist. 100% centre tune worst ch. | 0.3% |
| Mono dist. 100% op. tune av. | 0.3% |
| St. L = —R 50% centre tune av. | 0.2% |
| St. single ch. 100% centre tune worst ch. | 0.18% |
| MPX reject 19kHz worst ch. | 70dB |
| MPX reject 38kHz w | >100dB |
| X-talk 1kHz centre tune w | 36dB |
| X-talk 10kHz centre tune worst ch. | 33dB |
| X-talk 1kHz op. tune av. | 36dB |
| Freq. resp. St. —3dB L/R 9Hz/16.8kHz | —9Hz/16.6kHz |
| Freq. resp. St. 15kHz L/R | +2.7dB/+3.2dB |
| Limit threshold | 0.8μV |
| Muting threshold | 1.3μV |
| St. s/n CCIR 100μV/1mV av. | 46dB—59dB |
| Mono s/n 1mV av. CCIR | 64dB |

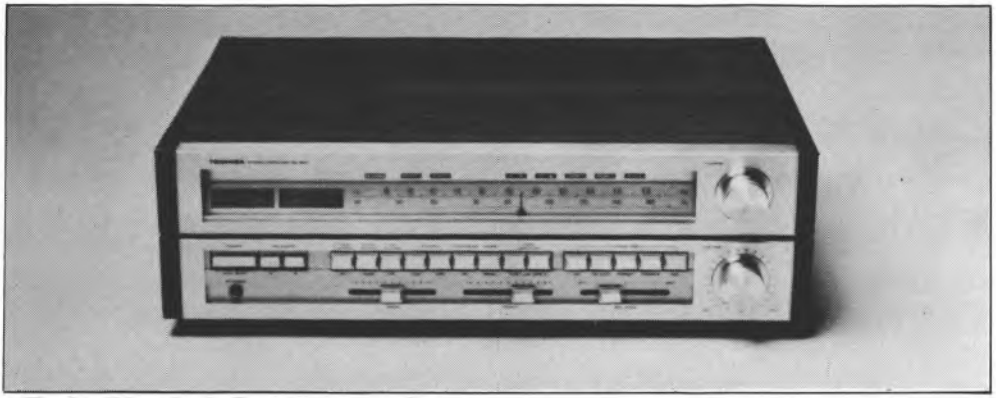
**General Data**

| | |
|---|---|
| Dimensions | 530 x 163 x 435mm |
| Weight | 17kgs |
| Typical selling price including VAT | £250.00 |



# Toshiba SA-620

Toshiba (UK) Ltd., Toshiba House, Great South West Rd., Feltham, Middlesex.
01-751 1281



The SA-620 is identically styled and has the same facilities throughout as the model SA-520, with the exception that two extra push buttons (false teeth) are provided for audio muting and tone control cancelling. On the back panel, unlike the SA-520, break points are mounted to enable external equipment to be inserted inbetween the pre-amplifier and power amplifier sections. The maximum power output though is somewhat higher, 71W into 8 ohms, rising to 105 watts into 4 ohms.

The tone burst tests on the main amplifier revealed virtually the same transient power available as is produced on continuous maximum output tests. The half-power bandwidth extends to only 45kHz, but unwisely the power amplifier response extends to 160kHz, which is yet again misplaced specmanship. The swept IM charts showed the not unexpected dramatic rise above 50kHz to a peak at 150kHz. Harmonic distortion, as with the model SA-520, was higher than average, reaching nearly 0.1% at 1dB below clipping. The subjective sound quality seemed better than that of the SA-520, but bass frequencies were still a little flabby, and high frequencies slightly bright. Output noise performance was acceptable, but the quarter inch stereo headphone jack socket would provide a slightly hissy reproduction into high impedance models. The 22 step position volume control was very smooth and tracked well, but I would have preferred double the number of steps. Tone control and balance control comments are the same as for the SA-520. Output levels from the phono to tape sockets from disc were satisfactory, but the FM tuner's output level was rather low, particularly on the DIN socket.

The pick-up input circuitry had a well optimised input impedance, dropping quite rapidly subsonically, and both the weighted noise and distortion measurements were very good. No clipping problems were encountered, and the frequency response was very good.

The RF sensitivity of the FM tuner section measured extremely well. RFIM measured well, and image response and IF breakthrough were excellent. The selectivity was excellent on one side, but fair on the other, the measurements being very uneven. Thus, good rejection will be obtained from a strong signal one side of a weak station, but not on the other side. Capture ratio and limiting threshold both measured well. AM rejection was only fair on weak signals, but better on strong ones. Muting was much too sensitive. Tuning scale accuracy was excellent. De-emphasis can be switched theoretically to 25, 50 or 75$\mu$S, but all positions were totally wrong, the same errors being noted as for the SA-520. Noise levels were very inadequate, hiss being clearly noticeable in the background of a wide dynamic range programme. On the correct indicated tuning position, distortion measured rather poorly, particularly on left or right alone, at high deviation. Some improvement though was noted when tuned off-centre, and the subjective quality was adequate, although some high frequency crosstalk and spitch was noticed. The response errors and poor hiss levels, however, made the sound quality unacceptable. Tuning was extremely critical for optimum results, and slight backlash was noted, but the ergonomics were nevertheless quite liked. AM reception seemed adequate.

As with the other Toshiba models, the very poor tuner audio section, in particular, withholds any possibility of a recommendation. (Please note that the same modifications mentioned in the SA-320

review would improve the performance in the same way.) It is difficult to understand how the design could have overlooked such a basic necessity as a flat frequency response. It is hoped that Toshiba will be able to correct the problem, and they have intimated their willingness to modify receivers in this series that have already been supplied. Even with the modification, the receiver is relatively poor value for money.

**Amplifier Section**

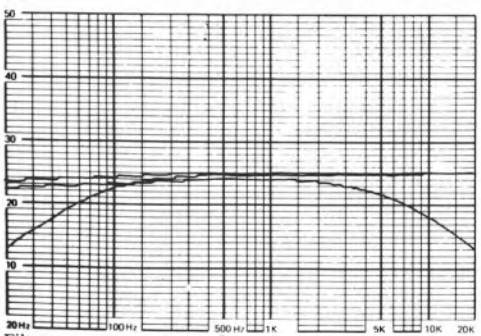
Av. power o/p both chs. driven 8Ω . . . . . 66W
Av. power o/p single ch. driven 8Ω . . . . . 71W
Av. power o/p single ch. driven tone burst 8Ω . . . . . 68W
Av. power o/p single ch. driven 4Ω . . . . . 105W
Av. power o/p single ch. driven tone burst 4Ω . . . . . 101W
Idle DC output worst ch. . . . . 12mV
Turn on/off max. DC swing worst case . . . . . 800mV
Damping factor 8Ω . . . . . 64
X-over distortion . . . . . No
Harmonic dist. —3dB ref 1% 1kHz 8Ω av. . . . . 0.06%
Harmonic dist. —1dB ref 1% 1kHz 8Ω av. . . . . 0.07%
IM dist. 10W av. . . . . N/A
IM dist. RIAA/rec. out . . . . . 0.004%
Half power bandwidth . . . . . 2Hz-45kHz
Av. RIAA impedance . . . . . 52kΩ
Av. RIAA sensitivity . . . . . 2.5mV
Av. RIAA clipping . . . . . 145mV
Av. RIAA capacitance . . . . . 90pF
Av. aux. impedance . . . . . 90kΩ
Av. aux. sensitivity . . . . . 165mV
Av. tape impedance . . . . . 90kΩ
Av. tape sensitivity . . . . . 165mV
Mic impedance . . . . . —
Mic. sensitivity . . . . . —
Mic. clipping . . . . . —
Max. level from tuner-rec. out . . . . . 344mV
Max. level from RIAA-rec. out . . . . . 520mV
Rec. out impedance DIN av. . . . . 79kΩ
Rec. out impedance phono av. . . . . 3.2kΩ
Av. RIAA noise ref 8mV—rec. out unw. . . . . 76dB
Av. RIAA noise ref 8mV—rec. out CCIR . . . . . 72.5dB
Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω . . . . . 83dB
Amp. noise zero vol. CCIR s/n av. . . . . 90dB
Amp. noise worst vol. CCIR s/n av. . . . . 84dB
Amp. noise zero vol. unw. 20/20kHz . . . . . N/A
Volume control tracking worst error . . . . . 0.6dB

**Tuner Section**

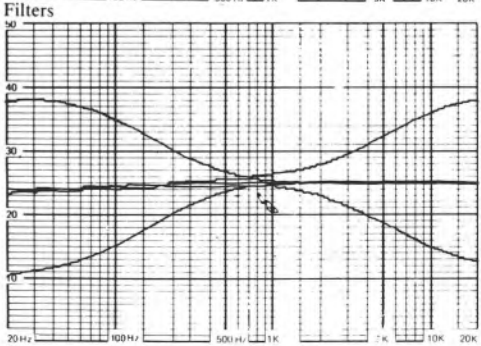
Mono RF sens. 30dB IHF . . . . . 0.8μV
Mono RF sens. 50dB IHF . . . . . 3μV
Stereo RF sens. 50dB. . . . . —
RFIM . . . . . 74dB
Adj. ch. av . . . . . 11dB
Alt. ch. av. . . . . 61dB
Image resp . . . . . 88dB
Capture ratio. . . . . 0.5dB
AM reject . . . . . 61dB
Mono dist. 100% centre tune worst ch. . . . . 0.34%
Mono dist. 100% op. tune av. . . . . 0.26%
St. L = —R 50% centre tune av. . . . . 0.1%
St. single ch. 100% centre tune worst ch. . . . . 0.8%
MPX reject 19kHz worst ch. . . . . 66dB
MPX reject 38kHz worst ch. . . . . >100dB
X-talk 1kHz centre tune worst ch. . . . . 31dB
X-talk 10kHz centre tune worst ch. . . . . 29dB
X-talk 1kHz op. tune av. . . . . 35dB
Freq. resp. St. —3dB L/R 7Hz/16.8kHz—8Hz/16.8kHz
Freq. resp. St. 15kHz L/R . . . . . +2.7dB/+1.9dB
Limit threshold . . . . . 0.5μV
Muting threshold . . . . . 0.8μV
St. s/n CCIR 100μV/1mV av. . . . . 51dB—59dB
Mono s/n 1mV av. CCIR . . . . . 64dB

**General Data**

Dimensions . . . . . 530 x 163 x 435mm
Weight . . . . . 18.5kgs
Typical selling price including VAT . . . . . £360.00



Filters



Tone controls.

RECOMMENDED

# Trio KR-4070

B H Morris Ltd., Precision Centre, Heather Park Drive, Wembley, Middlesex HA0 1SU. 01-902 9422.


This is the first of a new series to be launched over the next year or so from Trio (known as Kenwood in Europe and the USA) and provides 64W into 8 ohms and 88W per channel into 4 ohms. Housed in a metal cabinet, it employs bass and treble controls with 11 slightly uneven steps and a centre indented balance control complimented by a large volume control having rather poor tracking at higher positions. Two selectable pairs of speakers can be interconnected on terminals which we found a bit stiff and awkward. DIN sockets for 300 ohm FM and AM antennae were provided on the review sample, but production for the UK should include an FM coax socket, terminals also being provided for 75 and 300 ohm antennae. Phono inputs are provided for pick-up, auxiliary, and one tape recorder, a 5-pole DIN socket also being provided for tape. There is a 3-core mains lead, together with an earth terminal. Push buttons select loudness compensation and tape monitoring. The loudspeaker switch incorporates the mains on/off. The input switch selects AM, FM with auto mute mono, pick-up and auxiliary. There are no filters.

Tone burst tests on the amplifier revealed 10% more transient power into 8 and 4 ohms. Whilst harmonic distortion measured well, at 1dB below clipping, harmonics were noted up to quite high frequencies at lower levels. Although the half-power bandwidth extended to 90kHz the response unfortunately extended to 150kHz, and as might be expected the swept IM charts showed distortion rising above 45kHz, reaching a maximum at 200kHz. It would be better to curtail the response above 40kHz or so. The sound quality was basically good, and no problems were experienced.

Output noise measured very well indeed, and headphones inserted into their stereo jack socket operated well, but as usual too much level was available into high impedance models. A slight turn on thump was noticed, but is not serious. Damping factor was a little low at 30, and tone controls operated within the power amplifier's feedback circuits, which is perhaps questionable. The tuner's outout level to tape was considerably higher than that from disc, whilst the latter was at a low level on the DIN socket. Other input and output levels were satisfactory. The pick-up input stage had a well optimised impedance characteristic, and a good clipping margin. Noise level and distortion measured well. The response was flat, and insufficient subsonic filtering was provided especially since there is no rumble filter.

Whilst RF input sensitivities on the FM section all measured quite well, RF IM was just average, though certainly not poor. Image response was rather poor, but IF rejection good. Local oscillator radiation was poor, and could cause annoyance. Selectivity was rather average, but capture ratio and limiting were excellent. Muting was much too sensitive, but AM rejection adequate. Frequency response measured reasonably well, but multiplex filtering was very poor. Signal to noise ratios on weak signals were quite good, but rather poor on stronger ones. Whilst distortion measured quite well, optimum tuning came in different positions for best distortion and best crosstalk.

Subjective quality was quite good, but slight spitch was noted when tuning for best crosstalk, showing slight misalignment at the factory. At best, crosstalk measurements were excellent. Dial accuracy was very good, and tuning ergonomics proved far better than last year's Trio models. AM

RECOMMENDED

reception was better than average. Provided Trio can improve the alignment of the discriminator/decoder section, this receiver can be recommended, for it offers reasonable power output capabilities at a modest comparative price. Recommended as good value for money, but not quite in the best buy class.

**Amplifier Section**

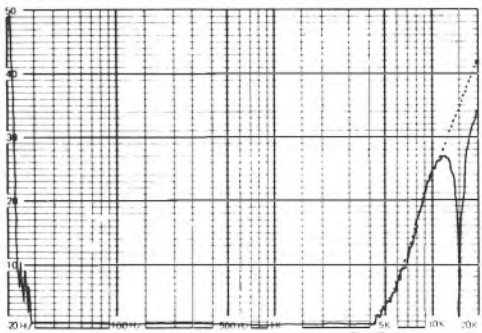
Av. power o/p both chs. driven 8Ω . . . . . 54.5W
Av. power o/p single ch. driven 8Ω . . . . . 64W
Av. power o/p single ch. driven tone burst 8Ω . . . . . 69W
Av. power o/p single ch. driven 4Ω . . . . . 88W
Av. power o/p single ch. driven tone burst 4Ω . . . . . 105W
Idle DC output worst ch. . . . . 25mV
Turn on/off max. DC swing worst case . . . . . 8V
Damping factor 8Ω . . . . . 40
X-over distortion . . . . . No
Harmonic dist. —3dB ref 1% 1kHz 8Ω av. . . . . 0.01%
Harmonic dist. —1dB ref 1% 1kHz 8Ω av. . . . . 0.03%
IM dist. 10W av. . . . . N/A
IM dist. RIAA/rec. out . . . . . 0.005%
Half power bandwidth . . . . . 3Hz-93kHz
Av. RIAA impedance . . . . . 52kΩ
Av. RIAA sensitivity . . . . . 3mV
Av. RIAA clipping . . . . . 200mV
Av. RIAA capacitance . . . . . 65pF
Av. aux. impedance . . . . . 54kΩ
Av. aux. sensitivity . . . . . 170mV
Av. tape impedance . . . . . 61kΩ
Av. tape sensitivity . . . . . 170mV
Mic impedance . . . . . —
Mic. sensitivity . . . . . —
Mic. clipping . . . . . —
Max. level from tuner-rec. out . . . . . 672mV
Max. level from RIAA-rec. out . . . . . 467mV
Rec. out impedance DIN av. . . . . 78.5kΩ
Rec. out impedance phono av. . . . . 3kΩ
Av. RIAA noise ref 8mV—rec. out unw. . . . . 76dB
Av. RIAA noise ref 8mV—rec. out CCIR . . . . . 72dB
Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω . . . . . 102dB
Amp. noise zero vol. CCIR s/n av. . . . . 97.5dB
Amp. noise worst vol. CCIR s/n av. . . . . 88dB
Amp. noise zero vol. unw. 20/20kHz . . . . . N/A
Volume control tracking worst error. . . . . 2dB

