BY ANGUS McKENZIE · £1

HI-FI CHOICE

RECEIVERS

A UNIQUE CONSUMER GUIDE TO £100+ TUNER AMPLIFIERS

Instead of buying a less expensive name, why not buy a less expensive Yamaha?

Some people, because they think Yamaha tuner amplifiers are expensive, settle for a cheaper make.

What a pity.

Instead, they could have bought a less expensive Yamaha.

For example, the CR400 below.

The CR400 has everything you could wish for, including very simple controls.

There's a separate microphone input.

Twin tuning meters and a loudness switch.

Connections for 2 sets of speakers. Even a handsome walnut finish cabinet.

And everything is beautifully made.

Because even though it's in Yamaha's lower price range, it's made by the very same craftsmen who make Yamaha's most expensive tuner amplifiers.

With the same legendary skill. The same attention to detail. The care you just won't get with a less expensive name.

YAMAHA

MAKERS OF FINE MUSICAL INSTRUMENTS SINCE 1887

Send for our free colourbook.

Natural Sound Systems Ltd, Strathcona Road, North Wembley, Middx. 01-904 0141.

Yamaha CR400 Tuner Amplifier.
£177 inc VAT at 25%. Fully guaranteed for 2 years.

Yamaha. Yes.

CONTENTS

Hi-Fi Choice: Receivers

Written by Angus McKenzie

Test Measurements by Angus McKenzie Facilities Limited

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RECOMMENDED FOR USE WITH MORE THAN 50% OF THE 'BEST BUYS' IN HI-FI CHOICE: CASSETTE DECKS.

OUR FIRST 5 SECONDS WILL TRANSFORM YOUR NEXT 45 MINUTES.

Maxell Ultra Dynamic tape is the most remarkable thing ever to happen to your cassette deck. Not only does it sound better than any other tape, but it actually improves the performance of your tape deck.

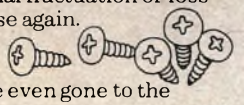
It's the cassette whose first five seconds of leader is also a head cleaner.

And because it's non-abrasive, it keeps your tape heads perfectly clean without wearing them down.

Our head cleaner is also a timing leader. Just align the starting line and the capstan, and five seconds later, away you go without wasting any tape.

We've given our UD cassette quite a few other special details.

Take our pressure pad. Instead of just sticking it in with glue, like so many other cassettes do, we've designed a tiny metal frame to hold it firmly in place. You won't ever need to worry about signal fluctuation or loss of response again.



We've even gone to the trouble of putting our round screws into square holes. That way the thread shavings are squeezed into the corners to make sure nothing gets into the works. You get the best sealed cassette possible.

As to the tape itself, we've made the particles of PX gamma ferric oxide so tiny that our frequency response reaches 22,000 Hz.

How's that for a great high? Our signal-to-noise ratio is 8dB better than ordinary cassettes so you get less noise and cleaner sound. And our dynamic range is so wide, you can practically forget about distortion.

One last thing. Maxell UD tape comes in four different time lengths. Each one guaranteed never to go wrong. Each one designed to give you the most exciting performance you've ever had from your cassette deck. All you have to do is try one. It's very little to spend on a lot of beautiful sound.

maxell.

Before it plays, it cleans.

A member of the Jonathan Fallowfield Group of Companies
Distributed by Natural Sound Systems Ltd,
Strathcona Road, Wembley, Middlesex HA9 8QL. 01-904 0141

IN the introduction to 'Hi-Fi Choice: Cassette Decks' it was hoped that by studying the publication the reader would be able to choose equipment more wisely and understand the function of that equipment more fully. The reaction from both trade and public has been such that we would appear to have succeeded.

On behalf of everybody concerned with 'Hi-Fi Choice'—the publishers, Angus McKenzie Facilities Limited and myself—I would like to thank all those who wrote to offer both their congratulations and suggestions. Because of the number of letters we received, it has been impossible to answer them all personally, and it is regretted that neither the publishers nor Angus McKenzie Facilities Limited are able to reply to technical queries from readers. Should you need further information on any of the products reviewed in 'Hi-Fi Choice', I can only suggest that you either contact the manufacturer or importer concerned, or ask the advice of your dealer.

I should point out that the findings published in 'Hi-Fi Choice' are based on the results obtained from samples supplied. And, although every effort has been made to ensure that all results and conclusions are as accurate and as typical as possible, it should be remembered that any sample can perform either better or worse than another.

Once again, I must give my thanks to Angus McKenzie and his colleagues, Tony Faulker, Nicky Paul Barron and Dave Hudson, all of whom have worked tirelessly and conscientiously to ensure the success of this publication. Although the proof of the pudding will be in the reading, they have proved to my satisfaction that they are the best in their field. Additionally, my thanks to Fiona McKenzie and Lyn Burnett, who typed the copy, made us all coffee, and helped to ensure both my sanity and the project remaining on schedule.

Finally, my thanks to all the manufacturers, distributors and advertisers, who have given so much time and support to this project, and to you—the reader who, by buying 'Hi-Fi Choice', proves that we have not completely wasted our time. And should you wish to receive details of future editions of 'Hi-Fi Choice' please send a stamped addressed envelope. We will forward information as soon as it becomes available.

The Editor

A.T. Labs

191 Chase Side, Enfield, Middlesex EN2 0QZ

Monday-Saturday 10.00-18.00 **01-363 7981**

Receivers

(Carriage and Insurance £3.75 per item)

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Armstrong 626	P.O.A
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Goodmans Module 110	£148.00
Goodmans 120	£148.00
Goodmans 150	£225.00
Leak 1800	£152.00
Leak 2000	£179.00
Lux R600	P.O.A
Lux R800	P.O.A
Lux R1500	P.O.A
Marantz 2220B	P.O.A
Marantz 2230	P.O.A
Marantz 2245	P.O.A
NAD 140	P.O.A
NAD 160a	P.O.A
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Nikko 5050	£127.00
Nikko 7070	£149.00
Nikko 8080	£170.00
Pioneer 434	£114.50
Pioneer 535	£157.00
Pioneer 636	£183.00
Pioneer 737	£226.75
Pioneer 838	£276.75
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Pioneer 1010	£397.00
Rotel RX 152	£81.50
Rotel RX 202	£90.00
Rotel RX 402	£124.00
Rotel RX 602	£162.00
Rotel RX 802	£209.00
Tandberg TR 220	P.O.A
Tandberg TR 1000	P.O.A
Tandberg TR 1010	P.O.A
Tandberg TR 1040P	P.O.A
Tandberg TR 1055	P.O.A
Tandberg TR 2075	P.O.A
Tandberg Holdra 10	P.O.A
Technics Stocked	
Trio KR 2400	£118.00
Trio KR 3400	£156.00
Trio KR 4400	£188.00
Trio KR 5400	£224.00
Trio KR 6400	£274.00

All prices include VAT at 25%.

Trio KR 7400	£296.25
Trio KR 9400	£418.00
Wharfedale SXP	£159.00
Yamaha CR200	P.O.A
Yamaha CR400	P.O.A
Yamaha CR 450	P.O.A
Yamaha CR 600	P.O.A
Yamaha CR800	P.O.A
Yamaha CR1000	P.O.A

Speakers (Pairs)

(Carriage and Insurance £3.75 pair)

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Celestion Ditton 44	£170.00
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IMF TLS 50 II	P.O.A
IMF TLS 80	P.O.A
JBL Range	P.O.A
KEF Coda	P.O.A
KEF Cantor	P.O.A
KEF Chorale	P.O.A
KEF Cadenza	P.O.A
KEF Concerto	P.O.A
KEF 103	P.O.A
KEF 104	P.O.A
Leak 2030	£98.00
Marantz	P.O.A
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Monitor Audio MA 3	P.O.A
Monitor Audio MA 4	P.O.A
Monitor Audio MA 5 II	P.O.A
Monitor Audio MA 7	P.O.A
Videotone Minimax II	P.O.A
Videotone Saphir I	P.O.A
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Wharfedale Denton 2XP	£42.50
Wharfedale Linton 3XP	£59.00
Yamaha	P.O.A

We have tried to ensure all prices are correct at time of going to press – however prices are liable to alteration without notice (E&OE)

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For sales over £40.00. Phone for details. Facilities for reclaiming VAT available.

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Repairs and maintenance of all types of Hi Fi/Audio equipment by qualified engineers.

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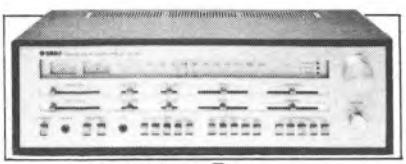
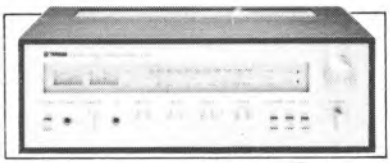
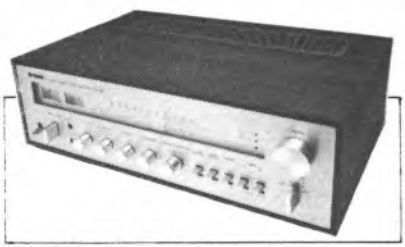


CR 1000 YAMAHA



YAMAHA CR450



CR600 YAMAHA

A. T. Labs prices on request.

YAMAHA CR800

We have Yamaha on continuous demonstration and we feel their range of receivers is hard to beat. After reading this comparative review you'll know why – what you probably won't know is that Yamaha receivers are very reliable and fully guaranteed for 2 years – if you're still not convinced – then come and listen.

Turntables–Arms Speakers Tape Amps–Tuner Amps–Tuners

A.T. Laboratories

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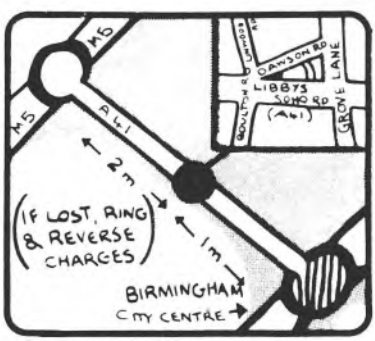

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YOU'LL BE SURPRISED WHAT ROTEL CAN GET OUT OF YOUR SYSTEM.

The Rotel RX 402 Receiver.

The Rotel RA 312 Amplifier.

At Rotel, we believe that the amplifier or receiver that is the heart of your system should set the standard for your system.

And if you take a close look at our range, and compare the specifications and prices with anybody else's, you'll see that Rotel equipment sets a very high standard indeed.

The RX 402, for example, delivers 24 watts per channel RMS into eight ohms with less than 1% THD.

The tuner section has an FM FET front end for outstanding sensitivity, and ceramic filters and integrated circuitry in the FM IF department.

Naturally there's an FM muting switch to remove annoying inter station noise. The left and right channel bass and treble controls are separate.

Balance, loudness and hi-filter switches give you complete mastery over your listening environment.

And a simulated 4-channel switch gives you impressive Hafler surround sound.

Mike Cross of 'Popular Hi-Fi' described the RX 402 as "setting new standards for any receiver at the price."

We couldn't have said it better ourselves.

The RA 312 Amplifier delivers 18 watts per channel RMS with both channels actually driven into 8 ohms. (All Rotel power outputs are measured this way, so you can tell how much-power an amplifier will have in your living room, not in our laboratories).

There's a tape dubbing facility from tape 1 to tape 2. High and low filters reduce unnecessary noise.
A loudness switch lets you listen quietly, but with quality, and the Hafler 4-channel switch gives surround sound.

As you can see, a Rotel receiver or amplifier could give a new lease of life to your current system, but why not visit your dealer and see the entire Rotel range?

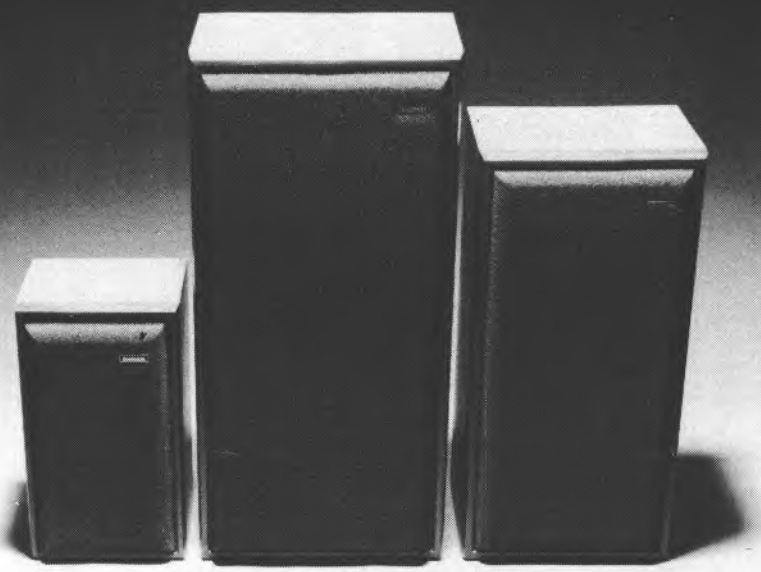
Turntables, tuners, receivers, amplifiers, speakers and a new cassette deck. In fact, enough to make up a complete Rotel system.

You'll be surprised what you can get out of that, too.

ROTEL

Rank Hi Fi, PO Box 70, Great West Road, Brentford, Middlesex TW8 9HR.

Goodmans loudspeakers and receivers — made for one another



Achromat 100 **Achromat 400** **Achromat 250**

As a discerning listener, your system deserves the unsurpassed accuracy of speech and music obtainable with Goodmans Achromat speakers.

Goodmans offer a 5 year warranty on Achromat speakers, which confirms their high standards of construction and technical superiority. With over 50 years of sound experience it makes sense to choose Goodmans speakers and associated high fidelity equipment - made for one another - and for you. Write to Goodmans for details.

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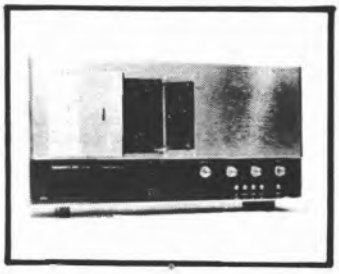
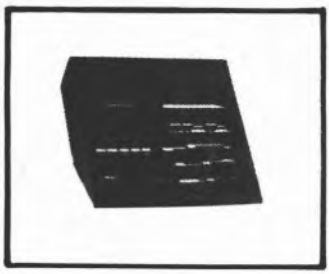
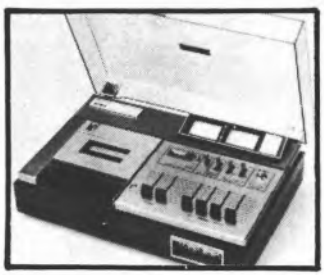
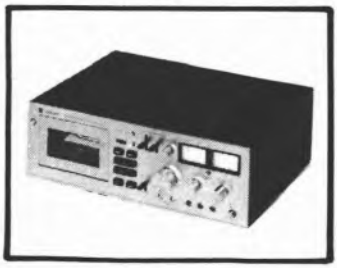
COME TO THE BEST FOR THE BEST

Not only do we demonstrate the pick of the Hi-Fi Choice receivers but you can hear them through the best ancillary equipment including Spendor BC1, 2 and 3s, stacked Quads, Chartwell BBC monitors, Kef 103 and 104, B & W DM6 and many others.









An extra 5% discount on your choice of receiver from Audio T when this copy of Hi-Fi Choice is presented.

190 West End Lane, London, NW6 1SQ. Tel. 01-794 7848.

AUDIO T

Also agents for AR, AKG, Akai, Amcron, Armstrong, Beyer, B&W, Cambridge Audio, Denon, Dual, Fons, Harmon-Kardon, IMF, JBL, KEF, Lux, Maxell, Monitor Audio, NAD, Nagra, Nakamichi, NEAL, Phase Linear, PWB, Quad, Revox, Spendor, Technics, Trio, Uher, Yamaha.

This is virtually the entire Sonab range.

It's undeniably small – it goes from dear to dearer. (Though it was once dearer still.)

Yet it includes a system for every environment; but not for everybody.

Only for those who can truly appreciate high fidelity.

The discreet range of Swedish-designed stereo is centred around the unique ortho-acoustic speakers. Designed as precisely matched pairs, they give all the spatial depth of omnidirectionals – but with a perfect stereo image.

The geometry would take too long; it's explained in the Sonab literature. But the effect is instantly arresting.

Firstly, Sonab help you choose the system for your room.

Then you listen. And you'll hear something quite ethereal, quite extraordinary.

The music. Spacious, virtually infinite.

The system merges into the background. You don't even know it's there.

Sonab

The range is small, the possibilities are near-infinite.

☐ Here's a rough sketch of my living room, with dimensions. Which Sonab system would be best? ☐ I'll need to know much more. Send me some literature, and tell me where I can hear Sonab.

Name

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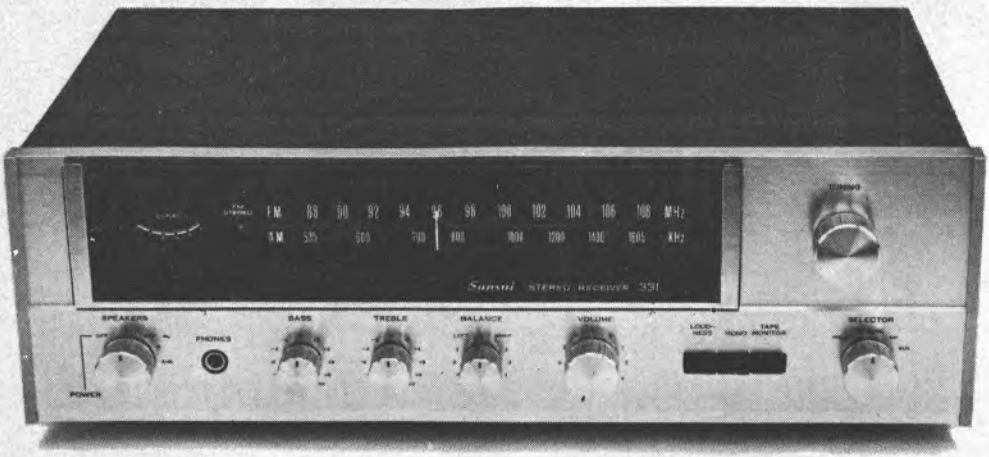
Sonab

Sansui 331 stereo receiver.

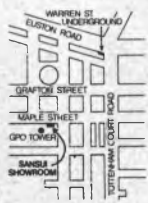


Hi Fi reduced to basics.

This 15 Watts per channel (each channel driven into 8 ohms, 1000 Hz) Sansui stereo receiver is the perfect choice for the music lover who whishes to enjoy stereo music without going to great expense.

Beneath its simple design, are sophisticated electronics. They guarantee the famous Sansui sound.

The 331 receiver offers excellent FM/AM reception with high stability and low distortion. Connected to a turntable and a pair of speakers, it allows you to sit back and enjoy the music you like.
If you're in the London area, drop into our Showroom for a full demonstration. It's just next to the G.P.O. tower. Or if you're out of town, see a qualified Sansui dealer.



(closed Monday)

Continuous power into 8Ω 1000 Hz, each channel driven	15 W x 2
Continuous power at 1000 Hz into 8Ω, both channels driven	13 W x 2
Min. RMS into 8Ω, 40 to 20 000 Hz both channels driven	12 W x 2
Total harmonic distortion	1.0%
Power bandwidth	20-40 000 Hz
Hum and noise (IHF)	80 dB
FM Sensitivity	1.3 μV (DIN)
FM stereo total harmonic distortion	1.0%
Controls	Bass, Treble, Loudness

Sansui

Thank you for listening

Sole importer for the U.K.: Vernitron Ltd., Thornhill Southampton, S095QF England.
Sansui Audio Europe S.A., Diacem Building, Vestingstraat 53/55, 2000 Antwerp, Belgium.
Sansui Electronics Corporation, 55-11 Queens Boulevard, Woodside, N.Y. 11377, U.S.A.
Sansui Electric CO. Ltd., 14-1, 2-chome, Izumi, Suginami-ku, Tokyo 168, Japan.

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Very powerful amplifiers can degrade tuner and preamplifier performance. So separate components became the rule and—for years—the rule made sense. But now we've found ways to break the rule and build a very high-powered receiver with better performance for less cost than comparable separate components.

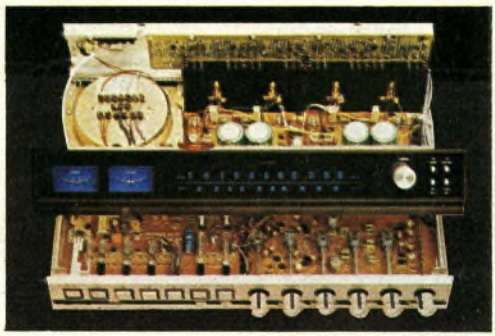
We started with a high-power toroidal transformer to eliminate stray electrical influence on other components within the unit. An expensive device not usually found in consumer products, it offers superior stability and performance.

The transformer feeds two powerful amplifiers. They have a wide frequency range for transparent sound. Ample overload margin for low distortion. And true complementary, direct-coupled circuits. Four protective circuits help deliver this exceptionally clean high power safely to your speakers.

TR-2075 has separate preamplifiers for each input to keep low-level signals noise-free. And sensitivity controls to equalize listening levels. (First stages of amplification occur within millimeters of signal input. An expensive but effective way to achieve low noise and clean sound.)

Push-button electronic time-delayed diode switching provides noise-free blends when changing programme sources. This innovation allows us to put the controls in the best position for easy operation and the electronics where they can deliver the best performance. Independent tape-to-tape facilities add to the extreme versatility of TR-2075.

TR-2075 also offers electronic FM tuning for stability and long life. Phase locked loop decoding for superb stereo separation. And phase linear filtering for low distortion. (Just a few of the reasons why this FM tuner/IF strip equals—or excels—any we know.



Put it all together and you can see Tandberg has actually built three separate components—and overcome the problems of combining them on one chassis. Your ears can tell you more than our technical descriptions. So we invite you to listen to the new TR-2075. But don't compare it only to receivers that cost the same. Compare it to separate components that cost far more.

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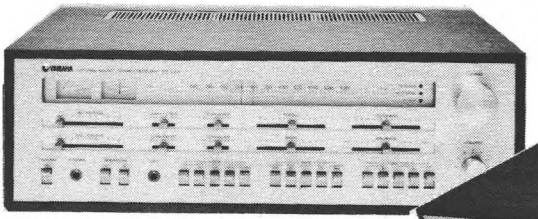
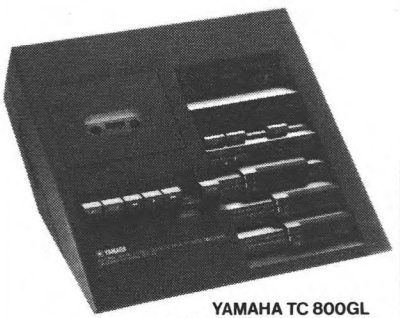
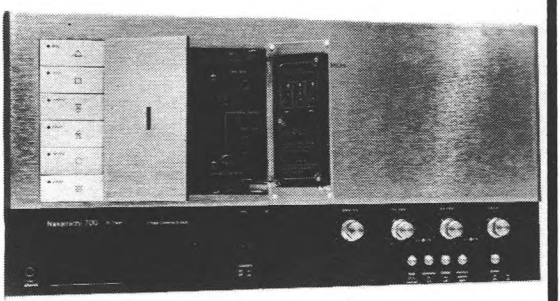


YAMAHA CR 1000 TUNER/AMPLIFIER

YAMAHA CR 600 TUNER/AMPLIFIER



YAMAHA TC 800GL
CASSETTE DECK



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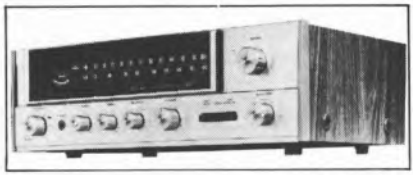
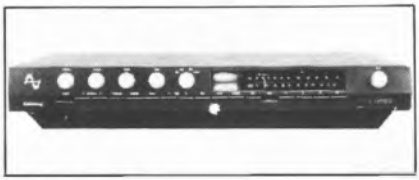


Sansui 331



Armstrong 625

Akai 1020	*POA*	Luxman 800	*POA*	Sansui	*POA*
Armstrong 625	*POA*	Marantz	*POA*	Tandberg	*POA*
Armstrong 626	*POA*	Pioneer	*POA*	Technics	*POA*
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Due to a long time lapse between preparation of this advertisement and publication, we are unable to print prices. But rest assured, REW offer the most competitive prices in London. BE SURE TO CONTACT US FOR A QUOTE BEFORE BUYING.

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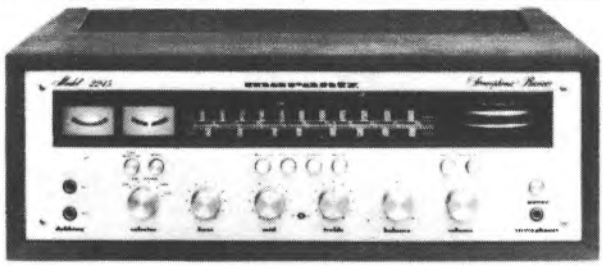
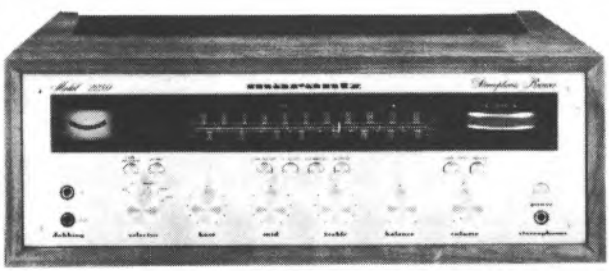


Marantz 2245 Stereo Receiver £361 INC VAT

For superb FM stereo, clean power, and sophisticated control, Model 2245 is unmatched at its price. With professional quality, impressive specs, and features galore, the Model 2245 delivers more than 90 Watts continuous power, both channels driven, from 20 Hz to 20 kHz, with under 0.3% THD and IM distortion. Preamp control section includes: stepped three-zone tone controls for BASS, MID, TREBLE; provisions for two tape decks, phones, four-channel adaptors; ultra low-noise, low-distortion FET, RF, and IF circuitry; massive heat sinks; direct-coupled output circuitry, automatic protection for internal circuitry and associated speakers.



Marantz 2230 Stereo Receiver £224 INC VAT

Best in it's class. With impressive specifications and Marantz-exclusive features, the Model 2230 offers more value and performance than any other receiver in its class. It delivers 60 Watts continuous power, both channels driven, from 20 Hz to 20 kHz with total harmonic and intermodulation distortion well under 0.5%. Stepped, three-zone tone controls for BASS, MID, TREBLE. Provisions for tape decks, phones, record changers and 4-channel adaptors. Ultra low-distortion FET, Rf and IF circuitry. Massive heat sinks; automatic protection for internal circuitry and associated speakers, plus the famous Marantz gold-anodized front panel.

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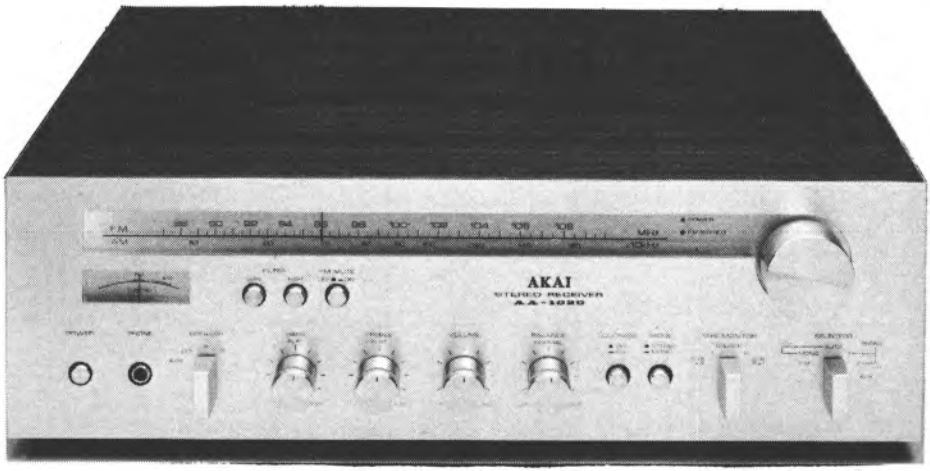

Akai 1020 Receiver.

Those of you who already own one of our reel-to-reel or cassette decks may find it hard to believe that any improvement in performance is possible.

But a tape machine can only sound as good as the signal that goes in, and the amplifier and speakers through which that signal is played back.

In the past, it's been difficult to be sure of putting together a system that matches the performance and quality, not to mention the looks, of an Akai tape deck.

Hence these latest additions to our range; receivers, tuners, amplifiers, speakers and turntables.

Akai SA 1000 Speakers

Akai 1020 Receiver.

The Akai 1020 is an AM, FM and FM stereo receiver. It delivers 20 watts per channel of continuous power, with both channels driven into 8 ohms from 20–20,000 HZ with no more than 0.4% THD.

To make sure that the radio signal is clear and strong when you want to record* (or even when you just want to listen), the tuner section has Phase Locked Loop integrated circuitry, with an automatic Frequency control and a local/distant FM station selector.

There are Phono and Aux inputs, and two tape input/outputs on the back of the receiver, and on the front, a host of facilities. Especially important is the tape dubbing. From tape 1 to tape 2, or the other way round. If you have two tape decks, imagine the opportunities that presents.

Akai SA 1000 Speakers.

The SA 1000's are just one pair from Akai's new range of speaker systems.

With a 10" bass driver, a 3" cone midrange unit and a 3" treble speaker they have a frequency response of 35 HZ to 20 KHZ.

The SA 1000's are of 8 ohms impedance, and will handle 45 Watts of continuous power. Naturally, they're supplied in matched pairs, which will also match the rest of an Akai system audibly and visibly.

Akai 003 Belt drive turntable.

Whilst we at Akai believe that tape is by far the best way to store recorded music, we realise that a lot of important work on disc deserves to be heard.

nce of your Akai tape deck.

Akai 003 Belt drive turntable.

For those with valuable record collections, transferring that music onto tape is the best way of preserving it, for tape, does not scratch or warp.

Of course, this transcribing requires a record deck of transcription quality.

The Akai AP003.

The 003's die-cast aluminium turntable is belt-driven from a 4-pole synchronous motor with less than 0.05% wow and flutter.

An Audio-Technica AT-11 cartridge with a frequency response of 15–25,000 HZ faithfully reproduces whatever is encoded on the record.

And the whole deck is housed in an elegant and remarkably compact plinth.

If you've heard Akai tape equipment, you'll need no convincing that a system to match would sound superb.

If not, visit your dealer and ask for a demonstration. It will be an impressive performance in itself.

Before I call on my dealer I'd like to know more.
Please send me full details of the Akai range.

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AKAI

*In some cases recording may require a licence

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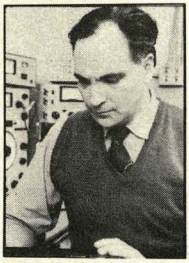

"On looking over all the machines tested, it... (the Pioneer CT-F2121) ... probably becomes the best buy."

(ANGUS McKENZIE 'Hi-Fi Choice.')

Or to put it another way... 'this machine then must be regarded as extremely good value for money and is strongly recommended.'

On the signal-to-noise-ratio he said, 'it was about the best measured averaging −57·5dB below Dolby level and quite remarkable for a cassette recorder.'

And on the distortion figures, '... only 0·55% at Dolby level on Ferric and Ferrichrome tapes... these figures alone are quite remarkable.'

He added in plain English, 'The recorder gave a performance in the absolute top class, with a very wide dynamic range and brightness of sound which was a sheer joy to hear on the cassette medium.'

If you'd like more details about the CT-F2121, clip out this coupon or ask your newsagent to get you the copy of Hi-Fi Choice No. 1 Cassette Decks.

Please send me the 24-page full colour brochure of specifications and technical data about Pioneer Hi-Fi.

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PIONEER

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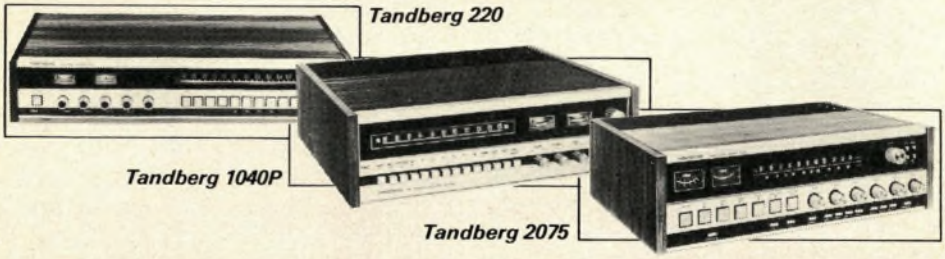
TANDBERG at REW



REW are very enthusiastic about this high quality range of Norwegian Hi-Fi equipment and tape recorders. Most models are on display and demonstration at REW's Centrepoint Showroom.

REW AudioVisual

- 126 Charing Cross Road and 17 Denmark Street, London WC2. Tel: 01-836 2372/7851
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If you think high power means hi fi listen to this.

The Pioneer SX 535 Receiver in the picture has a power output of 18 watts per channel. Not very powerful you might think.

But every one of those 18 watts sounds clearer, sharper and cleaner than almost any other receiver's. Producing enough high fidelity sound to fill 11,000 cu. ft. of space. (The average lounge measures 3,000 cu. ft.)

Why?

Because the SX 535's power output is constant across the whole sound spectrum. In other words, when you're listening to an orchestra you'll be able to hear the highest notes of the piccolo and the lowest of the double bass—both at their precise pitch and value.

Many other receivers quoting a higher maximum output reach this maximum only at certain points along the spectrum.

The Tuner (Radio) Section

High sensitivity and selectivity in the tuner guarantee perfect FM reception with even the weakest signals.

And special low noise components, along with the PLL Circuitry and Ceramic Filters, totally eliminate interference—all you hear is what you want to hear.

Attention to Detail

Distortion is kept down to an astonishing 0·8%—so low you can't hear it!

The RIAA Curve—the standard of perfect record reproduction—is adhered to with hardly any deviation.

Most of the connections are 'wire-wrapped' instead of soldered to improve reliability when the equipment gets hot.

It's a Complete Stereo Control Centre

The SX 535 has facilities for operating 2 Stereo Tape Decks, 2 pairs of Speakers (working individually or simultaneously), a pair of Stereo Headphones and a turntable.

If you're interested in quality of sound rather than volume of noise, clip out the coupon and find out more about Pioneer Hi-Fi equipment.

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YOU'VE NEVER HEARD ANYTHING LIKE THIS BEFORE.

Our sensational new Stereo Cassette Deck combines the designing expertise of both Japan and Italy. Mario Bellini designed the outside so the deck can sit at 45°. You can place it high or low on your shelving and still easily see the meters and controls. Yamaha designed the inside for superb sound. And you'll find it irresistible at £179.