**Tuner Section**

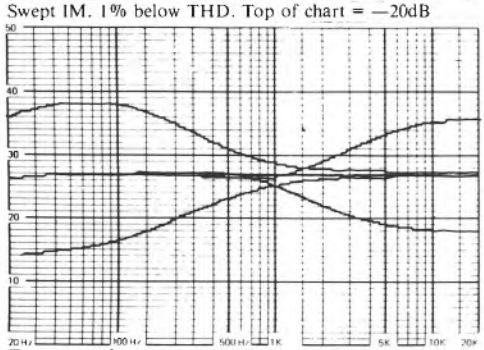
Mono RF sens. 30dB IHF . . . . . 0.9μV
Mono RF sens. 50dB IHF . . . . . 7μV
Stereo RF sens. 50dB . . . . . 40μV
RFIM . . . . . 67dB
Adj. ch. av . . . . . 4dB
Alt. ch. av. . . . . 53dB
Image resp . . . . . 54dB
Capture ratio. . . . . 0.9dB
AM reject . . . . . 62dB
Mono dist. 100% centre tune worst ch. . . . . 0.21%
Mono dist. 100% op. tune av. . . . . 0.15%
St. L = —R50% centre tune av. . . . . 0.19%
St. single ch. 100% centre tune worst ch. . . . . 0.41%
MPX reject 19kHz worst ch. . . . . 38dB
MPX reject 38kHz worst ch. . . . . 61dB
X-talk 1kHz centre tune worst ch. . . . . 36dB
X-talk 10kHz centre tune worst ch. . . . . 35dB
X-talk 1kHz op. tune av. . . . . 39.5dB
Freq. resp. St. —3dB L/R 16Hz/17kHz—16Hz/16.5kHz
Freq. resp. St. 15kHz L/R . . . . . —1.7dB/—2dB
Limit threshold . . . . . 0.6μV
Muting threshold . . . . . 1μV
St. s/n CCIR 100μV/1mV av. . . . . 52dB—60dB
Mono s/n 1mV av. CCIR . . . . . 65.5dB

**General Data**

Dimensions . . . . . 468 x 149 x 360mm
Weight . . . . . 9.4kgs
Typical selling price including VAT . . . . . £190.00



Swept IM. 1% below THD. Top of chart = —20dB



Tone controls

# Trio KR-9600

B H Morris Ltd., Precision Centre, Heather Park Drive, Wembley, Middlesex HA0 1SU. 01-902 9422.


The model KR-9600 delivers 88W into 8 ohms and 120W into 4 ohms, and whilst three pairs of loudspeakers can be interconnected with spring-loaded clamps, only two at a time are selectable on a rotary switch. Interconnection with two tape recorders is also provided, one being duplicated on a 5-pole DIN. An input selector switch can be turned to AM/FM/pick-up 1 and 2 and auxiliary. A rotary dubbing and tape monitoring switch is provided, thus covering all tape requirements. The volume control was smooth and well liked, and is complemented by a centre indented balance control having a good law. Bass and treble controls each have 11 steps, which were, however, rather uneven. Lever switches operate an additional low bass lift and a presence lift. Push buttons operate rumble filter (6dB per octave below 250Hz — much too high) and treble filter (6dB per octave above 3.5kHz — too low). I suggest that this can only be seriously used if you have a very bad turntable, and incredibly scratched records! Additional buttons provide mono/stereo, loudness compensation, FM 25μsec de-emphasis and FM muting. FM antenna inputs for 75 and 300 ohms are on terminals, and an additional AM one is complemented by an internal ferrite rod, which gave reasonable AM reception. A heavy duty 3-core mains cable and earth terminals are provided. Break point with U-links allow insertion of external equipment before the power amplifier section. The unusually styled case is quite attractive, and the ergonomics generally good.

Marginally more power is available from the power amplifier on transients, judging by the tone burst performance, and harmonic distortion measured moderately well. However, whilst half-power bandwidth extended to 90kHz, frequency response extended too far up to 140kHz, thus showing up in the swept IM pen charts, which were generally satisfactory in the audio range though showing large increases above around 50kHz. The subjective sound quality was reasonably good, but showed some brittleness at high frequencies on transients. Bass frequencies were well damped though. Output noise was very slightly hummy, but the hiss level was very low. A stereo jack socket provided fairly high levels for 8 ohm headphones and very high levels for high impedance models. The volume control tracked rather poorly at high levels, and image shifting might be noticed. Tape input and output levels were reasonable on phono sockets, but the DIN outout level was a little low. Input impedances were on the low side, but will be generally satisfactory.

The RIAA pick-up input circuit had well optimised input impedance and an excellent clipping margin. Noise level measured very well, distortion was low, but the response showed a valley of 1dB at middle frequencies. Otherwise the response was reasonably flat.

The FM tuner section's RF sensitivities measured quite well, but RF IM performance was barely adequate. Image response and IF breakthrough measured well though. Local oscillator radiation was very bad, and disturbance could be caused to neighbours. Selectivity was only fair, and rather lopsided. Capture ratio was average, but limiting threshold measured well. Muting was too sensitive, and AM rejection poor on weak signals. Frequency response measured well, and multiplex filtering was excellent. Signal to noise ratios were just adequate, but below average. Distortion measurements were again average. Tuning was spongy, and was very

critical for optimum performance, but at best the sound quality was reasonable. Crosstalk measurements were reasonably good. The tuning dial accuracy calibration marks will be found adequate.

This model is not particularly good value for money, and does not quite come into the recommended category.

**Amplifier Section**

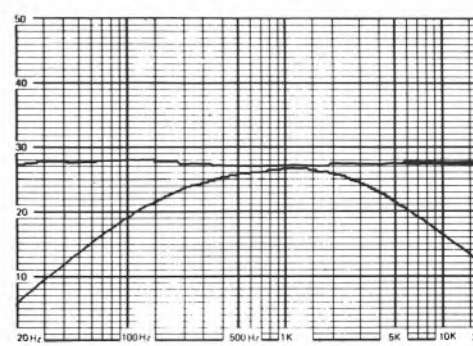
Av. power o/p both chs. driven 8Ω . . . . . 81W
Av. power o/p single ch. driven 8Ω . . . . . 88W
Av. power o/p single ch. driven tone burst 8Ω . . . . . 90.5W
Av. power o/p single ch. driven 4Ω . . . . . 121W
Av. power o/p single ch. driven tone burst 4Ω . . . . . 128W
Idle DC output worst ch. . . . . 20mV
Turn on/off max. DC swing worst case . . . . . 1V
Damping factor 8Ω . . . . . 75
X-over distortion . . . . . No
Harmonic dist. —3dB ref 1% 1kHz 8Ω av. . . . . 0.03%
Harmonic dist. —1dB ref 1% 1kHz 8Ω av. . . . . 0.04%
IM dist. 10W av. . . . . N/A
IM dist. RIAA/rec. out . . . . . 0.01%
Half power bandwidth . . . . . 4.5Hz-90kHz
Av. RIAA impedance . . . . . 52kΩ
Av. RIAA sensitivity . . . . . 3.6mV
Av. RIAA clipping . . . . . 200mV
Av. RIAA capacitance . . . . . 64pF
Av. aux. impedance . . . . . 41kΩ
Av. aux. sensitivity . . . . . 220mV
Av. tape impedance . . . . . 40kΩ
Av. tape sensitivity . . . . . 220mV
Mic impedance . . . . . 51kΩ
Mic. sensitivity . . . . . 1.9mV
Mic. clipping . . . . . 120mV
Max. level from tuner-rec. out . . . . . 432mV
Max. level from RIAA-rec. out . . . . . 450mV
Rec. out impedance DIN av. . . . . 79.6kΩ
Rec. out impedance phono av. . . . . 2.1kΩ
Av. RIAA noise ref 8mV—rec. out unw. . . . . 77dB
Av. RIAA noise ref 8mV—rec. out CCIR . . . . . 72dB
Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω . . . . 75.5dB
Amp. noise zero vol. CCIR s/n av. . . . . 89.5dB
Amp. noise worst vol. CCIR s/n av. . . . . 85.5dB
Amp. noise zero vol. unw. 20/20kHz . . . . . N/A
Volume control tracking worst error . . . . . 2.7dB

**Tuner Section**

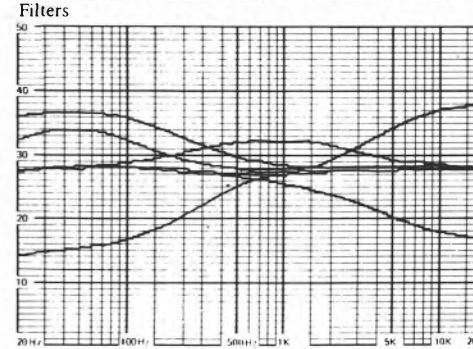
Mono RF sens. 30dB IHF . . . . . 1.1μV
Mono RF sens. 50dB IHF . . . . . 2.5μV
Stereo RF sens. 50dB. . . . . —
RFIM . . . . . 65dB
Adj. ch. av. . . . . 2.5dB
Alt. ch. av. . . . . 65dB
Image resp . . . . . 87dB
Capture ratio . . . . . 1.4dB
AM reject . . . . . 59dB
Mono dist. 100% centre tune worst ch. . . . . 0.36%
Mono dist. 100% op. tune av. . . . . 0.24%
St. L = —R 50% centre tune av. . . . . 0.1%
St. single ch. 100% centre tune worst ch. . . . . 0.32%
MPX reject 19kHz worst ch. . . . . 65dB
MPX reject 38kHz worst ch. . . . . 87dB
X-talk 1kHz centre tune worst ch. . . . . 39dB
X-talk 10kHz centre tune worst ch. . . . . 31dB
X-talk 1kHz op. tune av. . . . . 39.5dB
Freq. resp. St. —3dB L/R 20Hz/15.6kHz—20Hz/15.8kHz
Freq. resp. St. 15kHz L/R . . . . . —0.9dB/—1.4dB
Limit threshold . . . . . 0.7μV
Muting threshold. . . . . 1.2μV
St. s/n CCIR 100μV/1mV av. . . . . 51dB—61dB
Mono s/n 1mV av. CCIR . . . . . 65dB

**General Data**

Dimensions . . . . . 524 x 151 x 365mm
Weight . . . . . 16.3kgs
Typical selling price including VAT . . . . . £380.00



Filters

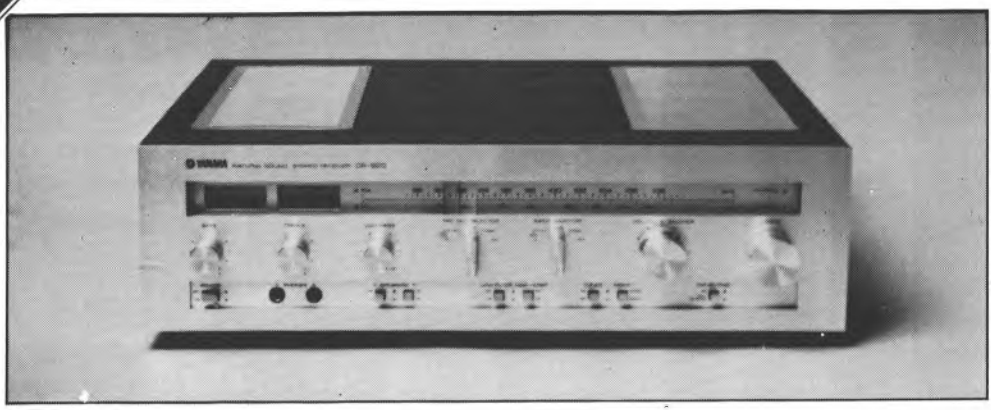


Tone controls.

BEST BUY

# Yamaha CR-620

Natural Sound Systems Ltd., 10 Byron Rd., Wealdstone, Harrow, Middlesex. 01-863 8622.



This model is the lowest powered of the new Yamaha models reviewed, and up to 58W is available into 8 ohms and 76W into 4 ohms. Two tape recorders can be interconnected on phono sockets, and an exceptionally useful dubbing switch allows transfer from tape to tape in either direction, and also can switch any input direct to tape, allowing another input to be independently auditioned. A rotary switch is provided for selecting the main source from tuner, auxiliary, pick-up or for monitoring either tape recorder's playback. The main volume control tracked well, but grated slightly near the bottom. Concentrically mounted behind it, the centre-indented balance control changed position fairly slowly across the centre. The bass and treble controls unfortunately had 11 very uneven steps. A loudness compensator switch with 11 positions allowed a very wide range of compensation to be achieved, which was well liked.

Push buttons are provided for mains on/off, speaker selection (two pairs available with spring-loaded clamp connectors), rumble filter (12dB per octave below 27Hz), treble filter (12dB per octave above 11kHz), FM/AM, stereo/mono and FM muting. The FM muting control switches the tuner to mono when not muted. A swivellable ferrite rod is supplied for AM. and five antenna terminals are provided for external AM, 75 ohms or 300 ohms FM. The mains lead is only 2 core, but earth terminals are fitted. No 5 pole DIN sockets are provided for tape. The receiver is particularly well-presented, and has excellent ergonomics.

A very slight power reserve for transients was noted in the tone burst tests, and power amplifier harmonic distortion measured extremely well below 0.01% even at 1dB below clipping. Half-power bandwidth extended to 90kHz, but unfortunately frequency response was up to 160kHz, which is a pity. The swept IM pen charts clearly showed a severe deterioration above 90kHz. The overall sound quality of the amplifier was excellent. Output noise was extremely low, and two quarter inch stereo headphone jacks provided excellent quality, but too high a level into high impedance models. A slight DC offset was noted on one channel, however. Input sensitivities and impedances were all well optimised, but the tuner's record output level was rather lower than that from an average disc.

The RIAA pre-amplifier input had a rather high capacity, but was otherwise well optimised in noise performance, clipping margin, response and distortion. Pick-ups sensitive to capacity loading might become over-brittle.

The FM tuner's RF sensitivities measured well, and in particular, the RFIM performance was really excellent. Image response and IF rejection though were not too good. Selectivity and capture ratio were quite reasonable, and limiting excellent. Muting and AM rejection both measured very well. Whilst the frequency response was excellent, multiplex rejection was just adequate. Signal to noise ratios were very good, strong stereo signal noise in particular being excellent. Despite the excellent distortion figures on centre tune, they were even better slightly off centre. The subjective sound quality was always excellent, and most creditable, but low frequency crosstalk was actually slightly below average, although good at other frequencies. Tuning dial accuracy was only fair, but tuning ergonomics excellent. Although the medium wave reception was very good, a loud whistle was audible on Radio 4 Brookmans Park.

# Yamaha CR-620

BEST BUY

The tuner section of this receiver is extremely good, putting to shame more expensive models. Whilst the sound quality of the amplifier section was very good, I was disappointed with the uneven steps in the tone controls. I can recommend this model though without hesitation, and even at its fairly high price, it must surely be considered a best buy.

**Amplifier Section**

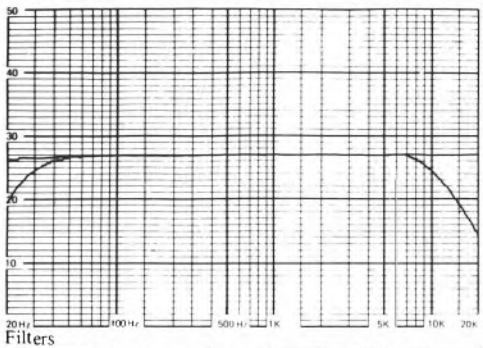
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 49.5W |
| Av. power o/p single ch. driven 8Ω | 58W |
| Av. power o/p single ch. driven tone burst 8Ω | 62W |
| Av. power o/p single ch. driven 4Ω | 76.5W |
| Av. power o/p single ch. driven tone burst 4Ω | 88W |
| Idle DC output worst ch. | 38mV |
| Turn on/off max. DC swing worst case | 420mV |
| Damping factor 8Ω | .61 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.01% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.01% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.01% |
| Palf power bandwidth | 3.5Hz-90kHz |
| Av. RIAA impedance | 49.5kΩ |
| Av. RIAA sensitivity | 2.4mV |
| Av. RIAA clipping | 140mV |
| Av. RIAA capacitance | 220pF |
| Av. aux. impedance | 51.5kΩ |
| Av. aux. sensitivity | 140mV |
| Av. tape impedance | 51.5kΩ |
| Av. tape sensitivity | 140mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 332mV |
| Max. level from RIAA-rec. out | 460mV |
| Rec. out impedance DIN av. | — |
| Rec. out impedance phono av. | 5kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 79dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 73dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 97dB |
| Amp. noise zero vol. CCIR s/n av. | 97dB |
| Amp. noise worst vol. CCIR s/n av. | 85dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1dB |

**Tuner Section**

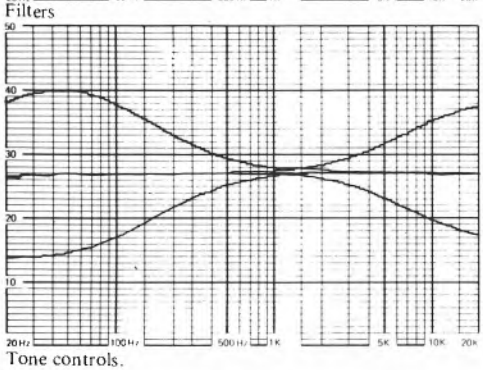
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1μV |
| Mono RF sens. 50dB IHF | 3μV |
| Stereo RF sens. 50dB | 35μV |
| RFIM | 83dB |
| Adj. ch. av | 7dB |
| Alt. ch. av. | 60dB |
| Image resp | 60dB |
| Capture ratio | 1.5dB |
| AM reject | 68dB |
| Mono dist. 100% centre tune worst ch. | 0.25% |
| Mono dist. 100% op. tune av. | 0.1% |
| St. L = —R 50% centre tune av. | 0.08% |
| St. single ch. 100% centre tune worst ch. | 0.08% |
| MPX reject 19kHz worst ch. | 50dB |
| MPX reject 38kHz worst ch. | 83dB |
| X-talk 1kHz centre tune worst ch. | 35dB |
| X-talk 10kHz centre tune worst ch. | 34dB |
| X-talk 1kHz op. tune av. | 43dB |
| Freq. resp. St. —3dB L/R 8Hz/16.2kHz—8Hz/16.3kHz | |
| Freq. resp. St. 15kHz L/R | —0.6dB/—0.6dB |
| Limit threshold | 0.6μV |
| Muting threshold | 2.5μV |
| St. s/n CCIR 100μV/1mV av. | 52dB—66dB |
| Mono s/n 1mV av. CCIR | 76dB |

**General Data**

| | |
|---|---|
| Dimensions | 508 x 167 x 395mm |
| Weight | 12.5kgs |
| Typical selling price including VAT | £230.00 |



Filters

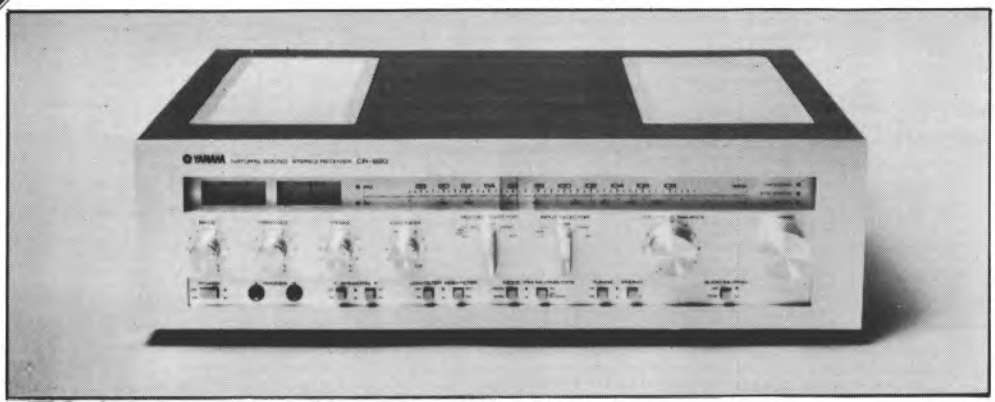


Tone controls.

RECOMMENDED

# Yamaha CR-820

Natural Sound Systems Ltd., 10 Byron Rd., Wealdstone, Harrow, Middlesex. 01-863 8622.



Whilst the basic provisions on this model are very similar to those on the CR-620, a presence tone control with 11 steps is added, but bass presence and treble controls all had very uneven steps. The maximum output power measures 80W into 8 ohms, and 108W into 4 ohms. Two pick-up inputs are provided, and also a 20dB audio mute button. Rumble and treble filters were both approximately 12dB per octave operating at 30Hz and 11kHz respectively. Again, I must commend Yamaha on their excellent tape record routing switch enabling independent recording from tuner and playback from disc at the same time, for example. Other functions and facilities were virtually identical to the CR-620's.

Tone burst tests on the power amplifier showed marginally more transient power available into 8 ohms, but slightly less into 4 ohms than for the continuous ratings. Harmonic distortion measurements were quite remarkably good, and half-power bandwidth extended to 100kHz. Unfortunately, response was allowed to extend to 160kHz, but nevertheless, the swept IM charts showed far less distortion than usual, even at 160kHz! The output noise level was extremely low, and good headphone quality was obtained, but again, too high a level is available into high impedance models. The subjective sound quality was generally excellent, and no problems were encountered. Volume control tracking was just adequate, with the centre-indented balance control behind it which operated gradually across the centre. Phono socket inputs and outputs were all reasonable, but the tuner's output level was rather lower than that from disc.

The RIAA input circuitry measured extremely well, but the input capacity was much higher than usual, and some pick-ups might not like it.

The FM tuner's RF sensitivities all measured extremely well. RFIM though was just reasonably good. Image response and IF breakthrough were both excellent. Adjacent selectivity was rather poor, but alternate good. Capture ratio, limiting threshold, muting and AM rejection were all excellent. Although frequency response was excellent, beat notes were audible on frequencies near 19kHz. Pilot tone breakthrough was well rejected. Weighted signal to noise ratios were all excellent. Distortion and crosstalk measurements were all very good indeed. The subjective sound quality was superb, and definitely one of the best. Tuning dial accuracy was only fair, but ergonomics excellent. AM reception was quite good, but a whistle was noticed on Radio 4 Brookmans Park.

As with the model CR-620, the CR-820 is clearly recommended, but you should look carefully at the price differentials, and the differences in facilities. The main points of criticism are the uneven steps of the tone controls and the tuner's pilot tone rejection system which seems to allow beat notes through. RFIM performance was also inferior to that of the CR-620.

# Yamaha CR-820

RECOMMENDED

**Amplifier Section**

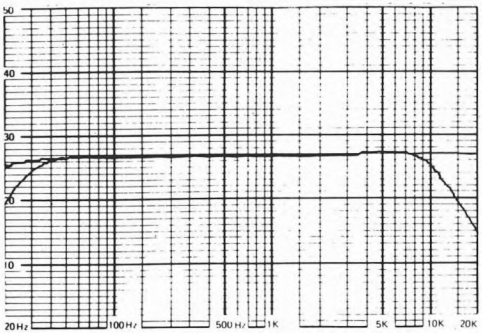
Av. power o/p both chs. driven 8Ω . . . . . 69W
Av. power o/p single ch. driven 8Ω . . . . . 80W
Av. power o/p single ch. driven tone burst 8Ω . . . . . 86W
Av. power o/p single ch. driven 4Ω . . . . . 108W
Av. power o/p single ch. driven tone burst 4Ω . . . . . 91W
Idle DC output worst ch. . . . . 28mV
Turn on/off max. DC swing worst case . . . . . 400mV
Damping factor 8Ω . . . . . 69
X-over distortion . . . . . No
Harmonic dist. —3dB ref 1% 1kHz 8Ω av. . . . . 0.01%
Harmonic dist. —1dB ref 1% 1kHz 8Ω av. . . . . 0.01%
IM dist. 10W av. . . . . N/A
IM dist. RIAA/rec. out . . . . . 0.01%
Half power bandwidth . . . . . 5Hz-100kHz
Av. RIAA impedance . . . . . 49kΩ
Av. RIAA sensitivity . . . . . 2.6mV
Av. RIAA clipping . . . . . 140mV
Av. RIAA capacitance . . . . . 230pF
Av. aux. impedance . . . . . 52kΩ
Av. aux. sensitivity . . . . . 145mV
Av. tape impedance . . . . . 52kΩ
Av. tape sensitivity . . . . . 145mV
Mic impedance . . . . . —
Mic. sensitivity . . . . . —
Mic. clipping . . . . . —
Max. level from tuner-rec. out . . . . . 328mV
Max. level from RIAA-rec. out . . . . . 460mV
Rec. out impedance DIN av. . . . . —
Rec. out impedance phono av. . . . . 5.5kΩ
Av. RIAA noise ref 8mV—rec. out unw. . . . . 78dB
Av. RIAA noise ref 8mV—rec. out CCIR . . . . . 72.5dB
Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω . . . . . 95dB
Amp. noise zero vol. CCIR s/n av. . . . . 98dB
Amp. noise worst vol. CCIR s/n av. . . . . 85dB
Amp. noise zero vol. unw. 20/20kHz . . . . . N/A
Volume control tracking worst error . . . . . 1.4dB

**Tuner Section**

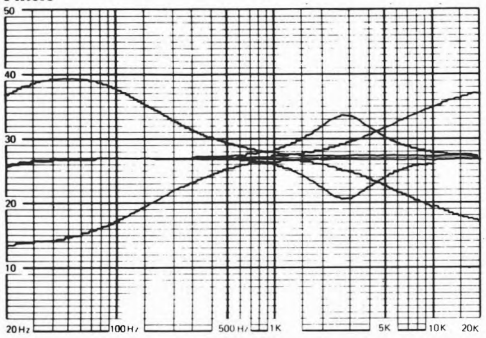
Mono RF sens. 30dB IHF . . . . . 0.9μV
Mono RF sens. 50dB IHF . . . . . 2.4μV
Stereo RF sens. 50dB . . . . . 18μV
RFIM . . . . . 71dB
Adj. ch. av. . . . . 4dB
Alt. ch. av. . . . . 69dB
Image resp . . . . . 91dB
Capture ratio . . . . . 0.5dB
AM reject . . . . . 67dB
Mono dist. 100% centre tune worst ch. . . . . 0.08%
Mono dist. 100% op. tune av. . . . . 0.08%
St. L = —R 50% centre tune av. . . . . 0.06%
St. single ch. 100% centre tune worst ch. . . . . 0.09%
MPX reject 19kHz worst ch. . . . . 55dB
MPX reject 38kHz worst ch. . . . . 92dB
X-talk 1kHz centre tune worst ch. . . . . 47dB
X-talk 10kHz centre tune worst ch. . . . . 40dB
X-talk 1kHz op. tune av. . . . . 56dB
Freq. resp. St. —3dB L/R 6Hz/flat—6Hz/flat
Freq. resp. St. 15kHz L/R . . . . . Flat/—0.3dB
Limit threshold . . . . . 0.6μV
Muting threshold . . . . . 6μV
St. s/n CCIR 100μV/1mV av. . . . . 53dB—66dB
Mono s/n 1mV av. CCIR . . . . . 76dB

**General Data**

Dimensions . . . . . 508 x 167 x 395mm
Weight . . . . . 13.1kgs
Typical selling price including VAT . . . . . £300.00

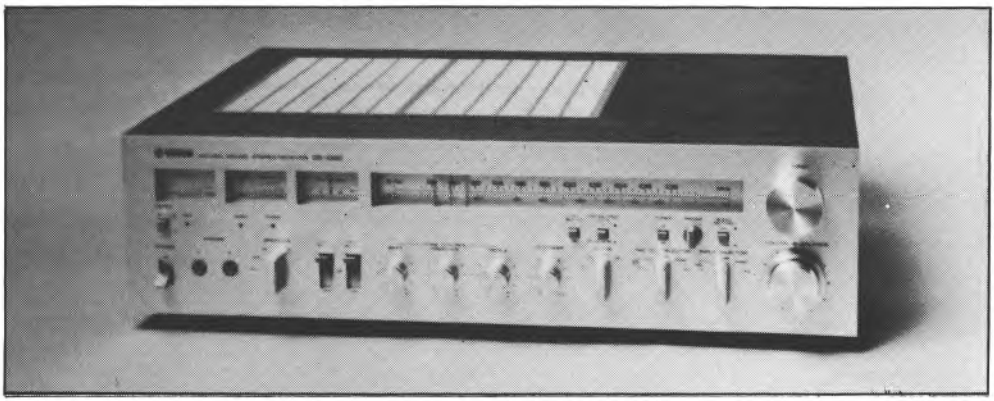



Filters



## Yamaha CR-1020

Natural Sound Systems Ltd., 10 Byron Rd., Wealdstone, Harrow, Middlesex. 01-863 8622.



This high-powered model can provide up to 112W into 8 ohms and 150W into 4 ohms. A rotary switch selects up to two of three pairs of speakers which can be interconnected on spring-loaded clamps on the rear. Very comprehensive facilities are provided which include dubbing and monitoring facilities to two tape recorders, and independent record feeds from any input to tape. An input switch for the main pre-amp/amplifier sections selects tape 1/2, tuner, pick-up or auxiliary, push button or switches being provided for phono pick-up 1/2, AM/FM, FM muting/mono, FM HF blend, audio muting stereo/mono routing and meter functioning (two meters provided for loudspeaker power indication, one of them switching to RF signal strength). An additional tuning indication meter is provided.

Bass, mid and treble controls all had 11 uneven steps, and an additional 11 stepped rotary gives a very wide range of loudness compensation. Two lever switches are provided for rumble filter (12dB per octave below 70Hz or 15Hz), and treble filter (12dB per octave above 8kHz or 12kHz). The volume control was very smooth and tracked reasonably, and was concentrically mounted with the centre-indented balance control All low level inputs and outputs are on phono sockets, no 5-pole DIN type being provided. A ferrite rod is supplied for AM, but terminals for external AM and 75/300 ohm FM aerials. The mains lead is 2 core, but adequate earthing terminals are included. Switched break points are provided before the power amplifier section.

Approximately 10% more transient power is available than continuous. Harmonic distortion measured extremely well even near clipping. Half-power bandwidth extended to 100kHz, which is excellent, but response extended to 125kHz. Considering this, the swept IM charts were much better than average. Output noise levels were extremely low, and two headphone jacks provided excellent quality, although too high a level was available into high impedance models. The subjective sound quality was excellent, and as good as many more expensive amplifiers. A higher output level was available from discs than from the tuner section though, which is a pity.

The RIAA pick-up input had a very well optimised impedance, clipping, distortion and noise performance. The frequency response was also extremly flat.

The FM tuner section had a very poor input sensitivity on 75 ohms, and a second sample was not much better, but on the 300 ohm input it was rather more satisfactory. RFIM was very poor indeed, but better on 300 ohms. Image response and IF breakthrough was reasonable. Selectivity was adequate, but not good. Capture ratio, limiting threshold, and AM rejection were all excellent, but muting was far too sensitive. Frequency response was excellent, but very high frequencies created beat notes with pilot tone, the latter being moderately well rejected. Weighted signal to noise ratios were very good on strong signals. Distortion levels all measured extremely well, but crosstalk was poor at high frequencies. The subjective sound quality was very good, but slight roughness was noted in the crosstalk. Dial accuracy was poor, but tuning ergonomics superb. Whistles were audible on many strong medium wave stations, and some RFIM was noted.

Even if a 300 ohm aerial is used on this receiver, the performance would not be sufficiently good for

a recommendation. It cannot be recommended at all for 75 ohm aerials, and Yamaha will have to sort out the mis-matched aerial input circuitry. The tone control steps should be more even, and so this model is relatively poor value for money.