Unique to the TC 800GL are the 46Db peak level meters with L.E.D.s that flash green at -3 peak level and flash red at +3 level. And listen to all the other things it has: a Memory. A Limiter so you don't over-record. Dolby® noise reduction. Switchable bias and equalisation for chrome, ferric and ferrichrome tape. Pitch Control and full mike-line mixing facilities.

It also has a headphone outlet. Inputs for two microphones. And it's portable with a built-in mains transformer. You can even record while you're out by putting the deck into the record mode, and connecting it to a simple time switch.

When Martin Colloms heard the TC 800GL, he got figures of 0·06% wow and flutter and 64Db signal to noise ratio. From this he concluded: "performance equals, and in some respects exceeds, the highest standards currently available." (Hi Fi News, July 1975.)

For more details write or telephone Natural Sound Systems Ltd. Strathcona Road, Wembley, Middx. 01-904 0141.

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TC800GL Stereo Cassette Deck, £179 plus VAT.

Hi-Fi tuner amplifiers, or receivers as they now seem to be called, have only recently become popular in the UK. However, most other countries have made use of them for far longer. This anachronism was due to purchase tax which, in the past, was only applicable on a tuner or receiver, but not on an amplifier. A tuner and an amplifier bought separately were therefore comparatively less expensive. The situation changed dramatically with the start of VAT and now the sales of separates have fallen markedly in favour of complete receivers.

So many words have been written in the past about the differences between various amplifiers and tuners, it seemed logical to write as comprehensive a survey as was reasonably possible on complete receivers, so that the reader could discover what in practice these differences actually were and then decide which model would be individually most suitable.

My colleagues and I listened to each receiver in turn following a very exhaustive test procedure. All programme material heard through the systems was taken from professional 'A' Dolby processed 15 ips. master tapes. These included recordings of the Hendon Brass Band, Elgar's Symphony no. 1, choral music of John Joubert, and an extremely clean recording made by the 'A Raincoat' pop group, (the latter kindly supplied by courtesy of EMI Records). We were all surprised to find that the majority of amplifiers failed to sound alike, although I admit that in many cases the differences in sound quality were fairly slight. The available room volume was checked under typical listening conditions using a Bruel & Kjaer sound pressure meter, as would be used to measuring the volume of Concorde for example! For testing the tuners we specially recorded some clock chimes and some speech before comparing the quality of each tuner with the best available standard known to us—the Yamaha CT7000. We were appalled to find that many of the tuners were rather inadequate in one way or another. In general, the greatest difference between various models was to be found in the tuner sections and in the ergonomics of operation of the complete receiver. The results show that you do not necessarily have to spend hundreds of pounds if you want really good reproduction of disc and stereo radio, but on the other hand it is clear from past experience that you may have to pay quite a lot for a good pair of loudspeakers. Consequently the next 'Hi-Fi Choice' is likely to be a survey of complete loudspeaker systems.

In the laboratory we checked the performance of 60 different models of receivers submitted to us and, in several cases, re-tests were called for. This was done to determine whether a specifically poor performance was typical of the model. A few models arrived with the wrong FM de-emphasis. If this was switchable we corrected it ourselves, but in the case of the Trio 4400, for example, the importers modified the circuit (see review).

The 60 receivers were given very comprehensive laboratory tests and the remainder were rejected after the subjective tests as having sufficiently obvious faults in design or alignment as to render them, in our opinion, clearly poor value for money. These 'aborted' models are only given brief reviews in order to leave as much room as possible for the remainder. After the laboratory tests were completed five out of sixty had also to be aborted for a similar reason. Further information on these 5 can be noted from the 'jumbo chart'.

Naturally the testing of a colossal number of receivers was an enormous job for both my colleagues and myself. It was only made possible by the co-operation of all the manufacturers/importers concerned. I would like therefore to take this opportunity of thanking my colleagues Tony Faulkner, Nicky Paul-Barron and David Hudson, my patient secretary Lynn Burnetts and also my wife—all of whom worked so many hundreds of hours on the project. Thanks are also due to the innumerable helpers who assisted me during all the subjective tests, thus allowing my colleagues to continue with the laboratory tests with far fewer interruptions! For my part I realise that it is only after testing such an enormous array of products that it is possible to see more clearly how any particular unit compares in performance against an average.

Finally I must thank Aquarius Books and the Editor for putting so much trust in my company, and for the opportunity of carrying out this survey, which has proved to be so illuminating.

*please see page 225 for introductory letter to manufacturers/importers

With an introduction by C.B.B. Wood, MBE, of the British Broadcasting Corporation

Anyone interested enough to have got as far as reading this preface must be aware that enthusiasm for high fidelity sound reproduction in the home has increased enormously during the past few years. Of the several sources of audio signal available, independent observers have said that the highest quality consistently available is that provided by the VHF/FM stereo transmissions of the BBC.

The BBC has always taken great care to provide excellent signals by the use of the most sophisticated studio apparatus and techniques, but until recently the results could only be fully appreciated by listeners in the South-East and the Midlands. Further afield the quality was limited by the land-lines used to carry the signals to the transmitters. It was for this reason—and also to facilitate the extension of stereo broadcasting—that the BBC developed the remarkable Pulse Code Modulation system for network distribution of audio signals. It is now possible to deliver a signal of precisely similar quality to each transmitter connected to the system, regardless of the distance involved, and the stereo service is already available in all the more populous areas—including much of Scotland and Northern Ireland.

Every year the BBC deals with thousands of letters about stereo reception and by far the greatest number of problems arise from the reluctance of some listeners to provide themselves with a proper aerial. As a reader of this book, you are no doubt interested in the choice of receiver: might I suggest that you check your priorities and make sure that, whichever model you choose, you provide it with a signal which will enable it to do justice to the quality which is now available from BBC Radio.

BBC VHF RADIO TRANSMITTING STATIONS

Engineering Information Department, BBC, Broadcasting House, London W1A 1AA. Tel: 01-580 4468 Ext. 252.
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			

KEY: S Carries stereophonic programmes. * Slant polarisation. + Vertical polarisation. All other transmissions use horizontal polarisation.

continued overleaf

VHF RADIO TRANSMITTING STATIONS

Radio 1/2, Radio 3, Radio 4

South West							
Les Platons	91.1	94.75	97.1	1.5			
North Hessary Tor	88.1	90.3s	92.5	60			
Barnstaple	88.5s	90.7s	92.9s	0.15			
Okehampton	88.7	90.9	93.1	0.015			
Redruth	89.7	91.9	94.1	9			
Isles of Scilly	88.8	91.0	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			
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	94.1	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)			Max		Frequencies (MHz)			Max
	R1/2	R3	Radio Scotland	erp kW		R1/2	R3	Radio Scotland	erp kW
Kirk o'Shotts	89.9s	92.1s	94.3s	120	Rosemarkie	89.6	91.8	94.0	12
Ashkirk	89.1s	91.3s	93.5s	18	Ballachulish	88.1	90.3	92.5	0.015
Ayr	88.7s	90.9s	93.1s	0.055	Fort William	89.3	91.5	93.7	1.5
Campbeltown	88.6	90.8	93.0	0.035	Kinclochleven	89.7	91.9	94.1	0.002
Forfar	88.3s	90.5s	92.7s	10	Melvaig	89.1	91.3	93.5	22
Lochgilphead	88.3s	90.5s	92.7s	0.01	Oban	88.9	91.1	93.3	1.5
Millburn Muir	88.8s	91.0s	93.2s	0.025	Penifiler	89.5	91.7	93.9	0.006
Perth	89.0	91.2	93.4	0.015	Skriaig	88.5	90.7	92.9	10
Pitlochry	89.2	91.4	93.6	0.2	Sandale	88.1	90.3	92.5	120
Rosneath	89.2s	91.4s	93.6s	0.025					
Toward	88.5s	90.7s	92.9s	0.25					
Meldrum	88.7	90.9	93.1	60					
Bressay	88.3	90.5	92.7	10					
Grantown	89.8	92.0	94.2	0.35					
Kingussie	89.1	91.3	93.5	0.035					
Orkney	89.3	91.5	93.7	20					
Thrumster	90.1	92.3	94.5	10					

WALES

Radio 1/2, Radio 3, Radio 4

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

NORTHERN IRELAND
Radio 1/2, Radio 3, Radio 4

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

The Independent Programme Companies

ILR Belfast
Community Radio Services Ltd,
Rademon,
Crossgar, Downpatrick, Co. Down,
Northern Ireland.
Tel: Crossgar (039683) 491
293 metres (1025kHz), VHF **96.0MHz**

ILR Birmingham
BRMB Radio
(Birmingham Broadcasting Ltd),
Radio House, PO Box 555,
Birmingham B6 4BX
Tel: 021-359 4481/9. Telex: 339707
261 metres (1151kHz), VHF **94.8MHz**

ILR Bradford
Pennine Radio
(Bradford Community Radio Ltd),
PO Box 235, Pennine House,
Forster Square, Bradford BD1 5NP
Tel: Bradford (0274) 305600
235 metres (1277kHz), VHF **96.0MHz**

ILR Edinburgh
Radio Forth Ltd, Forth House,
Forth Street, Edinburgh EH1 3LF
Tel: 031-556 9255. Telex: 727374
194 metres (1546kHz), VHF **96.8MHz**

ILR Glasgow
Radio Clyde Ltd, Ranken House,
Blythswood Court, Anderston Cross
Centre, Glasgow G2 7LB
Tel: 041-204 2555
(Sales: 041-221 6615/8)
261 metres (1151kHz), VHF **95.1MHz**

ILR Ipswich
Radio Orwell Ltd,
Electric House, Lloyds Avenue,
Ipswich IP1 3HU
Tel: Ipswich (0473) 211762
257 metres (1169kHz), VHF **97.1MHz**

ILR Liverpool
Radio City (Sound of Merseyside) Ltd,
PO Box 194, 8-10 Stanley Street,
Liverpool L69 1LD
Tel: Liverpool (051) 227 5100
Telex: 628277
194 metres (1546kHz), VHF **96.7MHz**

ILR London
General and Entertainment Service
Capital Radio Ltd, Euston Tower,
London NW1 3DR
Tel: 01-388 1288
194 metres (1546kHz), VHF **95.8MHz**

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

ILR Manchester
Piccadilly Radio Ltd,
127-131 The Piazza, Piccadilly Plaza,
Manchester M1 4AW
Tel: 061-236 9913
261 metres (1151kHz), VHF **97.0MHz**

ILR Nottingham
Radio Trent, 29-31 Castle Gate,
Nottingham NG1 7AT
Tel: Nottingham (0602) 581731
301 metres (998kHz), VHF **96.2MHz**

ILR Plymouth
Plymouth Sound Ltd, Earl's Acre,
Alma Road, Plymouth PL3 4HL
Tel: Plymouth (0752) 27272
(Sales: 0752 25744)
261 metres (1151kHz), VHF **96.0MHz**

ILR Portsmouth
Radio Victory, PO Box 257,
Portsmouth PO1 5RT
Tel: Portsmouth (0705) 831243-until Sept; (0705) 27799-from Sept.
257 metres (1169kHz), VHF **95.0MHz**

ILR Reading
Thames Valley Broadcasting,
PO Box 210, Reading, Berks.
210 metres (1430kHz), VHF **97.0MHz**

ILR Sheffield & Rotherham
Radio Hallam Ltd, PO Box 194,
Hartshead, Sheffield S1 1GP
Tel: Sheffield (0742) 71188
(Sales: 0742 78771)
194 metres (1546kHz). VHF **95.2MHz** (Sheffield), **95.9MHz** (Rotherham)

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

ILR Teesside
Radio Tees, 74 Dovecot Street,
Stockton-on-Tees, Cleveland
Tel: Stockton-on-Tees (0642) 615111
257 metres (1169kHz), VHF **95.0MHz**

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

ILR Wolverhampton
Beacon Broadcasting Ltd,
56-57 Queen Street, Wolverhampton
Tel: Wolverhampton (0902) 29634
303 metres (989kHz), VHF **97.2MHz**

Information courtesy BBC Engineering Information Department and Independent Broadcasting Authority

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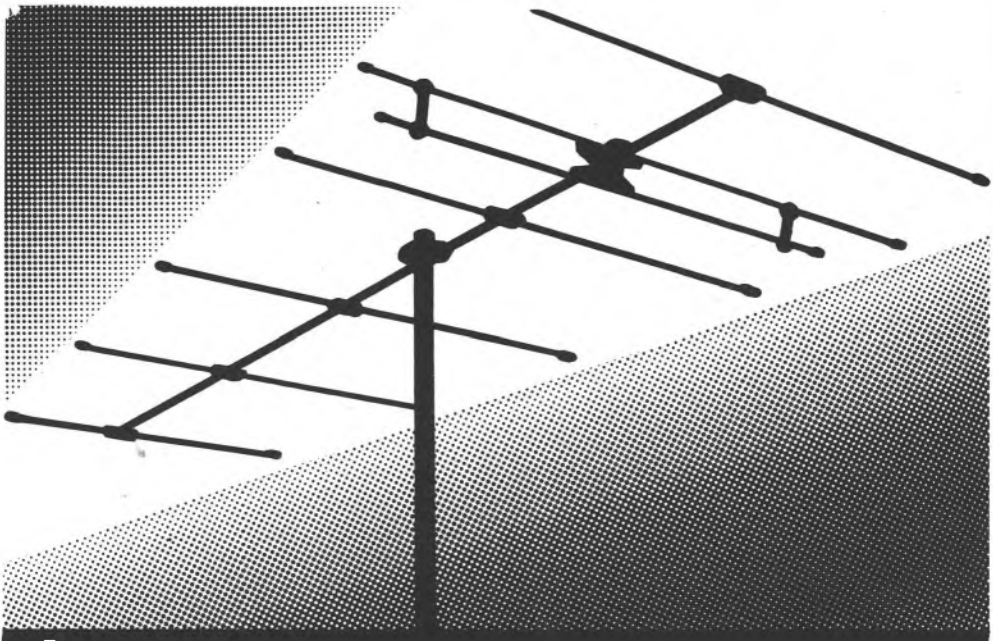
Stereo Coding and Decoding

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 at tens of thousands of times every second where to come from 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 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 different 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 of taking place in a stereo decoder, whether made of discrete components or one of the new 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 band width from 20Hz or so 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 transmissions. High quality modern decoders made with discrete components can give a superb performance and virtually all of the best tuners do not use integrated circuit decoders. The phase lock loop technique was first developed in the United Kingdom by Integrex Ltd. and their decoder originally described in 'Wireless World' gave cross-talk figures as good as 55dB between left and right in addition to having excellent signal to noise ratio. Many designs incorporating either discrete or integrated circuit phase lock loop decoders obviate the necessity of having tuning coils in the decoder and thus their performance is both far more predictable and more reliable for long periods. Integrated circuit decoders unfortunately have in general an insufficient dynamic range, for their weighted noise performance is somewhat poorer than discrete circuits, whilst high levels sent through them tend to produce considerable degrees of distortion. The choice of operating levels therefore through such i.c.'s has to be a compromise between poor hiss performance and higher degrees of distortion and it is quite clear that very few manufacturers have settled for the best compromise. An example of a receiver having an exceptionally bad hiss performance using an i.c. is the Marantz model 2015, whereas one with a very good signal to noise ratio but poor distortion is the Audiotronics model 2500, now discontinued.

Stereophonic reception requires two independent audio signals, one for each of the two loudspeakers. Neither of these is suitable for mono reception—imagine having the double basses louder than the first violins—and so the left- and right-hand signals are combined at the transmitter in a coder to give a sum signal (L + R) and a difference signal (L−R)÷2. The sum signal being the average of the left- and right-hand contributions is quite suitable for mono use and thus leads to 'compatibility'.

The problem now is how to transmit the difference signal in a way which is easily accessible to the stereo receiver but does not interfere with mono reception of the sum. The method adopted in the Zenith-GE pilot-tone system, now in use in many parts of the world including the U.K., is to modulate the amplitude of a 38kHz sub-carrier with it, and to suppress the sub-carrier itself. When the resulting sidebands are added to the sum signal a composite waveform is produced which looks like an ordinary amplitude-modulated carrier except that the envelope on one side of the zero line is not the same as that on the other. It can easily be shown mathematically that there are two envelopes, one being the left-hand signal and one the right, and that they cross each other because of the suppression of the sub-carrier. To this waveform is added a



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low-level pilot tone of 19kHz—half the sub-carrier frequency—and the whole combination (known as the multiplex signal) is used to modulate the FM transmitter in place of the ordinary mono signal.

Ordinary mono receivers respond only to audio-frequency modulation and all the information from 19kHz upwards therefore has no audible effect on their output. Stereo receivers, however, use decoders to extract the extra information and re-constitute the original left- and right-hand signals. They separate the 19kHz pilot tone and use it to regenerate the suppressed 38kHz sub-carrier. This sub-carrier can then be used in either of two ways: it can operate a switch to route the multiplex signal to a left-hand output at the peaks and a right-hand output at the troughs, thus making use of the concept of the two envelopes, or it can demodulate the sidebands of the sub-carrier in a synchronous detector to recover the difference signal, which can then be combined with the sum signal to yield the left- and right-hand signals. This latter method has an advantage over the former in terms of signal-to-noise ratio.

Suppression of the sub-carrier clearly leads to extra complications in the system and especially in the stereo decoder, and it might be thought that everyone would be better off if the sub-carrier were modulated to a more usual depth of, say, 80% or 90%. This would, however, entail increasing the amplitude of the multiplex signal without increasing its information content. The signal would then have to be reduced in level to avoid overmodulation of the FM transmitters and there would be a serious reduction of signal-to-noise ratio for both mono and stereo listeners.

Nowadays complete decoders are available in integrated-circuit form and these are used in many receivers.

Aerials

All the tuner sections of the receivers tested 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 used flat 300 ohm ribbon which has two fine 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. Outside this metal sheathing is an outer protection insulated sleeve. Some tuners incorporated coaxial sockets, usually of the ubiquitous television type (R.M.A.) but occasionally an odd type of Japanese coaxial socket, having a special mating plug, was provided, but in addition to the more convenient terminals most tuners were just provided with screw terminals. 300 ohm inputs were either screw terminals or a special type of 2 or 3 pin socket for direct connection to 300 ohm ribbon. FM band 2 aerials are of many different types, varying from the simple dipole to antennas having many elements. If you live by, 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. 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 £12 to £25 including the cost of aerial, cable and erection. Specialist antennae, though, of course can be quite expensive and many people, including the writer, 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 stations, but receive 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, especially if you are not allowed to erect your own antenna. Do not accept 'no' for an answer, and if necessary get all your friends 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.

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 tune 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, and if you do not think that this is possible in this day and age then perhaps you may change your mind when I mention that one firm that installed an aerial for an old customer of mine in Chelsea, positioned it 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 itself together with any additional elements must always be broad side on to the station, 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.

Tuner Section: RF Sensitivity

The sensitivity rating of a tuner represents its ability to adequately receive weak signals and reproduce the programme satisfactorily in order to give pleasure to a listener. In layman's terms, it is equivalent to how sensitive a microphone is or how large a pair of ears an animal has in the jungle. In the laboratory we measure this sensitivity in a way which typifies objectively what is heard subjectively in practice. Thus the RF sensitivity is stated as being the input signal level required to give a 30dB ratio between the output level obtained from the tuner from a fully deviated carrier and the level of the hiss background added to the distortion products of the fundamental tone transmitted on the original RF carrier. The level in microvolts is called the IHF mono RF sensitivity. The most sensitive tuners require only 0.8uV or so, however the least sensitive tuners require several microvolts and can thus be 10dB or even 20dB less sensitive.

Ultimate sensitivity is not of vital importance unless you have a poor antenna system or, alternatively, you live in an interference free locality—such as would be produced in a detached house in the depths of the country with extremely well suppressed electrical appliances. Even in such a location the noise level received by a good radio may well be many dBs above the noise inherent in the front end of the tuner. This radio noise is in general received from outside the earth's atmosphere (radio stars etc.). Some noise will be received from car ignition etc. from roads even one mile away in the form of an almost random continual background, which is occasionally interspersed with tiny spits from particularly badly suppressed cars. In towns this background noise is appreciably worse and can rise to alarming proportions, as many listeners have reported to me, and other forms of interference too can rear their ugly head. (See section on radio interference suppression.) Should you wish to receive weak distant stations successfully you do not necessarily require

the most sensitive receiver, since other factors become equally or even more important, these being limiting threshold, alternate channel selectivity and signal to noise ratio.

In general today's receivers are certainly sensitive enough to allow weak stations to be received reasonably well. But we found in the laboratory that other problems existed in many of the models tested. RF sensitivity is largely dependent on the type of transistor employed in the front end of the tuner. Additionally, the effectiveness with which the alignment of the front end tuned circuits is carried out is also vitally important.

A tuner's front end has to be tuned to the frequency being received. This has to vary very precisely with the tuning of the local oscillator that beats with the incoming radio signals to provide a difference frequency (the intermediate frequency), which is then amplified up, limited, and finally discriminated to provide an audio signal. RF tuning can be done either by employing ganged variable capacitors, which tune coils or, alternatively, the latter can be tuned by working them in parallel with varicap diodes. Varicaps have their capacity altered by varying a small DC voltage across them and thus such a voltage can effectively tune a circuit to resonate at the required radio frequency.

Since a stereo decoder requires a higher RF input level into the tuner to provide a good stereo signal to noise ratio, a tuner will always be more noisy on stereo programmes than on mono ones when the station being received is fairly weak. Only when strong stations are being received should almost no increase of hiss be noticed should the tuner be switched to stereo rather than mono. It is important, therefore, to provide the tuner with an adequate signal strength. Please look at the section on aerials, which will help you decide on the best aerial for your situation.

RF Intermodulation

When there is more than one strong station capable of being received by a tuner, spurious signals can be tuned in at frequencies bearing mathematical relationships to the frequencies of the strong stations' carriers coming down the antenna cable. The mathematics are complicated but nevertheless I will give one example of a spurious signal that could be found on a poor tuner. In the London area Radio 3 is at 91.3MHz whilst Radio 4 is at 93.5MHz. If we double 93.5 (187MHz) and then subtract the frequency of Radio 3 (91.3) we get a further frequency of 95.7MHz. This in mathematical terms results from a predicted intermodulation product of $2f_2-f_1$. The strength of this apparent signal will be dependent on the received strength of Radio 3 and 4 and the RF intermodulation performance of the receiver in question. The better the receiver, the weaker the spurious signal, and good receivers should not pick up this spurious at all, which incidentally will be found 100kHz below the frequency of Capital Radio. The spurious will consist of a mixture of Radio 3 and Radio 4 modulation and sometimes such spurii can be louder than a weak distant station on the same frequency, which can of course be most annoying. On occasion the receiver itself is not to blame for this problem. The intermodulation products can be caused by a bad connection to the radio (ie. a dry soldered joint) or can even be generated in the transmitter coupling networks in the radio feeds at the bottom of the mast. However, the BBC and IBA take immense trouble to avoid the problem at their end. You can calculate the spurious frequencies that can result from intermodulation by multiplying various transmitter frequencies by any number and then subtracting multiples of other frequencies to obtain difference frequencies inside band 2. If your tuner is generating these spurii remember this can be checked by comparing calculated spurii with those found.

Image Response

On nearly every receiver tested the local oscillator runs at 10.7MHz higher than the frequency of the station being received. In order to produce the correct intermediate frequency by heterodyning the two frequencies, for example, if you are receiving Radio 3 from Wrotham at 91.3MHz, the local oscillator will be on 102.0MHz. It is possible for a tuner, therefore, to receive another frequency which is produced by adding 10.7MHz to 102.0MHz, thus receiving a station of 112.7MHz. This unwanted channel is termed the image, and is normally rejected by effective input tuned circuits. The ratio of the wanted frequency to the unwanted one is termed the image response ratio and can be quoted in dB.Poor tuners may have a ratio of only 50dB or so, whereas good ones will be better that 74dB. Fortunately there are relatively few stations in the general image pass band covered by most of the

main BBC networks, but unfortunately a few network stations and almost all local radio stations have image frequencies in the band between 115MHz and 120MHz. This frequency band is allocated to aircraft, especially for talk-in with airports, and if you are near an airport, or underneath a well used flight path, you might receive occasional trouble which would usually be audible as a warbling beat tone with some indistinct speech switching on and off at intervals. If you have experienced any trouble of this type with transistor portables, you would be well advised to consider a receiver having a good image response ratio.

IF Rejection

A few tuners are sensitive unfortunately to short wave signals transmitted around the 10.7MHz intermediate frequency. Although this is not likely to pose a problem it can crop up if you are near a high power short wave transmitting station, and tuners showing a poor i.f. rejection should be avoided. A certain degree of isolation is produced in a good aerial system, since it is resonant on band 2, and tends to discriminate sharply against frequencies in other bands. Sometimes, though, the outer screen of the coaxial cable can pick up short wave interference, and this can make its way through into the i.f. section. Occasionally interference can be picked up in the mains lead, or even from the mains itself, and an interference filter incorporated in the mains lead may be necessary. IF breakthrough should not be confused with electromagnetic compatibility.

Adjacent and Alternate Channel Selectivity

When a tuner is tuned correctly to a specified centre frequency, it will have a band width of at least 200khz. Therefore, as the transmitted carrier is varying in frequency in proportion to the audio modulation either side of centre, the total band width required is that which extends over the complete width of the frequency shift, plus an additional amount, necessary to ensure that the modulation is correct in phase over its entire deviation. Provided that the response over this band width is very flat indeed and that there are no phase changes within the pass band required, mono and stereo broadcasts should be reproduced with very low distortion, but see *Discriminator and Decoder*. The response outside this pass band should fall as rapidly as possible to improve the rejection of interference from adjacent stations. Unfortunately, if the response falls very sharply immediately outside the required band width almost all filters providing such a characteristic, with only rare exceptions, also have variations in their output within the pass band.

The adjacent channel selectivity is the amount by which the response is down at 200kHz plus and minus of the centre frequency. The sensitivity of the tuner to interference by adjacent stations is largely governed by this measurement. The alternate channel selectivity is measured in the identical manner, but at plus and minus 400kHz. If the adjacent channel selectivity is too good then the tuner is likely to distort on peak modulation, although very esoteric filters will perform far better than the cheaper ceramic types. On the other hand alternate channel selectivity should be very good indeed, and on the best tuners a rejection of at least 60dB is achieved. The measurement is carried out with two signal generators, mixed by a hybrid transformer, with the output feeding the tuner. The wanted signal is set to give an equivalent aerial signal of 100uV without modulation and the unwanted signal with full deviation is increased in amplitude at the relevant spacing until the output of the tuner reaches 30dB below the full output that would be obtained if the wanted signal was fully deviated. It thus represents the interference that would be produced in practice.

Frequently a tuner will have a different selectivity either side of the main carrier. This is usually caused by the tuner's input impedance being different either side of centre, thus attenuating one unwanted signal more than another. For example a few 100kHz off frequency, the tuner may present an impedance to the aerial of 125 or 40 ohms rather than 75 ohms at the tuned frequency, and thus the rejection of the tuned circuit will be different above and below this tuned frequency. A good alternate channel selectivity will mean that the tuner will be able to receive a weak station fairly close to the frequency of a much stronger one, without the stronger signal having any effect on the quality reproduced from the weaker one.

Local Oscillator Radiation

Sometimes under perfectly normal conditions a whistle becomes audible in the background of a

broadcast and this whistle changes in frequency as the tuning frequency is changed slightly. This can be due to the local oscillator of another receiver in another room or even in a neighbour's premises radiating through its aerial system into your own aerial. If your receiver radiates an appreciable amount from its local oscillator you might in turn affect someone else's receiver and so we measured the amount of radiation produced by the receiver's oscillator on to a dummy aerial connected to the set. The lower the amount of radiation produced, the better is the receiver in this respect.

A similar effect to the above is produced when a station that has unfortunately been allocated a frequency close to nine times the receiver's i.f. frequency is received. Wenvoe in South Wales for example includes a transmitter on 96.8MHz. When this is received on some receivers the 9th harmonic distortion of the 10.7MHz i.f., usually produced in the limiter or discriminator circuit, finds its way back into the aerial input circuit and beats with the incoming signal, which thus causes a whistle. Many receivers have this problem, which is extremely difficult to eradicate. Since it is so widespread it is probably better for FM transmitters throughout the world to avoid the spot frequencies around 96.3MHz (9×10.7) for the problem will not arise at frequencies other than around this.

Capture Ratio and the FM VHF Broadcast Band

There is only a limited amount of space on band 2 for public broadcasting. The situation has been made even more difficult because of the intrusion since World War Two 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 unfortunate. It means that the entire 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 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 is 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. For example 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 background. 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 become severe. Receivers with capture ratios better than 2dB should give appreciably better freedom from this inteference than receivers having capture ratios inferior to 4dB. Fortunately almost all the receivers tested were at worst good in this respect.

IF and Discriminator 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 band width 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. This intermediate frequency is then amplified very considerably before being passed through a stage called a limiter, which should provide a consistent output to the discriminator for all levels of RF input signal. The i.f. 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 i.f. section, usually of the order of at least 600kHz, and often as much as 1MHz band width.

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. This varying voltage passes through a capacitor to block off the DC, which 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 and in some models 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. 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. This effect can usually be noted if the tuner sounds and measures better 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.

In order to achieve a good i.f. band pass characteristic, most tuners incorporate ceramic filters and the circuits which feed or are fed by them must be matched properly. It is not necessarily correct to peak every component for maximum sensitivity as this may provide too sharp a peak in the centre with rapid fall-offs either side. More usually, the curcuits have to have slightly staggered peaking to widen the band width in the centre. but also to achieve a steeper 'skirt'. On some tuners we noticed that the circuits were peaked at one edge of the ceramic filters pass band, 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.

Limiting

All signals being received should be equally loud, and whereas on AM receivers a system known as AVC or more correctly AGC was used, FM systems employ a device known as a limiter. An FM limiting system employs a very high gain and all input wave forms become clipped heavily, so that the discriminator only responds to frequency changes and not amplitude ones. As the RF carrier level is reduced to a low level a point is reached where the audio output begins to fall and when a fully modulated carrier is reduced in RF level, such that the tuner's audio output falls by 3dB, the level is referred to as the limiting threshold. Good tuners have this threshold substantially below the 30dB I.H.F. sensitivity level but poorer models sometimes have a threshold many dB above that of the I.H.F. sensitivity rating. An example of a good tuner performance in this respect is that of the Yamaha CR1000.

Good limiting is almost always synonymous with good AM rejection and improved suppression of ignition interference. A tuner having a good limiting threshold will allow all usable input signals to be reproduced from the tuner at compatible levels, whereas tuners having bad limiting will reproduce weaker signals more quietly than strong ones. Incidentaly a tuner with good limiting will always hiss louder in between stations than a poor one, provided of course that the mute control is not operating.

Muting Thresholds

Many users only require a receiver to pick up local stations, although just occasionally they like to listen in to more distant ones. When an FM tuner is tuned

across band 2 a loud hissing noise is audible in between stations and muting circuits are designed to cut this out. In a few cases the level of input signal that will overcome the muting action can be pre-set by the user, but in the majority of cases it is predetermined by the manufacturer. This level was usually between 2 and 10uV, so that even fairly distant stations could overcome the muting action whilst the hiss between the stations was virtually eliminated. In many receivers the muting circuit automatically switches the tuner to mono on a stereo station if the signal that would be received in stereo was too weak to give an adequate signal to noise ratio. A stereo station received at 5uV for example would be extremely noisy whereas the same station received on a tuner switched to mono would probably be tolerable on the majority of receivers. The levels at which the muting circuits operated were noted in the laboratory, and are given in the tables where appropriate.

In some cases the muting only allowed a station to come through when it was correctly tuned, and some difficulty was experienced in locating a station quickly when the mute control was operating. A dial spun too quickly could easily go over a station without its being noticed. It is very much a matter of personal preference whether a mute is used or not and we could find no definite preference emerging from discussions with various people who are all keen Hifi enthusiasts. In general, though, women were more inclined to use muting, whereas men were split into an even ratio between those not normally using it and those who used it regularly.

Tuning Indication

Many people find it quite difficult to tune an FM receiver correctly, especially if no indicator is fitted, typical examples of this being found on portable transistor radios. Nearly all the receivers in the survey did have some form of tuning indication and the majority incorporated a centre zero tuning meter. This type of meter shows a station to be correctly tuned when the needle is resting on the centre zero mark. The needle moves away from centre when the station is not tuned in correctly. Several receivers had only a signal strength indicator and the instructions told the user to tune in each station for maximum meter indication. One or two models incorporated a pair of small lamps and when these were lit equally the receiver was stated to be correctly tuned. As explained in the sections on discriminators and distortion, many receivers do not give optimum performance when tuned theoretically correctly, since the centre zero type of indication relies on monitoring the average voltage present on the output of the discriminator. Similarly, but for other reasons, a peak signal indicator may not show optimum tuning position, which may well be obtained when the tuner is re-tuned either slightly LF or HF of the maximum indication position. To check on the accuracy of your tuning indication, select a local strong station having a loud programme on it and tune either side of the correct indicated position. Distortion should become apparent at both a similar swing either side of centre and a similar amount of rotation of the tuning knob either way. Furthermore the output volume produced when the tuner is tuned either side of centre should be more or less the same up to the point where distortion becomes noticeable. Some tuners gave up to 6dB more output when tuned one side with respect to the other, thus showing severe mal-alignment. With experience you should be able to tune your reciever more accurately by ear than by using the meter, if you choose a mid-way position between the tuning points where distortion is just becoming noticeable, and this is probably better if you have reason to distrust your tuning meter. It is surprising how quickly most people learn to use this method for tuning, and you should be able to apply it also on VHF portables.

Tuning Ergonomics

Considerable differences in the feel of the tuning control were noted between different models. In some cases a given manufacturer tended to use a similar type of tuning drive on all their models, whereas in others the rate of tuning across the dial varied quite appreciably from an average. Some receivers required only a small amount of turning to change from one station to the next, whereas others had more effective band spread. Although the majority of receivers could only be tuned into stations by a rotary tuning knob, a few had several pre-set station positions in addition to a normal control. Pre-set stations are extremely convenient particularly when the family are using the Hifi set up and although most people do not normally listen to more than 3 different stations, receivers having 6 or more pre-selected stations are to be commended.

The Armstrong had three pre-sets for FM and three for medium wave on the review sample, but the FM only model has all its pre-sets on band 2. We found that some receivers' pre-set station controls were easy to adjust whereas others were frankly rather difficult to set accurately.

Tuning Scale Accuracy

All receivers include some form of tuning dial and on band 2 frequency it is given in MHz. The length of the scale and the number of indications vary from sample to sample as does the accuracy. You will soon get to know the positions of the more important stations, but sometimes you may want to listen to a more distant station, which can be identified by its position on the dial. We measured the tuning accuracy at 3 positions on each dial, and whereas most receivers were accurate throughout to within 100KHz or so, some had quite bad errors, which are mentioned in the reviews. Under really good conditions, and with a good aerial system, stations can normally be heard at the rate of 3 or 4 every MHz.