**Amplifier Section**

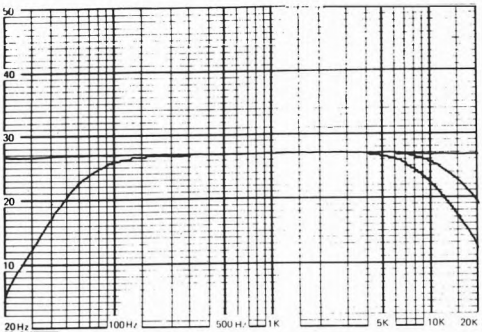
Av. power o/p both chs. driven 8Ω . . . . . 100W
Av. power o/p single ch. driven 8Ω . . . . . 112W
Av. power o/p single ch. driven tone burst 8Ω . . . . . 121W
Av. power o/p single ch. driven 4Ω . . . . . 149.5W
Av. power o/p single ch. driven tone burst 4Ω . . . . . 171W
Idle DC output worst ch. . . . . 3mV
Turn on/off max. DC swing worst case . . . . . 125mV
Damping factor 8Ω . . . . . 56
X-over distortion . . . . . No
Harmonic dist. —3dB ref 1% 1kHz 8Ω av. . . . . <0.01%
Harmonic dist. —1dB ref 1% 1kHz 8Ω av. . . . . 0.01%
IM dist. 10W av. . . . . N/A
IM dist. RIAA/rec. out . . . . . 0.01%
Half power bandwidth . . . . . 2Hz-100kHz
Av. RIAA impedance . . . . . 50.1kΩ
Av. RIAA sensitivity . . . . . 2.3mV
Av. RIAA clipping . . . . . 270mV
Av. RIAA capacitance . . . . . 140pF
Av. aux. impedance . . . . . 44.5kΩ
Av. aux. sensitivity . . . . . 145mV
Av. tape impedance . . . . . 44.5kΩ
Av. tape sensitivity . . . . . 145mV
Mic impedance . . . . . —
Mic. sensitivity . . . . . —
Mic. clipping . . . . . —
Max. level from tuner-rec. out . . . . . 340mV
Max. level from RIAA-rec. out . . . . . 500mV
Rec. out impedance DIN av. . . . . —
Rec. out impedance phono av. . . . . 4.8kΩ
Av. RIAA noise ref 8mV—rec. out unw. . . . . 79dB
Av. RIAA noise ref 8mV—rec. out CCIR . . . . . 72dB
Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω . . . . . 104dB
Amp. noise zero vol. CCIR s/n av. . . . . 100dB
Amp. noise worst vol. CCIR s/n av. . . . . 86dB
Amp. noise zero vol. unw. 20/20kHz . . . . . N/A
Volume control tracking worst error . . . . . 1.4dB

**Tuner Section**

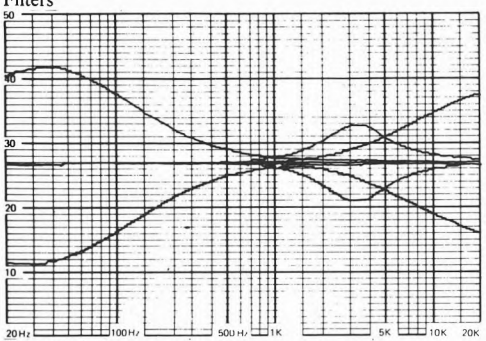
Mono RF sens. 30dB IHF . . . . . 1.8μV
Mono RF sens. 50dB IHF . . . . . 5.5μV
Stereo RF sens. 50dB . . . . . 50μV
RFIM . . . . . 59dB
Adj. ch. av. . . . . 5.5dB
Alt. ch. av. . . . . 60dB
Image resp . . . . . 75dB
Capture ratio . . . . . 0.8dB
AM reject . . . . . 67dB
Mono dist. 100% centre tune worst ch. . . . . 0.11%
Mono dist. 100% op. tune av. . . . . 0.07%
St. L = —R50% centre tune av. . . . . 0.08%
St. single ch. 100% centre tune worst ch. . . . . 0.12%
MPX reject 19kHz worst ch. . . . . 57dB
MPX reject 38kHz worst ch. . . . . 96dB
X-talk 1kHz centre tune worst ch. . . . . 46dB
X-talk 10kHz centre tune worst ch. . . . . 28dB
X-talk 1kHz op. tune av. . . . . 47dB
Freq. resp. St. —3dB L/R 4Hz/flat—4Hz/flat
Freq. resp. St. 15kHz L/R. . . . . —0.4dB—0.5dB
Limit threshold . . . . . 0.9μV
Muting threshold . . . . . 2.2μV
St. s/n CCIR 100μV/1mV av. . . . . 44dB—63dB
Mono s/n 1mV av. CCIR . . . . . 78dB

**General Data**

Dimensions . . . . . 521 x 146.5 x 415mm
Weight . . . . . 18.3kgs
Typical selling price including VAT . . . . . £390.00



Filters

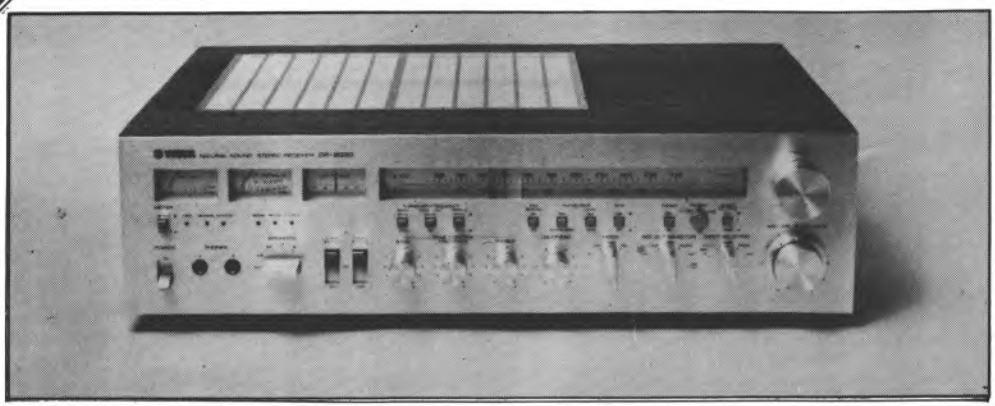


Tone controls.

BEST BUY

# Yamaha CR-2020

Natural Sound Systems Ltd., 10 Byron Rd., Wealdstone, Harrow, Middlesex. 01-863 8622.



This powerful receiver can deliver up to 150W per channel into 8 ohms and 210W into 4 ohms. It is superbly finished, and has excellent ergonomics, providing very extensive facilities including dubbing, monitoring and independent input selection for two tape recorders. Mid, bass and treble controls with 11 even steps provide a wide range of adjustment, turnovers for bass and treble being selectable at 125 or 500Hz, and 2.5 and 8kHz respectively. A tone cancel button is provided. 12dB per octave rumble and treble filters can be switched to 15 or 70Hz, and 8 or 12kHz respectively. Two pairs out of three pairs of speakers can be selected with a rotary switch, and interconnected on spring loaded clamp connectors. The smooth rotary volume control tracked reasonably, and incorporated a centre indent balance control behind it. The main input selector switch chooses tape 1/2, tuner, pick-up or auxiliary inputs, push buttons/switches being provided for AM/FM and phono 1/normal moving coil/pick-up 2 and stereo/mono etc routing. Additional buttons switch FM high frequency blend, FM muting/mono, muting level, tuner AFC and audio muting. The back panel interconnections are identical to those on the CR-1020 (note no 5-pole DIN sockets).

Tone burst tests on the power amplifier showed slightly more available power into 8 ohms and considerably more into 4 ohms on transients. Harmonic distortion measured very well, and half-power bandwidth was excellent at 100kHz. Response extended to 125kHz but swept IM pen charts were quite satisfactory. Output noise levels were unbelievably good (best in the survey), and two stereo headphone jacks gave an excellent quality, although an excessive level into high impedance models. The subjective sound quality was very good, but slight hardness was suspected occasionally. Bass frequencies were crisp and punchy. Phono socket input levels and impedances were well optimised, but the disc output to tape was somewhat higher than the tuner's output level.

The RIAA pick-up input stage had a well optimised impedance characteristic, excellent clipping margin and very low noise. Frequency response was very flat indeed. The FM sections RF sensitivities were rather average and the RFIM performance was fair. Image response and IF breakthrough were excellent though. Adjacent channel selectivity was only fair, but alternate excellent. Capture ratio, limit threshold, AM reject and muting facilities were all excellent. The frequency response was very flat, but beats were noticed with pilot tone, which was rather poorly filtered. Weighted signal to noise ratios measured extremely well, but weak signals were noisier than average. Distortion levels measured extremely well, but crosstalk was a little disappointing. Subjective sound quality was superb, and clearly one of the best. Tuning dial accuracy was reasonable, and ergonomics splendid. AM reception was good, but a whistle was noticed on Radio 4, Brookman's Park.

This receiver generally performed extremely well, and was much liked. It can therefore be recommended, but RF sensitivity and multiplex filtering circuitry need to be improved. It will give superb quality on stronger stations, but will probably be disappointing on weaker ones. Despite the price, it is reasonably good value for money.

# Yamaha CR-2020

BEST BUY

**Amplifier Section**

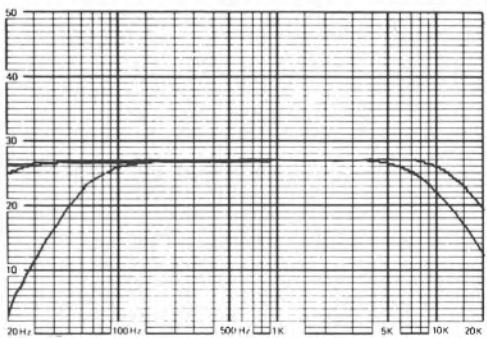
| | |
|---|---|
| Av. power o/p both chs. driven 8Ω | 136W |
| Av. power o/p single ch. driven 8Ω | 153W |
| Av. power o/p single ch. driven tone burst 8Ω | 170W |
| Av. power o/p single ch. driven 4Ω | 212W |
| Av. power o/p single ch. driven tone burst 4Ω | 265W |
| Idle DC output worst ch. | 5mV |
| Turn on/off max. DC swing worst case | 240mV |
| Damping factor 8Ω | 58 |
| X-over distortion | No |
| Harmonic dist. —3dB ref 1% 1kHz 8Ω av. | 0.01% |
| Harmonic dist. —1dB ref 1% 1kHz 8Ω av. | 0.01% |
| IM dist. 10W av. | N/A |
| IM dist. RIAA/rec. out | 0.01% |
| Half power bandwidth | 2Hz-100kHz |
| Av. RIAA impedance | 51kΩ |
| Av. RIAA sensitivity | 2.3mV |
| Av. RIAA clipping | 280mV |
| Av. RIAA capacitance | 140pF |
| Av. aux. impedance | 55.5kΩ |
| Av. aux. sensitivity | 140mV |
| Av. tape impedance | 55.5kΩ |
| Av. tape sensitivity | 140mV |
| Mic impedance | — |
| Mic. sensitivity | — |
| Mic. clipping | — |
| Max. level from tuner-rec. out | 336mV |
| Max. level from RIAA-rec. out | 500mV |
| Rec. out impedance DIN av. | — |
| Rec. out impedance phono av. | 5.4kΩ |
| Av. RIAA noise ref 8mV—rec. out unw. | 80dB |
| Av. RIAA noise ref 8mV—rec. out CCIR | 73dB |
| Amp. hum zero vol. AMF wtd. av. ref. 1W 8Ω | 102dB |
| Amp. noise zero vol. CCIR s/n av. | 110dB |
| Amp. noise worst vol. CCIR s/n av. | 93dB |
| Amp. noise zero vol. unw. 20/20kHz | N/A |
| Volume control tracking worst error | 1.3dB |

**Tuner Section**

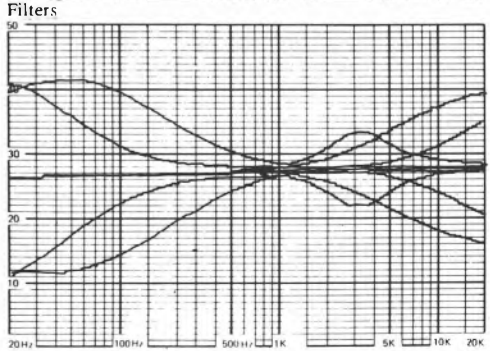
| | |
|---|---|
| Mono RF sens. 30dB IHF | 1.3μV |
| Mono RF sens. 50dB IHF | 2.9μV |
| Stereo RF sens. 50dB | 30μV |
| RFIM | 68dB |
| Adj. ch. av | 5dB |
| Alt. ch. av. | 68dB |
| Image resp | 84dB |
| Capture ratio | 0.6dB |
| AM reject | 64dB |
| Mono dist. 100% centre tune worst ch. | 0.09% |
| Mono dist. 100% op. tune av. | 0.09% |
| St. L = —R 50% centre tune av. | 0.06% |
| St. single ch. 100% centre tune worst ch. | 0.1% |
| MPX reject 19kHz worst ch. | 49dB |
| MPX reject 38kHz worst ch. | 91dB |
| X-talk 1kHz centre tune worst ch. | 40dB |
| X-talk 10kHz centre tune worst ch. | 30dB |
| X-talk 1kHz op. tune av. | 40dB |
| Freq. resp. St. —3dB L/R 6Hz/flat—6Hz/flat | |
| Freq. resp. St. 15kHz L/R. | —0.9dB/—0.3dB |
| Limit threshold | 0.7μV |
| Muting threshold | 1.3—14μV |
| St. s/n CCIR 100μV/1mV av. | 49dB—66dB |
| Mono s/n 1mV av. CCIR | 78.5dB |

**General Data**

| | |
|---|---|
| Dimensions | 521 x 146.5 x 415mm |
| Weight | 18.6kgs |
| Typical selling price including VAT | £495.00 |



Filters



Tone controls.

# Conclusions

It has been most illuminating comparing 37 recently-designed models with results obtained from tests of 85 published in the original edition. In general, the majority of the power amplifier sections gave audibly good performances within their power ratings, and it is clear that, in order to avoid any possibility of problems, you should go for a receiver having more power available than you think you need. Programme sources at their best, such as direct cut LPs, contain very brief peaks of high amplitudes, and the maximum level is far higher than you might think it to be from purely listening. It is perhaps surprising that most amplifiers sounded so similar, and in cases where criticism has been made, normally the defects were not very serious, but nevertheless audible to keen listeners. We measured half-power bandwidth differently this time, and so it is not easy to correlate figures from the two books, but notwithstanding this, it is evident that nearly all the receivers have far better amplifiers than the average one had two years ago. Although most receivers would drive 4 ohm speakers satisfactorily, a few were not too good, but in most cases, manufacturers promised to look into the problem areas and rectify them. Output noise levels in general varied from excellent to good, relatively few being poor. However, levels provided for headphones were usually grossly excessive, particularly for high impedance models. I most strongly recommend manufacturers to add a resistor in parallel with the headphone outputs to attenuate the levels appropriately, and at least 2W dissipation resistors will have to be used.

The response measurements on the pre-amplifier/amplifier sections showed frequently a ludicrous extension of bandwidth up to 100kHz, or even 200kHz, and in my opinion, this is totally wrong. However, the power amplifier itself should have as wide a bandwidth as possible, and indeed this also applies to half-power bandwidth. Bandwidth limitation should be applied passively at the input of the power amplifier, attenuating frequencies as rapidly as possible above 40kHz, or substantially below the half-power bandwidth frequency. Switch on/off thumps are particularly annoying and can damage speakers, and credit is due to the many manufacturers now avoiding the problem. Whilst most harmonic distortion and swept intermodulation distortion measurements were satisfactory, some receivers gave up to 0.1% distortion, even at half-power, and this is almost always a poor indication. On the other hand, exceptionally low harmonic distortion figures are not necessarily a good indication, and analysis is both very lengthy and laborious. Out of sheer necessity, I place considerable importance, therefore, on subjective sound quality, for our test programme was very stringent and telling.

Volume controls are either normal rotary ones, slide faders or stepped position types. Whilst I prefer stepped ones having sufficient positions (ie 22 is insufficient), it is clearly personal taste, and many readers will prefer normal rotaries. However, in a recent question that I asked a Harrogate Fair audience, only one person out of around 150 actually preferred faders, so manufacturers please note! Some faders, however, such as those on the JVC models 200 and 600, were far better than average. Balance controls should, I feel, have a clear centre indent position, and should swing reasonably evenly in either direction, but certainly not rapidly across the centre. Some were poor, but most were at least adequate. As with volume controls, I prefer stepped position tone controls, but only if the steps are even throughout. I do not rate the provision of a mid-frequency tone control too important, but a tone control cancel button is highly desirable, and too many receivers omitted this. Rumble and treble filters, where fitted, were usually only 6dB per octave, which is poor, or even worse they commenced action too near the middle frequency area. For example, some rumble filters commenced cutting as high as 200Hz, and some treble filters as low as 3.5kHz. I was pleased to see some Japanese models, including Yamaha, introduce 12dB per octave treble filters, as these are far more effective. Too many receivers, without rumble filters, failed to attenuate subsonic frequencies sufficiently, and whilst you might think this is not so important, particularly with the better turntables, remember that almost all LP records have in-built acoustic and pressing rumble. Several receivers omitted a

stereo/mono switch, and I must deprecate this, since mono records, for example, will sound much better without stereo rumble and surface noise. Loudness compensation might be useful if you like music as a quiet background, but I never use it myself, and neither do most of my friends. I would much prefer to see a widening and narrowing control for stereo than a loudness switch. I must here make a confession that I was delighted to see several receivers leaving 5-pole DIN sockets right out, but on the other hand, I do appreciate that to have both available is useful for the majority of people. However, I consider it quite ridiculous for a receiver to have standardised DIN inputs/outputs only, as interchangeability with recorders having phono sockets is virtually impossible, and DIN to DIN circuitry is so frequently poor in response, or signal to noise performance.

Most RIAA pre-amplifiers worked well, but the Grundig Receiver 30 had a poor signal to nose ratio and clipping margin, whilst the B. & O. and Tandberg ranges, for example, showed extremely poor compatibility with high impedance cartridges, such as the Decca London. Some receivers had a high effective input shunt capacitance, and this will create a high frequency damped resonance on many types of cartridge, although their manufacturers may well stipulate this, in my opinion, mistakenly. RIAA responses almost always were either very flat or showed only very minor deviations between 50Hz and 20kHz, and no cases were found of poor responses. Sound quality of pick-up input stages is so dependent on choosing appropriate pick-ups that it is difficult to be helpful, but in general, almost all the top recommended cartridges in 'Hi-Fi Choice: Turntables and Cartridges' should work reasonably well, but note any shunt capacity requirements.

In quite a few cases, output levels to tape were several dB different to equivalent outputs from the tuner section, and this will be annoying if you wish to leave record level controls in a typical operating position. Furthermore, in quite a few cases, 5-pole DIN sockets gave too low a level from either discs or tuner, or even both.

I consider it essential for receivers to have an available earth terminal allowing the user to experiment with earthing external equipment, such as turntables. Whilst I prefer 3-core mains leads, 2-core ones are not necessarily poor, but often it is advisable to earth the receiver as the centre of a system. I am sorry to see AC outlets go because of new regulations, for I feel it must be downright carelessness, clumsiness and incompetence if a user gets a shock by plugging into 'live' sockets. Expensive enclosed sockets are being developed because of this, which are likely to put up the cost considerably, which is unfortunate. It seems safer to consider the old type of outlet than to have floppy and dangerous adaptor stacks in the wall.

By far the greatest differences between models were found in the tuner sections, and in particular, the variation in radio frequency intermodulation performance was rather alarming (bad performers can create spurii and rubbish all across band 2). Receivers having poor RFIM measurements will be satisfactory for local station reception if you use an attenuator on the aerial input, but this of course may seriously curtail the number of stations that you will be able to listen to enjoyably. I therefore rate a poor RFIM performance very seriously. Relatively few receivers had poor RF sensitivity, and indeed, most were excellent here. Image response was a bad problem in many cases, and you could find it annoying if your favourite programme is interrupted by transmissions outside band 2, the same applying for IF rejection.

Adjacent channel selectivity was only excellent in comparatively few models, and it is a credit that, when it was such, audio distortion was usually not noticeably affected. I consider it most unfortunate that none of the receivers had a variable selectivity switch which would greatly assist in the optimisation for weak or strong station reception. Poor selectivity will make it very difficult to pick out more distant stations without interferance but this may not worry you too much. AM rejection is particularly important if you live near a main road, or if you have a very modest aerial system. However it often indicates other tuner problems. Almost all the receivers had an adequate capture ratio, and some were excellent, the best capture ratios perhaps

surprisingly to the reader, being consistent with average-to-poor selectivity!

Frequency dial accuracy was very poor on some models, errors of up to 500kHz being noted, but this will only be important to you if you want to find a station for which you have an accurate frequency. Usually, you will know the positions of all your local stations, and even distant ones. I place the provision of pre-set stations as an important priority, and unfortunately no Japanese tuners or receivers have provided them. Is this because the Japanese have only one VHF national network? It is significant that most European models incorporate them, and this may well be a most important factor in your choice. Many muting circuits were most annoying, opening up the audio output on unusable weak stations, or even just aerial noise. Most people who do choose to use muting, would be tuning in a reasonably local station, and will not want to hear every conceivable one available. I have frequently commented on local oscillator radiation only if it is poor, and in some circumstances the local oscillator frequency of one receiver can interfere with reception on another one if their respective aerials are within ten or twenty metres or so of each other.

All the receivers reviewed incorporated a form of tuning meter, but some of these were poorly optimised, showing correct tuning in the wrong place. This is usually poor quality control, but sometimes a design fault.

Aerial input interconnections are, in most cases, with terminals, but quite a few models incorporate useful TV-type coaxial sockets for 75 ohms. 300 ohm connections will only be rarely used in the UK, so they can be ignored, unless you have an appropriate balanced feeder. Ferrite rods for AM were incorporated on almost every model, but some either just pushed in and out or flapped up and down. Easy to swivel types will give a much better pick-up in the required direction.

Frequency response was often a problem, in the worst cases up to 7dB loss was noted at 15kHz, or in the case of the Toshiba range, a response like a switchback! This is inexcusable and is almost invariably due to poor multiplex filter matching, or the use of cheaper components. Whilst multiplex tone rejection was usually adequate, a few models (eg Sony) were very poor indeed, and not only might whistles be audible on some tape recorders, but many teenagers will hear the breakthrough, which will be annoying to them, whilst not being audible at all by the majority of adults (me included!). Signal to noise ratios varied over a range of around 10dB or so, and the poorer receivers will sound decidedly more hissy than the best ones on good broadcasts. However, you may not find hiss too annoying, but my colleagues and I most certainly do. However, there was rarely a problem with mono. Crosstalk was at least acceptable on almost all the receivers, but some produced crosstalk distortion, which can be unpleasant. Bad distortion at peak deviation will cause transients to sound rough, harsh or scraggy, and remember that the BBC and IBA at best transmit no more than 0.2% distortion. The audio quality produced by the various models differed greatly, and was frequently responsible for recommendations being withheld.

I was sorry to see only Yamaha incorporate an independent recording output facility from the tuner section, whilst maintaining through connection between, for example, disc and loudspeakers. I very frequently require to tape a broadcast whilst playing discs to friends, and the facility is so simple to incorporate, and Yamaha must be particularly commended for providing it, as did Pioneer in their model SX-737, now discontinued.

Summing up my overall conclusions, I was pleased to find that the majority of the receivers could produce generally very good quality, but if some were consistently better than others at the same price, naturally the better ones are to be recommended. This, in effect, means that manufacturers must not rest on their laurels, but continue to improve, and even more important, examine their competition very closely. Now that my colleagues and I have listened to and tested over 130 models in the last three years, it is staggering to find that some models are still of poor quality, but nevertheless apparently selling in the market place. Isolated reviews in hi-fi magazines are useful, but frequently fail to consider performance in the context of its competition.

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
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| AKAI AA 1050 | 205.95 | JVC JRS 600 | P.O.A. | ROTEL RX 803 | 264.95 | TECHNICS SA 5370 | P.O.A. |
| AKAI AA 1010 | 99.95 | JVC JRS 50 | P.O.A. | SANSUI 551 | 138.95 | TOSHIBA SA 220L | P.O.A. |
| AKAI AA 1020 | 137.95 | JVC 5456 | P.O.A. | SANSUI 661 | 149.95 | TOSHIBA SA 320L | P.O.A. |
| AKAI AA 1030 | 154.95 | LEAK 3200 | 153.95 | SANSUI 771 | 187.95 | TOSHIBA SA 420 | P.O.A. |
| AMSTRAD 5050 | 89.95 | LEAK 3400 | 188.95 | SONY STA 4800 | 199.95 | TOSHIBA SA 520 | P.O.A. |
| GOODMANS MODULE 90 | 136.95 | NATIONAL 250 | P.O.A. | SONY STA 5800 | 255.95 | TOSHIBA SA 620 | P.O.A. |
| GOODMANS MODULE 120 | 155.95 | PIONEER SX 300 | P.O.A. | SONY STA 6800 | 302.95 | TRIO KR 2600 | 99.95 |
| GOODMANS MODULE 150 | 220.95 | PIONEER SX 450 | P.O.A. | SONY STR 1800 | 99.95 | TRIO KR 4070 | 179.95 |
| HARMON KARDON 330C | P.O.A. | PIONEER SX 550 | P.O.A. | SONY STR 2800 | 137.95 | TRIO KR 5600 | 251.95 |
| HITACHI SR 302S | 99.95 | PIONEER SX 650 | P.O.A. | SONY STR 3800 | 151.95 | TRIO KR 6600 | 319.95 |
| HITACHI SR 502S | 99.95 | PIONEER SX 750 | P.O.A. | SONY STR 11 | 106.95 | YAMAHA CR 600 | P.O.A. |
| HITACHI SR 302 | 107.95 | PIONEER SX 850 | P.O.A. | TANDBERG TR 2025 FM | P.O.A. | YAMAHA CR 200E | P.O.A. |
| HITACHI SR 503 | 119.95 | PIONEER SX 950 | P.O.A. | TANOBERG TR 2025 M | P.O.A. | YAMAHA CR 450 | P.O.A. |
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| HITACHI SR 703 | 153.95 | ROTEL RX 102 Mark II | 81.95 | TECHNICS 2S SA 5160 | P.O.A. | YAMAHA CR 820 | P.O.A. |
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In trying to decide which receivers should finally become best buys or which are given recommendations, I have had to judge by comparing the average prices that will generally be found. Unfortunately, though, some important factors have to be taken into account before considering a purchase. You may find some receivers advertised at considerably lower prices than those quoted in this book. Sometimes the retailer concerned will have made a special bulk deal with his supplier, but in other circumstances he may be cutting his profit margin to the bone or may even be clearing out his stock with the knowledge that a new model is forthcoming. On the other hand, you will find some shops quoting significantly higher prices. Usually, high quality specialist dealers do not discount as heavily as discount houses, but that is not always to say that the discount house gives an inferior service, for some are very helpful with after sales problems. Do not forget that the more profit a dealer makes, the greater is the after sales service that he will be economically able to give, whether he gives it or not.

**Receivers typically costing below £200 including VAT**

The **JVC JRS-50** at about £100 is clearly an excellent best buy at the very cheapest end of this survey, but note the irritating volume control. However, the **Sansui 331**, although having only very basic facilities, is ergonomically easier and since it offers a very good performance for its price of around £110, it must also be rated a best buy. I also liked the **Akai AA-1020** which contains some useful facilities but costs somewhat more (around £140).

I am sorry that I was not able to find any receivers between £140 and £200 which completely satisfied me as having good performance, consistent with the additional cost as compared with the best buys. You will have to spend over £200 for this. But if you cannot afford this then the following models can be recommended for the reasons explained: the **Trio KR-4070** generally performed well but factory setting up needs to be improved. It offers 64W per channel for around £190 and is thus excellent value in terms of pounds per watt. The **Harman Kardon 430** generally measured well and can be safely recommended, although its price seems a little high at about £195.

The **Pioneer SX-550** is also worth looking at costing around £150, since it offers a reasonable power output but has a few failings.

If you must have pre-set stations and you cannot afford more than £200, the cheapest that I can recommend is the **Goodmans Module 90** at £140 but, unfortunately, its performance is not as good as the other recommendations in this section.

Another receiver that it would be fair to mention here is the **Armstrong 626** averaging around £195. It offers excellent facilities but has, unfortunately, some technical problems and the subjective sound quality is not as good as that from many competitors. It has, however, pre-set stations and is also available as an FM only model (625) costing around £170.

**Receivers costing between £200 and £350 including VAT:**

In this area by far the best buy was the **Yamaha CR-620** which, at £230, gave a good overall performance and had no serious problems. Another best buy, is the **Tandberg TR-2025** which had an excellent tuner section including pre-set stations and costs around £245.

The **Goodmans 150** did have some minor failings but since it offers 7 pre-set stations and nearly 80W per channel, it must be recommended as very good value for money if you specially require its facilities and thus is just within the best buy class, priced at about £230.

The **Harman Kardon 730** can be recommended at £300 but seems a little over priced although it measured generally very well. The **Pioneer SX-850** giving 108W per channel is quite good value at £330 but did have some minor failings. The **Tandberg TR-2055** also measured well and cost around £340 but is not quite in the best buy class.

The **Yamaha CR-820** can also be recommended but does not offer any way near such good value as the model 620 which out-

performed it in some areas, although the model 820 offers slightly more facilities, at around £305.

**Receivers costing between £350-£450 including VAT:**
Of the many receivers in this group quite a number could be rated best buys but since the facilities are so varied I cannot directly point to a single one as being the very best. The **Bang & Olufsen Beomaster 4400** has 6 pre-set stations and costs typically £395. It measured and sounded extremely well although it is not compatible with high impedance cartridges such as the Decca London.

The **Sansui 9090** is still one of my personal favourites and offers excellent overall performance at around £435. Unfortunately, its price has risen somewhat since the first edition but it is still good value.

The **JVC JR-S600 Mk II** has an excellent graphic equaliser as well as a generally good overall performance and can be strongly recommended as a best buy costing around £440. The **Tandberg TR-2075 Mk II** is yet another best buy having some excellent facilities and costs around £450.

Just recommended is the **Sansui 8080** which is now appreciably cheaper than the 9090. At about £360, it offers a good overall performance but is frankly outclassed by the best buy receivers.

**Receivers costing over £450 including VAT:**
The cheapest receiver in this category is the **Yamaha CR-2020** which had excellent facilities and high power output. It measured particularly well and costs about £495.

The **Rotel RX-1603** is a very fine receiver indeed, measuring and sounding well and costing around £530. I personally preferred, though, the **Pioneer SX-1250** which was, for me, the best stereo receiver in the survey costing around £550, and worth the extra £20 over the Rotel.

In a class completely on its own is the **Sansui QRX-9001.** An amazing quadrophonic receiver, it is able to decode CD4, SQ, QS and BBC Matrix H and even includes a Dolby B stereo processor. It has, however, one or two minor failings in the tuner section which, however, are highly likely to be improved by the time this book is published. The QRX-9001 at around £730 is clearly an example of many eggs in one basket.

Finally, bear in mind that the prices quoted in this section are only typical ones just before going to press and, naturally, prices will vary over the period that this book is current. Please do not just look at this section but read as many of the reviews as you have time to since there may be criticisms raised which might affect your own personal requirements.