On many models the tuning knob is not mechanically directly connected to the tuning mechanism —driving chords and other devices being frequently incorporated in between the actual control and the tuning mechanisms. This frequently leads to what is called backlash. The Trio 7400, although an excellent receiver in general, had rather poor backlash, so that when tuning in a weak station some sponginess was noted, and the optimum position when tuning clockwise was different to that when tuning anticlockwise, making it rather difficult to tune backwards and forwards to obtain the optimum centre tuning.

Some tuning mechanisms incorporated fly-wheels so that the control felt much freer and continued moving through part of a revolution if given a rotational jerk. This could make the transfer from one station to another on widely different frequencies easier and quicker. Occasionally a model incorporating such a fly-wheel tended to produce a rattling sensation in the hand, whereas others were extremely smooth. A few tuners were really stiff, and tuning over the band became slightly laborious. The type of tuning control must in the end be a matter for personal choice and to help guide you comments are made in each individual review

Stereo Separation and Crosstalk

If a programme is applied in a transmission system to just 1 channel, the system should not produce a noticeable output on the other channel. If some 'spillage' occurs somewhere and usually in the decoder or i.f. 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. Two extremely stringent tests were employed to show up subjectively crosstalk and its inherent distortion problem in every receiver. I have at home an antique grandfather clock with a chime that is particularly penetrating and this was recorded at 15ips and the resultant tape was played back into an encoder through either left or right or both channels, the latter test being done in and out of phase. The peak deviation was set extremely accurately with a B & K peak reading voltmeter, which read the peak level of a transient as short as .05 of a mS (1/20,000th second). Some tuners gave a noticeable clanking noise on the bell, whereas others gave a sound which can be described as a splat on the crosstalk channel. In some cases cracking was so severe as to give a most oppressive sound quality. Although no stereo radio transmissions should contain a pure difference signal, the difference channel is frequently loaded fairly heavily when in a broadcast instruments containing high overtones are present on extreme left and right. Reproduction of these instruments can appear raspy and unnatural on some tuners. Sometimes the ear can actually perceive the distortion being reproduced on the opposite channel. If tuners were particularly bad in this respect and it was felt that there would be a noticeable detraction from enjoyment, they are not recommended in this survey.

We also recorded my voice in the garden, using an extremely high quality omni directional capacitor microphone, and this recording was played back again through the system in left, right and central information modes. We listened both to the quality of the speech reproduction, and for any presence of distortion particularly in the crosstalk channel. Some poor tuners gave a screeching sound on sibilants,

which appeared to come from the whole sound stage, whereas the best ones were virtually immaculate, producing in the crosstalk channel a gentle, relatively undistorted murmur, which was completely inaudible in context of the complete overall sound. When I have carried out this test before, some people have suggested that it is unrealistically cruel. In my experience it is certainly a realistic test, since I have noticed very high deviations in speech reproduction on extreme left and right, both in broadcasts of stereo plays on BBC R3 and in interview programmes, on, for example, Capital Radio. Every tuner was given a lengthy 'on the air' test for which I plugged in my normal VHF antenna into the tuner and listened to all the London programmes. The worst tuner sections were very obviously poor, whereas the best were virtually indistinguishable from the Yamaha CT7000 tuner, which was used as the standard through the tests. It was perhaps surprising that a number of receivers were virtually as good as the Yamaha costing approximately £500 just for a tuner. However the CT7000's superiority was undoubtedly its incredibly good distortion performance, markedly better than any receiver reviewed in this book.

In the laboratory we measured as crosstalk all the signals present in the crosstalk channel and thus the measurements include any harmonic distortion present. A tuner having fundamental crosstalk, but no harmonic distortion in the crosstalk and giving a figure of say 30dB at 1kHz could be noticeably superior to one having a figure of say 36dB, but with the majority of the crosstalk as pure harmonic distortion. For this reason, 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.

Distortion

It has in the past been extremely difficult to measure the distortion performance of the best tuners, because virtually all the test equipment that has been available in the past has significantly higher inherent distortion than the very best tuners. Approximately 18 months ago we carried out considerable research work, and modified our Radiometer stereo encoder/transmitter, reducing its inherent distortion to no more than 0.15%, which is approximately three times better than the manufacturer's specification. This generator was used for all the subjective listening tests, since it includes pre-emphasis and is most convenient for rapid testing work. In the laboratory, however, we used the latest Sound Technology generator, which has an inherent distortion well below 0.1%. Some reviewers have in the past only measured mono distortion and stereo distortion sending left plus right. Such measurements show only a small part of the story, since frequently the sum channel throughout the system produces excellent measurements, but the difference channel produces distortion of several percent, which can introduce a roughness on any sound images that are not central. We found that with many tuners optimum distortion was not reached when the receiver's tuning meter showed correct tuning, and indeed in some cases the tuner had to be re-tuned so that it was almost on the verge of switching away from stereo before the best performance could be achieved. In these circumstances the tuning meter showed the tuning position to be in error and in almost all such cases the discriminator had been incorrectly aligned at the factory (see section on Discriminators).

Distortion can be introduced in several places, normally in the i.f. section, the discriminator or the decoder. If the i.f. pass band is not linear, or is too sharp, distortion will become apparent, particularly at high levels. Furthermore distortion at this stage will also become noticeable in severe cases by a change of apparent position of transients. An incorrectly aligned discriminator will produce another form of distortion, which will sometimes improve if the tuner is off tuned slightly in one direction. Quite frequently distortion is introduced in the decoder, particularly if the basic design parameters are not very carefully watched. In this case usually all samples of a particular model show the same distortion symptoms, whereas faults in alignment of course will vary from sample to sample in any particular model. It has been very evident in all our tests that most of the inadequacies in receivers, as far as subjective sound quality is concerned, are in the tuner sections, for we consistently found that a signal replayed through the tape input sounded substantially cleaner than one passed through the tuner.

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 gramophone records can produce, let alone other forms of pre-recorded music. Although the broadcasting organisations do sometimes transmit rather hissy or hummy programmes, the general 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 at best. Usually when noise was present, hiss was audibly worse than hum, but some tuners had quite a noticebale hum although hiss was not noticeable. We tested in the laboratory the noise performance of each receiver in stereo and mono on both channels on strong and weak signals and the results were taken both unweighted and CCIR weighted. 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 20dB 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 stereo 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 Yamaha CT7000 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 64dB 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 S/N of 62dB, and a weighted S/N of 61dB. A tuner introducing noise of the same magnitude as that produced on the broadcast would sound 3dB worse as 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, i.e. 66dB unweighted and 65dB 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.

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. Typical figures on DIN equipment might occasionally be marginally better than those quoted if one is referring to a direct loudspeaker feed, but in these instances I must hold the DIN standard responsible for a degradation of quality brought in by the employment of this standard. 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.

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 10dB.

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. For example, the old Marconi AXBT ribbon microphone now sounds distinctly woolly compared to the more recent STC type 4038 ribbon and AKG type D202 moving coil now used for the majority of BBC speech transmissions.

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 installed in poor signal strength areas, a novel form of device has been introduced known as a pre-emphasis limiter. This equipment reduces the maximum energy at high frequencies without affecting peaks at middle or low ones. The signal entering the limiter is fed directly to the control chain, which acts upon a delayed signal, and thus any transient is reduced a few thousandths of a second before it reaches the output. The amount of pre-emphasis, in fact, changes, thus cutting the amount of high frequency energy permitted to pass through immediately prior to and during a loud high frequency peak. 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.

In the United States even more pre-emphasis is used thatn in the UK, their pre-emphasis being approximately 13.5dB boost at 10kHz, and so their problem is even more severe, and American peak levels are substantially lower than ours in order to give sufficient leeway for high frequency peaks. Unfortunately several imported tuners, usually amongst those made in Japan and the US have been provided with the wrong de-emphasis. The effect is to produce a rather dull sound quality, since frequencies from lower treble to extreme top are reduced by approximately 3.5dB. If your tuner has the wrong time constant, it is usually only necessary to change one capacitor on each output channel and this should not be costly.

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.

Multiplex Filtering

The output of all stereo decoders contains a proportion of 19kHz, 38kHz and other supersonic frequencies, which are not part of the main left and right audio signals. These tones etc. are generated in the multiplex system, and must be filtered out if whistles are to be avoided on many types of tape recorder, although most domestic recorders made today contain additional filters to improve further the suppression of multiplex frequencies. All recorders incorporating Dolby noise reduction for example contain multiplex filters. It is far better for the multiplex tones to be filtered out in the tuner, and most receivers incorporate a filter either as part of the de-emphasis network or immediately following it. The perfect filter is designed to have as flat

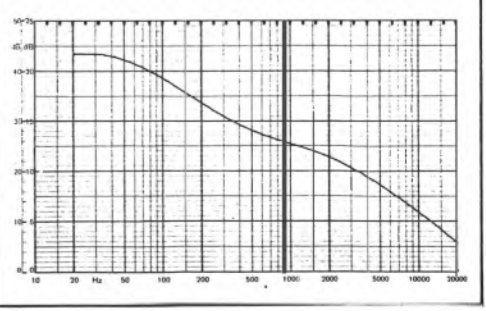
a response as possible to 15kHz with a maximum rejection at 19kHz, but also a good rejection of all supersonic frequencies. The perfect filter unfortunately is rather expensive, and so many manufacturers use relatively inexpensive ones, which whilst having a good rejection at 19kHz, start cutting the response noticeably from as low as 10kHz. We noted some examples of tuners having a response 6dB down at 15kHz, and such a reduction of response at extreme high frequencies will cause a noticeable lack of sheen and clarity on many orchestral instruments. Note the response at 15kHz of each tuner reviewed and you will see very considerable variations. To check the effectiveness with which the filters removed pilot tone etc., we measured the 19kHz and 38kHz outputs on the record output sockets with reference to full deviation at 1kHz. Good multiplex filtering produced outputs no higher than −50dB, whereas poor ones could present −40dB or worse levels, which might cause whistles to be recorded on some tape recorders, particularly when recording at a low tape speed. We suspect that some tuners did not include a multiplex filter at all, and we consider this extremely bad practice.

Pick Up Pre-Amplifier Section

The output of the magnetic type cartridges of today is very low indeed, a maximum output level of around 6mV being typical at 1kHz. In order for the groove modulations in a record to be held within bounds, bass cut is applied in disc cutting, and so bass boost has to be applied in the receiver's RIAA pick up input circuit. Furthermore, when a record is cut, considerable high frequency boost is applied so that as the frequency increases on a gramophone record, the output from the cartridge will also increase. This results in the necessity for a top cut as well as the bass boost referred to around the pre-amplifier. The amount of boost and cut has been internationally standardised, and the compensating curve that is required to achieve a theoretically flat response from a perfect pick up cartridge is shown in the figure. It will be seen that the bass boost rises down to about 100Hz and then begins to level off to an almost flat response below 50Hz, whereas at the treble end the response continues to fall right up to the highest frequencies that are normally reproduced. In order for a record to be reproduced through the amplifier with the correct response, the pick up pre-amplifier must have the correct amount of boost and cut, and we checked each receiver to see if this indeed was so, and comments are made in each review if any significant errors were found. The pre-amplifier also has to increase the level from 6mV or so to somewhere between 100mV and ½V, and some pre-amplifiers create more inherent noise in their circuits than others. In the past, many reviewers have measured this noise substituting a 1K ohm resistor for the pick up, but we do not consider this realistic, and so we actually placed a Shure cartridge inside a mumetal can, connected 2'6" of high quality screened cable to each half, and connected this to each hi-fi amplifier, to represent a typical situation that would be found in the home, with the sole exception that the pick up was of course not mounted in an arm on the turntable. This was done to avoid any unfair degradation of receiver performance by hum induced from the motor of the turntable, since we wanted to make sure that we were reviewing the amplifier and not the turntable or cartridge with respect to any hum. Any receiver that had a noise level that was felt to be below par receives an appropriate comment.

Almost all magnetic cartridges made today are designed to work into a resistive load in the pre-amplifier of 47K ohms. We checked the input impedance and capacitance of each pre-amp, and our measurements showed that many were not correct, although only a few showed variations of impedance

Base Boost Compensating Curve



that would probably be audible. Variations in capacitance, however, were fairly large, and since some cartridges required different capacitive loading to others, the input capacitance added to a typical value of 125pF for an average pick up lead attached to a turntable represents a true value. Shure cartridges, for example, are stated by the manufacturer to work best into a relatively high capacity, whereas other makes, including the Decca and B & O ranges seem to work better into a lower input capacitance. I do not necessarily agree with manufacturers' recommendations though, as for example the Shure V15/111 seems to work better into a lower impedance.

We also measured the overload margin of each pre-amplifier to ensure that no distortion was likely to be produced either on transients recorded on to a disc at a high level, or sharp edge transients formed when the stylus traverses a scratch on a record. If a pre-amplifier is overloaded with the cartridge output obtained from a scratch transient it can take a short while to recover, thus producing an audible 'bonk' after the scratch. An overload margin of at least 20dB is advisable to avoid this problem.

To check all the distortion characteristics of the pre-amplifier section, the intermodulation distortion between the pick up input and the tape recorder feed socket was checked at a level of 10mV, which represents about the maximum level on music that is normally encountered on gramophone records. Comments will be made in the reviews if the performance is unsatisfactory.

The rf interference tests shows that many pick up pre-amplifiers were very prone to picking up and rectifying locally transmitted radio signals of one form or another. Please refer to the section dealing with this problem for further information.

Finally the gain between the pick up input and the tape recorder output was checked to see if it was compatible with the output level from the tuner on an equivalent programme. Ideally a record played back on an average cartridge should require the receiver's volume control to be in the same position as an equivalent record being played, for example, on a BBC broadcast, when reproduced with the same volume output from the system. In a few cases the volume control levels were appreciably different—which is rather ridiculous and annoying.

Audio Switching Selectors

Nearly all the receivers incorporated a switch to select the appropriate input for a tape monitor facility. The latter allows the user to listen to the input programme direct or via the tape recorder. Various receivers had switching for two separate recorders and also allowed copying in either direction. Some receivers incorporated a stereo mode switch which chooses normal stereo, reverse stereo, mono, left or right combinations to feed both or sometimes either output. This can be extremely useful and in particular the mono switched position. A few models also included an audio "dim" or total mute key or button and this can be quite useful.

Tone Controls

All the receivers tested, with the exception of some Sonab models, incorporated at least two conventional tone controls, or in the case of the JVC VR55 25 UK, a graphic equaliser. One tone control is termed bass, and varies the output at low frequencies with respect to middle ones, whilst a treble control adjusts high frequencies up and down, also with respect to middle frequencies. A few receivers incorporate a mid frequency control, which usually gave a boost or reduction of frequencies around 1kHz. A number of receivers had independent control for left and right, and these were either mounted concentrically or were totally independent. The JVC graphic equaliser is far more complex, and allows the user to boost and cut several areas of the frequency range independently, and although this is fun to play with, most users will find that after a while the novelty wears off, and the controls are almost always used flat, or as one would normally use tone controls, with slight boosts or cuts at the extreme ends of the frequency spectrum. However, if the user wants to make specialist recordings, and correct for microphone deficiencies, or deficiencies of a tape that has to be copied, graphic equalisers become exceptionally useful, and are used by most professional studios.

The rate at which a tone control affects the boost or cut with respect to frequency can be very different from one receiver to another, as a study of the different equalisations show on the graphs for each receiver. It is bad practice for any boost to continue outside the audio spectrum, but some

controls had either noticeably much more boost at 20kHz than 10kHz, or 20Hz as opposed to 40Hz. Excessive boost at high frequencies will not only emphasise distortion, but may give an amplifier a very hard job in reproducing sharp transients, which may then become clipped at supersonic frequencies, thus causing audible oppressive effects. Too much low bass boost will emphasise rumble, particularly from record turntables, and although the rumble may not be too audible, the loudspeaker cone may will be literally belting in and out with a dangerous amplitude. Apart from the possibility of such cone excursions damaging the loudspeaker, low frequency acoustic feedback through the floor or even the air back to the turntable will be encouraged, and clear signs of intermodulation and doppler distortion may be produced in the loudspeaker. These effects show up as a gurgling noise on instruments such as the clarinet, if rumble is allowed to intermingle with the woodwind instruments' sound.

As with balance controls, a number of tone controls had clear centre indents this making it very simple to find the nominal flat position. Whereas most controls varied continually from one end to the other, some had 11 stepped positions, five of boost, five of cut and a centre flat one. We found that whereas some receivers having such controls had approximately equal steps, others hardly changed at all between positions four and eight, but changed violently between positions one and two and 10 and 11. Controls having even steps would seem to be more popular and more predictable, and are thus rated generally better than the other type. A similar remark can be made concerning the law of some of the ordinary rotary continuously variable types. A few receivers had sideways or up and down movement faders for tone control, and these were not liked generally, since the majority of them were rather jerky. (See the section on volume controls etc. for further comment).

The large majority of tone controls are ganged so that the effect on both channels should be identical. We checked that this was so, on all the positions of the controls at 50Hz, 1kHz or 10kHz where appropriate. Whilst controls having a centre indent position were very convenient, my colleagues and I all abhorred the absence of tone control cancel buttons to allow the user to check quickly how much tone control effect is in use.

A few pre-amplifiers, including two of the Tandberg models, allow the tone controls to be used either normally or in the feed to a tape recorder, so that tone compensation can be made before recording. Whilst this type of facility is used by the majority of professional engineers, a very full understanding of the power response capabilities of the recording system are necessary since too much treble boost applied before recording can cause serious overloading of a tape, thus creating a very poor sound quality on the recording, and encouraging severe high frequency distortion. It is probably safer for normal users to record flat on to tape, and adjust the response on play back unless one is copying a muffled or over bright tape from one machine to another through the pre-amplifier. Many receivers had break points in the audio feeds after the pre-amplifier, but before the main amplifier, allowing insertion of external equalisation or specialised control equipment. Either shorting links, or a switch, allow the receiver to work normally.

Treble and Bass Filters

Most receivers had at least one filter switch, and in some cases different amounts of filtering, or roll offs, were available below or above different frequencies. The rate at which the response falls away from the nominal filter frequency varied appreciably between different models, and here I wish to state quite firmly that in my opinion a push button that reduces the response by only 6dB per octave cannot really be classed a filter at all. Perhaps 'roll off' would be more apt since the word 'filter' implies a steep cut off away from the nominal frequency. The entire laboratory staff are of the opinion that the slope should be at least 12dB per octave for the term 'filter' to be realistic, and perhaps most companies might be sailing rather close to the wind with respect to the Trade Descriptions Acts, although their defence might be that the definition is a matter of opinion. Quite clearly it is more likely to be a matter of production cost, since the steeper the design of roll off, the more components are necessary in the circuit. Manufacturers incorporating filters with 12dB or more per octave must be highly commended, and particularly those that have different filter slopes available by combining the effects of two buttons for example, such as those found on the Armstrong, Leak and Goodmans ranges. Whereas treble filters

may subjectively remove much of the effect of distortion or unpleasant screeching in a recording, rumble filters are introduced to remove very low frequencies to reduce loudspeaker cone excursions, and audible low frequency noises that are not inherently part of the music etc. Some of the rumble filters cut very steeply and effectively, whereas others cut more gradually, but from much too high a frequency, thus removing low notes (organ pedal notes, bass drums and bass guitar fundamentals for example). Remarks on the effectiveness of filters are made in the reviews where appropriate. Filters having only 6dB per octave cut off are usually referred to as 'roll offs' in this book.

Balance Controls

These controls are necessary to adjust the relative gains of the two channels so that compensation may be made if a programme has an incorrect left/right ratio, or if the user owns two loudspeakers of unequal sensitivity. I find I have to use a balance control on commercial records quite frequently, and the rate of change of adjustment around the centre position is important ergonomically. Even more important is a clear indication that the control is central, and I noticed that many receivers now have what I term a centre indent, which can be easily felt as the balance control is moved through the centre. One surely has more confidence in a clearly felt indent, than a line on a knob which is theoretically correct when vertical, since most knobs can easily be screwed or fixed on their spindles incorrectly. Some controls shifted the sound smoothly from left to right, whilst others had relatively no shifting effect near the centre, or moved the image too rapidly across the stage at this point. Almost all the controls worked by reducing the gain of the channel that was too loud, but some controls increased the required channel at the same time (Leak, Revox for example). It is useful sometimes to be able to cut one channel completely, and a few balance controls did not do this (Revox). Some balance controls were knobs or 'faders' which were completely separate from the volume control, whereas others either consisted of a concentric round knob behind the volume control, or in some cases a lever working behind and underneath or above it, around a common centre. I personally prefer a separate balance control having a centre indent, but many users will prefer the concentric lever type. One or two receivers incorporating faders either had a left/right sliding movement, or an up/down one, and these were not always as smooth as they might have been, a few actually being very jerky and difficult to set. It must be said that pseudo professional faders incorporated into a main hi fi set up may give the uninitiated an impression of professionalism, but are of such a low performance standard as to be significantly inferior to their more common rotary counterparts. Professional faders cost upwards of £20 each, and clearly those costing pence rather than pounds cannot really be considered too seriously, although again this is a matter of personal preference and opinion. Finally, it is well known that the eye can detect a minute angle difference on a rotary control far more accurately than the vertical or horizontal position of a slider. Most rotary controls, therefore, can be reset to established positions more easily and accurately.

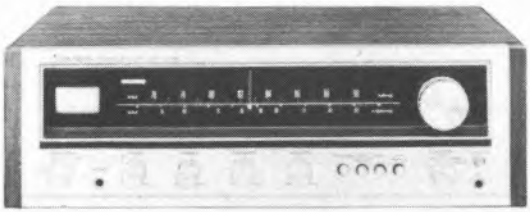
Volume and Automatic Loudness Controls

The relative positions of instrumentalists in a stereo programme should not alter if the volume control is raised or lowered. When stereo preamplifiers were first produced in quantity around 15 years ago the ganging of the left and right channels (the accuracy with which each channel was changed in volume identically to the other channel) was very poor. One frequently noticed images shifting quite violently from half left to half right and back again. Fortunately, and much to our surprise, the ganged volume controls of the vast majority of receivers tested were extremely good, as was shown in a surprisingly time consuming test. A Hewlett Packard gain/phase meter connected to both outputs of the receiver was balanced up with the volume controls flat out, and with the same input tone applied to both channels so that the two outputs were identical, thus giving a zero dB reading on the meter. The volume control was then brought down through a change of some 30dB, and the maximum difference in levels between the two channels noted in dB on the gain phase meter. Most receivers did not show a channel difference with respect to the other channel of more than ± dB swing. The meter was then re-set with the volume control at −30dB and the control then taken down to −50dB as an additional check on the ganging,

COMET Super Buy

PIONEER® SX 434 Tuner/Amplifier

Incorporating advanced electronic circuitry throughout, the SX–434 is specifically designed for music lovers who insist on low distortion without wasting watts. An output of 15W + 15W continuous RMS power (both channels driven at 8 ohms), is enough to drive two pairs of stereo speaker systems individually or simultaneously. With all the facilities you'd expect on Pioneer equipment, the SX434 at Comet is a super buy for you.



AMPLIFIER SECTION
Continuous Power Output
40 Hz to 20KHz 15 watts + 15 watts (8 ohms) (both channels driven)
Harmonic Distortion: Less than 0·8%
Power Bandwidth: 10Hz to 70KHz (H.D. 0·8%)
Damping Factor: More than 25 (1KHz, 8 ohms)
Input Sensitivity/Impedance
PHONO: 2·5mV/50 Kohms
AUX: 150mV/80Kohms
TAPE PB: 150mV/80Kohms
TAPE PB (DIN connector): 150mV/80 Kohms
Frequency Response
PHONO (RIAA equalization): 30Hz to 15KHz ± 1dB
AUX, TAPE PB: 30Hz to 25KHz ± 1dB
Tone Controls
BASS: +9dB, −8dB (100Hz)
TREBLE: +5dB, −7dB (10KHz)
Hum & Noise (IHF, short-circuited A network):
PHONO: More than 70dB
MIC: More than 65dB
TUNER, AUX, TAPE PB: More than 90dB
FM TUNER SECTION
Usable sensitivity (IHF): 1·9μV
Capture Ratio (IHF): 1·0dB
Selectivity (IHF): 60dB
Signal-to-Noise Ratio: 70dB
Harmonic Distortion: Stereo less than 0·4%
Stereo Separation: More than 40dB (1KHz)
Antenna input 300 ohms balanced and 75 ohms unbalanced
AM TUNER SECTION
Selectivity: 35dB
Signal-to-Noise Ratio: 50dB
Dimensions: Without package
16—15/16 (W) × 5½ (H) × 13—21/32 (D) inches

Rec. Ret. Price *£168.51 inc. VAT **Comet Price* £106.99 inc.VAT**

• Prices correct at time of going to press April 1976.
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and once again almost all the receivers were remarkably good. A poor control would show a clear image shift, particularly when the volume was reduced considerably, towards one channel or the other, and if your old stereo pre-amplifier shows this tendency, a more recent type of stereo control may show a significant improvement.

We also noted the actual feel of the control, and found that whilst some were smooth, others felt scratchy or rough, or even loose. The actual feel of a control is a matter of personal taste, but I rather like one that is silky and very slightly oily in feel. A few had independent variable controls on the same shaft, which obviated the necessity for a balance control, but this was found extremely inconvenient, particularly if the record or programme source was not properly centralised. Normally split concentric controls are friction locked, but some were rather loose.

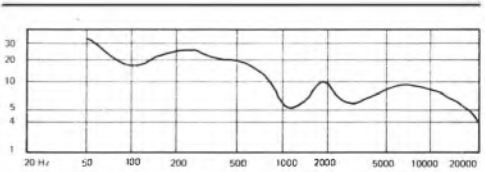
Almost all the receivers provided a facility termed automatic loudness correction, and whilst this was usually an on/off function, a few receivers, such as some Yamaha models, had controls to vary the effect. Because of the characteristics of the human ear, we tend to lose low frequencies and to a lesser extent very high ones when music is played quietly. Whilst most of the controls gave a noticeable increase in bass and treble automatically as the volume was reduced, a few affected the bass end only. To enable the volume control itself to produce this effect reasonably when the circuits are operating, the rate of change of volume law in the control has to be slightly altered in manufacture and we noticed this on the majority of volume controls. When they were used without automatic loudness correction we noted a relatively small change of volume when the control was moved from a quarter to approximately one third of its travel. Once again, the employment of this circuitry is a matter of personal taste, and virtually no professional engineers ever use it, even domestically, because of its misleading effect on estimating sound balance. I personally find the circuits extremely annoying, especially when the treble end is boosted excessively at low volumes, producing a quiet but totally unrealistic sound. The control has some virtues however, in that music can be played as a background at parties, and give the impression of being hi-fi, although being reproduced at totally unrealistic levels.

Amplifier Noise Levels

A few receivers create audible hum or hiss from the loudspeakers in a quiet small room, even when the volume control is at minimum. We noted both unweighted and weighted noise levels on the output of each receiver. We also re-checked these at the position of the volume control that gave maximum noise when the auxiliary or tape inputs were loaded with screened 10k ohm resistors. If any noise problems were present they receive comment in the reviews.

The Power Amplifier

Loudspeakers require maximum rms voltages of between 5 volts and 20 volts to drive them at listening levels found in general use domestically. In addition to providing this range of peak voltages, loudspeaker driver amplifiers also have to give at up to 3 amps rms or so, and whereas sometimes the voltage and current maxima occur at the same time, frequently the loudspeakers require the maximum current at a fractionally different moment from maximum voltage. A loudspeaker is never exactly 8 ohms impedance at all frequencies and will vary over a very considerable range (and an example of loudspeaker impedance versus frequency is shown in the accompanying chart, which shows the impedance performance of a Spendor BC3 professional monitor speaker). It will be seen that the impedance rises to 40 ohms at low frequencies but falls to 4 ohms at very high ones. In order for the amplifier's output to be distributed correctly to the different units in the speaker, crossover units have to be designed to split up different frequency bands to the appropriate units. Such crossovers can present extremely complex impedances to the amplifier and unfortunately amplifier performance can be very different when a pure 8 ohm resistive load is changed for a loudspeaker complete with its inherent built in crossover.



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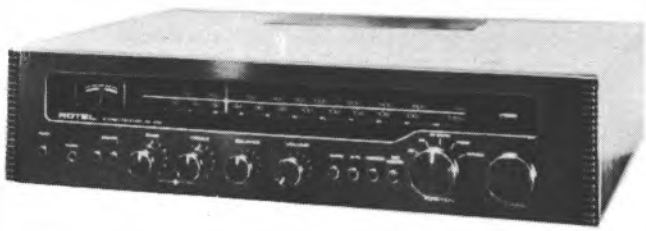
ROTEL® RX 402 Tuner/Amplifier

Excellent specification, performance and construction, stylish good looks and a remarkable Comet price make the RX 402 a Comet Super Buy.
24W + 24W RMS continuous power into 8 ohms, advanced PLL MPX for superb stereo separation and an FM muting facility, inputs and outputs for TAPE, AUX and TAPE MONITOR—plus a PHONO input, a simulated 4-channel activation switch, plus another important extra—an electronic protection circuit to safeguard your speaker system.
The RX 402 at Comet is a Super Buy for you.



AMPLIFIER SECTION
Continuous Power Output (RMS) (both channels driven) 24W+24W (8 ohms)
Harmonic Distortion less than 0·15%
Frequency Response 10 to 75,000 Hz ±3dB
Input Sensitivity Impedance MAIN IN 580mV/35 Kohms
TAPE MONITOR 125mV/15 Kohms
AUX 125mV/22 Kohms
PHONO 2mV/60 Kohms
Tape Output 340mV/5 Kohms
Bass Control ±10dB at 100 Hz
Treble Control ±10dB at 10KHz
Loudness Contour +8dB/100 Hz + 5dB/10KHz
Hum and Noise (S/N) PHONO 65dB
TAPE 80 dB
Speaker Impedance 4 to 16 ohms

FM TUNER SECTION
Frequency Range 88 to 108 MHz
Sensitivity (1HF) 2·0 microvolts
Signal-to-Noise Ratio 67 dB
Harmonic Distortion 0·2%
Selectivity 70dB ±400 KHz
Capture Ratio 2dB
Stereo Separation 35dB at 1 KHz

AM-TUNER SECTION
Frequency Range 525 to 1650 KHz
Sensitivity 20 microvolts

GENERAL
Power Supply 200–250v 50 Hz
Dimensions (overall) 474 (W) × 331 (D) 115 (H) mm

Rec. Ret. Price* £177.50 inc.VAT **Comet Price* £124.99 inc.VAT**

***Prices correct at time of going to press April 1976.**
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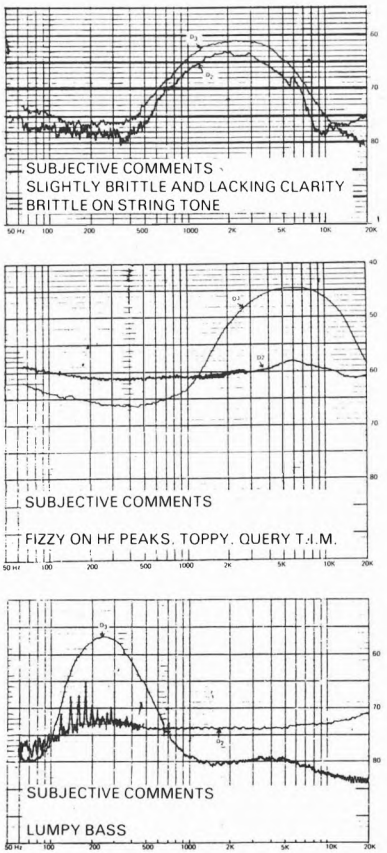
In the past reviews used to contain only harmonic distortion measurements taken at various levels but by approximately 2½ years ago intermodulation distortion measurements had become commonplace. It has already been realised by electronic engineers that harmonic distortion is fairly irrelevant, although 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 30% 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 was 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 actually 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 amplifiers to check correlation between various forms of distortion and the remarks are made by my colleagues and I in the subjective listening tests. Fortunately we were able to prove satisfactorily that our subjective comments were always pretty accurate and time did not allow every receiver to be tested exhaustively as this test alone takes several hours for each receiver, whereas a subjective test took only an average of two hours for each complete receiver.

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



COMET Super Buy

Sansui 9090 Stereo Receiver

Delivering a massive 120W + 120W RMS continuous power into 8 ohms, the mighty 9090 incorporates all the latest Sansui control/preamplifier and FM/AM tuner circuitry. Its low distortion performance whether the volume is turned up or down, puts it in the very front rank of Hi-Fi equipment.

SPECIFICATIONS
POWER OUTPUT (at rated distortion)
CONTINUOUS RMS POWER both channels driven 120 watts per channel into 8 ohms at 1,000Hz
TOTAL HARMONIC DISTORTION OVERALL (AUX to speaker terminals) less than 0.2% at rated power output
LOAD IMPEDANCE 4 to 16 ohms
FREQUENCY RESPONSE (at 1 watt) OVERALL (from AUX) 10Hz to 30kHz + 1dB - 1dB
CHANNEL SEPARATION (at rated output 1,000Hz) PHONO better than 50dB
HUM AND NOISE PHONO better than 70dB
INPUT SENSITIVITY AND IMPEDANCE (1,000Hz for rated output) PHONO 2.5mV, 50k ohms
CONTROLS BASS +10dB, -10dB at 50Hz
MIDRANGE +5dB, -5dB at 1.5kHz
TREBLE +10dB, -10dB at 10kHz
FILTERS LOW -10dB at 50Hz
HIGH -10dB at 10kHz
FM SECTION
TUNING RANGE 88 to 108MHz
SENSITIVITY (IHF) 1.7 V
TOTAL HARMONIC DISTORTION STEREO less than 0.3%
SIGNAL TO NOISE RATIO (MONO) better than 70dB
SELECTIVITY better than 85dB
CAPTURE RATIO less than 1.5dB
STEREO SEPARATION better than 40dB at 1kHz
AM SECTION
TUNING RANGE 535 to 1,605kHz
SENSITIVITY (Bar Antenna) 50dB/m at 1,000kHz
DIMENSIONS 540mm W: 182mm H 397mm D

Rec. Ret. Price* £497.90 inc.VAT **Comet Price * £373.50 inc.VAT**

Sansui 331 Stereo Receiver

Simple yet superb is the specification of this new FM/AM stereo receiver from Sansui, which meets the need for high quality Hi-Fi at an inexpensive price. With an output of 15W + 15W RMS continuous power into 8 ohms, the 331 is easy to operate and attractively styled to blend into the most modern room decor.