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# Overall comparison chart

| | RF input sensitivity | RF selectivity | Spurious receptions | AM inter-ference suppression | Multiplex filter | Muting facilities | Strong signal mono noise | Weak signal stereo noise |
|---|---|---|---|---|---|---|---|---|
| Aiwa AX-7500 | excellent | average | fair | v. good | v. good | fairly good | excellent | excellent |
| Akai AA-1020 | v. poor | poor | fair | fair | fair | good | v. good | v. poor |
| Akai AA-1030 | v. poor | average | v. good | fair | poor | excellent | good | v. poor |
| Armstrong 626 | poor | poor | good | bad | good | v. good | v. good | v. poor |
| Audiotronics LR-2626 | fair | poor | excellent | bad | bad | average | good | v. poor |
| Beomaster 2400 | excellent | average | v. good | poor | excellent | — | poor | good |
| Beomaster 4400 | excellent | good | excellent | v. good | excellent | good | good | excellent |
| Eagle R-6500 | v. good | rather poor | poor | excellent | good | good | v. good | fair |
| Goodmans Module 90 | v. poor | poor | fair | fair | bad | fair | good | v. poor |
| Goodmans 120 | fair | v. uneven | excellent | bad | bad | poor | excellent | fair |
| Goodmans 150 | excellent | fairly good | excellent | poor | excellent | fair | fair | excellent |
| Grundig Receiver 30 | fair | excellent | bad | v. good | v. good | v. good | excellent | poor |
| Harman Kardon 430 | fair | v. uneven | poor | fair | fair | excellent | excellent | v. poor |
| Harman Kardon 730 | excellent | v. uneven | good | excellent | excellent | excellent | excellent | excellent |
| Hitachi SR-503L | poor | v. poor | bad | excellent | good | good | v. good | poor |
| Hitachi SR-903 | excellent | average | v. poor | poor | excellent | good | good | poor |
| JVC JR-S50 | excellent | poor | fair | poor | fair | average | good | poor |
| JVC JR-S200L | excellent | rather poor | excellent | v. poor | good | good | fair | v. poor |
| JVC JR-S600 mk II | v. good | good | v. good | v. good | excellent | v. good | v. good | good |
| Optonica SA-2121 | v. good | rather poor | v. poor | v. good | v. good | average | good | fair |
| Pioneer SX-550 | excellent | poor | poor | bad | bad | poor | good | fair |
| Pioneer SX-850 | excellent | poor | excellent | fair | v. good | poor | good | excellent |
| Pioneer SX-1250 | v. good | v. good | excellent | v. good | excellent | poor | excellent | excellent |
| Rotel RX-1603 | excellent | good | excellent | excellent | fair | fair | good | excellent |
| Sansui 331 | fair | uneven | good | poor | bad | — | excellent | fair |
| Sansui 551 | v. good | v. uneven | good | poor | poor | fair | excellent | v. poor |
| Sansui 5050 | fair | good | poor | good | fair | good | fair | poor |
| Sansui 7070 | excellent | v. good | v. poor | poor | excellent | v. good | fair | good |
| Sansui 8080 | excellent | excellent | excellent | fair | v. good | fair | good | excellent |
| Sansui 9090 | v. good | v. good | good | fair | v. good | v. good | excellent | excellent |
| Sansui QRX-9001 | excellent | good | poor | excellent | excellent | good | fair | good |
| Sanyo JCX-2300K | excellent | average | poor | poor | good | good | v. good | good |
| Setton RS-220 | poor | v. uneven | v. poor | poor | v. good | poor | good | fair |
| Setton RS-440 | fair | good | v. good | poor | v. good | fair | good | fair |
| Sony STR-2800L | good | v. poor | v. poor | bad | bad | poor | fair | poor |
| Sony STR-3800L | v. good | poor | v. poor | bad | bad | fair | good | poor |
| Sony STR-5800 | excellent | v. poor | poor | excellent | excellent | average | good | good |
| Tandberg TR-2025L | excellent | v. good | excellent | fair | v. good | v. good | v. good | poor |
| Tandberg TR-2055 | v. good | v. good | good | v. good | good | fair | excellent | excellent |
| Tandberg TR-2075 mk II | excellent | excellent | v. good | v. good | good | good | excellent | excellent |
| Toshiba SA-320L | poor | v. poor | poor | poor | excellent | fair | fair | v. poor |
| Toshiba SA-520 | v. good | v. poor | v. good | bad | excellent | fair | fair | v. poor |
| Toshiba SA-620 | excellent | v. uneven | v. good | fair | excellent | poor | fair | poor |
| Trio KR-4070 | excellent | poor | fair | fair | bad | fair | fair | fair |
| Trio KR-9600 | v. good | v. poor | poor | poor | excellent | fair | fair | poor |
| Yamaha CR-620 | excellent | average | excellent | excellent | fair | good | excellent | fair |
| Yamaha CR-820 | excellent | rather poor | good | excellent | fair | v. good | excellent | good |
| Yamaha CR-1020 | poor | fair | bad | excellent | good | fair | excellent | v. poor |
| Yamaha CR-2020 | fair | average | fair | v. good | poor | excellent | excellent | v. poor |

| Strong signal stereo noise | Crosstalk | Distortion | Scale accuracy | Ergonomics | No of pre-set stations | Frequency response | AM section | DIN socket compatibility | Phono compatibility | * see text |
|---|---|---|---|---|---|---|---|---|---|---|
| excellent | fair | average | excellent | v. good | — | v. poor | yes | v. good | fair | Aiwa AX-7500 |
| fair | good | v. good | fair | v. good | — | v. poor | yes | v. good | fair | Akai AA-1020 |
| fair | v. good | good | excellent | good | — | v. poor | yes | v. good | poor | Akai AA-1030 |
| poor | average | fair | fair | fair | 6 | fairly good | yes | good | poor* | Armstrong 626 |
| fair | average | v. good | excellent | poor | — | v. poor | yes | v. good | fair | Audiotronics LR-2626 |
| fair | good | v. good | fair | v. good | 4 | excellent | no | fair | — | Beomaster 2400 |
| v. good | fairly good | average | bad | fair | 6 | excellent | no | fair | — | Beomaster 4400 |
| v. good | good | fair | poor | v. good | — | excellent | yes | fair | v. good | Eagle R-6500 |
| fair | fair | average | good | fair | 4 | v. poor | yes | average | — | Goodmans Module 90 |
| excellent | fair | poor | excellent | fair | — | fair | yes | average | — | Goodmans 120 |
| good | good | good | poor | good | 7 | v. good | yes | good | fair | Goodmans 150 |
| excellent | average | average | v. poor | average | 7 | fair | yes | fair | excellent* | Grundig Receiver 30 |
| v. good | average | v. good | excellent | v. good | — | fairly good | yes | good | fair | Harman Kardon 430 |
| excellent | fair | average | good | average | — | excellent | yes | fair | v. good | Harman Kardon 730 |
| v. good | average | excellent | v. poor | excellent | — | v. poor | yes | v. good | excellent | Hitachi SR-503L |
| fair | v. good | average | fair | v. good | — | fairly good | yes | v. good | v. good | Hitachi SR-903 |
| fair | average | excellent | excellent | good | — | v. poor | yes | fair | fair | JVC JR-S50 |
| fair | v. good | quite good | poor | good | — | v. poor | yes | v. good | v. good | JVC JR-S200L |
| good | excellent | v. good | excellent | good | — | excellent | yes | v. good | excellent | JVC JR-S600 mk II |
| fair | good | excellent | good | good | — | excellent | yes | fair | poor | Optonica SA-2121 |
| good | v. good | good | excellent | v. good | — | fairly good | yes | fair | fair | Pioneer SX-550 |
| fair | v. good | average | excellent | v. good | — | fairly good | yes | fair | v. good | Pioneer SX-850 |
| excellent | v. good | v. good | fair | excellent | — | excellent | yes | fair | v. good | Pioneer SX-1250 |
| excellent | excellent | v. good | excellent | v. good | — | excellent | yes | v. good | fair | Rotel RX-1603 |
| excellent | fair | good | excellent | v. good | — | fairly good | yes | v. good | fair | Sansui 331 |
| excellent | good | fair | fair | good | — | fair | yes | v. good | fair | Sansui 551 |
| poor | good | v. good | excellent | good | — | v. poor | yes | v. good | v. good | Sansui 5050 |
| v. poor | v. good | good | fair | good | — | fair | yes | fair | fair | Sansui 7070 |
| excellent | quite good | average | excellent | good | — | fair | yes | v. good | poor | Sansui 8080 |
| excellent | good | excellent | excellent | good | — | fair | yes | v. good | poor | Sansui 9090 |
| poor | v. good | good | excellent | good | — | fair | yes | fair | poor | Sansui QRX-9001 |
| fair | average | good | excellent | v. good | — | excellent | yes | — | v. good | Sanyo JCX-2300K |
| fair | v. good | fair | fair | good | — | excellent | yes | fair | v. good | Setton RS-220 |
| poor | v. good | v. good | good | good | — | excellent | yes | fair | v. good | Setton RS-440 |
| poor | good | average | excellent | v. good | — | fairly good | yes | fair | v. good | Sony STR-2800L |
| poor | v. good | fair | excellent | good | — | excellent | yes | fair | v. good | Sony STR-3800L |
| fair | v. good | average | good | v. good | — | fair | yes | v. good | excellent | Sony STR-5800 |
| fair | v. good | good | good | v. good | 3 | excellent | yes | fair | — | Tandberg TR-2025L |
| excellent | excellent | excellent | fair | good | — | excellent | yes | v. good | excellent | Tandberg TR-2055 |
| excellent | excellent | v. good | excellent | good | — | excellent | yes | v. good | excellent | Tandberg TR-2075 mk II |
| v. poor | fair | v. poor | fair | v. good | — | v. poor* | yes | fair | fair | Toshiba SA-320L |
| v. poor | average | good | poor | v. good | — | v. poor* | yes | fair | fair | Toshiba SA-520 |
| v. poor | poor | poor | good | good | — | v. poor* | yes | fair | poor | Toshiba SA-620 |
| poor | good | average | excellent | v. good | — | fairly good | yes | fair | v. good | Trio KR-4070 |
| fair | good | good | poor | good | — | v. good | yes | fair | fair | Trio KR-9600 |
| excellent | v. good | v. good | poor | excellent | — | excellent | yes | — | poor | Yamaha CR-620 |
| excellent | excellent | excellent | fair | excellent | — | excellent | yes | — | poor | Yamaha CR-820 |
| good | good | excellent | v. poor | excellent | — | excellent | yes | — | poor | Yamaha CR-1020 |
| excellent | v. good | excellent | good | excellent | — | excellent | yes | — | poor | Yamaha CR-2020 |

# Overall comparison chart

| | Rumble filter | Treble filter | Tone controls | Balance control | Headphone compatibility | Pick-up input | MIC input | Input overload performance | Output power into 8 ohms |
|---|---|---|---|---|---|---|---|---|---|
| **Aiwa AX-7500** | fair | — | fair | v. good | good | good | yes | excellent | 39W |
| **Akai AA-1020** | fair | poor | good | average | v. good | good | no | good | 32W |
| **Akai AA-1030** | fair | poor | good | average | average | average | no | good | 52.5W |
| **Armstrong 626** | average | excellent | fair | fair | good | fair | no | fair | 58W |
| **Audiotronics LR-2626** | — | poor | fair | v. good | good | average | no | fair | 36W |
| **Beomaster 2400** | — | — | poor | fair | v. good | fair | no | poor | 40W |
| **Beomaster 4400** | excellent | excellent | fair | average | good | good* | no | fair | 57W |
| **Eagle R-6500** | — | fair | good | average | fair | good | no | good | 60.5W |
| **Goodmans Module 90** | good | poor | poor | bad | good | poor | no | poor | 33W |
| **Goodmans 120** | excellent | excellent | fair | fair | v. good | fair | no | fair | 45W |
| **Goodmans 150** | excellent | excellent | fair | fair | v. good | average | no | fair | 77.5W |
| **Grundig Receiver 30** | — | excellent | average | bad | bad | bad | no | poor | 29W |
| **Harman Kardon 430** | — | poor | average | average | good | average | no | fair | 28W |
| **Harman Kardon 730** | v. good | poor | average | average | average | v. good | no | good | 58W |
| **Hitachi SR-503L** | — | — | average | fair | v. good | poor | no | good | 39W |
| **Hitachi SR-903** | average | fair | v. good | fair | average* | fair | no | fair | 140W |
| **JVC JR-S50** | — | fair | average | bad | good | v. good | no | good | 23.5W |
| **JVC JR-S200L** | — | — | excellent | good | v. good | v. good | no | excellent | 55W |
| **JVC JR-S600 mk II** | fair | poor | excellent | average | good* | v. good | no | excellent | 171W |
| **Optonica SA-2121** | fair | — | good | v. good | good | good | no | excellent | 52.5W |
| **Pioneer SX-550** | — | — | fair | average | good | v. good | yes | excellent | 34W |
| **Pioneer SX-850** | average | poor | v. good | v. good | fair* | v. good | yes | excellent | 107.5W |
| **Pioneer SX-1250** | average* | excellent | excellent | v. good | fair* | v. good | yes | excellent | 220W |
| **Rotel RX-1603** | average* | excellent | excellent | v. good | average* | v. good | yes | excellent | 249W |
| **Sansui 331** | — | — | average | fair | good | good | no | good | 16.5W |
| **Sansui 551** | — | poor | average | fair | good | v. good | no | good | 24.5W |
| **Sansui 5050** | — | poor | fair | v. good | good | good | yes | excellent | 49W |
| **Sansui 7070** | rather poor | poor | v. good | v. good | average | good | yes | excellent | 88W |
| **Sansui 8080** | fair | poor | v. good | v. good | average | average | yes | excellent | 105W |
| **Sansui 9090** | fair | poor | excellent | v. good | fair* | v. good | yes | excellent | 180W |
| **Sansui QRX-9001** | poor | poor | average | v. good | average | good | yes | fair | 101W/136W |
| **Sanyo JCX-2300K** | — | — | average | v. good | poor | good | no | excellent | 38W |
| **Setton RS-220** | — | poor | excellent | v. good | average | v. good | no | excellent | 63W |
| **Setton RS-440** | — | poor | excellent | good | average | v. good | no | excellent | 85W |
| **Sony STR-2800L** | — | — | good | good | average | good | no | good | 35W |
| **Sony STR-3800L** | — | — | good | good | average | average | no | fair | 43W |
| **Sony STR-5800** | good | fair | v. good | good | v. good | good | no | fair | 87W |
| **Tandberg TR-2025L** | good | excellent | average | average | average | average* | no | good | 45W |
| **Tandberg TR-2055** | average | excellent | average | v. good | average | quite good* | no | excellent | 67W |
| **Tandberg TR-2075 mk II** | good | excellent | good | good | average | good* | no | excellent | 101W |
| **Toshiba SA-320L** | — | fair | fair | v. good | v. good* | quite good | no | excellent | 26.5W |
| **Toshiba SA-520** | quite good | fair | good | average | fairly good | good | no | good | 52.5W |
| **Toshiba SA-620** | average | fair | good | average | average | good | no | good | 71W |
| **Trio KR-4070** | poor | — | average | v. good | good | good | no | excellent | 64W |
| **Trio KR-9600** | good | poor | average | v. good | average | good | yes | excellent | 88W |
| **Yamaha CR-620** | good | excellent | fair | good | good | good* | no | good | 58W |
| **Yamaha CR-820** | good | excellent | average | good | good | good* | no | good | 80W |
| **Yamaha CR-1020** | good | excellent | average | good | good | good | no | excellent | 112W |
| **Yamaha CR-2020** | good | excellent | good | good | v. good* | v. good | no | excellent | 153W |