SPECIFICATIONS
POWER OUTPUT (at rated distortion) CONTINUOUS POWER each channel driven 15/15 watts into 8 ohms
TOTAL HARMONIC DISTORTION less than 1.0% at rated power output
LOAD IMPEDANCE 4-16 ohms
FREQUENCY RESPONSE 25 to 30,000Hz +2.0dB, -3.0dB
CHANNEL SEPARATION (at rated output 1,000Hz) PHONO better than 45dB
IHF HUM AND NOISE PHONO better than 70dB
INPUT SENSITIVITY and IMPEDANCE PHONO 2.5mV (50k ohms)
FM SECTION
TUNING RANGE 88 to 108MHz
SENSITIVITY (IHF) 2.5uV
SIGNAL TO NOISE RATIO better than 65dB
STEREO SEPARATION better than 35dB at 1,000Hz
AM SECTION
TUNING RANGE 535 to 1,605kHz
SENSITIVITY (Bar Antenna) 50dB/m at 1,000kHz
DIMENSIONS 424mmW: 125mm H: 266mm D

Rec. Ret. Price* £131.31 inc.VAT **Comet Price * £99.99 inc.VAT**

***Prices correct at time of going to press April 1976.**
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In these tests Spendor BC3 loudspeakers were used to represent a difficult but not too untypical a load on each amplifier, but we also used both Spendor BC1 8 ohm and Yamaha NS645 4 ohm loudspeakers, particularly for listening to receivers with a limited output power. Each receiver was compared in performance with a standard high quality HiFi system, which included the Yamaha CT7000 tuner, a Technics 9600 pre-amplifier and a Quad 405 current dump amplifier. This amplifier incidentally is capable of delivering 100 watts per channel into an 8 ohm load and was regarded as one of the better amplifiers heard, although to our surprise just a few receivers actually produced a slightly cleaner sound quality. We were able to confirm that the Quad amplifier used did not measure as well as the Sansui 9090 for example and showed some significant traces of transient intermodulation distortion at middle and very high frequencies into a Spendor BC3 load. To put this in perspective, though, I would like to confirm that I consider the Quad amplifier a pretty good one and it would be fair to say that relatively few listeners would notice very much difference in sound quality between the Quad and the handful of amplifiers that seemed better.

Some amplifiers have a capacitor in series with the output feed to the speaker, whereas others omitted this, since the output when idle should normally be at earth potential with respect to chassis or the neutral loudspeaker line. Many amplifiers have both positive and negative HT rails and when no input is fed into them the centre point output voltage should be balanced with respect to the nominal zero volts. We checked to see how much DC was present on each output, since any continuous DC voltage present would cause many loudspeaker units to go slightly off centre position. It has been claimed by Peter Walker of Acoustical Manufacturing Ltd. that DC offsets can result in bass frequency distortion with some loudspeakers. We also checked to see if there was an appreciable DC voltage 'thump' when amplifiers were switched on by examining a storage oscilloscope trace which showed the DC level produced in the first few seconds after switch on. Some amplifiers produced almost no thump at all whereas others reached peak DC voltages which could damage some types of loudspeaker, possibly immediately, or perhaps after repetitive turn ons/offs. Several amplifiers had protection circuits, which were either electronic or relay operated, which connects the loudspeaker terminals a few seconds after turn on.

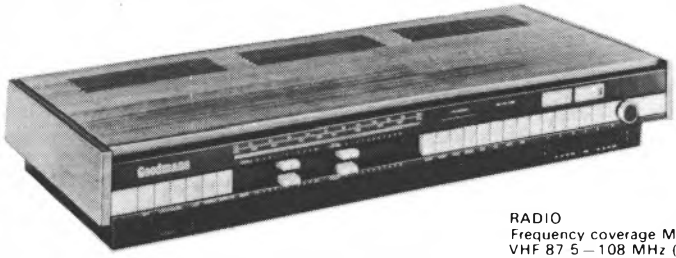
We measured the power output for 1% harmonic distortion and the ½ power band width for 0.1% harmonic distortion or 0.3% if a 0.1% measurement was inappropriate, for example Sansui 771. Great variations in power response can be seen in the individual reviews. We also checked the intermodulation distortion (50Hz with 7kHz, 4:1 mix) at several levels. Some amplifiers showed a considerable increase in distortion at 100mW as compared with 10W. The output power was measured with each amplifier driven separately and with both driven and furthermore a tone burst test was applied to see if any of the amplifiers could give a significantly higher undistorted output on a transient and indeed most of them did. We also checked each amplifier into a partly capacitive load, but this only rarely presented a problem. We also measured the damping factor at 60Hz of each receiver, calculating it from open circuit voltage and voltage across a pure 8 ohm resistor. Very few receivers had an unsatisfactory damping factor and very little audible difference would be noted between receivers having damping factors in excess of 20, other things being equal.

Output Connections

Loudspeaker leads could be connected to different amplifiers by different types of terminal or socket, variations including terminals, spring loaded clamps, and loudspeaker DIN sockets. Almost all the headphone sockets were of the normal stereo jack type and almost all receivers had provision for two or more pairs of loudspeakers and a pair of headphones. Receivers including this facility incorporated a switch allowing the user to select a required combination. We preferred receivers having spring loaded lock connectors as these could accommodate either bare wire, spade or banana plug connections but none had this type. Loudspeaker DIN sockets are quite convenient, but the plugs are sometimes a little flimsy and many require soldering. Always use fairly thick twine cable for connecting speakers to minimise lead resistance in loudspeaker circuits, as otherwise damping factor at the loudspeaker end will suffer and in the worst cases power will be lost in the leads.

COMET Super Buy

Goodmans Module 90 Stereo Receiver



The 90 offers you 30 watts per channel (driven) AM/FM and medium wave, with pushbutton selection for 4 FM stations, superb performance, and at Comet, a really attractive price

PERFORMANCE DATA
AUDIO
Power output (measured with both channels working)
45 Watts per channel into 4 ohms to DIN 45 500
30 Watts per channel into 8 ohms
Total harmonic distortion less than 0 1% at 35 Watts into 4 Ohms
Cross talk (any input) 45dB

RADIO
Frequency coverage Medium Wave 525–1630 kHz
VHF 87 5—108 MHz (87 5—101 MHz on presets)
FM Sensitivity Typically 2uV into 240 Ohms) 1uV into 75 Ohms) for 30dB S/N with 75 kHz deviation
Capture ratio Better than 1 5dB
Stereo separation 35dB at 1 kHz
AM Sensitivity Typically 50uV (for 20dB S/N at 30% modulation)
Dimensions Length 614mm 24⅛ins Depth 300mm 11¾ins (excluding knobs) Height 100mm 4ins

Rec. Ret. Price * £180.46 inc. VAT **Comet Price * £129.99** inc. VAT

Goodmans Model 150 Stereo Receiver

Impressive in every way The Model 150 gives all the facilities you'll ever want, and more besides Just glance at the specification

Typical Performance Data
Audio
Power Output (measured 1kHz sine wave with both channels working) 110 Watts per channel into 4 Ohms. 70 Watts per channel into 8 Ohms
Total harmonic distortion 0 02% for 100 Watts into 4 Ohms or 60 Watts into 8 Ohms
Preferred loudspeaker impedance 8 Ohms, for the simultaneous use of 2 pairs
Frequency response –3dB at 20Hz and 30kHz
Overload capability 38dB (any input)
Hum and Noise (unweighted): Tape inputs –80dB Magnetic pick-up input –70dB Auxiliary input –80dB
Cross-talk (any input) –50dB

Radio-FM
Frequency Coverage: 87 5MHz—108MHz
Sensitivity (for 30dB signal/noise ratio): Less than 1uV into co-axial input Less than 2uV into balanced input
Capture ratio: Better than 1 5dB
Signal/Noise ratio (for 1mV input) 70dB
Stereo separation 40dB at 1kHz
Radio-AM
Frequency coverage Long Wave 148kHz—350kHz Medium Wave 520 kHz—1625kHz
Sensitivity (for 20dB signal/noise ratio) MW—20uV; LW—40uV
Dimensions: Length 540mm; Depth 360mm; Height 200mm
Finishes: Black facia with Teak or Walnut veneers

Rec. Ret. Price *£299.00 inc. VAT **Comet Price * £215.99** inc. VAT

*Prices correct at time of going to press April 1976.
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Connecting a Tape or Cassette Recorder and Relevant Safety Precautions

All the receivers surveyed incorporated either or both a DIN socket and phono sockets, for interconnection with recorders. Some receivers actually incorporated a facility for interconnecting two recording machines and also provided switching enabling a user to copy from one machine to another whilst monitoring either. There are two completely different conventions for interconnecting recording equipment, one involving 5 pole DIN sockets, the other involving phono sockets. To meet the DIN specification a receiver incorporating a 5 pole socket has to provide a voltage which will correspond to an approximate level of 1mV per k ohm of the recorder's DIN input sockets' impedance. To enable such a level to be achieved, some equipment delivers a relatively low level from a low source impedance, whereas others choose a very much higher level but from a high source impedance. In the former case the low impedance produces only a slight attenuation of the level when interconnected with the recorder, whereas in the latter high source impedance case the high output level is effectively severely attenuated when interconnected with a recorder having a low DIN input impedance. I am personally totally against the entire DIN concept of interconnection as applied to levels and impedances, and matters are exceptionally confusing. An explanation of DIN interconnections, however, will be found in the February and April 1976 issues of 'Hi-Fi for Pleasure'. Reference is also made to the problems in 'Hi-Fi Choice No 1' on cassette decks.

Phono output impedances were substantially lower than DIN ones, and in some cases as low as a few hundred ohms. Phono sockets for providing feeds to a tape recorder should ideally present a source impedance lower than 5k ohms and thus allowing fairly long leads to be used if necessary, and also giving an improvement to the rejection of radio frequency interference and hum problems.

It is normal for a receiver to be earthed to the mains, and thus to avoid earth loops, which can cause hum, it is advisable to avoid a mains earth connection to a tape recorder. It must be pointed out strongly, though, that if any piece of equipment is not earthed, there is a very slight possibility that an electrical fault occurring in the equipment could produce an AC voltage on the chassis, which could in some circumstances give an electric shock to a user. If the equipment is always left connected to the receiver and the recorder's mains earth is disconnected the fault condition producing an AC voltage on the chassis would return to earth via the receiver and thus the mains fuse in the recorder's plug should blow. Trouble could be experienced, however, if the recorder's earth was left off when the equipment was being plugged through and a fault occurred in this situation. A user could receive a severe shock if one hand was on the recorder whilst the other hand was on the receiver or its associated interconnection lead. To obviate this always make connections to an unearthed recorder with the mains to it unplugged. If a fault has developed the fuse should blow immediately the plug is connected to the mains socket. Always examine the mains plug to ensure that the fuse is of an appropriate value and not more than a 2 amp fuse should be used for the large majority of recorders. Particularly check that 13 amp fuses are not in the plug, for these are only required for use with electric fires, etc.

If you ever have to replace a fuse always replace it with one of the same value and type. It is far better to lose the availability of the equipment for a day or so than to risk either life or a fire.

Radio Frequency Interference and Electromagnetic Compatibility (E.M.C.)

There are now approximately 25,000 amateur radio enthusiasts in the UK, who transmit amateur radio messages from their homes and cars usually fairly regularly. There are probably in excess of 200,000 public utility, military and other transmitters including both fixed and mobile ones in virtually every part of the country. Whilst most commercial mobile radio communications are on different VHF bands many military and Government installations transmit high power on short waves. Almost every embassy contains high power short wave transmitters and thus wherever you are in the UK you are likely to find a fixed transmitter within a mile radius or so of your home in an urban area, although in the country you may be several miles from the nearest one. Furthermore the chances are that vehicles equipped with transmitters may well be transmitting as they are driving along the street outside your home and thus it is important for hi-fi equipment to be completely undisturbed by the

presence of all these transmissions, regardless of their frequency or mode of transmission. Quite understandably many people have complained about the activities of radio amateurs for example and have even attempted legal injunctions to stop the source of the interference. Let me say quite categorically that if the interference is picked up on a cassette recorder or on a receiver when a record is being heard, the fault must lie entirely in the hi-fi equipment and is not due to any inadequacies of the nearby transmission. Both radio amateurs and commercial radio fixed and mobile operators pay a licence fee to the Home Office which entitles them to transmit and receive on the appropriate frequencies and such a licence allows the use of the transmitting equipment at any time required. Restrictions placed on such users include the maximum power that can be used and specifications of maximum allowable harmonics etc. that are permissible. Some transmitters that have inadequate filtering transmit harmonics in frequency bands occupied by other services, which of course include television and sound radio frequencies. An amateur radio transmitter for example on the 14.2MHz band may well produce a harmonic radiation inside band 1 television frequency (405 line). Similarly a commercial radio transmitter on medium wave may well pump out harmonics in an amateur radio allocated band. Harmonics of transmitters can never be completely eradicated but it should be possible to keep their radiation down to negligible proportions. Only rarely have band 2 VHF receivers picked up actual spurious transmissions from nearby transmitters but in such circumstances the Hone Office has the right to insist that adequate filtering is inserted at source.

Such instances of harmonic interference into radio or television transmissions are now less common, especially since the large majority of television sets are now tuned to UHF. However, one particular source of trouble which can involve band 2 is the blocking of inadequately filtered mast head pre-amplifier installations by local amateur and public utility transmitters. In such cases filters allowing only the required frequencies to pass through to the pre-amplifier can be inserted in the aerial lead, which thus minimises any blocking or cross modulation produced by the local interfering transmission.

Radio transmissions are of many different types and amongst the types of emission that might cause most interference are amplitude modulation, morse code, single side band and 405 line TV. Frequency modulation transmissions will not normally cause any interference other than the carrier actually causing blocking to radio reception equipment. You might hear from your loudspeakers a Donald Duck type of voice or just a series of clicks or even actual voices clearly coming over your equipment and these all typify the problem. Radio frequency interference forms are available from your local post office and when you hand these in after completion you will receive a visit or a phone call from a post office engineer, who is in effect representing the Home Office. Such action can sometimes take several days or even weeks and you should get quicker co-operation if you contact the equipment manufacturer or importer direct. If the latter action produces a lack of interest, then unfortunately the form filling is your only action to resolve the problem, in which case the post office will contact the manufacturer on your behalf.

We checked every receiver in the survey for its susceptibility to radio frequency interference on both a low frequency (1.9MHz) and a very high one (144.16MHz). Single side band transmissions were transmitted for a few seconds into aerials above the building and also down the garden at the rear, and whilst some receivers were to all intents and purposes free from interference, others were so bad on either or both frequencies as to render them quite unusable when used anywhere near a local transmitter. Manufacturers can modify receivers to prevent this interference pick-up, but it is clearly more satisfactory to design them correctly in the first place because of the vast increase in the numbers of different transmitters generally around. All the tests were checked by assembling a Shure cartridge in a mumetal box with approximately 2'6" of high quality screened cable appropriately plugged into the receiver under test. Loudspeakers were connected to the output and the equipment was earthed if a 3 core mains leads was provided. In most cases no interference was picked up when the volume control was at a minimum and when interference was present it usually became worse when the volume control was progressively turned up. The worst case of susceptibility to radio frequency interference was the Pioneer 1010, which had the distinction of giving a full 100 watts output per channel when I commenced speaking into a transmitter. After approximately 2 seconds the

1010's output safety relay switch operated, thus turning the sound off. Fortunately powerful speakers were connected at the time for less powerful ones might well have suffered damage!

The worst receivers for susceptibility to low frequency interference were Aiwa AX7500, Armstrong, Howland West, JVC, Luxman 600, Pioneer 434, Pioneer 535, Pioneer 737, Pioneer 1010, Rotel 602, Sansui 661, Sanyo 8000K, Sonab R7000 and Yamaha CR450, whereas the worst cases for interference from VHF transmissions were Audiotronics LR2500X, Goodmans 120, Sansui 331, Sonab R3000, Sony 7035, Trio 5400 and Trio 7400. In general VHF interference is easier to eradicate than LF types, and if the problem is occurring in the pick-up pre-amplifier, capacitors of around 220pF suitable for VHF applications wired neatly from the first bass to emitter junctions of the pre-amplifier, may well eradicate the problem. In some cases however further decoupling might be necessary. Sometimes the interference is picked up in the mains or loudspeaker leads and if these are individually wound round ferrite rings, available from the post office, interference division, complete eradication or a significant improvement can usually be achieved. More usually, however, pick-up occurs in the turntable/pick up input leads and phono pre-amplifier decoupling will usually be the only remedy. Changing the general earthing of the turntable and pick-up connections can sometimes help.

Receivers having either no or only very slight susceptibility to the problem were the Akai 1020, Akai 1030, Audiotronics LR2626, B & O 907, B & O 2000, Harmon Kardon 330B, Harmon Kardon 430, Leak 1800, Leak 2000, LG 3400G, Luxman 800M, Marantz 2230, Marantz 2245, Philips 22RH741, Rotel 102, Rotel 152, Sansui 881, Sansui 9090, Sanyo DCX 600K, Scandyna (Dansk), Sonab R4000, Tandberg TR1040, Technics 5150, Trio 3400, Trio 4400, Wharfedale SXP, and Yamaha's CR200/CR400/CR600/CR800/CR1000.

Readers should be reminded that the radio frequency interference tests were carried out specifically with reference to the pick-up input and the results quoted are from one or at the most two samples of each model. It is possible that other samples could be significantly better or indeed worse than the ones tested in this survey, but it is noteworthy that several brands including Leak/Wharfedale and Yamaha were in general excellent, whereas others such as Pioneer left much to be desired in interference protection. Surely manufacturers could insert just a few components costing pence and eradicate the problems in their equipment.

If you can be sure that no amateur or professional transmitting systems are within a few hundred yards of your home, then you need not worry too much about the radio frequency interference problem. If, however, you notice odd antennae within 200 yards or so of your home, then a simple enquiry will tell you if a transmitter is occasionally in use, in which case the transmitter user should be prepared to tell you what frequency bands are normally used. With this information and the notes on r.f.i. in the reviews you should be able to come to a reasonable decision. One British manfacturer, Armstrong Audio, are always prepared to fit interference elimination components on their equipment without charge to the user and you are advised to ask for this, if you are likely to have a problem. I only wish that other suppliers were as helpful, for in my experience many just 'don't want to know'.

Purchasing Hi Fi Equipment, and the Law

There are now so many acts of parliament that protect the consumer's rights that a brief outline of some might be helpful. Every piece of equipment sold should be supplied with a written specification, implying that the equipment shall be at least as good as specified. Naturally, some samples might not come up to their specification, but the Trades Description Act 1968 states specifically that all equipment sold must be equal to, or better than, the printed specification. If not, there is an infringement of the Act, in one form or another, and if this is proved the supplier can be taken to court by a local authority for marketing a product with a misleading or incorrect description.

The Sale of Goods Act, with its recent amendments, is also very powerful, and combined with the Trades Descriptions Act could possibly be said to be almost too much in favour of the consumer.

Undoubtedly consumers could create havoc to retailers if they really wanted to, and it seems to me that the fairest way of dealing with the legal problem is to have regard for the moral intent of the

law, and its protection, rather than winning points by dotting 'i's' and crossing 't's', and becoming too pedantic. When a piece of equipment is purchased its specification and expected performance should be consistent with the price paid. When a product is sold at a discount, its quality should be identical to that of the same product sold at full price, and the only differences might be of service at the point of sale, and speed and effectiveness of after sales service. Herein lies the rub, for if a piece of equipment does not come up to specification, or is faulty, the same laws apply to discount sales as to full price ones. Perhaps readers may not know that if a piece of equipment has been taken home and found to be faulty or out of specification, in any significant way, the purchaser has the right to demand money back instantly. The dealer should be informed by telephone as soon as possible. This even applies if the equipment was ordered specially for the customer. The dealer may suggest immediate replacement, repair, or at worst, a credit note, but the purchaser can insist on full compensation, which can include the cost of transport. Ironically, many retailers tell me that it is the customers receiving the largest discounts who frequently cause the most after sales problems, whereas customers paying full price are sometimes more understanding, though obviously still expecting good and straight service. If you pay full price for your equipment, it is only fair to expect absolutely top treatment, which may include delivery to your home and installation, together with prompt attention and advice afterwards. However, discount houses will often give good advice, and some have even reasonable demonstration facilities and service centres, although many claiming to have such services in fact pack up the equipment and send it back to the poor importer or manufacturer to repair, and thus increase the cost of servicing which will ultimately result in price increases all round.

If the equipment goes faulty after a period, then the law states that it shall be repaired free of charge within a reasonable time, although the actual length of time cannot be stipulated. It would seem that one week would be reasonable, but two months would be utterly unreasonable. Any undue delay in servicing might be in contravention of the Sale of Goods Act, since the user is effectively losing possession of the equipment for an unreasonable period, and in such circumstances could probably demand a replacement or a loan set. If a fault develops either in the guarantee period or within what can be termed well within the expected life of the equipment, allowing for wear and tear, the Sale of Goods Act 1893 amended by the Supply of Goods (Implied Terms) Act 1973 of the Fair Trading Act 1973 might well be applicable.

Whilst much has been said about guarantee forms, and in the past many of these have not been worth the paper they are written on, more recently most guarantees inspire a deal of confidence.

Remember that the main legal points are: 'does the equipment come up to its advertised specification', and 'is the equipment fit for the purpose as advertised, or requested by the purchaser?'. A receiver which picks up the transmissions of a local radio amateur when gramophone records are being played is clearly not fit for the purpose, provided that the interference is sufficient to affect listening enjoyment. A receiver which does not switch in to stereo properly on a medium or strong stereo transmission would also clearly be at fault. However, before condemning a receiver for an inability to receive distant stations, or for hiss behind even fairly local stations, check that your aerial is satisfactory, and that it is wired in to the receiver correctly. A certain amount of understanding and patience is required of both the supplier and purchaser, but in the last resort the user should consult the local trading standards organisation, at the town or county hall, or else a citizen's advice bureau. Legal action through solicitors can be extremely expensive, but in a few cases this may be the only course of action. Before you take any action, however, make absolutely sure that your complaint is thoroughly justified. Always allow for fair wear and tear, and always try a courteous approach first, particularly as the problem could be what is termed 'finger trouble'.

Most dealers though are not the rogues that some people make them out to be, and indeed there are several who offer loan equipment whilst repairs are being made under guarantee. Before you make a complaint, however, do check the amplifier fuses, for they may be blown quite innocently due to your accidentally short circuiting the loudspeaker leads, perhaps. Many dealers have been known to return equipment to a manufacturer, just for this fault, not having checked it first.

With an output power of 34W (both channels driven), it has provision for connecting two tape recorders; dubbing is possible only from 2 to 1, although either can be monitored or can take a recording from disc or tuner. Phono, aux and tape inputs/outputs are on phono sockets but 5 pole DIN sockets are also provided for the latter, tape 1 at the rear and tape 2 on the front panel. The smooth volume control is complemented by a balance control having a good law and with a centre indent and both bass and treble controls have 11 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 headphones only. A stereo jack socket for the latter and spring loaded clamps for speakers 1 and DIN sockets for speakers 2 are fitted. The case work 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 and loudness controls are available but unfortunately there is no treble filter. Other buttons include AFC, bearing the legend 'push off'(!) and 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 on the rear which can be angled with difficulty provides a reasonable signal for AM.

Although the amplifier section was pleasant to use, the stepped treble had much too little variation around the centre and also between the two maximum boost positions. 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 and this was evidenced by slight pumping and subjective response changes when very quiet music was reproduced. The intermodulation distortion measured fairly well at high levels but deteriorated at low ones, although the harmonic distortion performance was fairly good and the power band width 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 (but note crossover distortion). All the input and output levels and impedances presented no problems but the microphone input clipped at only 14mV (inadequate for most 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, (n.b. no treble filter). The rumble filter only cut 2.6dB at 20Hz (inadequate). Some ticky hum was noted on the aux input with high volume settings, although the pick-up pre-amp noise measured well.

The tuner section unfortunately has as many failings as good points, for although the input sensitivity was excellent and all the signal to noise ratios were clearly amongst the better ones measured distortion was on the high side. Fortunately very little distortion appeared in the crosstalk, which, however, gave rather poor figures (eg. 22dB at 10kHz). The adjacent channel performance was poor. The alternate channel on one side was exceptionally bad, although on the other it was excellent. This failing contributed to the appalling image response figure of 200uV and the bad RF intermod performance. AM rejection was not good either although the capture ratio was superb. It would seem that the tuner was not well aligned for I cannot believe that so many excellent figures could be complemented by such poor ones. The frequency response tailed off rather rapidly above 12.5kHz but was relatively flat below this and so fairly acceptable. The MPX 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 posiiton with automatic switching, for on mono the mute is permanently off and this willl be found rather irritating. Medium wave reception was satisfactory but had too narrow a band width.

It is a pity that this receiver cannot really be recommended, since its good points are outweighed by some poor alignment and design problems. Difficulties are likely to be experienced with the reception of weaker stations despite good RF sensitivity. The equipment would be likely to pick up aircraft communications if used near a flight path. Furthermore the pick-up input is very poorly protected from interference from local transmitters. Local low frequency amateur transmissions (1.9MHz) produced severe annoyance whilst VHF ones were clearly audible. A well laid out receiver which is easy to operate but with electronics that leave much to be desired.

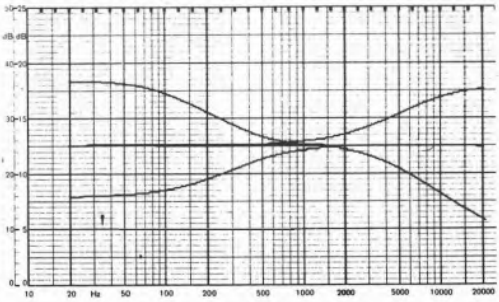
Amplifier

Av. Power output both channels driven	34W
Power output single channel driven	38.7W
Power output tone burst average	36W
Idle DC out worst case	11.3mv
Turn on/off Max. DC (swing worst case)	2v
Damping Factor L= –R	34/33%
IM 10w L/R	0.045/.09%
IM 100mw L/R	0.275/.28%
IM 1% output watts L/R	24.5/24.5%
Av. IM distortion pickup input/record out	0.0035%
Av. Harmonic Distortion 0.1% (power cut)	32W
Power Bandwidth L/R 0.1%	35Hz–45K/35Hz–25K
Av. Pickup impedance	54.5KΩ
Pickup sensitivity	2.15mv
Pickup clipping	248mv
Pickup capacitance	220pf
Auxiliary impedance	52KΩ
Auxiliary sensitivity	118mv
Tape impedance one/two	134KΩ/52KΩ
Tape sensitivity one/two	133.6mv/118mv
Mic impedance	4.7KΩ
Mic sensitivity	800μv
Mic clipping	14.5mv
Max level from tuner (RO)	420mv
Max level from pickup (RO)	397.5mv
Tape output impedance DIN Av	79.4KΩ
Tape output impedance phono Av	3.75KΩ
Av. Pickup noise ref 8mv record output socket unw	71.5dB
Av. Pickup noise ref 8mv record output socket CCIR	71.5dB
Amp output noise @ 0 volume unw	290μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	95.2dB
Worst weighted noise Aux in/L out S/N ratio	80.83dB

Tuner

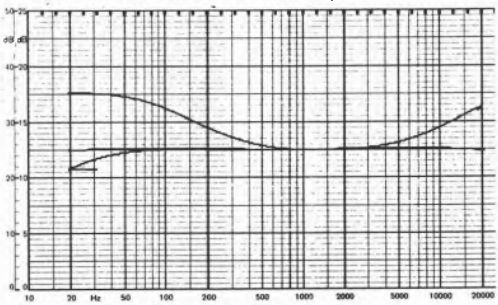
Mono RF sensitivity 30dB IHF	1μv
Mono RF sensitivity 50dB IHF	2.3μv
Stereo RF sensitivity 50dB IHF	25μv
IM RF	62.9dB
Adjacent Channel worst figure	1dB
Alternate Channel worst figure	25dB
Image Response	46dB
Capture Ratio	0.75dB
AM Reject	45.5dB
Mono distortion 100% 1kHz centre tune worst case	0.6%
Optimum tune mono Average	0.34%
Stereo L= –R centre tune L	0.57%
Stereo L= –R centre tune R	0.55%
Av. Stereo R= –L centre tune	0.18%
MPX filter reject worst fig. @ 19kHz	67dB
MPX filter reject worst fig. @ 38kHz	–
X talk centre tune worst fig. 1kHz	28½dB
X talk centre tune worst fig. 10kHz	22½dB
Optimum tune 1kHz L/R	35/35dB
FR Frequency response stereo –1dB L/R	13Hz–11.3K/12K
FR Frequency response stereo 3dB L/R	7Hz–13.8K/14.4K
Error @ 15kHz L/R	–7.5/–5dB
Limit threshold	0.5μv
Mute threshold	2.5μv
Av. Stereo S/N weighted 100μv/1mV	54/68dB
Av. Stereo unw 1mV	65dB
Av. Mono weighted 1mV	73.75dB
RRP Ex VAT	£170.59

Not normally discounted



Aiwa AX7500: Tone controls

Aiwa AX7500: Filters and loudness at ¼ pot



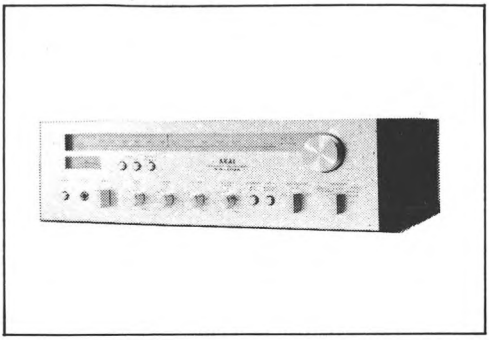
(Tested on 50dB scale)

Well styled, with an output power of 28W on both channels and including provision for connecting two separate pick-ups and two independent tape recorders. The lattter 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 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 metal plate covers the underneath, which is therefore well screened, but which also includes some ventilation slots. 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 good on all inputs, although a slight bass loss was noticed on the pick-up input (see pen chart). The SMPTE IM distortion measured well even at low levels but we noticed that the half power bandwidth reached only approximately 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 about 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 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 discernible image shift.

The tuner section behaved very well on medium and strong signals, and was fairly good on weak mono, though rather noisy on weak stereo ones. The distrotion performance was extremely good, and all the subjective listening tests proved this. Crosstalk was adequate at all frequencies, and the tuner was aligned well, 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 good, whilst the adjacent and alternate channel measurements were reasonable. The response falls rather rapidy above 13.5kHz, but this is not regarded as too serious. 75 and 300 ohm aerial input terminals are provided and also a 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), the susceptibility to image pick up and the dropping bass on the pick up input. Nevertheless one of the best buys. The poor bass response problem was mentioned to Akai, who within one day agreed to modify all units to give the correct playback response and so models in the shops after April 1st should already have been modified. We must particularly commend this model for its excellent freedom from pick-up of local transmissions since no problem was experienced on either LF or VHF transmission in the RF test on the pick-up input.



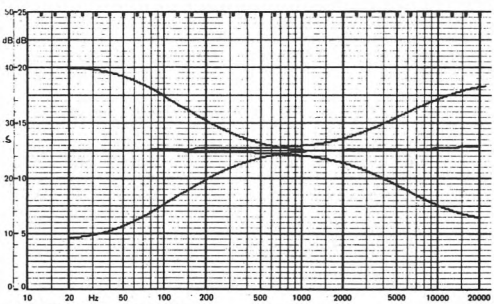
Amplifier

Av. Power output both channels driven	28W
Power output single channel driven	32W
Power output tone burst average	36W
Idle DC out worst case	1mv
Turn on/off Max. DC (swing worst case)	14.5v
Damping Factor L= –R	42/50%
IM 10w L/R	0.05/0.08%
IM 100mw L/R	0.05/0.048%
IM 1% output watts L/R	18/18.9W
Av. IM distortion pickup input/record out	0.007%
Av. Harmonic Distortion 0.1% (power cut)	24.85W
Power Bandwidth L/R 0.1%	<10Hz–10.5kHz/<10Hz–11kHz
Av. Pickup impedance one/two	48KΩ/48KΩ
Pickup sensitivity one/two	3.45mv/3.45mv
Pickup clipping one/two	119mv/119mv
Pickup capacitance one/two	156pf/156pf
Auxiliary impedance	37.5KΩ
Auxiliary sensitivity	176mv
Tape impedance one/two	85.5KΩ/85.5KΩ
Tape sensitivity one/two	176mv/176mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	360mv
Max level from pickup (RO)	375mv
Tape output impedance DIN Av	31.3KΩ
Tape output impedance phono Av	1.55KΩ
Av. Pickup noise ref 8mv record output socket unw	75dB
Av. Pickup noise ref 8mv record output socket CCIR	71dB
Amp output noise @ 0 volume unw	655μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	91.2dB
Worst weighted noise Aux in/L out S/N ratio	78.9dB

Tuner

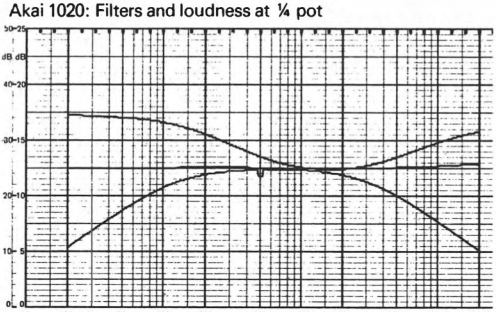
Mono RF sensitivity 30dB IHF	2.4μv
Mono RF sensitivity 50dB IHF	4μv
Stereo RF sensitivity 50dB IHF	51μv
IM RF	69.3dB
Adjacent Channel worst figure	0.5dB
Alternate Channel worst figure	49dB
Image Response	52.4dB
Capture Ratio	1.25dB
AM Reject	56dB
Mono distortion 100% 1kHz centre tune worst case	0.17%
Optimum tune mono Average	0.17%
Stereo L= –R centre tune L	0.15%
Stereo L= –R centre tune R	0.18%
Av. Stereo R= –L centre tune	0.24%
MPX filter reject worst fig. @ 19kHz	51dB
MPX filter reject worst fig. @ 38kHz	–
X talk centre tune worst fig. 1kHz	34dB
X talk centre tune worst fig. 10kHz	33.5dB
Optimum tune 1kHz L/R	34/37.5dB
FR Frequency response stereo –1dB L/R	107Hz–12.9K/13K
FR Frequency response stereo 3dB L/R	6Hz–14K/14.1K
Error @ 15kHz L/R	–6/–5dB
Limit threshold	1.5μv
Mute threshold	6μv
Av. Stereo S/N weighted 100μv/1mV	46.5/62dB
Av. Stereo unw 1mV	68dB
Av. Mono weighted 1mV	68.5dB
RRP Ex VAT	£154.00

Normally substantially discounted



Akai 1020: Tone controls

Akai 1020: Filters and loudness at ¼ pot



(Tested on 50dB scale)

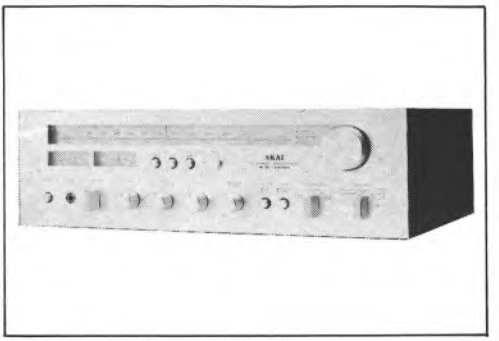
Rank Audio Products Limited, PO Box 70, Great West Road, Brentford, Middlesex. 01-568 9222

Similar but more powerful that the AA1020, 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. Unfortunately all these knobs can pull off rather too easily. Interconnection with and dubbing between two tape machines is possible. A front panel switch selects aux, 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 auxiliarly 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 low and input and output levels were compatible with both DIN and phono standard recorders. Other input impedances were sensible, and no clippling 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 all together satisfactory, the sensitivity being slightly below average, although the adjacent and alternate channel responses, and the RF intermod and capture ratios all measured well. The image and IF reject were rather poor, 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 S/N ratio. The distortion performance was excellent in mono and good in stereo, and the cross talk measured well. Unfortunately the frequency response failed 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 of more distant stations. We noted that the limited 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 S/N ratio. Virtually no interference was produced from local amateur radio transmitters, and Akai must be complimented on this. The receiver can be recommended, then, for picking up local stations only, and for giving good reproduction from records. We note that the response was much better at low frequencies that that of the 1020 (but see the 1020 review).



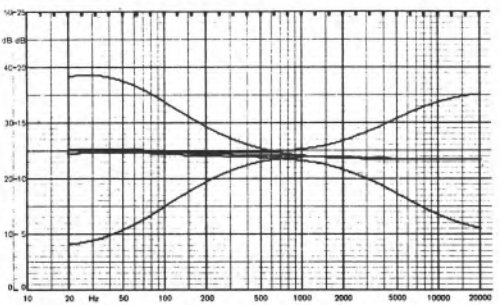
Amplifier

Av. Power output both channels driven	47.5W
Power output single channel driven	55W
Power output tone burst average	56W
Idle DC out worst case	81mv
Turn on/off Max. DC (swing worst case)	23v
Damping Factor L= –R	24/27%
IM 10w L/R	0.06/0.06%
IM 100mw L/R	0.09/0.085%
IM 1% output watts L/R	33/33W
Av. IM distortion pickup input/record out	.018%
Av. Harmonic Distortion 0.1% (power cut)	43W
Power Bandwidth L/R 0.1%	<10Hz–18kHz/<10Hz–35kHz
Av. Pickup impedance one/two	46KΩ/46KΩ
Pickup sensitivity one/two	3.5mv/3.5mv
Pickup clipping one/two	122mv/122mv
Pickup capacitance one/two	35pf/35pf
Auxiliary impedance	38.5KΩ
Auxiliary sensitivity	171.5mv
Tape impedance one/two	90KΩ/90KΩ
Tape sensitivity one/two	171.5mv/171.5mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	290mv
Max level from pickup (RO)	345mv
Tape output impedance DIN Av	32KΩ
Tape output impedance phono Av	162Ω
Av. Pickup noise ref 8mv record output socket unw	75dB
Av. Pickup noise ref 8mv record output socket CCIR	70dB
Amp output noise @ 0 volume unw	450μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	89.2dB
Worst weighted noise Aux in/L out S/N ratio	78.6dB

Tuner

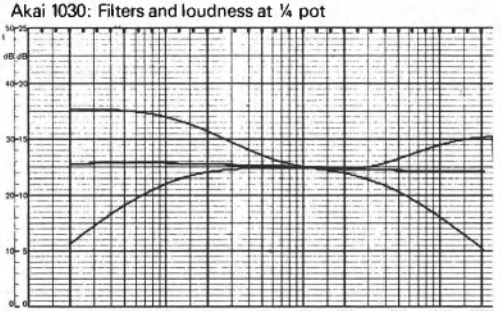
Mono RF sensitivity 30dB IHF	2.2μv
Mono RF sensitivity 50dB IHF	5μv
Stereo RF sensitivity 50dB IHF	60μv
IM RF	74.1dB
Adjacent Channel worst figure	0.5dB
Alternate Channel worst figure	none
Image Response	53.1dB
Capture Ratio	1.5dB
AM Reject	56dB
Mono distortion 100% 1kHz centre tune worst case	0.19%
Optimum tune mono Average	0.16%
Stereo L= –R centre tune L	0.34%
Stereo L= –R centre tune R	0.37%
Av. Stereo R= –L centre tune	0.35%
MPX filter reject worst fig. @ 19kHz	49dB
MPX filter reject worst fig. @ 38kHz	56dB
X talk centre tune worst fig. 1kHz	40dB
X talk centre tune worst fig. 10kHz	36dB
Optimum tune 1kHz L/R	40/43dB
FR Frequency response stereo –1dB L/R	10Hz–12.8K/12.6K
FR Frequency response stereo 3dB L/R	6Hz–14K/13.8K
Error @ 15kHz L/R	–5.5/–6dB
Limit threshold	3μv
Mute threshold	4.2μv–6mv
Av. Stereo S/N weighted 100μv/1mV	46/61.5dB
Av. Stereo unw 1mV	67dB
Av. Mono weighted 1mV	66.5dB
RRP Ex VAT	£167.60

Normally substantially discounted



Akai 1030: Tone controls

Akai 1030: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Armstrong 626.

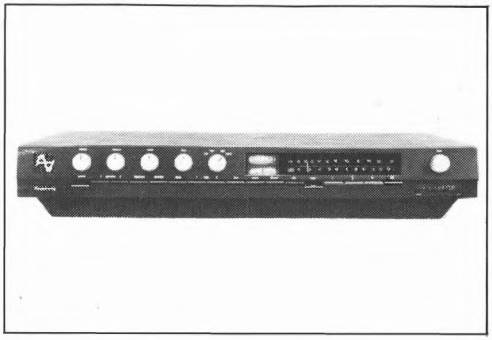
Armstrong Audio Limited, Warlters Road, London N7 0RZ.
01-607 3213

Armstrong Audio have two receivers in their range, on FM only, and the other, reviewed here, FM and AM (MW). An output power of 45W per channel was obtained in to 8 ohms with both channels driven. All the input and output sockets including the loudspeaker connections are DIN type, and while 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 three core. A 75 ohm RMA coaxial socket and a 300 ohm two pin sockets are provided for FM aerial input and a ferrite rod (for AM) which can be angled in any direction in a horizontal plane is far superior to the Japanese types. 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. The wooden case is mounted above a very shallow plastic tray at the rear of which are located all the input/output sockets, except for the stereo headphone jack at the front. 17 wide flat toggles operate all the different filters, outputs and tuner functions, whilst a very small tuning knob is provided to complement the six pre set stations (3 FM and 3 AM), having muting and AFC switching. 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 pretty well, and had a good damping factor and a reasonable transient power performance. The half power response was a little limited, extending to about 13kHz, but not withstanding this the amplifier section acquitted itself subjectively very well with a good bass performance, but slightly over bright treble. Although no crosstalk over 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, thus 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 (D.H. actually got burnt during tests!).

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 that average even on stronger signals. The image response was not too good, but IF breakthrough was virtually undetectable whilst the local oscillator radiation was minimal. 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, as was the frequency response, 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 band width was much too sharp and some hum was present.

Whilst the amplifier section was satisfactory, the tone control area clearly needs some redesign. I would prefer to see phono sockets complementing DIN ones, and a much slower tuning rate, since the existing knob is extremely difficult to set accurately, also due to the poor tuning meter. The general performance has nevertheless improved markedly on this model in the last few months, and Armstrong are continuing their development. The FM only version has six pre-sets, which is rather more useful than the review sample's three on FM. However, the treble filters are outstanding, and in general we feel that the receiver will clearly suit many fairly discriminating users, despite its few failings. Local lower frequency transmissions picked up on the mains or loudspeaker leads will cause severe trouble unless you insist on a specially suppressed model. Your dealer will have to send back a receiver for this modification.



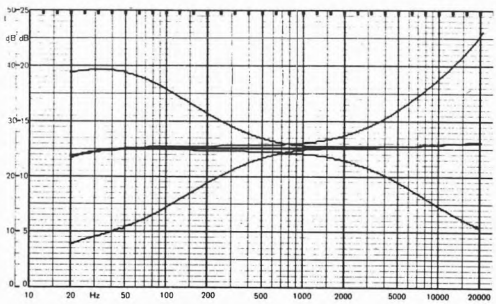
Amplifier

Av. Power output both channels driven	45W
Power output single channel driven	55W
Power output tone burst average	56W
Idle DC out worst case	<500μv
Turn on/off Max. DC (swing worst case)	3.9v
Damping Factor L= –R	35/39%
IM 10w L/R	0.1/0.06%
IM 100mw L/R	0.2/0.2%
IM 1% output watts L/R	32/33W
Av. IM distortion pickup input/record out	.19%
Av. Harmonic Distortion 0.1% (power cut)	43W
Power Bandwidth L/R 0.1%	<10Hz–10.5kHz/<10Hz–16kHz
Av. Pickup impedance one/two	40.5K/40.5K
Pickup sensitivity one/two	3.5mv/6.9mv
Pickup clipping one/two	100mv/193mv
Pickup capacitance one/two	40pf/40pf
Auxiliary impedance	101KΩ
Auxiliary sensitivity	152mv
Tape impedance one/two	90KΩ/27KΩ
Tape sensitivity one/two	319mv/268mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	640mv
Max level from pickup (RO)	300mv
Tape output impedance DIN Av	1KΩ
Tape output impedance phono Av	–
Av. Pickup noise ref 8mv record output socket unw	63.5dB
Av. Pickup noise ref 8mv record output socket CCIR	69dB
Amp output noise @ 0 volume unw	600μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	97.6dB
Worst weighted noise Aux in/L out S/N ratio	72.7dB

Tuner

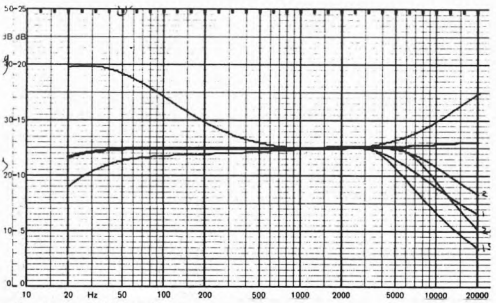
Mono RF sensitivity 30dB IHF	1.6μv
Mono RF sensitivity 50dB IHF	4.2μv
Stereo RF sensitivity 50dB IHF	50μv
IM RF	71.9dB
Adjacent Channel worst figure	2dB
Alternate Channel worst figure	44dB
Image Response	63.1dB
Capture Ratio	2.75dB
AM Reject	42dB*
Mono distortion 100% 1kHz centre tune worst case	0.6%
Optimum tune mono Average	0.12%
Stereo L= –R centre tune L	0.6%
Stereo L= –R centre tune R	0.55%
Av. Stereo R= –L centre tune	0.46%
MPX filter reject worst fig. @ 19kHz	57dB
MPX filter reject worst fig. @ 38kHz	–
X talk centre tune worst fig. 1kHz	42dB
X talk centre tune worst fig. 10kHz	31dB
Optimum tune 1kHz L/R	42/49dB
FR Frequency response stereo –1dB L/R	7Hz–14.6K/14.7K
FR Frequency response stereo 3dB L/R	4.5Hz–15.4K/15.7K
Error @ 15kHz L/R	–1.75/–1.5dB
Limit threshold	1.1μv
Mute threshold	4.5μv
Av. Stereo S/N weighted 100μv/1mV	49/60dB
Av. Stereo unw 1mV	65dB
Av. Mono weighted 1mV	68dB
RRP Ex VAT	£163.94

Occasionally discounted



Armstrong 626: Tone controls

Armstrong 626: Filters and loudness at ¼ pot



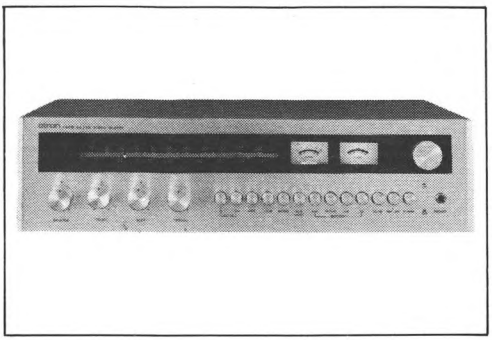
(Tested on 50dB scale)

Only basic facilities, are provided, with 24W per channel into main and remote loudspeakers, the latter being switchable on and off. Provision is made for extra loudspeakers to be driven both on the main and remote installation to the difference between the two live outputs, thus giving pseudo-quad, the rear speakers being fed out of phase in series. All the loudspeaker connectors are spring loaded push terminals, and it was a little difficult to insert bare wires in a hurry. An auxiliary input is fitted in addition to provision for one tape recorder which can be connected either with a five pole DIN socket or phonos. The remainder of the input sockets are also phone types. Rumble and treble roll offs are available on push buttons, and also loudness control, mute, and stereo/mono. Further push buttons choose FM or AM radio (MW), pick up (magnetic), tape monitor and auxiliary. The volume control felt smooth, but the balance control, having no centre indent, swung the image extremely slowly across the centre but violently towards the end positions. The bass and treble controls had no centre indent, and in particular had rather too much variation at the treble, so that misuse could cause clipping problems. The entire case is wooden, and the overall appearance is smart if simple. The tuning dial is always illuminated. A two core mains lead is fitted, and a mains fuse and output fuse are included.

The amplifier performance was a little disappointing, since some crossover distortion was noted at lower levels, giving a slight distorted pumping effect. At higher levels, high frequencies were slightly blurred and harsh and bass lacked body. The half power band width was good but the intermod distortion figures showed a deterioration at low levels. The bass control showed poor tracking, but the remainder of the controls were very good in this respect. Slight hiss and hum noticed on the loudspeakers could be disturbing on headphones. Although the pick-up input pre-amplifier was relatively quiet, the overload margin was barely adequate, although the phono input impedance was ideal. All other input and output impedances were compatible. The output damping factor was acceptable, and the amplifier seemed to give a reasonable volume, although it coarsened near clipping.

The tuner section had a very poor high frequency response which began to droop beyond 6.5kHz, reaching −3dB at 10kHz, and then falling rather rapidly. On strong signals the signal to noise ratio was very good, but weak signals were noisy. The discriminator was cearly out of alignment, since the distortion figures were very poor, but improved dramaticaly if the receiver was tuned considerably off centre, the supposed correct tuning point being indicated on a centre meter. An RF level meter shows the strength of the input signal, and whilst the input sensitivity was reasonable the alternate channel response measured badly, as did the image response and RF intermodulation. If the discriminator was better, and the response improved, the receiver might be quite reasonable on local stations, but the bad alternate channel, etc., would mean that if would be difficult to tune in weak stations anywhere near strong ones. The tuning itself was rather stiff, and several hard spots were noted. The tuning scale accuracy was very good. Some 19kHz pilot tone break through was noted, and some trouble could be experienced with whistles when interconnecting with low speed tape recorders not incorporating a multiplex filter.

It is difficult to have any enthusiasm for this product. Although very inexpensive, its general performance is rather poor and when compared with competitors does not seem to offer any particularly good features. Quite considerable improvements would have to be made in manufacturer (eg. quality control), before it could be rated reasonable value for money. Quite bad interference was experienced on any input from a local transmitter, in any position of the volume control. The problem would seem to be due to pick up in the mains and loudspeaker leads, which might be eliminated by using ferrite rings.



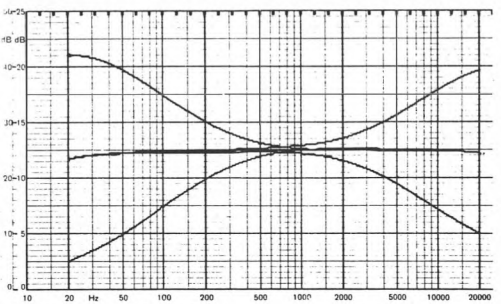
Amplifier

Av. Power output both channels driven	24.3W
Power output single channel driven	27.75W
Power output tone burst average	30.3W
Idle DC out worst case	46mv
Turn on/off Max. DC (swing worst case)	4v
Damping Factor L= –R	20.5/21%
IM 10w L/R	0.025/0.034%
IM 100mw L/R	0.175/0.25%
IM 1% output watts L/R	18.75/19.2
Av. IM distortion pickup input/record out	0.005%
Av. Harmonic Distortion 0.1% (power cut)	22.1W
Power Bandwidth L/R 0.3%	<10Hz–27kHz/<10Hz–32kHz
Av. Pickup impedance	49KΩ
Pickup sensitivity	3.43mv
Pickup clipping	58mv
Pickup capacitance	7pf
Auxiliary impedance	66KΩ
Auxiliary sensitivity	188mv
Tape impedance	80.5KΩ
Tape sensitivity	188mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	390mv
Max level from pickup (RO)	420mv
Tape output impedance DIN Av.	79KΩ
Tape output impedance phono Av.	4.5KΩ
Av. Pickup noise ref 8mv record output socket unw.	70.5dB
Av. Pickup noise ref 8mv record output socket CCIR	69dB
Amp output noise @ 0 volume unw.	1.8mv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	80dB
Worst weighted noise Aux in/L out S/N ratio	78.8dB

Tuner

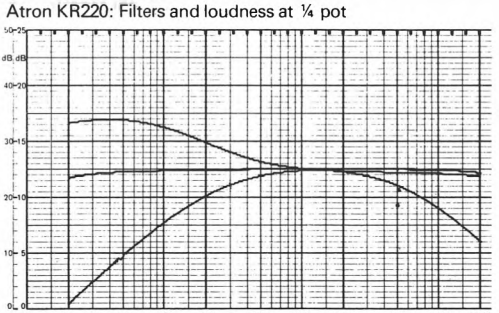
Mono RF sensitivity 30dB IHF	1.8µv
Mono RF sensitivity 50dB IHF	3.2µv
Stereo RF sensitivity 50dB IHF	40µv
IM RF	61.7dB
Adjacent Channel worst figure	–4dB
Alternate Channel worst figure	22dB
Image Response	59dB
Capture Ratio	3dB
AM Reject	61dB
Mono distortion 100% 1kHz centre tune worst case	1.2%
Optimum tune mono Average	0.2%
Stereo L= –R centre tune L	1.1%
Stereo L= –R centre tune R	1.1%
Av. Stereo R= –L centre tune	0.43%
MPX filter reject worst fig. @ 19kHz	40.5dB
MPX filter reject worst fig. @ 38kHz	–
X talk centre tune worst fig. 1kHz	33dB
X talk centre tune worst fig. 10kHz	34dB
Optimum tune 1kHz L/R	42/43dB
FR Frequency response stereo –1dB L/R	7Hz–6.5K/6.5K
FR Frequency response stereo 3dB L/R	3Hz–9.7K/9.7K
Error @ 15kHz L/R	–7/–7dB
Limit threshold	1.2µv
Mute threshold	3µv
Av. Stereo S/N weighted 100µv/1mV	48.5/65.5dB
Av. Stereo unw 1mV	71.5dB
Av. Mono weighted 1mV	77dB
RRP Ex VAT	£109.00

Occasionally discounted



Atron KR220: Tone controls

Atron KR220: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Audiotronics LR 2626

Audiotronics Limited, Audiotronic House, The Hyde, London NW9 6JJ. 01-200 0444

The Audiotronics brand is exclusively marketed by Laskys, and this new design provides 30W per channel r.m.s. 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 five 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 three core, and both a fuse and extra earth terminals are on the back. 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. When the receiver is on, the tuning dial illuminates green, but the tuning pointer and meters only light up when 'tuner' is selected. The unit is housed in a wooden case, having a large ventilation gap in the top, incorporating a metal mesh, whilst the underneath is screened with a metal sheet.

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 band width 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 pick up 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 quite reasonable, some unfortunate failings were found in the general performance. 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 MPX 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 cross talk 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 RF intermodulation figure, which shows that the tuner could be used fairly close to a stereo FM station without too many spurii being decoded, although the capture ratio was poor at 4.5dB. Despite the performance on strong stations being 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 oscillation radiation. The receiver had excellent electromagnetic compatibility, since virtually no interference was produced from test transmissons on LF and VHF. Recommended, then, for its price, but check performance by asking for a demonstration, and listen for any inequality of response.

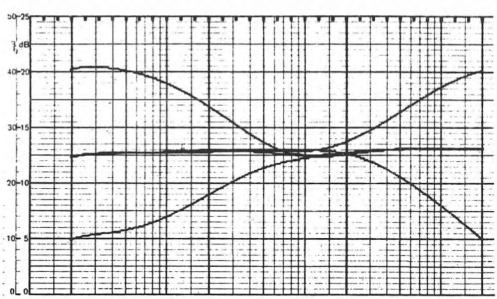
Picture unavailable at time of going to Press

Amplifier

Av. Power output both channels driven	30W
Power output single channel driven	36W
Power output tone burst average	42W
Idle DC out worst case	61mv
Turn on/off Max. DC (swing worst case)	2.75v
Damping Factor L= −R	39/35%
IM 10w L/R	0.06/0.065%
IM 100mw L/R	0.07/0.07%
IM 1% output watts L/R	21/19.5W
Av. IM distortion pickup input/record out	0.0045%
Av. Harmonic Distortion 0.1% (power cut)	26.4W
Power Bandwidth L/R 0.1%	<10Hz−13K/10Hz−16K
Av. Pickup impedance	50KΩ
Pickup sensitivity	2.64mv
Pickup clipping	96mv
Pickup capacitance	75pf
Auxiliary impedance one/two	66KΩ/66KΩ
Auxiliary sensitivity one/two	167.4mv/167.4mv
Tape impedance one/two	66.5KΩ/79KΩ
Tape sensitivity one/two	167.4mv/167.4mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	550mv
Max level from pickup (RO)	435mv
Tape output impedance DIN Av	76KΩ
Tape output impedance phono Av	96Ω
Av. Pickup noise ref 8mv record output socket unw	70dB
Av. Pickup noise ref 8mv record output socket CCIR	71.5dB
Amp output noise @ 0 volume unw	460μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	90.65dB
Worst weighted noise Aux in/L out S/N ratio	83.38dB

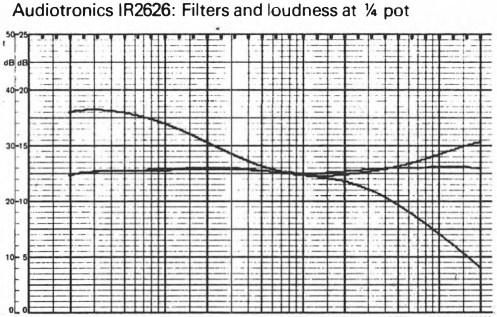
Tuner

Mono RF sensitivity 30dB IHF	1.5μv
Mono RF sensitivity 50dB IHF	3μv
Stereo RF sensitivity 50dB IHF	32μv
IM RF	80.45dB
Adjacent Channel worst figure	0dB
Alternate Channel worst figure	none
Image Response	52.33dB
Capture Ratio	4.5dB
AM Reject	47dB
Mono distortion 100% 1kHz centre tune worst case	0.21%
Optimum tune mono Average	0.2%
Stereo L= −R centre tune L	0.2%
Stereo L= −R centre tune R	0.21%
Av. Stereo R= −L centre tune	0.6%
MPX filter reject worst fig. @ 19kHz	41.5dB
MPX filter reject worst fig. @ 38kHz	–
X talk centre tune worst fig. 1kHz	33.5dB
X talk centre tune worst fig. 10kHz	33dB
Optimum tune 1kHz L/R	38.5/33.5dB
FR Frequency response stereo −1dB L/R	11Hz−9.1K/11.3K
FR Frequency response stereo 3dB L/R	5Hz−12K/16.8K
Error @ 15kHz L/R	−5.5/−1.5dB
Limit threshold	1μv
Mute threshold	2.4μv
Av. Stereo S/N weighted 100μv/1mV	49/62dB
Av. Stereo unw 1mV	68dB
Av. Mono weighted 1mV	67dB
Typical retail selling price	



Audiotronics IR2626: Tone controls

Audiotronics IR2626: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Bang & Olufsen 2000

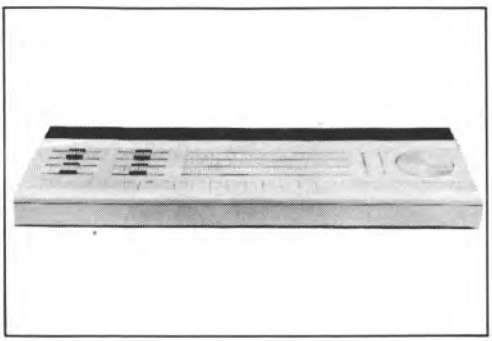
Bang & Olufsen (UK) Limited, Eastbrook Road, Gloucester GL4 7DE. 0452 21591

A highly individual receiver giving just 32W per channel into 8 ohms. All inputs are on DIN sockets and provision is made for driving two selectable pairs of loudspeakers. The mains lead is only 2 core and no earth terminal is provided. Coaxial 75 ohm and 300 ohm FM aerial sockets are complemented by an AM one, (LW and MW). The unit is wide and shallow and virtually all the functions are along the top including a tuning wheel, which rotates flush with the surface. Volume, balance, bass and treble controls are all sideways sliders having no centre indents. Along the front is a row of flat flush mounted push buttons, and at the ends of these sliding doors reveal loudness and tape copying buttons, and 5 preset station controls with AFC and mute controls. The push buttons include power off, 5 preset stations, tuning, mono/stereo, tape and phono. Although the receiver includes preset stations, clearly a considerable portion of the high price is due to the unusual and very modern styling, which will undoubtedly attract some purchasers. The equipment is only suitable for interconnection with DIN standard recorders. No rumble or high frequency filters are provided.

Although general intermodulation and harmonic distortion performance was good at intermediate and high levels, some crossover distortion was audible very low. The speaker damping factor measured extremely well. The pick-up input had low intermodulation distortion at all normal levels, but the clipping margin was not quite as high as is optimum. Whilst the general amplifier S/N ratios were very good, some hum was introduced into the pick-up input section. (NB. no external earth connection.) All the controls tracked satisfactorily except volume which showed a slight error at low settings. The tone controls provided a wide range of adjustment at the ends of the audio spectrum and the loudness control gave an adequate boost of bass and treble at low volume settings. The RIAA pick-up response was very flat, but gave an output on the record DIN socket (only just adequate for most DIN equipment). Many Japanese recorders, and some others, will have noise problems because of the very low output level. The pick-up level is approximately 3.5dB lower that that obtained from a typical radio programme. The pick-up input impedance was just a little high but compatible with B & O cartridges. The tape inputs clipped at 3.4V and are thus unsuitable for many non DIN types of recorder, unless these have an output gain control. The half power bandwidth performance was rather poor, extending to only 10kHz. Some transient intermodulation distortion was obviously present since the amplifier was rather bright and lab. tests on sweep i.m. tests tended to reinforce this suspicion.

Once set, the preset stations were found most useful and when the AFC was switched on the main rotary control worked well with the mute, which, however, was very awkward without AFC. Tuning was liked but the tuning dial accuracy was very poor (maximum error 600kHz!). The general hiss levels on both weak and strong stations were excellent but some100Hz hum was occasionally audible on quiet programmes. When theoretically correctly tuned the distortion performance was poor, but a reasonable improvement was obtained by tuning off centre. Slight distortion was noticed in the crosstalk, which in isolation, however, measured extremely well at middle frequencies and just satisfactorily at high ones. The frequency response started rolling off from below 10kHz but was only 4 down at 15kHz. The RF sensitivities measured particularly well, and most praiseworthy were the adjacent and alternate channel responses. RF intermodulation was pretty good and all these help to give an excellent impression of the RF performance. The tuner was able to receive quite weak stations comparatively close to strong ones. It is a pity that the distortion performance just did not match the RF performance. The multiplex filtering was excellent. Quite clearly the discriminator was misaligned and if corrected would have improved distortion performance.

If you like the presentation and ergonomics of this receiver you will probably be reasonably satisfied with it general performance. The excellent RF measurements and the preset station facility together with the provision of long wave and medium wave AM must commend this model to those requiring a simple receiver. Small legs at the back allow it to be tilted up, thus angling the operating surface. If you are prepared to pay the price you will probably be well satisified, but if you want more comprehensive facilities and a better general audio performance you will have to look elsewhere. B & O will have to improve their frequency dial calibration. Excellent electromagnetic compatibility.

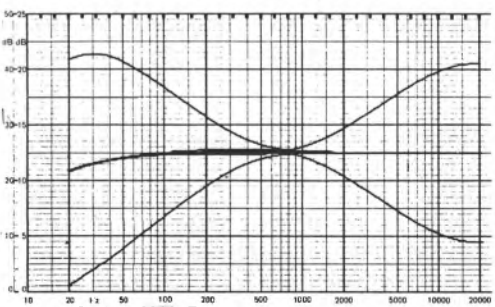


Amplifier

Av. Power output both channels driven	32.5W
Power output single channel driven	36W
Power output tone burst average	36W
Idle DC out worst case	80μv
Turn on/off Max. DC (swing worst case)	5v
Damping Factor L= −R	42/43%
IM 10w L/R	0.08/0.04%
IM 100mw L/R	0.08/0.08%
IM 1% output watts L/R	24/25W
Av. IM distortion pickup input/record out	0.05%
Av. Harmonic Distortion 0.1% (power cut)	30.5W
Power Bandwidth L/R 0.1%	<10Hz−9kHz/<10Hz−11kHz
Av. Pickup impedance	55KΩ
Pickup sensitivity	3.36mv
Pickup clipping	50mv
Pickup capacitance	80pf
Auxiliary impedance	−
Auxiliary sensitivity	−
Tape impedance one/two	1.1MΩ/1.1MΩ
Tape sensitivity one/two	236.8mv/236.8mv
Mic impedance	−
Mic sensitivity	−
Mic clipping	−
Max level from tuner (RO)	94mv
Max level from pickup (RO)	13.5mv
Tape output impedance DIN Av	20KΩ
Tape output impedance phono Av	−
Av. Pickup noise ref 8mv record output socket unw	58.75dB
Av. Pickup noise ref 8mv record output socket CCIR	67.5dB
Amp output noise @ 0 volume unw	530μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	97.16dB
Worst weighted noise Aux in/L out S/N ratio	82.7dB

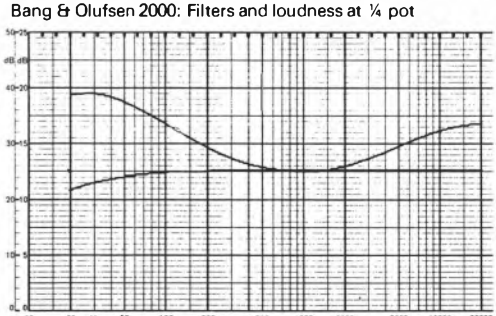
Tuner

Mono RF sensitivity 30dB IHF	1.4μv
Mono RF sensitivity 50dB IHF	2.3μv
Stereo RF sensitivity 50dB IHF	23μv
IM RF	75dB
Adjacent Channel worst figure	6.5dB
Alternate Channel worst figure	none
Image Response	70.9dB
Capture Ratio	1.5dB
AM Reject	62dB
Mono distortion 100% 1kHz centre tune worst case	0.74%
Optimum tune mono Average	0.35%
Stereo L− −R centre tune L	0.78%
Stereo L= −R centre tune R	0.8%
Av. Stereo R= −L centre tune	0.42%
MPX filter reject worst fig. @ 19kHz	59dB
MPX filter reject worst fig. @ 38kHz	49dB
X talk centre tune worst fig. 1kHz	43.5dB
X talk centre tune worst fig. 10kHz	46dB
Optimum tune 1kHz L/R	30.5/30.5dB
FR Frequency response stereo −1dB L/R	26Hz−8.6K/7.5K
FR Frequency response stereo 3dB L/R	12Hz−14.6K/14.8K
Error @ 15kHz L/R	−4.25/−3.5dB
Limit threshold	1μv
Mute threshold	2.7μv
Av. Stereo S/N weighted 100μv/1mV	54.5/65dB
Av. Stereo unw 1mV	66dB
Av. Mono weighted 1mV	68.5dB
Typical retail price ex VAT	£92.72



Bang & Olufsen 2000: Tone controls

Bang & Olufsen 2000: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Bang & Olufsen 4000

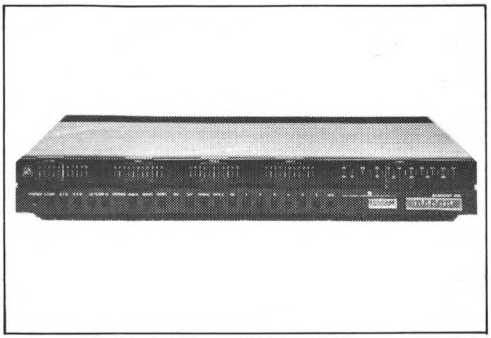
Bang & Olufsen (UK) Limited, Eastbrook Road, Gloucester GL4 7DE. 0452 21591

Despite its somewhat high cost this model contains only rather basic features incorporating provision for one pickup, one two head recorder and one three head recorder with monitoring. Output is 43W per channel (both driven). All input and output sockets including loudspeakers are DIN, although the headphone socket is a 3 pole stereo jack. The tuner section covers FM only but in addition to continuous tuning there are six preset stations available. Only a 2 core mains lead is provided and there is no earth terminal which is a serious disadvantage. It is necessary to predetermine tape monitoring, since the monitoring button is a lock type and if unlocked the entire recording function can become disengaged and this again is bad and clumsy. 75 ohm RMA coax and 300 ohm 2 pin sockets are provided for FM aerials. The receiver is very handsomely presented in a wooden case with a metal tray underneath. Presets are provided for pick-up input and record output gains. Volume, bass, treble and balance controls are of a sideways slide rule type similar to those found on much B & O equipment and it is clearly a matter of personal taste whether they are liked or not. Since they are not provided with centre indents, and are slightly sticky and squeely, we did not like them. Rumble and treble roll-offs are provided on push buttons as are loudness control, speaker selection, mono/stereo, quasi-quad and general functions. The tuning is again by means of a slide rule along a scale and fine adjustment is by means of minute milled wheels mounted inside the slider. The receiver ran slightly warm after a while. The tuner includes a signal strength meter and a pair of tuning indicator lights, both of which glow equally when tuning is correct. This equipment will only be found compatible with external DIN standard recorders because of the relatively low output levels, etc.

The actual amplifier performance was very well liked, since the subjective quality had a transparency and ease of reproduction clearly much better than average, although very low bass frequencies were not quite as clear as reproduced by the Quad 405. The intermodulation distortion measurements were good and the harmonic distortion measured well. No crossover distortion was detected subjectively and we were all very impressed with the pleasant silky string tone, which was preferred to that reproduced by the Quad 405. The half power bandwidth extended up to 16kHz, which is good but bettered by several other amplifiers. The output noise was remarkably low and still low even when the volume was at maximum. The theoretical dynamic range actually measured approximately 100dB! The pick-up input had adequate sensitivity but a very poor clipping margin of only about 10dB above normal peak record levels and this was confirmed by higher than average intermodulation distortion measurements from pick-up input to record output. The signal to noise ratio here though was excellent but the record output level should be reduced by 3dB or so by increased feed back, which would also help the clipping margin. Input and output impedances throughout were well in accordance with DIN recommendations (record outputs low level and lowish impedance). Tone controls had almost an excessive variation, the filters (6dB/oct) cut −3dB at 70Hz/7kHz. Stereo tracking throughout was pretty good. The pick-up input showed a fairly rapid bass loss below 50Hz.