| Distortion | Noise | Half-power bandwidth | On/off switch thump | No. of speaker outlets | Subjective sound quality | Typical selling price inc VAT | Value for money | * see text |
|---|---|---|---|---|---|---|---|---|
| good | v. good | good | excellent | 2 | average | 210 | reasonable | **Aiwa AX-7500** |
| average | fair | average | poor | 2 | average | 140 | excellent | **Akai AA-1020** |
| average | poor | good | v. poor | 2 | average | 160 | quite good | **Akai AA-1030** |
| fair | excellent | average | fair | 2 | average | 195 | good | **Armstrong 626** |
| average | fair | average | v. good | 2 | average | 140 | reasonable | **Audiotronics LR-2626** |
| v. good | excellent | excellent | v. good | 2 | v. good | 195 | moderate | **Beomaster 2400** |
| excellent | good | excellent | v. bad | 2 | excellent | 395 | good | **Beomaster 4400** |
| good | bad | good | v. bad | 2 | average | 150 | good | **Eagle R-6500** |
| fair | v. poor | fair | v. bad | 3 | good | 140 | v. good | **Goodmans Module 90** |
| average | good | good | poor | 2 | good | 155 | reasonable | **Goodmans 120** |
| average | fair | good | excellent | 2 | average | 230 | good | **Goodmans 150** |
| poor | v. good | excellent | v. poor | 2 | good | 330 | reasonable | **Grundig Receiver 30** |
| v. good | bad | v. good | v. good | 2 | v. good | 185 | moderate | **Harman Kardon 430** |
| v. good | fair | good | poor | 2 | good | 300 | moderate | **Harman Kardon 730** |
| average | excellent | good | v. poor | 2 | poor | 155 | fair | **Hitachi SR-503L** |
| average | fair | fair | excellent | 2 | average | 335 | reasonable | **Hitachi SR-903** |
| average | v. poor | excellent | v. good | 1 | average | 100 | excellent | **JVC JR-S50** |
| average | excellent | excellent | excellent | 2 | average | 210 | good | **JVC JR-S200L** |
| excellent | v. good | excellent | excellent | 2 | good | 440 | v. good | **JVC JR-S600 mk II** |
| good | good | excellent | excellent | 2 | v. good | 240 | good | **Optonica SA-2121** |
| good | good | excellent | fair | 2 | good | 150 | good | **Pioneer SX-550** |
| v. good | good | fair | excellent | 2 | excellent | 330 | reasonable | **Pioneer SX-850** |
| excellent | v. good | good | excellent | 3 | excellent | 550 | v. good | **Pioneer SX-1250** |
| good | v. good | fair | excellent | 3 | v. good | 530 | good | **Rotel RX-1603** |
| fair | fair | average | fair | 2 | good | 145 | excellent | **Sansui 331** |
| fair | v. poor | average | excellent | 2 | good | 195 | good | **Sansui 551** |
| v. good | fair | excellent | excellent | 2 | good | 195 | reasonable | **Sansui 5050** |
| good | fair | excellent | excellent | 2 | excellent | 310 | reasonable | **Sansui 7070** |
| good | poor | good | excellent | 3 | good | 360 | good | **Sansui 8080** |
| excellent | poor | excellent | excellent | 3 | excellent | 435 | v. good | **Sansui 9090** |
| average | poor | excellent | excellent | 2 | excellent | 730 | reasonable | **Sansui QRX-9001** |
| v. good | bad | good | poor | 2 | good | 150 | reasonable | **Sanyo JCX-2300K** |
| good | poor | excellent | excellent | 2 | v. good | 300 | rather poor | **Setton RS-220** |
| excellent | fair | good | excellent | 3 | v. good | 360 | fair | **Setton RS-440** |
| poor | v. poor | good | fair | 2 | average | 150 | moderate | **Sony STR-2800L** |
| fair | v. poor | good | poor | 2 | average | 175 | fair | **Sony STR-3800L** |
| v. good | good | good | excellent | 3 | good | 250 | rather poor | **Sony STR-5800** |
| v. good | good | excellent | excellent | 2 | v. good | 245 | good | **Tandberg TR-2025L** |
| v. good | good | excellent | excellent | 2 | good | 340 | quite good | **Tandberg TR-2055** |
| v. good | v. good | fair | excellent | 3 | v. good | 450 | good | **Tandberg TR-2075 mk II** |
| average | good | fair | fair | 2 | fair | 140 | rather poor | **Toshiba SA-320L** |
| fair | fair | good | excellent | 2 | average | 250 | rather poor | **Toshiba SA-520** |
| fair | poor | fair | excellent | 2 | average | 360 | rather poor | **Toshiba SA-620** |
| v. good | good | excellent | poor | 2 | good | 190 | good | **Trio KR-4070** |
| average | fair | excellent | excellent | 3 | good | 380 | fair | **Trio KR-9600** |
| excellent | good | excellent | excellent | 2 | v. good | 230 | good | **Yamaha CR-620** |
| excellent | v. good | excellent | excellent | 2 | v. good | 305 | moderate | **Yamaha CR-820** |
| excellent | v. good | excellent | excellent | 3 | v. good | 390 | fair | **Yamaha CR-1020** |
| excellent | v. good | excellent | excellent | 3 | v. good | 495 | good | **Yamaha CR-2020** |

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**Adjacent Channel Selectivity:** The ability of the tuning section to reject stations close in frequency to the required one.

**AFC:** Automatic frequency control. This holds the tuner steady on a required station.

**Auxiliary input:** An input for connecting various types of equipment such as TV sound tuners, external mixers and play back tape recorders.

**AM:** Amplitude modulation radio frequency signals such as are found on Long, medium and short wave commercial broadcasts. Also used for sound on band I/III TV. In this system the amplitude of the RF carrier is varied in proportion to the audio signal applied.

**Backlash:** Some tuners do not respond immediately to a change of frequency when tuning knob rotation is commenced. A bearing or the mechanism does not take up immediately if the tuning is said to have backlash.

**Brookmans Park:** The main BBC MW station just North of London which covers the SE of England.

**Capacitance (capacitor):** A component or its equivalent in a circuit which has the effect of reducing any impedance as the frequency is raised. A high capacitance offers a lower impedance path than a low one.

**Capture Ratio:** This concerns the ability of a receiver to reject an unwanted station from a slightly stronger wanted one on the same frequency.

**Clipping:** This refers to the level above which bad distortion becomes evident, due to a circuit being overloaded by being overdriven.

**Crosstalk:** Breakthrough of frequencies from one channel or direction to another.

**Damping factor:** The ratio of the loudspeaker load impedance to the source impedance of an amplifier measured in this book at 40Hz.

**DC Offset:** A fixed and usually very small DC voltage on the output of some amplifiers in addition to the varying audio one.

**Decibel (dB):** The logarithmic ratio between two levels which represents either a difference of level from a nominal one, or the gain or loss in volume of a particular circuit, sometimes at a specific frequency. A 1dB change of volume is approximately the lowest change on a programme or tone that can be heard by a fairly expert musician or engineer. 3dB represents double the power and 6dB a doubling of apparent volume, which is also equal to doubling the voltage, 10dB represents 10 times the power and $\sqrt{10}$ times the voltage, and 20dB represents 10 times the voltage and 100 times the power. dB's can be used to represent increased or decreased level changes or differences.

**Decoder:** The circuit which accepts the FM multiplex signal and produces left and right discrete outputs.

**DIN compatibility:** The ability of a 5 pole DIN socket to be interconnected with external equipment designed approximately or precisely to DIN specifications, without problems arising in mis-matching of hiss, response or distortion.

**Discrete:** Refers to a circuit with separate transistors as opposed to an integrated one.

**Discriminator:** An electronic circuit which converts the frequency modulated radio signal to an audio one which can then be decoded to left and right outputs.

**Distortion:** Any introduction of spyrious or unnatural tones generated in electronic circuits which are not present in the original signal.

**Earth Loop:** A situation produced, usually in interconnecting equipment, sometimes unfortunately present in the equipment itself, in which more than one earth path is present. It usually refers to earth paths connected to the earth pin of a mains plug.

**Equalisation (eq):** This refers to the necessary change in frequency response of an amplifier required so that an overall flat frequency response can be obtained.

**Faders:** Most volume controls in the past have been of a rotary type, but in recent years these have frequently been replaced by levers acting up and down or even sideways to adjust level or response.

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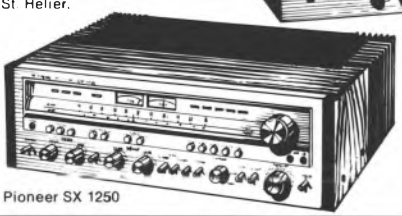
**WALES AND SOUTH WEST:** Bath, Bristol, Cardiff, Exeter, Gloucester, Hereford, Newport, Plymouth, Swansea, Taunton, Torquay, Wrexham.

**JERSEY:** St. Helier.

Sansui 9090

Sansui 331

Rotel RX 303



Pioneer SX 1250

Pioneer SX 550

**Feedback:** A voltage passed from the output back to the input around a circuit which assists in cancelling out distortion introduced inside the circuit. Sometimes feedback surprisingly tends to degrade and not improve performance if too much is applied.

**Ferrite Rod:** Highly efficient rod aerial used for picking up AM signals (MW, LW & SW).

**FET:** Field Effect Transistor. Acts more like a triode valve used to, rather than a normal type of transistor.

**5-Pole DIN Socket:** Special socket designed in Germany having two live input connections, an earth, and two output connections. Various types of DIN socket will be found on many European receivers for loudspeaker and remote control facilities.

**FM: Frequency Modulation:** A system of RF modulation used on band 2 VHF, and band 4 TV sound. In this system the frequency of the carrier alters slightly proportionate to the audio signal applied.

**Ganging:** The coupling of two controls which should have a simultaneous action on two separate circuits. Each circuit should operate identically.

**Hum:** A low frequency interfering sound produced by breakthrough from mains wiring or circuitry. If this is audible it can sometimes be produced by bad design, but also through earth loops, or bad, or even no earthing.

**IHF:** The American Institute of Hi-Fidelity have developed various testing methods and these have been used for some of the measurements — in particular mono RF sensitivity.

**Image Response:** A poorer tuner's unfortunate ability to pick up signals outside the required band, usually 21.4mHz above the nominal tuned frequency, and thus in the UK commercial aircraft frequency band.

**Impedance:** Basically similar to resistance but applied to alternating currents. Quoted as equivalent resistance and capacitance in pick up input or its equivalent elsewhere.

**Indents:** Small nicks in a tone control mechanism which allow allow a user to feel a particular position, usually centre.

**Inductance:** The reciprocal of capacitance. The impedance increases with frequency, can be tuned with a capacitance to resonate at a particualar frequency and will then present either a very high impedance (parallel) or an extremely low one (series).

**Limiting:** An FM tuner section should reproduce all usable signals at the same volume. The signal strengths are limited in the tuner so that equal levels are presented to the discriminator.

**Microvolt ($\mu$V):** 1$\mu$V is 1 millionth of a volt, and corresponds to the weakest possible station that the average tuner can receive although at poor quality.

**Microseconds ($\mu$S):** The time constant of a resistor/capacitor combination, involving a frequency response change (equalisation).

**Modulation:** The amount of volume that the medium can accept or reproduce, or alternatively the actual sound present on the radio carrier.

**Multiplex Filter (MPX):** A circuit which introduces severe attenuation at supersonic frequencies to decrease interference encountered with the outputs from stereo FM tuners.

**Mute:** A device which cuts programme either manually or automatically. FM muting cuts the ouput from a tuner unless an acceptable signal strength transmission is tuned in.

**Ohms ($\Omega$):** A unit of resistance or impedance. This refers to the load placed on a signal, or the equivalent source resistance in series with an output.

**1kHz:** This frequency used to be referred to as 1KC or 1000 c/s and is a note of approximately two octaves above middle C on a piano. 1Hz represents one vibration per second, and the human ear can easily hear from 40Hz to approximately 16kHz in an average room, although with an increase in age a listener begins to lose sensitivity at the high frequency end.

**Passband:** The range of frequencies over which a circuit or complete amplifier reproduces, and below and above which the response is attenuated. This can refer to audio or radio frequencies.

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**Phono (Line) Sockets:** These sockets are coaxial and accept a special plug (phono plug) with a long pin in the centre (live) and a cylindrical section around it providing an earth connection. Inputs are normally high impedance and outputs are low impedance, and are provided for interconnection with many types of external hi-fi equipment.

**Pilot (tone etc):** A 19kHz tone transmitted during stereo broadcasts that activates the stereo decoder.

**Replay Amplifier Hiss:** This is produced since very great amplification is required to increase the minute electrical energies produced by the play back head to a level sufficient to drive external equipment. Well designed circuits hiss less than poorly designed ones.

**RFIM:** (Radio Frequency Intermodulation) Introduces spurious signals into RF circuits of a tuner section, which may cover up weaker stations. Bad RFIM products are caused when more than one strong station is received on a tuner which is bad in this respect.

**RIAA:** An American standard accepted internationally in respect to gramophone pick-up equalisation. The input pre-amplifier has to boost low frequencies and cut high ones.

**Rumble:** Low frequency extraneous noise introduced either in to the medium source (disc or tuner) or by record turntable bearings etc.

**Spitch:** A crackling high frequency transient sound heard on peaks of modulation in circuits which are incorrectly adjusted or designed, frequently heard in the crosstalk channel rather than the main one.

**Tone Burst:** A short pulse of a frequency applied to a circuit, usually repeated each second or so.

**Transients:** Very short peaks in a programme that greatly exceed the average volume level.

**Unity gain:** This refers to a circuit in which the output level is identical to the input one, although the impedance may be different.

**Unweighted Noise:** Noise that is measured with a flat response over a bandwidth sufficient to encompass all frequencies heard by the human ear.

**Volt (V):** Usually quoted as 'route mean square' (RMS). Basically the actual level present, or that could be present in the context referred to.

**Watt (W):** A unit of power, in particular referring to the input power of a loudspeaker. Approximately equivalent to voltage x current in AC outputs.

**Weighted Noise:** This refers to noise in which equalisation has been introduced to emphasise frequencies that cause most subjective annoyance, and which also reduces noise of less concern to the human ear. Throughout the tests a CCIR filter has been employed.


# Don't gamble with Hi-Fi

With such a bewildering choice of brand names available to the Hi-Fi buyer, it must be comforting to know that Goodmans can take the risk out of choosing. All the products shown above are worthy of Goodmans' reputation for the highest quality and value for money.

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# The 75 watt receiver that delivers 160 watts when you need it.

"What I know about hi-fi you could write on a matchbox but I just have to tell you about the new Hitachi SR-903 stereo receiver I heard the other day.

Apparently, with something called Dynaharmony, Hitachi have cracked the problem of high output amps costing a fortune to buy. And they've overcome the difficulty of low and medium output amps 'clipping' the high peaks that only bigger amps can handle.

High peaks, so I'm told, only occur for under 2% of the total listening time so really high output amps are very inefficient and wasteful.

Anyway, Hitachi have cracked it with Dynaharmony.

Basically Dynaharmony is two amps in one. One 75 watt per channel (RMS) for low and medium outputs and another that boosts the power to 160 watts for those momentary high peaks.

Of course, if you could afford it you could buy a 160 watt amp, but really I wouldn't bother. You get the same amount of power with Dynaharmony, but only when it's needed.

Actually, there's a lot more to it than that but to be honest I don't understand it. But what a sound. And what a receiver.

It has a tuning control with a touch-sensitive Auto Lock. It somehow homes into the strongest signal for any frequency and stays there until you touch the tuning control again.

There's a built-in protection circuit that cuts off the power if the amp gets overloaded. And a midrange tone control as well as bass and treble.

When it comes to specifications I get left behind. But I'm sure you'll understand when I say harmonic distortion is an incredibly low 0.3% and the sensitivity of the FM receiver is an unbelievable 1.2$\mu$ volts (DIN).

The SR-903 sounds very expensive but at £334* it costs no more than an ordinary 75 watt receiver.

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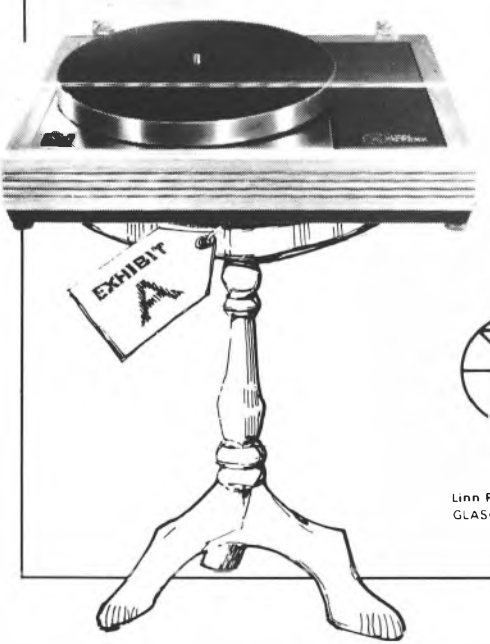
# The truth the whole truth and nothing but the truth.