The tuner section gave very good reproduction, but was found slightly difficult to tune (presets also difficult to set accurately). The AFC had a rather violent action making it essential to switch it off for locating weak stations. All the signal/noise ratios were excellent, particularly on weak stereo. The distortion levels were quite adequate as were the crosstalk measurements. The frequency response was amazingly flat throughout. The 19kHz pilot tone breakthrough was very poor. RF sensitivities were excellent as also were RF intermod and capture ratio. All other parameters were very satisfactory, although some warm up drift was noted for the first few minutes.

This model has some excellent as well as a few poor characteristics. Its choice will be highly personal and you are strongly advised to try it in your own home before purchase. The tuner performed very well indeed, the amplifier was excellent but the pick-up performance requires some attention. Another individual receiver from B & O. EMC was excellent.

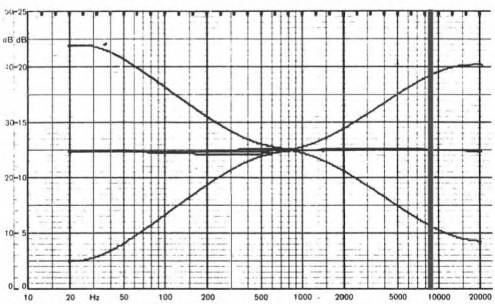


Amplifier

Av. Power output both channels driven	42.75W
Power output single channel driven	46.3W
Power output tone burst average	49W
Idle DC out worst case	<300μv
Turn on/off Max. DC (swing worst case)	9.5v
Damping Factor L= −R	22.5/22%
IM 10w L/R	0.115/0.095%
IM 100mw L/R	0.075/0.18%
IM 1% output watts L/R	30/30W
Av. IM distortion pickup input/record out	0.56%
Av. Harmonic Distortion 0.1% (power cut)	41W
Power Bandwidth L/R 0.1%	<10Hz−17kHz/<10Hz−15kHz
Av. Pickup impedance	47KΩ
Pickup sensitivity	1.85mv
Pickup clipping	27mv
Pickup capacitance	35pf
Auxiliary impedance	−
Auxiliary sensitivity	−
Tape impedance one/two	1MΩ/1MΩ
Tape sensitivity one/two	216mv/222mv
Mic impedance	−
Mic sensitivity	−
Mic clipping	−
Max level from tuner (RO)	55mv
Max level from pickup (RO)	67.5mv
Tape output impedance DIN Av	4.5KΩ
Tape output impedance phono Av	−
Av. Pickup noise ref 8mv record output socket unw	72.5dB
Av. Pickup noise ref 8mv record output socket CCIR	71dB
Amp output noise @ 0 volume unw	73μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	109.5dB
Worst weighted noise Aux in/L out S/N ratio	87.3dB

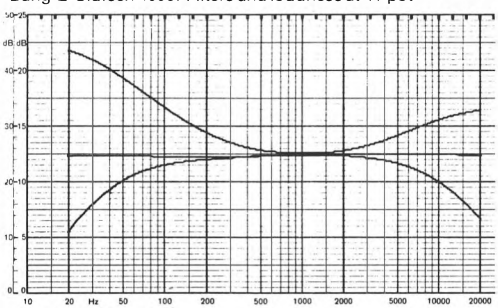
Tuner

Mono RF sensitivity 30dB IHF	1.2μv
Mono RF sensitivity 50dB IHF	3μv
Stereo RF sensitivity 50dB IHF	18μv
IM RF	80.4dB
Adjacent Channel worst figure	6dB
Alternate Channel worst figure	52dB
Image Response	72.4dB
Capture Ratio	1dB
AM Reject	56dB
Mono distortion 100% 1kHz centre tune worst case	0.4%
Optimum tune mono Average	0.33%
Stereo L= −R centre tune L	0.37%
Stereo L= −R centre tune R	0.38%
Av. Stereo R= −L centre tune	0.52%
MPX filter reject worst fig. @ 19kHz	32dB
MPX filter reject worst fig. @ 38kHz	46dB
X talk centre tune worst fig. 1kHz	34dB
X talk centre tune worst fig. 10kHz	36.5dB
Optimum tune 1kHz L/R	40/40dB
FR Frequency response stereo −1dB L/R	20Hz−17.5K/17.2K
FR Frequency response stereo 3dB L/R	12Hz−17.8K/17.9K
Error @ 15kHz L/R	−.5/−.75dB
Limit threshold	1.2μv
Mute threshold	−
Av. Stereo S/N weighted 100μv/1mV	54/65.5dB
Av. Stereo unw 1mV	68dB
Av. Mono weighted 1mV	77.5dB
Typical retail price ex VAT	£238.80



Bang & Olufsen 4000: Tone controls

Bang & Olufsen 4000: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Goodmans Module 90

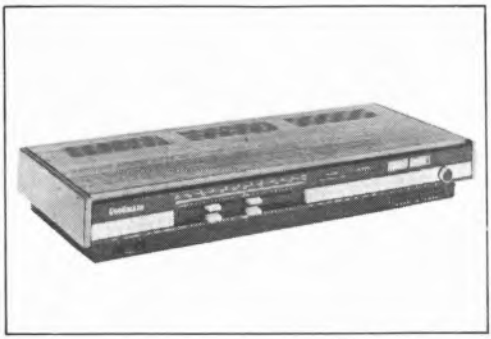
Goodmans Limited, Downley Road, Havant, Hants PO9 2NL.
070-12 6344

Extremely reasonably priced, it delivers 30W per channel into 8 ohms and two switchable pairs of loudspeakers can be plugged in. A quasi-quadraphonic switch allows the difference channel to be fed to the two back speakers. All the input and output sockets are DIN types and only DIN equipment 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. The wooden case has a metal tray which includes small rubber feet. 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 preset 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 surprisingly 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 intermodulation distortion performance, whilst being good at high levels, reached orders of several percent at very low levels, thus proving the presence of considerable crossover distortion. (2.5% at 1mW.) This, however, was overshadowed in our subjective tests from breakthrough of medium wave Capital radio, always present quietly on the loudspeaker if an earth or external equipment was connected. The harmonic distortion performance was quite reasonable, though. The half power bandwidth was relatively poor extending to only 9.7kHz at 0.1% The general hiss levels of the pre-amp and amplifier were satisfactory as far as we could tell (difficult to separate from MW breakthrough). An amazing 20V DC pulse occurred when the receiver was switched on and this would be very dangerous for some smaller loudspeaker units. The tone control varation was very wide. The rumble filter begins to cut (at 6dB octave) from 80Hz but this is additional to the amplifier's own response falling from 30Hz fairly sharply. The treble roll-off was 3dB down at 4.5kHz and continued at approximately 6dB per octave. The loudness control was satisfactory. The RIAA response was excellent. All the response controls tracked excellently. 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 RF intermodulation measurements were very good. The capture ratio was particularly good at only 0.75dB. The limiting threshold, however, was extremely poor at 6uV. Multiplex rejection was very poor. The frequency response reached a peak of +3dB at 7kHz but was −2dB at 15kHz and thus a particularly bright sound was produced from the tuner. 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 and most acceptable. The stereo hiss performance was rather average on strong signals, but significantly below average on weak ones. Unfortunately only a 300 ohm aerial input was provided, which will necessitate a transformer for most UK aerial installations. Correct tuning is indicated when a tuning lamp indicator ceases to glow.

Having reduced my standards for such a modestly priced unit, it seems to offer pretty good value for money, especially for the provision of preset FM stations, although I found the volume control sliders extremely annoying and 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. Some rather bad breakthrough of local low frequency transmissions was picked up by the amplifier and was irritating.



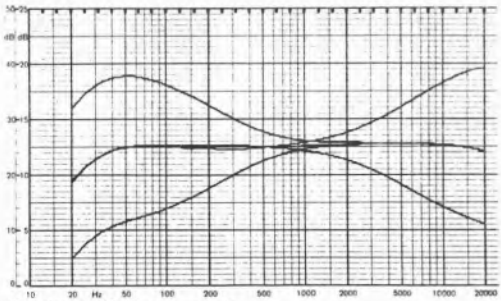
Amplifier

Av. Power output both channels driven	29.7W
Power output single channel driven	32.8W
Power output tone burst average	52.7W
Idle DC out worst case	39mv
Turn on/off Max. DC (swing worst case)	34v
Damping Factor L= –R	25/31%
IM 10w L/R	0.075/0.08%
IM 100mw L/R	0.27/0.28%
IM 1% output watts L/R	19.9/19.9%
Av. IM distortion pickup input/record out	0.028%
Av. Harmonic Distortion 0.1% (power cut)	26.8W
Power Bandwidth L/R 0.1%	20Hz–9.7kHz/20Hz–9.6kHz
Av. Pickup impedance	50KΩ
Pickup sensitivity	2.9mv
Pickup clipping	57mv
Pickup capacitance	55pf
Auxiliary impedance	645KΩ
Auxiliary sensitivity	94.2mv
Tape impedance	37KΩ
Tape sensitivity	237mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	110mv
Max level from pickup (RO)	60mv
Tape output impedance DIN Av	88KΩ
Tape output impedance phono Av	–
Av. Pickup noise ref 8mv record output socket unw	73.5dB
Av. Pickup noise ref 8mv record output socket CCIR	71dB
Amp output noise @ 0 volume unw	700μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	84.4dB
Worst weighted noise Aux in/L out S/N ratio	66.1dB

Tuner

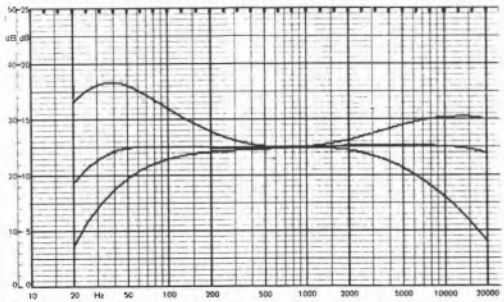
Mono RF sensitivity 30dB IHF	2.8μv
Mono RF sensitivity 50dB IHF	7μv
Stereo RF sensitivity 50dB IHF	65μv
IM RF	69.5dB
Adjacent Channel worst figure	48dB
Alternate Channel worst figure	48dB
Image Response	77dB
Capture Ratio	0.75dB
AM Reject	58dB
Mono distortion 100% 1kHz centre tune worst case	0.38%
Optimum tune mono Average	0.25%
Stereo L= –R centre tune L	0.27%
Stereo L= –R centre tune R	0.24%
Av. Stereo R= –L centre tune	0.14%
MPX filter reject worst fig. @ 19kHz	36.5dB
MPX filter reject worst fig. @ 38kHz	60.5dB
X talk centre tune worst fig. 1kHz	35.5dB
X talk centre tune worst fig. 10kHz	21.5dB
Optimum tune 1kHz L/R	42.5/41.5dB
FR Frequency response stereo –1dB L/R	12Hz–10.4K/10.6K
FR Frequency response stereo 3dB L/R	6Hz–12.1K/12.3K
Error @ 15kHz L/R	–6.5/–6.5dB
Limit threshold	6μv
Mute threshold	5.5μv
Av. Stereo S/N weighted 100μv/1mV	44/61dB
Av. Stereo unw 1mV	67dB
Av. Mono weighted 1mV	67dB
RRP Ex VAT	£144.37

Normally substantially discounted



Goodmans 90: Tone controls

Goodmans 90: Filters and loudness at ¼ pot



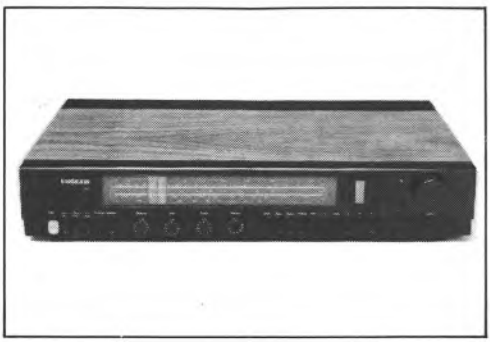
(Tested on 50dB scale)

Despite its relatively modest price, this can deliver 40W per channel 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, LS1, LS2 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 tone or balance controls and are all rotary including the volume control. 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 personal 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 intermoduation and harmonic distortion measurements were good, the half power bandwidth was poor on one channel (only 10kHz) whilst the other was very good. 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 and the treble control was average. Particularly commendable were the rumble and treble filters, which approached cuts of 18dB/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 good 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 position 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 also poor. Whilst the RF input sensitivities measured very well and the RF intermod, IF breakthrough and image response were excellent, the adjacent and alternate channel responses 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 some 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. Nevertheless it does offer very good value for money if purchased at a discount in terms of its actual basic sound quality potential, especially since it is capable of producing quite high volumes in the average loudspeaker system. Severe interference was produced on the pick-up input from a local VHF amateur radio transmitter and Goodmans must attend to this problem of electro magnetic compatibility. Recommended, then, if you can bear with its poor ergonomics and appearance.



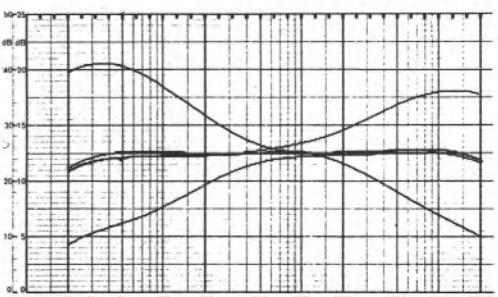
Amplifier

Av. Power output both channels driven	40.5W
Power output single channel driven	45W
Power output tone burst average	47.5W
Idle DC out worst case	30mv
Turn on/off Max. DC (swing worst case)	10v
Damping Factor L= –R	45/33%
IM 10w L/R	0.05/0.04%
IM 100mw L/R	0.08/0.08%
IM 1% output watts L/R	27/28W
Av. IM distortion pickup input/record out	0.04%
Av. Harmonic Distortion 0.1% (power cut)	35W
Power Bandwidth L/R 0.1%	30Hz–10kHz/30Hz–22kHz
Av. Pickup impedance	57.7KΩ
Pickup sensitivity	1.4mv
Pickup clipping	99mv
Pickup capacitance	90pf
Auxiliary impedance	450KΩ
Auxiliary sensitivity	88.2mv
Tape impedance	101KΩ
Tape sensitivity	88.2mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	74mv
Max level from pickup (RO)	60mv
Tape output impedance DIN Av	83KΩ
Tape output impedance phono Av	–
Av. Pickup noise ref 8mv record output socket unw	62dB
Av. Pickup noise ref 8mv record output socket CCIR	70dB
Amp output noise @ 0 volume unw	1.6mv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	91.6dB
Worst weighted noise Aux in/L out S/N ratio	80.2dB

Tuner

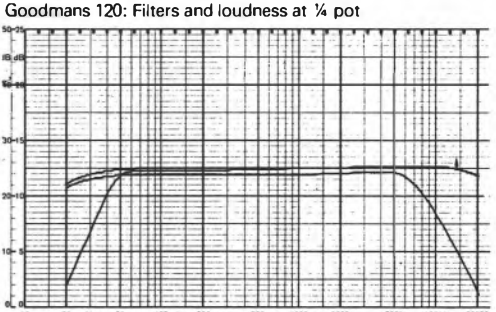
Mono RF sensitivity 30dB IHF	1.5μv
Mono RF sensitivity 50dB IHF	6.2μv
Stereo RF sensitivity 50dB IHF	30μv
IM RF	76.5dB
Adjacent Channel worst figure	–3dB
Alternate Channel worst figure	50dB
Image Response	74.5dB
Capture Ratio	3.75dB
AM Reject	47.5dB
Mono distortion 100% 1kHz centre tune worst case	0.25%
Optimum tune mono Average	0.22%
Stereo L= –R centre tune L	1%
Stereo L= –R centre tune R	0.9%
Av. Stereo R= –L centre tune	1.1%
MPX filter reject worst fig. @ 19kHz	37dB
MPX filter reject worst fig. @ 38kHz	60dB
X talk centre tune worst fig. 1kHz	34.5dB
X talk centre tune worst fig. 10kHz	19dB
Optimum tune 1kHz L/R	37/37dB
FR Frequency response stereo –1dB L/R	26Hz–9.8K/4K
FR Frequency response stereo 3dB L/R	12Hz–17.3K/15.5K
Error @ 15kHz L/R	–1.5/–2.8dB
Limit threshold	6μv
Mute threshold	u/s
Av. Stereo S/N weighted 100μv/1mV	52/68dB
Av. Stereo unw 1mV	62dB
Av. Mono weighted 1mV	70dB
RRP Ex VAT	£163.77

Normally substantially discounted



Goodmans 120: Tone controls

Goodmans 120: Filters and loudness at ¼ pot



(Tested on 50dB scale)

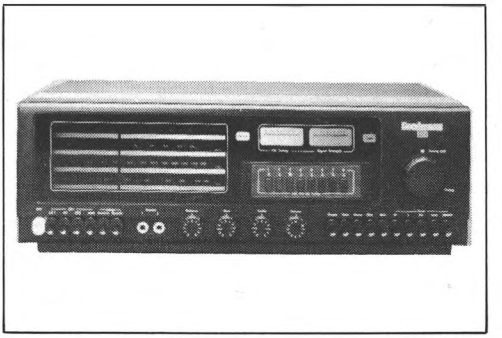
Goodmans Limited, Downley Road, Havant, Hants PO9 2NL.
070-12 6344

This high powered receiver gave a continuous output power of nearly 75W on both channels and will thus be found useful for the reproduction of loud pop music. 7 preset FM stations are provided together with continuous tuning of FM, and medium and long wave AM. Only a 2 core mains lead is provided but a separate mains earth terminal allows an external connection. Two AC specially shuttered 3 way outlet sockets are fitted. All input and output sockets are DIN type although the tape has also 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 has tape out 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 conversions whilst the phono sockets provide normal interconnection for non DIN equipment. Rumble and treble filters are incorporated together with an FM mute, (labeled Distant), AFC tuning, lock, mono/stereo and loudness controls. Two quarter inch stereo jack sockets are provided for headphones. Loudspeaker and headphone switching includes a quasi-quad function (difference channel at the rear). Although the main case work is wooden, most of the case is of slot spaced metal construction allowing excellent ventilation. The amplifier runs at a fairly high temperature but this is reasonable considering its high power.

The intermodulation distortion performance was most unusual being totally inconsistent between the channels at 10W. There was clearly a transient tone burst problem showing up, which suggests some divide action somewhere. Transient intermodulation distortion was audible judging by some brittle roughness. No output DC problems were encountered, since the loudspeakers were protected by relay switching. The damping factor measured quite well. The main amplifier was just slightly noiser 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, fall off at nearly 18dB per octave, which is extremely good. The loudness control worked well. 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, it fared rather 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 at 16uV. The RF sensitivity was extremely good, and a commendable surprise was the stereo 50dB S/N UnW of 22uV. The adjacent and alternate channel selectivities were very good, and even the RF intermod 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 200kHz, which is rather poor. The second sample had a very fine tuner section indeed, but Goodmans must improve their quality control on the decoder chip (ref. hiss level). The frequency response is excellent and yet the 19kHz rejection is also amazingly good (a rare combination). The pre set stations worked excellently and were most useful.

This receiver has clearly some very good points, but the amplifier's tone burst characteristics urgently needs attention. This is now being put right by Goodmans, and so new stock will be remarkably good value for money, since it will then offer an excellent tuner with a good high power amplifier Its rather unusual styling could appeal to some, and the receiver should do well.



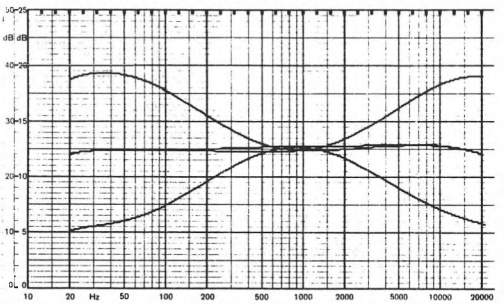
Amplifier

Av. Power output both channels driven	74.4W
Power output single channel driven	77.5W
Power output tone burst average	81W
Idle DC out worst case	5mv
Turn on/off Max. DC (swing worst case)	–
Damping Factor L= –R	31/36%
IM 10w L/R	0.12/0.42%
IM 100mw L/R	0.09/0.1%
IM 1% output watts L/R	52.5/52.5W
Av. IM distortion pickup input/record out	0.005%
Av. Harmonic Distortion 0.1% (power cut)	69W
Power Bandwidth L/R 0.1%	<10Hz–25kHz/<10Hz–20kHz
Av. Pickup impedance	50KΩ
Pickup sensitivity	2mv
Pickup clipping	175mv
Pickup capacitance	175pf
Auxiliary impedance	553KΩ
Auxiliary sensitivity	45.7mv
Tape impedance one/two	61KΩ/61KΩ
Tape sensitivity one/two	102mv/102mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	670mv
Max level from pickup (RO)	405mv
Tape output impedance DIN Av	43KΩ
Tape output impedance phono Av	10.3KΩ
Av. Pickup noise ref Bmv record output socket unw	70dB
Av. Pickup noise ref Bmv record output socket CCIR	71dB
Amp output noise @ 0 volume unw	1.4mv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	88.6dB
Worst weighted noise Aux in/L out S/N ratio	74.8dB

Tuner

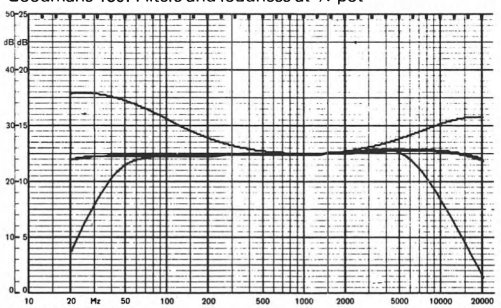
Mono RF sensitivity 30dB IHF	1μv
Mono RF sensitivity 50dB IHF	2.3μv
Stereo RF sensitivity 50dB IHF	22μv
IM RF	81dB
Adjacent Channel worst figure	6dB
Alternate Channel worst figure	none
Image Response	80dB
Capture Ratio	1.5dB
AM Reject	51.5dB
Mono distortion 100% 1kHz centre tune worst case	0.39%
Optimum tune mono Average	0.29%
Stereo L= –R centre tune L	0.23%
Stereo L= –R centre tune R	0.24%
Av. Stereo R= –L centre tune	0.48%
MPX filter reject worst fig. @ 19kHz	70dB
MPX filter reject worst fig. @ 38kHz	76dB
X talk centre tune worst fig. 1kHz	39dB
X talk centre tune worst fig. 10kHz	24.5dB
Optimum tune 1kHz L/R	43.5/44dB
FR Frequency response stereo –1dB L/R	48Hz–15.7K/15.6K
FR Frequency response stereo 3dB L/R	17Hz–16.1K/16.1K
Error @ 15kHz L/R	+1/+0.5dB
Limit threshold	.7μv
Mute threshold	1μv
Av. Stereo S/N weighted 100μv/1mV	55/61.5dB
Av. Stereo unw 1mV	65.5dB
Av. Mono weighted 1mV	64dB
RRP Ex VAT	£239.20

Normally substantially discounted



Goodmans 150: Tone controls

Goodmans 150: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Harman Kardon 330B

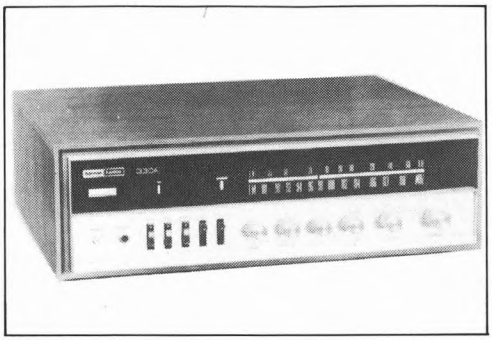
Highgate Acoustics Limited, 38 Jamestown Road, London NW1 7EJ. 01-267 4937

A modestly priced unit which provides 21W per channel in to two pairs of loudspeakers, either or both pairs being selectable. Its metal case is adequately ventilated, and the appearance is quite smart, the switches being of a rocker type, whilst all the main control knobs have pointers protruding. Only basic facilities are provided, inputs including pick up, tape monitor and auxiliary. Two tape recorders however can be fed from the receiver and the auxiliary input would normally be used for replay from a two head machine, leaving the monitor for a three head one. No filters are incorporated, but mono/stereo and loudness control switching is available. None of the controls have centre indents, and the balance control moves the image rather suddenly at the ends of its track. The tone controls had adequate variation, and all the ganging coincided well between the tracks, although we noted rather more bass boost on one channel than on the other with the loudness control, which affected bass but not treble. A two core mains lead is provided, and also one switched AC output socket, and an independent earth terminal. A ferrite rod aerial, which swings up and down rather uselessly, acts as an AM antenna for MW. Break points are provided for inserting external equalisation etc. before the main amplifier. Three fuses protect mains and both loudspeaker outputs.

Although subjectively the amplifier quality was not disliked, being generally very good, the IM distortion figures were a little on the high side and we noted quite a difference between 0.1 and 1% T.H.D. points. The half power bandwidth was quite reasonable, extending to 16.5kHz, and whilst the amplifier was basically quiet, hiss became noticeable when the volume control was wound 2/3rd's up. All the controls were well ganged. The pick up input performance was slightly below average, having a high IM distortion and a poor clipping, although noise level was excellent. The auxiliary input clipped at 3V but otherwise was satisfactory. The tape monitor input had a rather low impedance at 11.5K ohm, and a very poor sensitivity of 450mV, and this unfortunately virtually rules out interconnection with many DIN recorders. The damping factor was excellent, but we noticed a somewhat horrific 15V dc pulse on switch on, which after many repetitions might harm some small speakers, although the dc idle offset measured very well. The pick up input sensitivity was only just adequate, and it is difficult to understand the poor clipping levels on both pick up and auxiliary inputs.

Unfortunately the tuner section will only perform well from a 300 ohm source, but with this the sensitivity was good. The RF IM distortion was poor and image response awful, but the IF rejection excellent. The adjacent and alternate selectivity were very good, as was the capture ratio. Limiting threshold, AM rejection and local oscillator radiation measured well. The tuning scale was 200kHz inaccurate. The multiplex filter was adequate. The frequency response was exceptionally good and hiss level on strong signals excellent, although slight hum was noticed in the background on very wide dynamic range broadcasts. When correctly tuned the distortion was extremely low and the crosstalk very good indeed at middle frequencies and satisfactory at high ones. In practice the sound produced by the tuner was very much liked, having a better than average clarity and general sound quality. Only an RF signal strength tuning meter is provided. Unfortunately the tuning rate was rather fast, making accurate tuning a little awkward. The performance on weak stations was very good, with the appropriate aerial, and many continental stations were heard by coincidence during a duct opening occurring during the subjective tests, and no problems were experienced here, which is certainly praiseworthy.

Considering the reasonable price, this receiver sounded very good even if some of the measurements did not quite come up to expectations. Its facilities are very basic, but it is easy to use provided that it is connected with a 300 ohm aerial and a compatible tape recorder. It operated reliably, and for its price can be recommended as good value for money. One or two other receivers gave more facilities at the same price. The receiver must be commended for its freedom from interference from local transmitters.



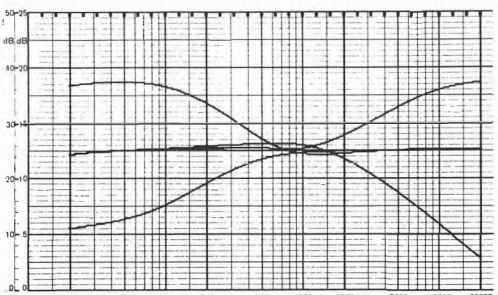
Amplifier

Av. Power output both channels driven	21W
Power output single channel driven	24.2W
Power output tone burst average	24.5W
Idle DC out worst case	8.8mv
Turn on/off Max. DC (swing worst case)	15v
Damping Factor L= −R	48/50%
IM 10w L/R	0.3/0.3%
IM 100mw L/R	0.27/0.26%
IM 1% output watts L/R	14.3/14.1W
Av. IM distortion pickup input/record out	0.17%
Av. Harmonic Distortion 0.1% (power cut)	16.5W
Power Bandwidth L/R 0.3%	21Hz−16kHz/23Hz−17kHz
Av. Pickup impedance	43K
Pickup sensitivity	3.9mv
Pickup clipping	48.5mv
Pickup capacitance	20pf
Auxiliary impedance	64.5K
Auxiliary sensitivity	247mv
Tape impedance	11.5KΩ
Tape sensitivity	578.5mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	740mv
Max level from pickup (RO)	547.5mv
Tape output impedance DIN Av	–
Tape output impedance phono Av	6.4K
Av. Pickup noise ref 8mv record output socket unw	73dB
Av. Pickup noise ref 8mv record output socket CCIR	71.5dB
Amp output noise @ 0 volume unw	400μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	88.6dB
Worst weighted noise Aux in/L out S/N ratio	78.7dB

Tuner

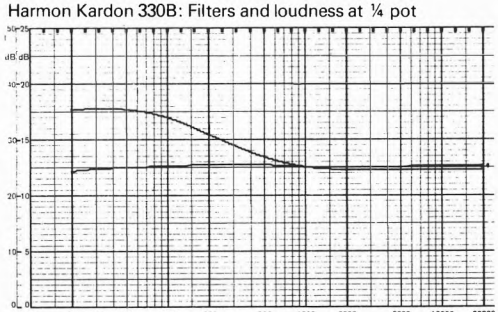
Mono RF sensitivity 30dB IHF	1.5μv
Mono RF sensitivity 50dB IHF	3.2μv
Stereo RF sensitivity 50dB IHF	46μv
IM RF	64.4dB
Adjacent Channel worst figure	4dB
Alternate Channel worst figure	55dB
Image Response	46dB
Capture Ratio	1.25dB
AM Reject	70dB
Mono distortion 100% 1kHz centre tune worst case	0.4%
Optimum tune mono Average	0.07%
Stereo L= −R centre tune L	0.36%
Stereo L= −R centre tune R	0.35%
Av. Stereo R= −L centre tune	0.27%
MPX filter reject worst fig. @ 19kHz	50dB
MPX filter reject worst fig. @ 38kHz	72dB
X talk centre tune worst fig. 1kHz	44dB
X talk centre tune worst fig. 10kHz	29.5dB
Optimum tune 1kHz L/R	44.5/44dB
FR Frequency response stereo −1dB L/R	13Hz−16.1K/15.7K
FR Frequency response stereo 3dB L/R	6Hz−16.7K/16.3K
Error @ 15kHz L/R	+1/0dB
Limit threshold	.9μv
Mute threshold	none
Av. Stereo S/N weighted 100μv/1mV	47/65dB
Av. Stereo unw 1mV	61.5dB
Av. Mono weighted 1mV	75dB
RRP Ex VAT	£125.00

Occasionally discounted



Harmon Kardon 330B: Tone controls

Harmon Kardon 330B: Filters and loudness at ¼ pot



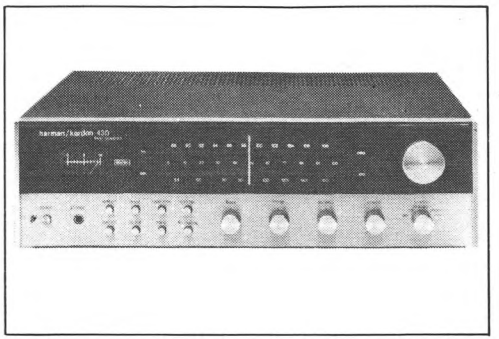
(Tested on 50dB scale)

It gives up to 28W per channel (both driven) in to either or both of two loudspeaker pairs. Loudspeaker connections are by a push lock. A two core mains lead is supplied with one switched and one unswitched mains outlet socket, and a spare earth terminal. Inputs include pick up, auxiliary, and tape, the last being available on phonos or five 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. The receiver is housed in a black metal case having ventilation slots above and below, towards the rear. 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 on to 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 just a little hissy, and this might 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. RF intermod and image were acceptable, and IF breakthrough was very low. Local oscillator radiation was slightly higher than average. The distortion and frequency response performances were generally excellent. Crosstalk performance was reasonable, but improved dramatically when tuned slightly off centre, which therefore 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 provides generally very good quality, but unfortunately will only give its best FM performance with a 300 ohm aerial feed, or with a special 75 ohm/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 in to headphones. This receiver is very free indeed from local radio frequency interference, highly commendable. As far as we can ascertain this is the only receiver in the survey having a dual power supply, which helps it to give optimum performance up to its output limitation. The unswitched AC outlet socket could be dangerous, and we would have preferred to see a three core mains lead, but this applies in so many cases. Many facilities found in other receivers are lacking here, but its simplicity may well attract purchasers.