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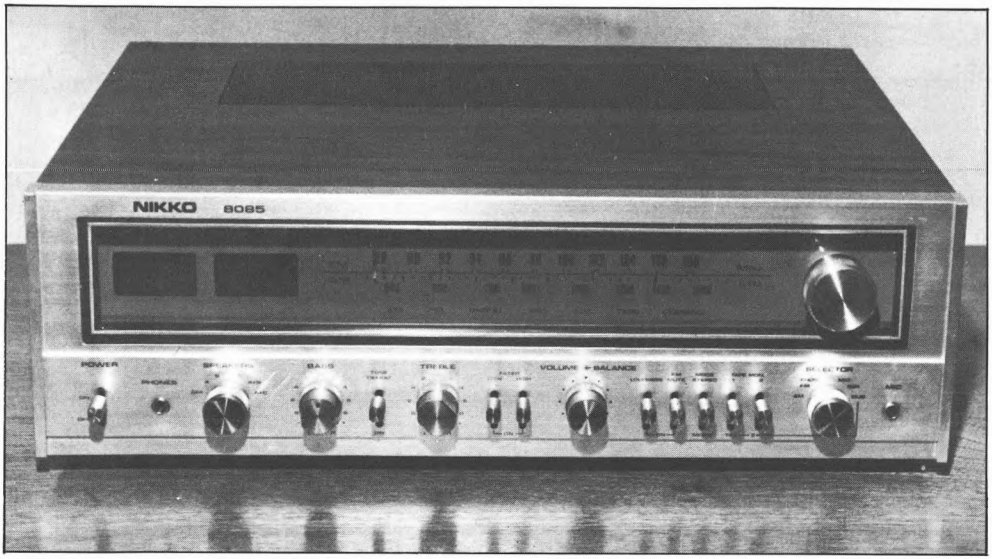


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RECEIVERS
- Akai 1020
- Goodmans 150
- JVC JRS 50
- JVC JRS 600
- Pioneer SX1250
- Rotel RX1603
- Sansui 331
- Sansui 9090
- Tandberg 2025
- Tandberg 2075 MkII
- Yamaha CR620
- Yamaha CR2020

### RECOMMENDED

RECEIVERS
- Armstrong 626
- Goodmans 90
- Harman Kardon 430
- Harman Kardon 730
- Pioneer SX550
- Pioneer SX850
- Sansui QRX9001
- Sansui 8080
- Tandberg 2055
- Trio 4070
- Yamaha CR820

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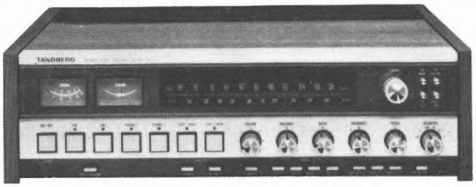
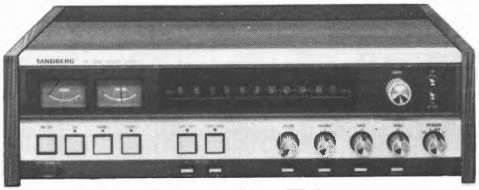


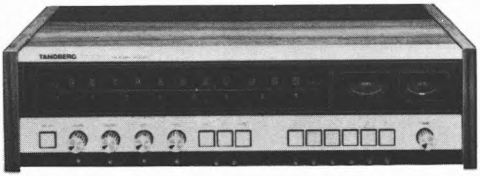
**TR-2075 AM/FM STEREO RECEIVER.**

Combines an extraordinary tuner, pre-amplifier and power section on one chassis, built to equal or better the performance of highest quality separate components.



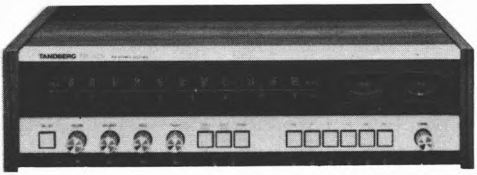
**TR-2055 FM STEREO RECEIVER.**

The virtuoso performer for those who want FM only, boasts the same high quality FM tuner as the TR-2075, along with unusually clean pre-amplifier and power amplifier performance.



**TR-2040 FM STEREO RECEIVER.**

Outstanding FM performance from an exceptionally fine tuner section, combined with pretuning capability for five FM stations.



**TR-2025 L AM/FM STEREO RECEIVER.**

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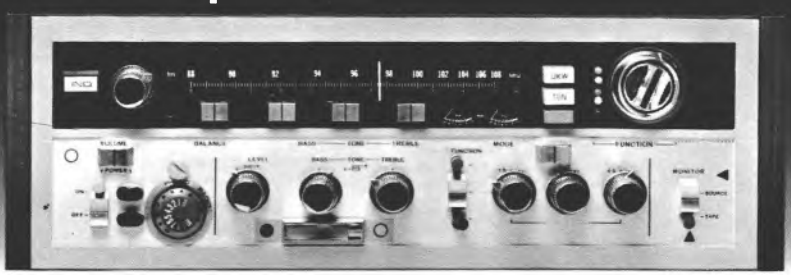
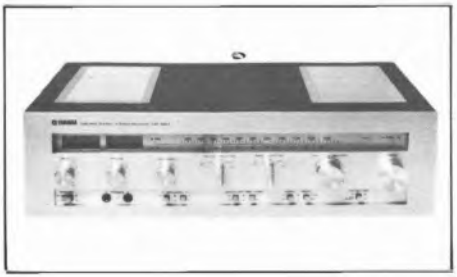


Sure, some manufacturers would like you to believe that the more knobs and switches a receiver has, the better it'll sound. But we believe that technology should be heard and not seen. So, instead of writing 'technology' all over the face of our receivers, we've concentrated on putting some impressive and very effective technology behind them.

**Square wave performance.**
Most receivers are designed using common or garden sine wave tests. Before we build a receiver, the amplifier design is evaluated to far more critical square wave test standards that reveal quite graphically any shortcomings in frequency and transient response, as well as instability or phase distortion. It's a difference that shows up immediately when our receivers are compared scientifically with their competitors. In fact we'll gladly send you information all about square wave tests that'll show you the difference.

**Twin power.**
The HK 430 has two independent power supply systems, one per channel, to overcome the problems of distortion and crosstalk that can occur when conventionally-designed single powered stereo receivers and amplifiers are driven hard. Harman Kardon first discovered the advantages of Twin Power some years ago. But most other manufacturers are just catching on to the idea.

**Wide band design.**
Traditionally, hi-fi designs have concentrated on the human hearing range (from around 20Hz to 20k Hz). It's only recently that this neat assumption has been questioned by more perceptive designers. They found



# YAMAHA

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that the ability of equipment to cope with sounds higher or lower in frequency than the previous limits had a quite marked effect upon what listeners heard in the audible range.

So you'll find that unlike most receivers in its class the HK 430 can comfortably handle signals as low as 4Hz and as high as 140kHz. You may not hear them – but you'll hear the difference.

**Conservative specifications.**
Which means that the HK 430 you buy will not only out-perform other receivers in its class, it'll almost certainly out-perform its own published specs.

**Power Output:** 25 Watts per channel RMS both channels driven.
**F.M. Sensitivity:** 1.9 microvolts, IHF.
**Price (RRP):** £240 inc. VAT.

## harman/kardon

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HFA1

# Summary and index of products reviewed

**Aiwa AX-7500**
Quite a good receiver but hum problem experienced on inputs if high gain used. Aiwa's first model which has improved in the last year. Just reasonable value for money.

**Akai AA-1020**
A strongly recommended receiver which performs well on strong aerial signals but poor on weak ones. It has useful facilities and is rated very good value for money. Rather low output power capability though. A best buy.

**Akai AA-1030**
Not such good value as the Akai 1020 and has some tuner problems, but the amplifier worked well. Reasonable value for money.

**Armstrong 626**
This model is also available as an FM only one (625). It has pre-set stations and excellent filters. It can be recommended but a few problems were encountered with the amplifier. Note that it runs rather hot. Good value for money though. Some areas a little disappointing.

**Audiotronics LR-2626**
Quite good value for money but has some response problems on the tuner section. Listen to it before contemplating purchase.

**Beomaster 2400**
Has amazing remote control facility. Many will find it tiresome after a while but its general performance was quite good. Has compatability problems and only recommended for specialised applications. Moderate value for money. Has four pre-set FM stations.

**Beomaster 4400**
A very fine receiver having 6 pre-set FM stations. Probably the finest product Bang & Olufsen have yet made. Strongly recommended but has some compatability problems. Generally sounded excellent. A best buy.

**Eagle R-6500**
Good value for money since it has a high output capability. Poor tuner distortion and poor output hiss, though, were bad points which Eagle hope to put right. Recommended with caution, provided improvements are forthcoming.

**Goodmans Module 90**
Four FM pre-set stations are provided on this budget priced receiver, but performance was not particularly good. Good value for money, though, for some of its facilities.

**Goodmans 120**
Rather poor ergonomics and appearance were disappointing but the sound quality was generally very good, but watch quality control. Recommended with caution but look at it.

**Goodmans 150**
This model has several pre-set stations and is rather unusually styled. Amplifier distortion problems have been rectified in the last year and this model offers quite high power at a very reasonable cost. Recommended and good value for money. A best buy.

**Grundig Receiver 30**
This model is thoroughly DIN standardised and whilst many of the knobs are rather small, its performance is quite good at best but very poor at worst. The pick-up input is very noisy and the tuner section has poor distortion at peaks. Not really recommended. It could have been a lot better if some care had been taken in design.

**Harman Kardon 430**
This model worked and measured very well but facilities are rather lacking, making it relatively poor value for money. Nevertheless, recommended.

**Harman Kardon 730**
Recommended as a good receiver with average facilities but some quality control problems were noted on our review sample. Rather expensive but it measured very well.

**Hitachi SR-503L**
This receiver has too many problems for any recommendation to be considered. Tuner response and output transient problems were particularly troublesome.

**Hitachi SR-903**
Not really recommended since it has too many minor problems and the sound quality was rather average.

**JVC JR-S 50**
Strongly recommended for its very good performance at modest cost but the volume/balance control is very annoying. Cannot be switched to mono but measured comparatively well. One of the best buys.

**JVC JR-S 200L**
Has a most useful graphic type tone control but the tuner section produced both good and poor measurements. Reasonable value for money but not quite recommended.

**JVC JR-S 600L Mark II**
Has an excellent graphic equaliser and generally very useful facilities. It sounded and measured well and is strongly recommended as one of the best buys.

**Optonica SA-2121**
This first Optonica product to be released in the UK measured and sounded comparatively well. The tuner performance was generally good but stereo hiss levels disappointing. A recommended receiver but not in the best buy class.

**Pioneer SX-550**
Although this receiver is good value for money problems may be experienced when receiving weak stations. Nevertheless, recommended for its good points.

**Pioneer SX-850**
This fairly high powered model is reasonably priced and generally measured and sounded well but a few problems in the tuner section keeps it out of the best buy class.

**Pioneer SX-1250**
This superb but very expensive receiver measured and sounded excellent and has very extensive facilities. A best buy even at its high price.

**Rotel RX-1603**
A very high powered receiver at a high price, but measured and sounded very well. Strongly recommended. A best buy.

**Sansui 331**
A low powered receiver which performed and sounded comparatively well for its low price. Strongly recommended as a best buy.

**Sansui 551**
This relatively low priced model can be recommended for a generally reasonable performance at its cost. Recommended as good value for money but not quite a best buy.

**Sansui 5050**
Unfortunately, the tuner was hissier than average on strong stereo stations, but in other respects this model was liked. Relatively small improvements in performance would recommend this receiver as being good value.

**Sansui 7070**
Strong stereo signal tuner noise was poorer than average but, as with the 5050, the sound quality was very good. Not quite recommended though, but reasonable value for money.

**Sansui 8080**
Although this receiver is recommended since it is more competitively priced now than it was originally, the Sansui 9090 clearly outperforms it. Nevertheless, quite good value for money.

**Sansui 9090**
One of my favourite receivers. This one measured very well and sounded excellent, but its price has increased somewhat in the last year. Strongly recommended and one of the best buys.

**Sansui QRX-9001**
This quarophonic model can be used with CD4, SQ, QS, Matrix H and discrete quadrophonic sources. It performed generally very well indeed but tuner hiss was a little disappointing. Quite a unique receiver which is recommendable but the price is very high.

**Sanyo JCX-2300K**
Although reasonably priced, there are too many problems in the tuner section for a recommendation to be considered.

**Setton RS-220**
Although capable of reproducing a good quality, there are too many problems in the tuner section and, furthermore, this model is considerably overpriced and is therefore not very good value for money.

# Summary and index of products reviewed

**Setton RS-440**
Although this receiver is recommended, the tuner section was hissier than average and the price asked is much too high, therefore not good value for money.

**Sony STR-2800L**
Too many tuner and other problems caused a recommendation to be withheld. Nevertheless, fairly reasonable value for money.

**Sony STR-3800L**
The sound quality here was below average and again too many problems caused a recommendation to be withheld. Not good value for money.

**Sony STR-5800**
Rather highly priced for its performance, this receiver cannot be recommended although better than the other two Sony models. Not good value for money.

**Tandberg TR-2025L**
Three pre-set FM stations are provided on this model which generally measured very well and it has an excellent tuner section. Strongly recommended and although one of the best buys perhaps slightly over priced.

**Tandberg TR-2055**
This model can be recommended as giving very good quality but is only moderate value for money, although it measured generally very well. Strongly recommended but not quite a best buy.

**Tandberg TR-2075 MK II**
One of my personal favourites, this model can give an excellent sound quality and has a superb tuner section. It is one of the best buys particularly since Tandberg are improving the output protection circuits. It has very extensive facilities.

**Toshiba SA-320L**
Provided Toshiba correct the tuner response as outlined in the review, this model could be reasonable value for money, but nevertheless a little hissy on FM. The sound quality was below average though, which would cause a recommendation to be withheld.

**Toshiba SA-520**
Whilst sounding a little better than the model SA-320, this model cannot really be recommended, although Toshiba promise to improve the frequency response of the tuner section.

**Toshiba SA-620**
Measuring and performing very similarly to the SA-520, a recommendation is withheld.

**Trio KR-4070**
This recommended receiver measured and sounded quite well, although a few minor problems keep it out of the best buy class. Clearly better than earlier Trio models.

**Trio KR-9600**
A recommendation is just withheld from this model since it is not very good value for money, and the performance was outclassed by several other models at around the same price.

**Yamaha CR-620**
Although clearly a best buy, the price seems just a little high, but the performance and sound quality were clearly very good. Strongly recommended.

**Yamaha CR-820**
Although this receiver is recommended it is poorer value for money than the CR-620, though with some excellent points.

**Yamaha CR-1020**
Unfortunately the 75 ohm FM aerial input circuitry measured rather poorly, two samples being checked. In other respects, though, the performance was generally good. Disappointing value for money, and not recommended.

**Yamaha CR-2020**
An excellent performer generally, this model has very extensive facilities but although strongly recommended the price is a little high. You may well like this model very much — clearly one of the best.

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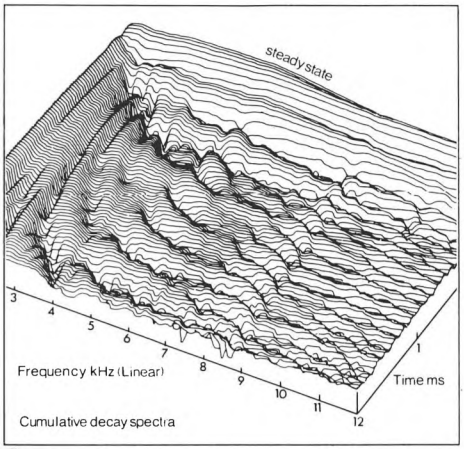


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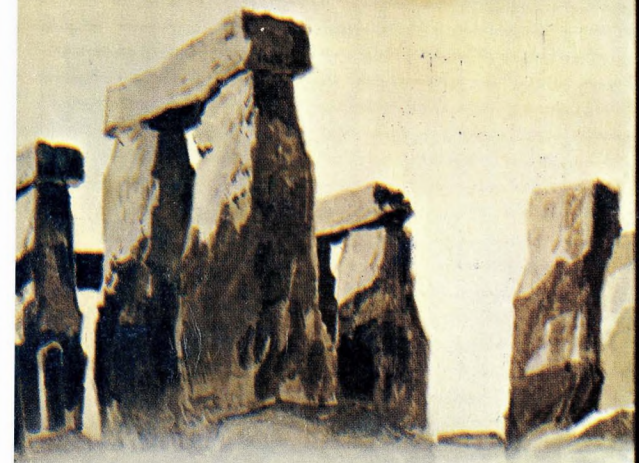

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