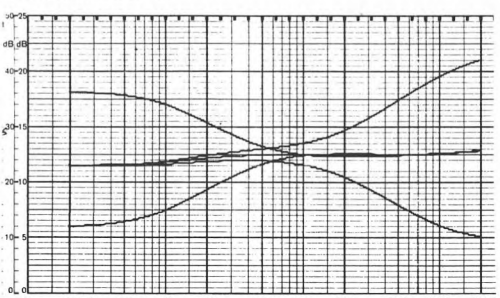
Amplifier

Av. Power output both channels driven	28W
Power output single channel driven	28W
Power output tone burst average	36W
Idle DC out worst case	3mv
Turn on/off Max. DC (swing worst case)	1.4v
Damping Factor L= −R	34/35%
IM 10w L/R	0.14/0.13%
IM 100mw L/R	0.045/0.048%
IM 1% output watts L/R	19.5/19.5W
Av. IM distortion pickup input/record out	0.011%
Av. Harmonic Distortion 0.1% (power cut)	27.4W
Power Bandwidth L/R 0.1%	<10Hz–20kHz/<10Hz–21kHz
Av. Pickup impedance	50KΩ
Pickup sensitivity	2.8mv
Pickup clipping	88mv
Pickup capacitance	20pf
Auxiliary impedance	43KΩ
Auxiliary sensitivity	136.5mv
Tape impedance	43KΩ
Tape sensitivity	136.5mv
Mic impedance	—
Mic sensitivity	—
Mic clipping	—
Max level from tuner (RO)	600mv
Max level from pickup (RO)	360mv
Tape output impedance DIN Av	470KΩ
Tape output impedance phono Av	1.1Ω
Av. Pickup noise ref 8mv record output socket unw	74dB
Av. Pickup noise ref 8mv record output socket CCIR	71dB
Amp output noise @ 0 volume unw	910μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	81.9dB
Worst weighted noise Aux in/L out S/N ratio	80dB

Tuner

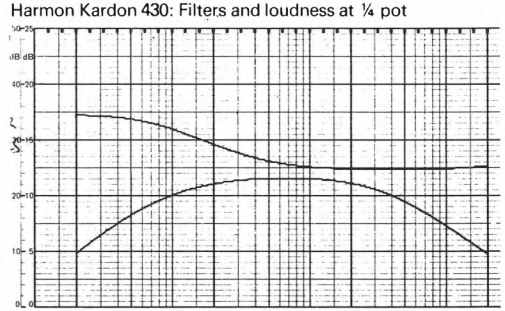
Mono RF sensitivity 30dB IHF	2.7μv
Mono RF sensitivity 50dB IHF	5.2μv
Stereo RF sensitivity 50dB IHF	60μv
IM RF	63.4dB
Adjacent Channel worst figure	0dB
Alternate Channel worst figure	40dB
Image Response	60.3dB
Capture Ratio	1.5dB
AM Reject	58dB
Mono distortion 100% 1kHz centre tune worst case	0.24%
Optimum tune mono Average	0.07%
Stereo L= −R centre tune L	0.19%
Stereo L= −R centre tune R	0.19%
Av. Stereo R= −L centre tune	0.16%
MPX filter reject worst fig. @ 19kHz	50dB
MPX filter reject worst fig. @ 38kHz	68dB
X talk centre tune worst fig. 1kHz	36dB
X talk centre tune worst fig. 10kHz	30dB
Optimum tune 1kHz L/R	42.5/43dB
FR Frequency response stereo −1dB L/R	16Hz–14.3K/14.8K
FR Frequency response stereo 3dB L/R	9Hz–15.4K/15.8K
Error @ 15kHz L/R	−2/−1.25dB
Limit threshold	1.5μv
Mute threshold	VAR*
Av. Stereo S/N weighted 100μv/1mV	46/65dB
Av. Stereo unw 1mV	72dB
Av. Mono weighted 1mV	81dB
RRP Ex VAT	£179.00

Occasionally discounted



Harmon Kardon 430: Tone controls

Harmon Kardon 430: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Hitachi SR 502

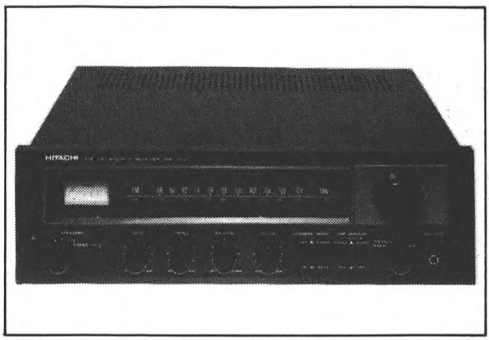
Hitachi Sales (UK) Limited, Hitachi House, Station Road, Hayes, Middlesex. 01-848 8787

Only basic facilities are provided, and output is 26W per channel. It has pick up and auxiliary inputs and two tape input/outputs, either of which can be monitored, and a dubbing switch. The tuner section has an aerial input for 300 ohms only on terminals. A ferrite rod is included for medium wave AM reception. Two pairs of loudspeakers can be accommodated with independent switching, and these are connected on screw up terminals. A three core mains lead is provided, and also a separate earth terminal. All the selectable inputs and tape outputs are on phono sockets, although an additional 5 pole DIN socket is supplied for feeding one tape output. Wooden side cheeks are complemented by metal top and bottom covers, which are well ventilated. Volume, balance, bass and treble controls are rotary. They do not have centre indents, but are reasonably smooth, although they can pull off. A stereo headphone jack is mounted on the front panel.

The amplifier section had higher than average intermodulation distortion, although the harmonic distortion measured well at middle frequencies. The half power bandwidth was very poor indeed, but no trouble was experienced with DC on the output, either idle or switched transients. The damping factor was fairly good, and in general the controls were well ganged, although the bass control tracking was a little out (maximum error 2dB). The tape DIN socket presented the correct level to DIN recorders. We noted that the tuner output here was some 3dB higher than the equivalent pick up output, but the RIAA characteristic and the input impedance measured well. The amplifier, whilst being basically quiet with volume down, became very hissy with volume up when switched to the auxiliary input, although this hiss almost completely disappeared when switched to the tape monitor. Quite clearly the auxiliary input is being amplified with virtually unity gain in a rather noisy circuit, presumably an emitter follower. In general the normal tape in and out impedances and levels were satisfactory. No rumble or treble filters are incorporated, and whilst the bass control had adequate variation the treble control only gave ± 8.5 dB variation at 10kHz, which is not quite adequate. The amplifier seemed subjectively better than the measurements indicated, and certainly should not create any problems.

Unfortunately only 300 ohm aerial installations (or 75 ohm ones with a suitable input transformer) will give optimum results with this receiver, and indeed the appropriate sensitivities were pretty good, as were capture ratio, IF breakthrough, AM rejection (exceptional) and local oscillator radiation. The adjacent and alternate channel performance was satisfactory, but the image response, RF intermodulation and limit threshold measurements were rather poor. The stereo distortion figures were very good up to the normal peak deviation, but mono programmes, which are sometimes marginally louder, just began to show slight distortion at peaks, although this was not too serious. The signal to noise ratios generally were very good, and whilst the crosstalk was good an improvement was noted if the tuner was slightly mistuned. The large tuning knob was a little stiff and wobbly, and had slight backlash, but the actual tuning scale was pretty accurate. The multiplex filter was exceptionally poor at 19kHz. The frequency response fell to −4dB at 15kHz, which is quite good. Only a signal strength meter is provided for tuning.

This receiver seems reasonable value for money, although it has compatibility problems. Local VHF transmissions caused noticeable problems in the amplifier section, being picked up in the mains or loudspeaker leads. Recommended with caution, then.

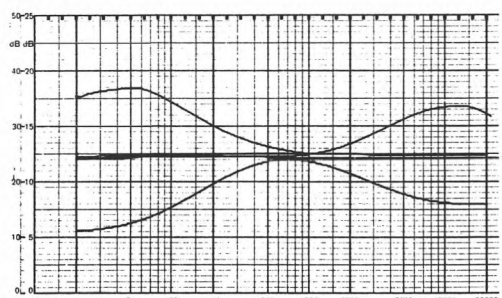


Amplifier

Av. Power output both channels driven	26W
Power output single channel driven	32W
Power output tone burst average	32.5W
Idle DC out worst case	2.8mv
Turn on/off Max. DC (swing worst case)	–
Damping Factor L= –R	26/27%
IM 10w L/R	0.094/0.2%
IM 100mw L/R	0.25/0.26%
IM 1% output watts L/R	20/20W
Av. IM distortion pickup input/record out	0.0055%
Av. Harmonic Distortion 0.1% (power cut)	23.6W
Power Bandwidth L/R 0.3%	<10Hz–8kHz/<10Hz–14kHz
Av. Pickup impedance	47.5KΩ
Pickup sensitivity	2.9mv
Pickup clipping	98mv
Pickup capacitance	100pf
Auxiliary impedance	108KΩ
Auxiliary sensitivity	224mv
Tape impedance one/two	57KΩ/57KΩ
Tape sensitivity one/two	222mv/222mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	880mv
Max level from pickup (RO)	562.5mv
Tape output impedance DIN Av	102KΩ
Tape output impedance phono Av	985Ω
Av. Pickup noise ref 8mv record output socket unw	71.5dB
Av. Pickup noise ref 8mv record output socket CCIR	67dB
Amp output noise @ 0 volume unw	295μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	86.5dB
Worst weighted noise Aux in/L out S/N ratio	66.6dB

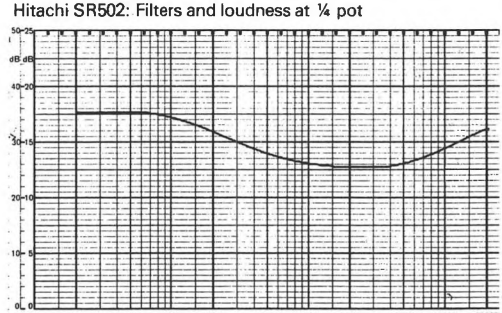
Tuner

Mono RF sensitivity 30dB IHF	2.1μv
Mono RF sensitivity 50dB IHF	4μv
Stereo RF sensitivity 50dB IHF	40μv
IM RF	62.5dB
Adjacent Channel worst figure	4dB
Alternate Channel worst figure	41dB
Image Response	54.4dB
Capture Ratio	1dB
AM Reject	80dB
Mono distortion 100% 1kHz centre tune worst case	0.5%
Optimum tune mono Average	0.3%
Stereo L= –R centre tune L	0.15%
Stereo L= –R centre tune R	0.18%
Av. Stereo R= –L centre tune	0.23%
MPX filter reject worst fig. @ 19kHz	35.5dB
MPX filter reject worst fig. @ 38kHz	63.5dB
X talk centre tune worst fig. 1kHz	39.5dB
X talk centre tune worst fig. 10kHz	32.5dB
Optimum tune 1kHz L/R	47/49dB
FR Frequency response stereo –1dB L/R	31Hz–10K/9.8K
FR Frequency response stereo 3dB L/R	14Hz–14.4K/14.2K
Error @ 15kHz L/R	–3.25/–3.5dB
Limit threshold	2μv
Mute threshold	9μv
Av. Stereo S/N weighted 100μv/1mV	48.5/64.5dB
Av. Stereo unw 1mV	69.5dB
Av. Mono weighted 1mV	70dB
Typical retail price ex VAT	£114.00



Hitachi SR502: Tone controls

Hitachi SR502: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Having a measured output of 28W at 1% distortion with both channels driven, this is the only receiver in the survey to include a graphic equaliser as a tone control. Switchable feeds to two pairs of loudspeakers are provided. There is no AC mains outlet, and the mains lead is three core. A separate earth push lock connector allows external equipment to be earthed direct to the chassis. Pull/push loudspeaker wire connectors allow rapid attachment. The input selector chooses phono, auxiliary 1 and 2, FM radio, MW and LW AM. Levers are incorporated for tape monitor, high frequency roll off, loudness, mono/stereo and FM mute, and a power on/off. Five vertical levers operate in 13 steps centre frequencies of 40Hz, 250Hz, 1kHz, 5kHz, and 15kHz, and adjust the response approximately from +13dB to −12dB (see pen chart). The balance control, having a centre indent, is very smooth, as is the volume control. An additional smaller rotary pot controls an extremely insensitive microphone input. The case is partly wood and partly metal, with ventilation grills, and the tuning dial illuminates green. All inputs are on phone sockets, but the tape connectors are on DIN and phono sockets. Break points are provided for insertion of external equipment immediately before the power amplifier.

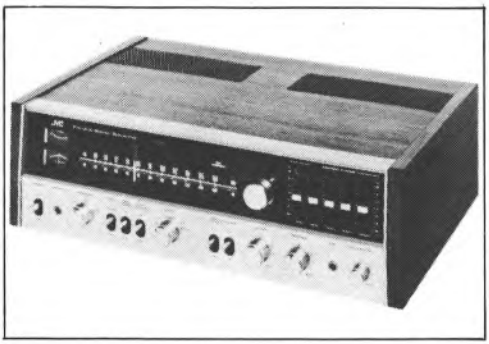
The intermodulation distortion performance of the amplifier section was very good, and some extra power was available on transients, allowing the amplifier to sound louder than the continous power tests suggest. The amplifier output noise was satisfactory, although hiss became just noticeable when the volume control was at 2 o'clock. The pick up input had very low distortion with the correct input impedence and sensitivity, although the clipping margin was barely adequate. The pick up/record output gain was slightly high, and 3dB less gain would have improved the level compatibility with the tuner, and the clipping margin. The auxiliary and tape input impedances and sensitivities were satisfactory. Despite the complexity of the tone controls their effect on the two channels was almost indentical, as was the tracking of the volume control.

Both damping factor and DC output measurements were good. The pick up input had a good signal to noise ratio, but a slight bass lift was noted of 2dB at 20Hz. No rumble filter was provided since the graphic equaliser gives such a remarkable available variation in the overall frequency response. The graphic equaliser was certainly most effective, but might well be rather a gimmick after its novelty had worn off. The subjective quality of the amplifier was pretty good, although interconnection with external equipment presented some serious AM breakthrough problems from both Capital Radio and Radio 4 (a few miles away).

The tuner performance left a lot to be desired since the distortion figures, unfortunately, were very poor, in particular the very high R−L figure of 5%! Despite the signal to noise ratio being exceptionally good on strong signals the frequency response was totally inadequate, but in practice it could be partially corrected with the graphic equaliser, though tape recorders would be badly down in top.

Although RF intermodulation performance and adjacent and alternate channel measurement were very good, RF sensitivity, image response and IF breakthrough were only fair. The limiting threshold was poor, but the capture ratio, AM rejection and local oscillator radiation were good. Tuning accuracy was excellent. The multiplex filter, though good at 19kHz was poor at 38kHz, and trouble might be experienced with some recorders when taping stereo broadcasts. Crosstalk was poor at middle frequencies and exceptionally bad at high ones, showing severe misalignment of the decoder on our sample.

This receiver can only be recommended if a built in graphic equaliser is essential, since the tuner performance is very poor with respect to distortion and crosstalk. It is possible that other samples might be better aligned. If the unit had a better tuner performance the receiver would be better value for money. Electromagnetic compatibility was very poor when no external equipment was plugged in, suggesting internal earth routing problems.



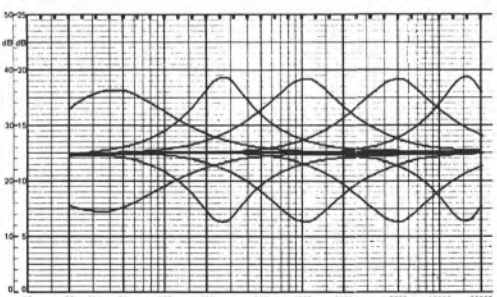
Amplifier

Av. Power output both channels driven	28W
Power output single channel driven	33W
Power output tone burst average	39W
Idle DC out worst case	24mv
Turn on/off Max. DC (swing worst case)	3.8v
Damping Factor L= −R	42/35%
IM 10w L/R	0.048/0.054%
IM 100mw L/R	0.054/0.06%
IM 1% output watts L/R	21/21W
Av. IM distortion pickup input/record out	0.015%
Av. Harmonic Distortion 0.1% (power cut)	26.3W
Power Bandwidth L/R 0.1%	14Hz–10kHz/14Hz–10kHz
Av. Pickup impedance	44KΩ
Pickup sensitivity	2.1mv
Pickup clipping	62mv
Pickup capacitance	65pf
Auxiliary impedance one/two	54.5KΩ/54.5KΩ
Auxiliary sensitivity one/two	124mv/124mv
Tape impedance	59KΩ
Tape sensitivity	124mv
Mic impedance	20KΩ
Mic sensitivity	12.3mv
Mic clipping	21.5mv
Max level from tuner (RO)	390mv
Max level from pickup (RO)	424mv
Tape output impedance DIN Av	54KΩ
Tape output impedance phono Av	555Ω
Av. Pickup noise ref 8mv record output socket unw	77dB
Av. Pickup noise ref 8mv record output socket CCIR	71.5dB
Amp output noise @ 0 volume unw	305μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	86.6dB
Worst weighted noise Aux in/L out S/N ratio	77.5dB

Tuner

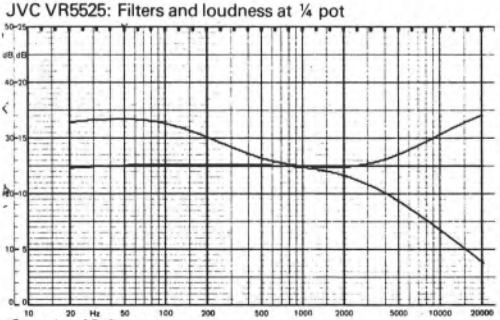
Mono RF sensitivity 30dB IHF	2μv
Mono RF sensitivity 50dB IHF	4μv
Stereo RF sensitivity 50dB IHF	40μv
IM RF	74.4dB
Adjacent Channel worst figure	4dB
Alternate Channel worst figure	54dB
Image Response	61.9dB
Capture Ratio	1.5dB
AM Reject	59dB
Mono distortion 100% 1kHz centre tune worst case	0.38%
Optimum tune mono Average	0.28%
Stereo L= −R centre tune L	0.65%
Stereo L= −R centre tune R	0.95%
Av. Stereo R= −L centre tune	0.5%
MPX filter reject worst fig. @ 19kHz	52dB
MPX filter reject worst fig. @ 38kHz	40.5dB
X talk centre tune worst fig. 1kHz	27dB
X talk centre tune worst fig. 10kHz	13dB
Optimum tune 1kHz L/R	29dB/32dB
FR Frequency response stereo −1dB L/R	7Hz–4.2K/4.3K
FR Frequency response stereo 3dB L/R	4Hz–9.9K/10K
Error @ 15kHz L/R	−7.25dB/−7.25dB
Limit threshold	2.5μv
Mute threshold	4.5μv
Av. Stereo S/N weighted 100μv/1mV	51/67dB
Av. Stereo unw 1mV	67dB
Av. Mono weighted 1mV	84dB
RRP Ex VAT	£205.00

Occasionally discounted



JVC VR5525: Tone controls

JVC VR5525: Filters and loudness at ¼ pot



(Tested on 50dB scale)

This provides up to 22W per channel continuously in to 8 ohms, and there is only one pair of terminals provided for speaker connections. A stereo headphone jack is located on the front panel. A three core mains lead is complemented by one switched outlet socket and also a separate earth terminal. Two pick-up inputs, two auxiliary inputs and provision for connecting a tape recorder with monitoring are provided for, the latter being interconnected with either phonos or a 5 pole DIN socket having an appropriate source impedance. All the tone, balance and volume controls are of slider type of better than average construction, although these were not liked by the reviewer, since it was difficult to set them for a nominal flat response (no centre indents or tone cancellation provided). No treble roll offs or rumble filters are included, but an RIAA input has an inherent rumble filter built in permanently (−3dB at 32Hz). Controls include AM/FM/FM mute, mono/stereo, tape monitor and loudness. The case is basically wood with a metal base, and is well ventilated. A ferrite rod antenna is supplied for AM (MW), but has a vertical tilt angle which does not allow the basic pick up angle to change, which is silly. The tuning scale is rather short, and the tuning knob felt spongy, some backlash being noted.

The amplifier performed pretty well within its ratings. The IM distortion figures were only average at higher levels but they improved at lower ones. Harmonic distortion performance was not too good at high levels, and thus the half power bandwidth was measured at 0.3%, extending to above 30kHz on both channels (excellent). No DC output problems were experienced, and the general output noise was adequate, although some slight hiss was noted when the volume control was advanced to 2/3. All the controls had good tracking between channels, and the loudness control performed well. The tone controls had adequate variation, although perhaps a little more 10kHz cut might have been welcome (N.B. no treble filter). The pick-up input characteristics were very good, but the output level here was rather higher than the tuner's.

The tuner's RF front end gave a rather average performance even considering the modest price, but we noted specifically some severe RF intermodulation distortion which caused severe spurii to appear across the band. Since the RF screening was rather poor, some measurements were made extremely difficult to mute. The IF rejection was very good, but other parameters only fair. The multiplex filter was not really adequate at 19kHz, and the general noise performance was just satisfactory at normal signal strengths, weaker stereo signals becoming rather noisy. Crosstalk performance was rather poor, and was probably misaligned, but the distortion and frequency response figures were good. Only an RF signal strength meter is included.

I am not particularly enthusiastic about this receiver. Although the amplifier sounded quite well and no specific problems were encountered, the tuner's performance left a lot to be desired. In particular, problems are likely to be encountered if you live anywhere near your local FM radio transmitters, since several spurii will be found across the band (perhaps other samples might be better). Almost no interference was produced, though, from local AM radio transmitters. Finally, although I personally do not like faders in domestic equipment, some undoubtedly will, and so this equipment might be suitable for locations away from large urban areas with their attendant transmitters. The manufacturers must improve the second harmonic distortion performance of the main amplifier section, since the output had to be reduced on one channel to only 11W for 0.1% THD to be achieved, although the other channel gave 16W for the same figure (probably incorrect DC biasing).

Picture unavailable at time of going to Press

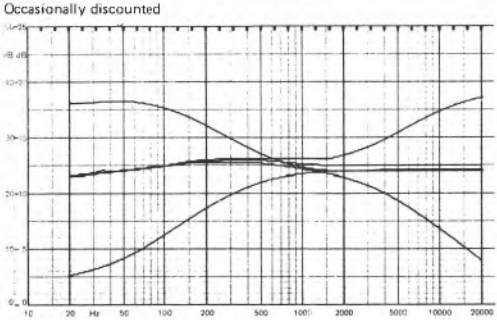
Amplifier

Av. Power output both channels driven	22W
Power output single channel driven	26.6W
Power output tone burst average	25W
Idle DC out worst case	<200μv
Turn on/off Max. DC (swing worst case)	3.6v
Damping Factor L= –R	25/21%
IM 10w L/R	0.12/0.12%
IM 100mw L/R	0.06/0.06%
IM 1% output watts L/R	16.5/16.5W
Av. IM distortion pickup input/record out	0.01%
Av. Harmonic Distortion 0.1% (power cut)	15W
Power Bandwidth L/R 0.1%	100Hz–8kHz/100Hz–8kHz
Av. Pickup impedance one/two	48KΩ/48KΩ
Pickup sensitivity one/two	3.7mv/3.7mv
Pickup clipping one/two	127mv/127mv
Pickup capacitance one/two	218pf/218pf
Auxiliary impedance one/two	49KΩ/49KΩ
Auxiliary sensitivity one/two	239mv/239mv
Tape impedance	61.5KΩ
Tape sensitivity	239mv
Mic impedance	—
Mic sensitivity	—
Mic clipping	—
Max level from tuner (RO)	340mv
Max level from pickup (RO)	398mv
Tape output impedance DIN Av	81KΩ
Tape output impedance phono Av	1.5KΩ
Av. Pickup noise ref 8mv record output socket unw	72.5dB
Av. Pickup noise ref 8mv record output socket CCIR	69dB
Amp output noise @ 0 volume unw	740μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	90dB
Worst weighted noise Aux in/L out S/N ratio	80.7dB

Tuner

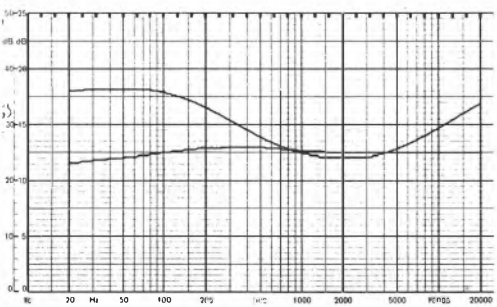
Mono RF sensitivity 30dB IHF	1.8μv
Mono RF sensitivity 50dB IHF	3.5μv
Stereo RF sensitivity 50dB IHF	50μv
IM RF	59.5dB
Adjacent Channel worst figure	0dB
Alternate Channel worst figure	45dB
Image Response	71.8dB
Capture Ratio	1.6dB
AM Reject	58dB
Mono distortion 100% 1kHz centre tune worst case	0.19%
Optimum tune mono Average	0.1%
Stereo L= –R centre tune L	0.4%
Stereo L= –R centre tune R	0.4%
Av. Stereo R= – L centre tune	0.13%
MPX filter reject worst fig @ 19kHz	42.5dB
MPX filter reject worst fig @ 38kHz	57dB
X talk centre tune worst fig 1kHz	29dB
X talk centre tune worst fig. 10kHz	24dB
Optimum tune 1kHz L/R	30/30dB
FR Frequency response stereo –1dB L/R	19Hz–13.4K/13.8K
FR Frequency response stereo 3dB L/R	10Hz–15.2K/15.5K
Error @ 15kHz L/R	–2.5/–2.25dB
Limit threshold	1.3μv
Mute threshold	3.5μv
Av. Stereo S/N weighted 100μv/1mV	49/61.5dB
Av. Stereo unw 1mV	68dB
Av. Mono weighted 1mV	72dB
RRP Ex VAT	£157.00

Occasionally discounted



LG 3400G: Tone controls

LG 3400G: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Senior model to the LG3400 with almost identical styling and all the same facilities plus some others including switchable provision for driving two pairs of loudspeakers. Also included are rumble and treble roll offs. The output power for both channels driven is 33W per channel (1% THD). Please refer to the 3400 review for details.

The half power band width was measured at 0.1% and extended to above 40Hz, and since the model 3400 had to be measured at 0.3%, the 3600 is clearly better. The IM distortion was average and showed a slight degradation at 100mW, but we suspect that it might well degrade further at much lower levels. The harmonic distortion measured fairly well, 0.1% THD being reached at 31W per channel, and the closeness of this latter figure to the 1% THD figure is regarded with satisfaction. The pick up input impedance was satisfactory, although the capacitance measured much higher than average at 230pF, and this will clearly resonate with some high inductance cartridges within the audio range, and cause ringing, allowing for an additional capacity of 110pF in an average pick up lead. The pick up output was approximately 3.5dB higher than that which would be typically obtained from the tuner. The auxiliary and tape input and output impedances and sentitivities were fully compatible with DIN and normal phono standards as found in practice. The RIAA pick up response fell fairly sharply below 40Hz and the rumble filter started cutting abnormally high at 150Hz. This produced a 10dB cut at 50Hz which is totally unacceptable. The treble roll off was 6dB per octave and cut −3dB at 5Hz. The tone controls, volume control and filters tracked very well between channels, but as with the 3400 it was difficult to position the controls accurately in the centre since no centre indents were provided. The amplifier ran hot after a while, and it would not be advisable to operate the receiver in an enclosed space. The general amplifier and pre-amplifier noise performances were good, and the tone controls provided a reasonable response variation.

As with the 3400, the crosstalk performance was rather poor, and almost certainly the decoder had not been correctly aligned. The general distortion performance was good, although L−R fully deviated at 1kHz showed 0.55% on the left output channel (not too bad). The s/n performance was very good on strong signals. On weaker signals the mono and stereo noise performance was quite acceptable. The capture ratio, RF intermod and local oscillator radiation measurements were rather poor, although the general RF sensitivities were pretty good. The adjacent and alternate channel measurements were good. We must commend the image response which is extremely good. The tuning dial accuracy reached a maximum error of 500kHz at 94mHz, which was one of the worst errors noted in this respect. The multiplex filter was rather mediocre, although the frequency response itself measured quite well, being only −3dB at 15kHz.

I cannot be particularly enthusiastic about this receiver, for although it sounded quite well on strong FM signals many of the parameters measured better on other models at the same, or lower, price. The sound quality was slightly over bright, although not specifically disliked, and if you did want this amplifier's power rating with slide faders which are better than average then you might find this model attractive. Some interference was produced on the pick up input from local amateur radio VHF transmissions, and this could present a problem to some potential users. Only average value for money.

Picture unavailable at time of going to Press

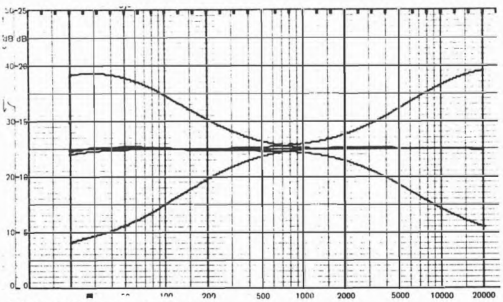
Amplifier

Av. Power output both channels driven	33W
Power output single channel driven	38.7W
Power output tone burst average	39.2W
Idle DC out worst case	–
Turn on/off Max. DC (swing worst case)	7.5v
Damping Factor L= –R	24/23%
IM 10w L/R	0.14/0.12%
IM 100mw L/R	0.17/0.19%
IM 1% output watts L/R	24/23W
Av. IM distortion pickup input/record out	0.008%
Av. Harmonic Distortion 0.1% (power cut)	31W
Power Bandwidth L/R 0.1%	25Hz–40kHz/17.5Hz–50kHz
Av. Pickup impedance one/two	47KΩ/47KΩ
Pickup sensitivity one/two	2.4mv/2.4mv
Pickup clipping one/two	132mv/132mv
Pickup capacitance one/two	230pf/230pf
Auxiliary impedance one/two	50KΩ/50KΩ
Auxiliary sensitivity one/two	151mv/151mv
Tape impedance one/two	63KΩ/63KΩ
Tape sensitivity one/two	151mv/151mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	320mv
Max level from pickup (RO)	420mv
Tape output impedance DIN Av	81KΩ
Tape output impedance phono Av	1.65KΩ
Av. Pickup noise ref 8mv record output socket unw	76.5dB
Av. Pickup noise ref 8mv record output socket CCIR	74dB
Amp output noise @ 0 volume unw	400μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	89.5dB
Worst weighted noise Aux in/L out S/N ratio	82.6dB

Tuner

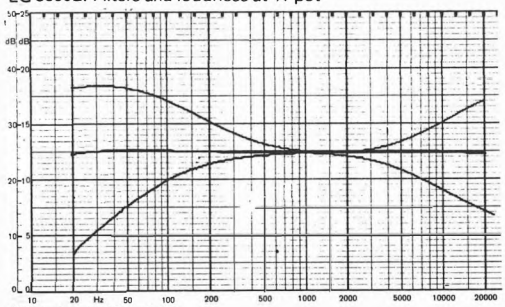
Mono RF sensitivity 30dB IHF	1.8μv
Mono RF sensitivity 50dB IHF	3.1μv
Stereo RF sensitivity 50dB IHF	30μv
IM RF	60dB
Adjacent Channel worst figure	0dB
Alternate Channel worst figure	52dB
Image Response	none
Capture Ratio	3.25dB
AM Reject	57dB
Mono distortion 100% 1kHz centre tune worst case	.2%
Optimum tune mono Average	0.2%
Stereo L= –R centre tune L	0.17%
Stereo L= –R centre tune R	0.19%
Av. Stereo R= –L centre tune	0.32%
MPX filter reject worst fig. @ 19kHz	0.45%
MPX filter reject worst fig. @ 38kHz	56.5dB
X talk centre tune worst fig. 1kHz	28dB
X talk centre tune worst fig. 10kHz	26dB
Optimum tune 1kHz L/R	36/30dB
FR Frequency response stereo –1dB L/R	18Hz–13.6K/13.4K
FR Frequency response stereo 3dB L/R	10Hz–14.9K/15K
Error @ 15kHz L/R	–3dB/–3dB
Limit threshold	1.1μv
Mute threshold	6μv
Av. Stereo S/N weighted 100μv/1mV	50/66dB
Av. Stereo unw 1mV	67.5dB
Av. Mono weighted 1mV	75dB
RRP Ex VAT	£184.00

Occasionally discounted



LG 3600E: Tone controls

LG 3600E: Filters and loudness at ¼ pot



(Tested on 50dB scale)

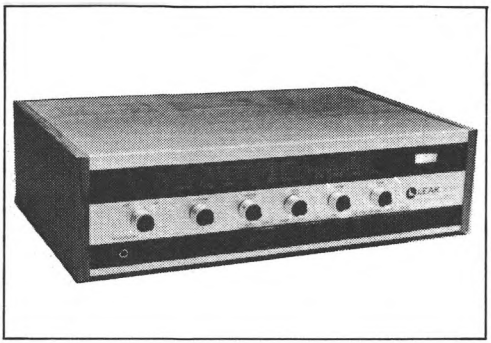
Rank Audio Products Limited, PO Box 70, Great West Road, Brentford, Middlesex. 01-568 9222

From the Leak stable which produced the well-known Stereofetic and Delta range, this gives an output of 23W per channel into two switchable pairs of speakers (connections on DIN loudspeaker sockets). The housing is very similar to the model 2000 (see review) and the main differences are the inclusion of a rumble filter, but the exclusion of auxiliary, cassette, quasi stereo, pseudo quad and mono high power functions. The FM mute level is pre set at 1uV, which is too low, and the receiver does include MW AM, but not LW. Mains input and output sockets are identical to the 2000. The unit is clearly only very basic, but fills an obvious need for many potential purchasers. The DIN tape socket has a source impedance of 110K ohms, and can thus only be used with DIN inputs on properly compatible DIN recorders (see *Hi-Fi Choice No. 1: Cassette Recorders*).

This moderatly priced unit gave quite a good account of itself with its amplifier section, and the sound quality was slightly preferred to the model 2000. The IM distortion figures were excellent at higher levels, but degraded slightly at lower ones, and the harmonic distortion figures measured well. The output s/n ratio was good but some breakthrough could be heard when monitoring, even if the monitor input switch was left on tuner. Those tape recorders presenting a fairly low impedance to the 1800 would reduce this breakthrough. The controls tracked adequately. The rumble filter (6dB per octave) cut off −3dB at 110Hz (frequency too high) whilst the treble roll off cut at the same slope from 4.5kHz. No loudness control is incorporated (a blessing for some!). All the levels were compatible with DIN standards, and the pick up input impedance was well optimised. The idle DC output offset measured badly at a permanent 100mV on one channel, and this could introduce slight bass distortion on some speakers. The pick up pre amplifier noise performance measured slightly below average, but will probably be adequate.

The decoder section of the FM tuner was clearly exceptionally well aligned, producing remarkable crosstalk figures and had considerably less than average distortion. Strong stereo stations reproduced with just a little hiss, and I would look for a 4dB improvement for it to be completely acceptable by current hi-fi standards. The capture ratio was superb, and the RF input sensitivities very good. The image response was poor (beware of aircraft flight paths). The multiplex filter was excellent, as was the response, although subjectively the sound quality was a little too bright, though always very clean. A signal strength meter is provided for tuning, but we thought the tuning scale somewhat cramped at its LF end, and the tuning rather stiff.

This product can clearly be recommended at its price, and although it lacks many facilities it did perform pretty well, giving a particularly good sound quality from the tuner, despite the slight noise that might be audible on some classical music programmes on Radio 3. The amplifier's sound quality was bettered by a few of its competitors at around the same price. We all found the centre indent controls most helpful, and distinctly preferable to ones having a visual centre line (see forward section). Virtually no interference was created by local LF and VHF radio transmissions, and this is particularly commendable. Regarded as good value for money. if obtained at a discount, despite its simplicity which will nevertheless attract many.



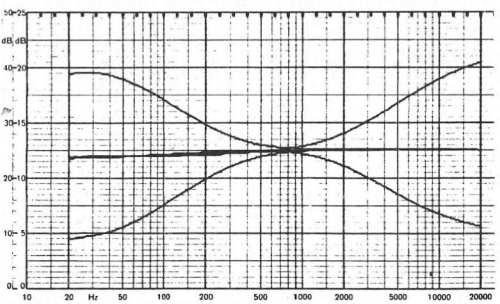
Amplifier

Av. Power output both channels driven	23W
Power output single channel driven	28W
Power output tone burst average	30W
Idle DC out worst case	99mv
Turn on/off Max. DC (swing worst case)	5.5v
Damping Factor L= –R	44/44%
IM 10w L/R	0.022/0.032%
IM 100mw L/R	0.08/0.075%
IM 1% output watts L/R	16.5/16.5W
Av. IM distortion pickup input/record out	0.029%
Av. Harmonic Distortion 0.1% (power cut)	21.1W
Power Bandwidth L/R 0.1%	17Hz–10kHz/14Hz–12.5kHz
Av. Pickup impedance	46K
Pickup sensitivity	2.7mv
Pickup clipping	167mv
Pickup capacitance	150pf
Auxiliary impedance	–
Auxiliary sensitivity	–
Tape impedance	63KΩ
Tape sensitivity	133.5mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	29.5mv
Max level from pickup (RO)	21.75mv
Tape output impedance DIN Av	110KΩ
Tape output impedance phono Av	–
Av. Pickup noise ref 8mv record output socket unw	72dB
Av. Pickup noise ref 8mv record output socket CCIR	68.5dB
Amp output noise @ 0 volume unw	700μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	84.7dB
Worst weighted noise Aux in/L out S/N ratio	79.7dB

Tuner

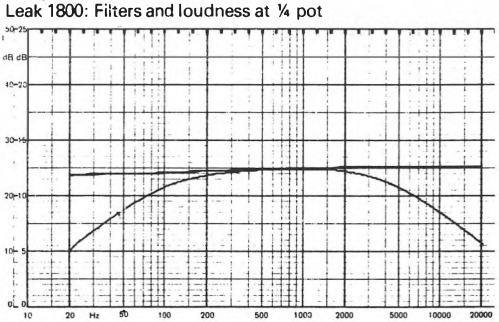
Mono RF sensitivity 30dB IHF	1.3μv
Mono RF sensitivity 50dB IHF	3μv
Stereo RF sensitivity 50dB IHF	25μv
IM RF	74.6dB
Adjacent Channel worst figure	0.5dB
Alternate Channel worst figure	45dB
Image Response	55.8dB
Capture Ratio	0.75dB
AM Reject	58dB
Mono distortion 100% 1kHz centre tune worst case	0.29%
Optimum tune mono Average	0.15%
Stereo L= –R centre tune L	0.2%
Stereo L= –R centre tune R	0.22%
Av. Stereo R= –L centre tune	0.22%
MPX filter reject worst fig. @ 19kHz	70dB
MPX filter reject worst fig. @ 38kHz	59dB
X talk centre tune worst fig. 1kHz	50dB
X talk centre tune worst fig. 10kHz	35dB
Optimum tune 1kHz L/R	55/53dB
FR Frequency response stereo –1dB L/R	7.7Hz–15.7K/15.5K
FR Frequency response stereo 3dB L/R	4Hz–16K/15.9K
Error @ 15kHz L/R	+0.75/+0.25dB
Limit threshold	.8μv
Mute threshold	1μv
Av. Stereo S/N weighted 100μv/1mV	50.5/59dB
Av. Stereo unw 1mV	63.5dB
Av. Mono weighted 1mV	63.5dB
RRP Ex VAT	£151.96

Normally substantially discounted



Leak 1800: Tone controls

Leak 1800: Filters and loudness at ¼ pot



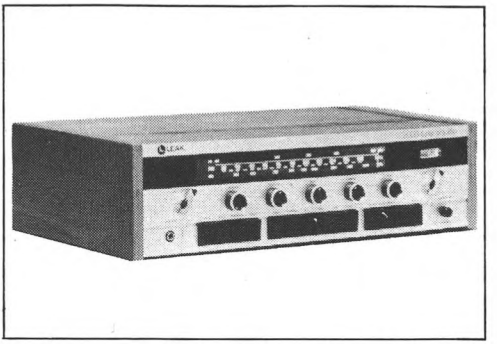
(Tested on 50dB scale)

Clearly, this has been developed from the earlier and highly successful Leak Stereofetic tuner, and their Delta range of amplifiers. 30W per channel is available, in two selectable output loudspeaker pairs, which can also be connected in a pseudo quad arrangement with a push button, allowing different channel signals to be fed to the rear speakers. A stereo headphone jack provides a reasonable level for high impedance headphones, but much too high a level for 8 ohm ones (damage to the phones and your ears is possible!). A three core mains lead is provided, and two AC outlets (one switched) with European type round two pin sockets. All the input and output connectors are the appropriate DIN type, no phono sockets being mounted at all. Record output levels can be switched optimally for DIN or phono recorders. Inputs include pick up, auxiliary, cassette and mains recorder, the cassette input/output not having monitoring facility. Balance, bass and treble controls have helpful centre indents, but feel rather rough. A series of flat push buttons incorporate a 12dB/octave treble filter (−3dB at 5.5kHz) FM mute (with variable mute pot) AFC, stereo width narrowing (FM), mono/stereo, input selection, loudness, tape monitor and speaker selection. A LW and MW AM section is also fitted, but no ferrite rod is available. A 75 ohm RMA coax socket is complemented by a 300 ohm balanced 2 pin one, and a separate AM terminal is fitted. The unit is housed in a wooden case with a metal base.

Although all normal laboratory measurements showed the amplifier section to be very good the subjective quality was at times rather hard, although bass frequencies seemed pretty good. The IM performance, for example, measured exceptionally well. A rather high dc offset was noted on one out put channel. The tracking of all the controls was at least reasonable. The treble filter was excellent. The pick up input performance measured extremely well, and had an excellent s/n ratio with a good clipping margin (two pick-up sensitivities switchable). All the general input and output impedances and levels were extremely well compromised, and compatible with sensitivity switching throughout. The tone controls had quite a wide range of adjustment and were well liked. For special uses the two outputs can be combined to give a very high power of 91W in to an 8 ohm load. A break point is provided (five pole DIN) for insertion of external equaliser. The loudness control affects only the bass, and was well liked. The amplifier became rather warm in use.

The tuner's RF sensitivities all measured extremely well, but the adjacent and alternate channel measurements were only average. The image response, RF, IM and local oscillator radiation were all poor. The capture ratio and limiting threshold were really excellent, and whilst the decoder gave amazing crosstalk figures at 1kHz, they deteriorated to average at high frequencies. Whilst the receiver was very good on weaker mono and stereo signals, strong stereo ones reproduced with only a very average s/n ratio. The multiplex filter was exceptionally good, as was response, although we detected slight over brightness in the presence region. A centre zero tuning meter is located behind the tuning dial, which was fairly accurate. The tuning knob was disliked, and was rather stiff. Subjectively the tuner sounded very good although the stereo distortion figures were just a little higher than average.

In general I liked this receiver, and it can be recommended, although I would like to see a quieter and better decoder fitted. The marginally below average amplifier sound quality showed up in some complex charts, producing noticeable IM peaks in the presence and bass region. If bought at a discount, reasonable value for money with excellent electromagnetic compatibility.



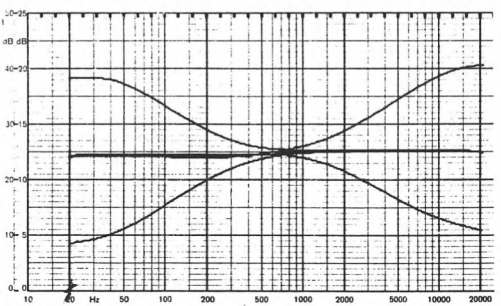
Amplifier

Av. Power output both channels driven	30W*
Power output single channel driven	34W
Power output tone burst average	39.2W
Idle DC out worst case	66mv
Turn on/off Max. DC (swing worst case)	3v
Damping Factor L= —R	39/46%
IM 10w L/R	0.01/0.02%
IM 100mw L/R	0.05/0.05%
IM 1% output watts L/R	22.8/22.8W
Av. IM distortion pickup input/record out	0.011%
Av. Harmonic Distortion 0.1% (power cut)	30W
Power Bandwidth L/R 0.1%	<10Hz—18kHz/<10Hz—24kHz
Av. Pickup impedance one/two	48KΩ/48KΩ
Pickup sensitivity one/two	2.3mv/6.2mv
Pickup clipping one/two	123mv/123mv
Pickup capacitance one/two	80pf/80pf
Auxiliary impedance one/two	128KΩ/94.5KΩ
Auxiliary sensitivity one/two	136mv/527mv
Tape impedance one/two	128KΩ/+128KΩ
Tape sensitivity one/two	139.5mv/139.5mv
Mic impedance	—
Mic sensitivity	—
Mic clipping	—
Max level from tuner (RO)	420mv
Max level from pickup (RO)	375mv
Tape output impedance DIN Av	108KΩ/9.3KΩ
Tape output impedance phono Av	—
Av. Pickup noise ref 8mv record output socket unw	66dB
Av. Pickup noise ref 8mv record output socket CCIR	72.5dB
Amp output noise @ 0 volume unw	1.8mv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	86.3dB
Worst weighted noise Aux in/L out S/N ratio	78.7dB

Tuner

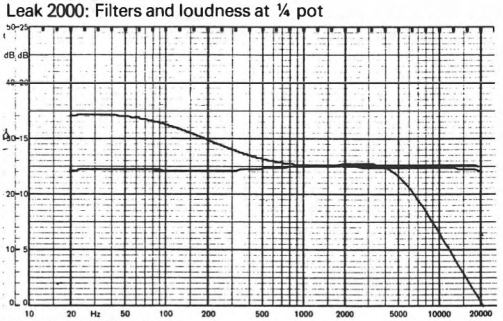
Mono RF sensitivity 30dB IHF	1.2μv
Mono RF sensitivity 50dB IHF	2μv
Stereo RF sensitivity 50dB IHF	20μv
IM RF	68.2dB
Adjacent Channel worst figure	0.5dB
Alternate Channel worst figure	44dB
Image Response	57.5dB
Capture Ratio	1dB
AM Reject	55dB
Mono distortion 100% 1kHz centre tune worst case	0.24%
Optimum tune mono Average	0.17%
Stereo L= —R centre tune L	0.62%
Stereo L= —R centre tune R	0.62%
Av. Stereo R= —L centre tune	0.17%
MPX filter reject worst fig. @ 19kHz	71dB
MPX filter reject worst fig. @ 38kHz	61dB
X talk centre tune worst fig. 1kHz	43dB
X talk centre tune worst fig. 10kHz	31dB
Optimum tune 1kHz L/R	53.5/55dB
FR Frequency response stereo —1dB L/R	8Hz—12.3K/12.6K
FR Frequency response stereo 3dB L/R	4Hz—15.4K/15.7K
Error @ 15kHz L/R	—1.5/—1.25dB
Limit threshold	0.7μv
Mute threshold	0.8μv/60mv
Av. Stereo S/N weighted 100μv/1mV	54/61.5dB
Av. Stereo unw 1mV	68dB
Av. Mono weighted 1mV	66dB
RRP Ex VAT	£179.17

Normally substantially discounted.



Leak 2000: Tone controls

Leak 2000: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Howland West Limited, 3/5 Eden Grove, London N7 8EQ.
01-609 0293/4/5

Some outstanding features are included. Output is 45W per channel. Up to three loudspeaker systems can be connected to the receiver with push lock connectors, and either any single system can be chosen, or the main system with one other pair, thus avoiding a possible amplifier overload situation. A stereo headphone jack operates well with medium impedance phones, but will not give as much level as is normal into 8 ohm ones. Inputs include two phono, two auxiliary and two tape recorder ones, with facilities for dubbing the latter in either direction. All these inputs and tape outputs are on phono sockets with an extra 5 pole DIN connector for feeding one recorder. Separate bass and treble controls having 11 click positions are provided for each channel, and the volume control is split with a friction lock, and thus no balance control is provided, which is extremely annoying for many users. A three core mains lead is provided, as are two unswitched and one switched AC output (these are now not recommended). Rumble and treble roll off controls each have two turnover frequencies selectable. Additionally front panel level switches provide FM muting, loudness control or LF boost, mono/stereo /rev. stereo. A separate microphone input has its own mixing gain control, and mono jack socket for P.A. applications. This well styled unit is housed in a wooden case with a ventilated metal base.

The amplifier sounded very well, but rather on the bright side, and lacked punch at very low frequencies. The sound, however, can be described as 'hi-fi-ish'. All the front panel controls worked extremely well, but we intensely disliked the split volume control, making it very difficult to make slight balance changes. The tone burst test revealed clearly a 50% increase in power output on transients, which is welcome, and the intermodulation distortion performance generally was very good, as were the harmonic distortion measurements throughout. No noise problems were experienced. The half power bandwidth was amazing, extending to 55kHz. The damping factor, whilst being good, was just a little disappointing on such a high quality product, and possibly contributed to the slightly soggy deep bass. Extended IM intermodulation plots over the audio spectrum were good, but showed up the presence region as being slightly 'humpy'.

Relays in the loudspeaker circuits prevented any dc from going through them on switch on/off. All the controls tracked excellently, except the volume control which was only fair. The pick up level was some 4dB higher than the tuner level, and the input impedance and capacity were both rather high. The rumble filter was 3dB down at 20/60Hz whilst the treble 'filter' fell 3dB at 6/10kHz, and we liked the loudness/low bass boost control.

The RF performance of the tuner was in general exceptionally good—in particular the adjacent and alternate channel, image, local osc. rad. and IF breakthrough measurements. The tuning knob had rather poor backlash, making the receiver slightly difficult to tune in to stereo. The signal to noise performance was really excellent on strong signals, and pretty good on fairly weak ones, although very weak ones were not quite as good as we had expected. The frequency response was pretty good, and the distortion figures very good, although some high frequency crosstalk was noted. The subjective sound quality produced was very good indeed. No radio frequency interference was produced by local transmitters, and this is most commendable, and allows the receiver to be recommended strongly provided a potential user can accept the volume/balance control inadequacy. It is certainly powerful enough to meet all normal requirements, and offers some unusual facilities, which will attract the real enthusiast. Considerable care has been taken to align the set well, and the only disappointing area was the poor receiver crosstalk, which in context is acceptable. At its price, it can only be said to be reasonable value for money.

Picture unavailable at time of going to Press

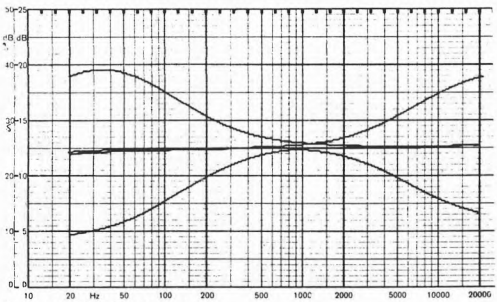
Amplifier

Av. Power output both channels driven	44.6W
Power output single channel driven	52.5W
Power output tone burst average	67W
Idle DC out worst case	5.5mv
Turn on/off Max. DC (swing worst case)	–
Damping Factor L= –R	23/27%
IM 10w L/R	0.01/0.02%
IM 100mw L/R	0.045/0.05%
IM 1% output watts L/R	32/32W
Av. IM distortion pickup input/record out	0.01%
Av. Harmonic Distortion 0.1% (power cut)	40W
Power Bandwidth L/R 0.1%	<10Hz–55kHz/<10Hz–63kHz
Av. Pickup impedance one/two	57.5KΩ/57.5KΩ
Pickup sensitivity one/two	2.8mv/2.8mv
Pickup clipping one/two	120mv/120mv
Pickup capacitance one/two	150/150pf
Auxiliary impedance one/two	77KΩ/77KΩ
Auxiliary sensitivity one/two	160mv/160mv
Tape impedance one/two	98.5KΩ/98.5KΩ
Tape sensitivity one/two	160mv/160mv
Mic impedance	57KΩ
Mic sensitivity	570μv
Mic clipping	22.5mv
Max level from tuner (RO)	310mv
Max level from pickup (RO)	435mv
Tape output impedance DIN Av	90KΩ
Tape output impedance phono Av	1.2KΩ
Av. Pickup noise ref 8mv record output socket unw	71dB
Av. Pickup noise ref 8mv record output socket CCIR	70.5dB
Amp output noise @ 0 volume unw	615μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	83.3dB
Worst weighted noise Aux in/L out S/N ratio	79.7dB

Tuner

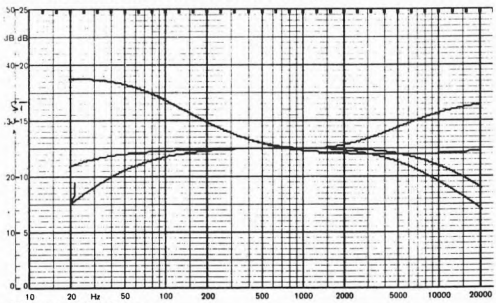
Mono RF sensitivity 30dB IHF	1.5μv
Mono RF sensitivity 50dB IHF	3μv
Stereo RF sensitivity 50dB IHF	40μv
IM RF	72.4dB
Adjacent Channel worst figure	4dB
Alternate Channel worst figure	none
Image Response	none
Capture Ratio	1.5dB
AM Reject	61dB
Mono distortion 100% 1kHz centre tune worst case	0.21%
Optimum tune mono Average	0.21%
Stereo L= –R centre tune L	0.21%
Stereo L= –R centre tune R	0.22%
Av. Stereo R= –L centre tune	0.16%
MPX filter reject worst fig. @ 19kHz	64dB
MPX filter reject worst fig. @ 38kHz	71dB
X talk centre tune worst fig. 1kHz	31.5dB
X talk centre tune worst fig. 10kHz	25.5dB
Optimum tune 1kHz L/R	33.5/32.5dB
FR Frequency response stereo –1dB L/R	13Hz–13.7K/11.3K
FR Frequency response stereo 3dB L/R	7Hz–15K/15.3K
Error @ 15kHz L/R	–3dB/–2.5dB
Limit threshold	1.1μv
Mute threshold	11μv
Av. Stereo S/N weighted 100μv/1mV	50/68dB
Av. Stereo unw 1mV	72.5dB
Av. Mono weighted 1mV	73.5dB
RRP Ex VAT	£232.00

Occasionally discounted



Luxman 800: Tone controls

Luxman 800: Filters and loudness at ¼ pot



(Tested on 50dB scale)

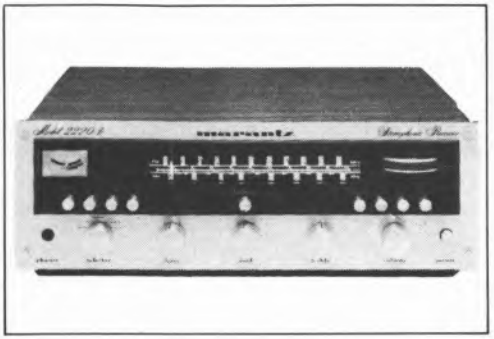
Pyser Limited, Fircroft Way, Edenbridge, Kent TN8 6HA.
0732-71 4111

With 30W per channel, this incorpates a three core mains lead, AC switched and unswitched output sockets and a separate earth terminal. Two pairs of loudspeakers can be separately switched, and the controls are of a push grip type. Phono, auxiliary and two tape recorder input/output sockets are all of phono type, and are appropriately selected by a front panel switch and the tape monitor button. Dubbing is possible from tape 2:1 but not in reverse, and thus tape 2 is only suitable for a two head machine, leaving tape 1 for a recorder with three head monitoring. Push buttons control mono/stereo, loudness, rumble and treble roll offs, and FM muting. The volume control (very smooth) is complemented by a horizontal slider type balance control which has a centre indent, thus making it very simple to use, and reset centrally. The tone controls (bass, mid and treble) all have 11 stepped positions, and were found delightful to use. Rumble and treble roll offs had only 6dB octave slopes, the turnovers being at 180Hz, and 4.5kHz respectively. The rumble filter in particular is so violent that it removes much bass as well as rumble, having a detrimental effect on programmes. The unit has an all metal case with several ventilation slots, and is styled very attractively.

Although this amplifier had generally very low measured intermod and harmonic distortion, and an excellent half power bandwidth, it sounded subjectively rather hard and 'hi-fi-ish'. Some slight pumping effects were noticed at exceptionally low volume settings, but I may be being hypercritical. The tone controls were very well liked and allowed a wide range of control. The tone control and volume tracking were adequate. All the internal noise levels measured very well indeed, including that of the RIAA input. No DC problems were encountered on the outputs which were in any case relay protected. The amplifier had an excellent damping factor. The pick up input impedance was satisfactory, and the clipping margin good, but the output level on the record sockets was well below that from the tuner. The auxiliary and tape inputs were just a little insensitive for some applications (approximately 200mV for full output), but the impedances are all reasonable.

The tuner's s/n performance was about average for stronger signals, but better than average for weak ones. The frequency response was excellent, as were the general distortion levels. The MF crosstalk was really excellent, but at 10kHz it was very average, though performing perfectly adequately. The tuning scale was accurate, and tuning was smooth with no backlash. The RF sensitivity was excellent, giving a remarkable 50dB unweighted s/n at 22uV. The IF and image responses were very good, whilst the capture ratio and RF IM measurements were satisfactory. Other RF measurements were satisfactory, although the adjacent channel performance was rather uneven.

At a discount price this unit is reasonable value for money, but you are recommended to listen to the amplifier section before purchase. The tuner should perform very well in most locations, and its stereo quality is better than average, particularly on weaker signals. The same remarks apply to discriminator and crosstalk alignment as do to the model 2245 (see review). The results in this review are obtained from a re-test sample, since the first one had severe distortion on the tuner section due to the importer's misalignment of the discriminator and crosstalk presets. If you already own a Marantz tuner, check that the onset of distortion occurs equally spaced either side of the centre tuning position on any particular station. If it does not, the discriminator may be out of alignment. Electromagnetic compatibility was quite good, although slight interference was caused from lower frequency AM transmissions if the volume control was almost fully advanced.



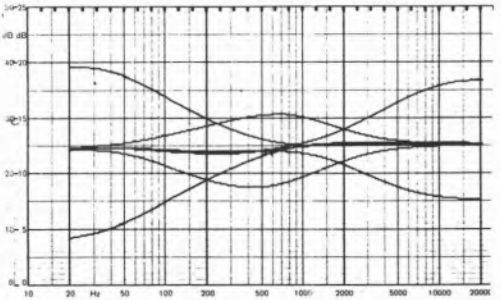
Amplifier

Av. Power output both channels driven	29.5W
Power output single channel driven	34W
Power output tone burst average	39.2W
Idle DC out worst case	8mv
Turn on/off Max. DC (swing worst case)	150mv
Damping Factor L= –R	42/43%
IM 10w L/R	0.021/0.018%
IM 100mw L/R	0.033/0.034%
IM 1% output watts L/R	20.3/21W
Av. IM distortion pickup input/record out	0.0085%
Av. Harmonic Distortion 0.1% (power cut)	27.4W
Power Bandwidth L/R 0.1%	<10Hz–30kHz/<10Hz–31kHz
Av. Pickup impedance	44KΩ
Pickup sensitivity	2.4mv
Pickup clipping	114mv
Pickup capacitance	65pf
Auxiliary impedance	128KΩ
Auxiliary sensitivity	215mv
Tape impedance one/two	128KΩ/128KΩ
Tape sensitivity one/two	215mv/215mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	1.25v
Max level from pickup (RO)	668mv
Tape output impedance DIN Av.	–
Tape output impedance phono Av.	660Ω
Av. Pickup noise ref 8mv record output socket unw.	76.5dB
Av. Pickup noise ref 8mv record output socket CCIR	72dB
Amp output noise @ 0 volume unw.	163μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	95.8dB
Worst weighted noise Aux in/L out S/N ratio	83.7dB

Tuner

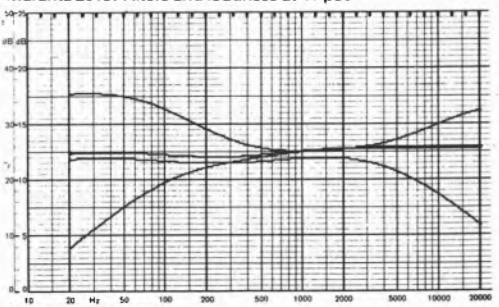
Mono RF sensitivity 30dB IHF	1.1μv
Mono RF sensitivity 50dB IHF	1.8μv
Stereo RF sensitivity 50dB IHF	22μv
IM RF	74.2dB
Adjacent Channel worst figure	–6dB
Alternate Channel worst figure	50dB
Image Response	none
Capture Ratio	2.5dB
AM Reject	59dB
Mono distortion 100% 1kHz centre tune worst case	0.24%
Optimum tune mono Average	0.23%
Stereo L= –R centre tune L	0.21%
Stereo L= –R centre tune R	0.18%
Av. Stereo R= –L centre tune	0.19%
MPX filter reject worst fig. @ 19kHz	65dB
MPX filter reject worst fig. @ 38kHz	>80dB
X talk centre tune worst fig. 1kHz	47dB
X talk centre tune worst fig. 10kHz	28dB
Optimum tune 1kHz L/R	48.5/48dB
FR Frequency response stereo –1dB L/R	12Hz–14.8K/14.5K
FR Frequency response stereo 3dB L/R	6.5Hz–15.5K/15.4K
Error @ 15kHz L/R	–1.25/–1.75dB
Limit threshold	0.8μv
Mute threshold	8.2μv
Av. Stereo S/N weighted 100μv/1mV	53.5/62.5dB
Av. Stereo unw 1mV	64.5dB
Av. Mono weighted 1mV	73dB
RRP Ex VAT	£228.50

Occasionally discounted



Marantz 2015: Tone controls

Marantz 2015: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Marantz 2230

Pyser Limited, Fircroft Way, Edenbridge, Kent TN8 6HA.
0732-71 4111

Very similar in styling to the 2220, this model gives 40W per channel (both driven) and has push lock terminals for two switched pairs of loudspeakers. A three core mains lead and both switched and unswitched AC outlet sockets are provided, together with a separate earth terminal. The unit is housed in a metal cabinet which is well ventilated, thus keeping the running temperature pretty cool. A horizontal tuning wheel was found easy to use, with no backlash, and is accompanied by a smart and accurate tuning scale. 11 stepped position, bass, mid and treble controls, having very even and adequate variation, are commendable, but the balance control had no centre indent, although it was smooth. The input selector switches phono, auxiliary, FM, AM (MW) and tape functions, this last also having a monitoring button. Additional push buttons control loudness, rumble and treble filters, mono/stereo, and FM muting. The filters rolled off from 125Hz (rumble) and 4kHz (treble) at 6dB/octave. The general layout is attractive, and the receiver is very simple to use. Push lock terminals are provided for 75 and 300 ohm FM aerials and an independent AM aerial, and a ferrite rod antenna for MW is located at the rear, with a ridiculous up and down movement giving no control of directivity.

Although this amplifier sounded on the bright side, its general quality was well liked, and no particular problems were experienced in reproduction. The IM and harmonic distortion performances measured very well, and the half power bandwidth extended up to 32kHz, although lower bass frequencies showed a slight increase in distortion. The amplifier's noise level was remarkably low with the volume control at minimum, but some hiss was noticed when it was at three quarters up. The tone and filter control tracking were pretty good, although a slight swing was noticed on the volume control in the top 30dB. Auxiliary and tape input inpedances and sensitivities were quite reasonable, although perhaps a little more sensitivity would have been welcome. The recorder output socket has a very low source impedance and approximately 600mV peak is produced here. The RIAA pre amplifier noise was very low and the input impedance about ideal. The input clipping levels were all excellent. No DC problems occurred at the output, and the damping factor was adequate. The available variation of the tone controls allowed considerable changes in overall response to be obtained.

The first sample had a very poorly aligned discriminator/decoder section, but both the frequency response and noise levels were good. The second sample, aligned on my premises, proved to have remarkably low distortion in all modes, except stereo difference channel which was still nevertheless quite acceptable, approximating 0.5% at full R—L deviation. The frequency response was quite remarkably flat to 15kHz and the s/n performance on both weak and strong stations measured amazingly well, being only bettered marginally by the Marantz 2245, and one or two other excellent tuners. The crosstalk was very good indeed at middle and high frequencies, and the general sound quality was really excellent, both subjectively and in 'on the air' tests. The RF input sensitivity measurements were superb and an input attenuator is provided, padding the aerial signal down by 20dB if necessary. This almost seems redundant because the RF intermod ratio was 81dB! The alternate channel, capture ratio, image response and IF breakthrough measurements were all very good, but some asymmetry was noted in the adjacent channel response. Some interference was noticed on Radio Oxford caused by BBC Radio London here. The limiting threshold was very good indeed, and no local oscillator radiation was noted that could cause trouble. Only an RF signal strength meter is provided, and it is necessary to adjust for peak indication to obtain minimum distortion, provided the tuner is correctly aligned. Generally, then, a most impressive tuner performance.

Although this receiver is rather expensive, even at a discount, it offers an excellent quality tuner with a good amplifier which has some useful features. We all liked the tone controls and the general presentation, and this model can be strongly recommended. Particularly commendable is the fact that no interference was noticed from either low power low frequency radio signals, or even high power VHF ones.

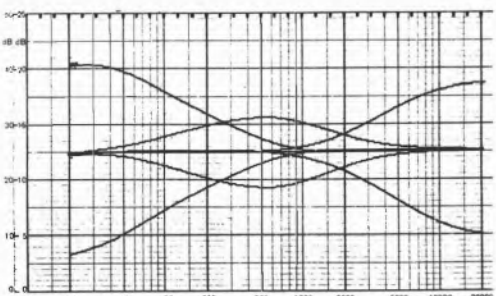
Amplifier

Av. Power output both channels driven	40.5W
Power output single channel driven	46.3W
Power output tone burst average	52W
Idle DC out worst case	<500μv
Turn on/off Max. DC (swing worst case)	6.7v
Damping Factor L= –R	25/28%
IM 10w L/R	0.06/0.13%
IM 100mw L/R	0.1/0.095%
IM 1% output watts L/R	27.2/27.2W
Av. IM distortion pickup input/record out	0.05%
Av. Harmonic Distortion 0.1% (power cut)	38.3W
Power Bandwidth L/R 0.1%	25Hz–33kHz/15Hz–32kHz
Av. Pickup impedance	44.5KΩ
Pickup sensitivity	2.4mv
Pickup clipping	118mv
Pickup capacitance	60pf
Auxiliary impedance	112KΩ
Auxiliary sensitivity	220mv
Tape impedance	117KΩ
Tape sensitivity	230mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	760mv
Max level from pickup (RO)	585mv
Tape output impedance DIN Av	–
Tape output impedance phono Av	90Ω
Av. Pickup noise ref 8mv record output socket unw	75dB
Av. Pickup noise ref 8mv record output socket CCIR	72dB
Amp output noise @ 0 volume unw	210μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	95.4dB
Worst weighted noise Aux in/L out S/N ratio	70.6dB

Tuner

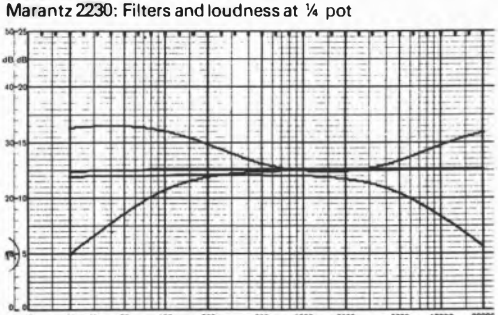
Mono RF sensitivity 30dB IHF	1μv
Mono RF sensitivity 50dB IHF	2μv
Stereo RF sensitivity 50dB IHF	30μv
IM RF	81dB
Adjacent Channel worst figure	–1dB
Alternate Channel worst figure	none
Image Response	72dB
Capture Ratio	1.5dB
AM Reject	57dB
Mono distortion 100% 1kHz centre tune worst case	0.15%
Optimum tune mono Average	0.15%
Stereo L= –R centre tune L	0.14%
Stereo L= –R centre tune R	0.16%
Av. Stereo R= –L centre tune	0.56%
MPX filter reject worst fig. @ 19kHz	>80dB
MPX filter reject worst fig. @ 38kHz	60.5dB
X talk centre tune worst fig. 1kHz	45.5dB
X talk centre tune worst fig. 10kHz	37.5dB
Optimum tune 1kHz L/R	68/51dB
FR Frequency response stereo –1dB L/R	26Hz–15.3K/15.3K
FR Frequency response stereo 3dB L/R	13Hz–15.8K/15.8K
Error @ 15kHz L/R	–0.5/–0.5dB
Limit threshold	0.7μv
Mute threshold	3.5μv→11μv
Av. Stereo S/N weighted 100μv/1mV	53/71dB
Av. Stereo unw 1mV	70.5dB
Av. Mono weighted 1mV	81.5dB
RRP Ex VAT	£215.00

Occasionally discounted



Marantz 2230: Tone controls

Marantz 2230: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Marantz 2245

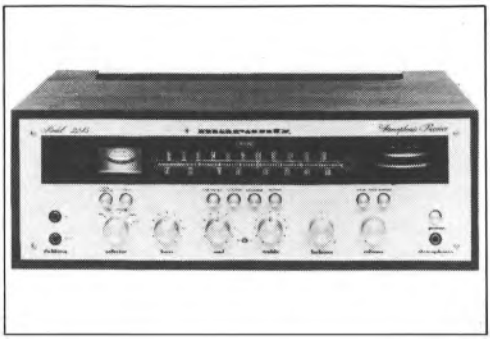
Pyser Limited, Fircroft Way, Edenbridge, Kent TN8 6HA. 0732-71 4111

This 63W per channel model is housed in a completely metal case and is well styled with some excellent features. A 3 core mains lead is supplied together with two AC outlets (one unswitched). A separate earth terminal is included. Phono type input and output sockets on the rear are provided for phono and auxiliary inputs and interconnection with one external tape recorder. Two additional pairs of sockets are connected to a break point immediately before the power amplifier, normally having special shorting links inserted. Loudspeaker outputs (main and remote) can be switched through on the front panel and spring loaded lever type connectors are used as they are also for 75 and 300 ohm FM and AM input aerial connections. A ferrite rod which can only be raised and lowered in a horizontal plane is also provided (why cannot Marantz employ a variable angle mount?). Front panel controls include 11 stepped position, bass, mid and treble and allow independent variation between channels, although they are friction locked and the back section can only be independently varied with difficulty. Push buttons select mono/stereo, loudness, rumble, and treble roll offs, muting and tape monitor. The volume and balance controls are very smooth and have well designed knobs, but the balance is not centre indented. Tuning is accomplished with a horizontal wheel neatly sticking out from the chassis, only a small arc being presented at one time. The tuning scale incorporates centre tuning and signal strength meters. Stereo headphone and tape dubbing jacks are mounted on the front panel.

The amplifier gave a pretty good subjective performance, although slight grittiness was suspected at high levels together with a tendency perhaps of boominess at low frequencies. The intermodulation and harmonic distortion performance was excellent. The basic noise performance of the amplifier section measured well but some slight hiss was introduced when the volume control was at about 3 o'clock. The tone controls provided a very comprehensive range of adjustment but the bass and treble roll offs only operated at 6dB/octave from 140Hz/4kHz respectively. It was felt that the rumble filter should have had a much lower turnover frequency. The tone and filter control tracking was excellent but swings of up to 2dB were noted on different positions of the volume control, thus causing slight image shifts with a change of volume. The half power bandwidth was amazingly good extending to above 42kHz. No DC problems existed on the output circuit and the damping factor was very good. The pick-up pre-amp noise performance was excellent and its input impedance and clipping margin about optimum. I must applaud the excellent general input and output levels, sensitivities and impedances on the auxiliary and tape sockets and particularly the compatible output levels from both the pick up and tuner circuitry, thus making interconnection with phono inputs and outputs on recorders very compatible. DIN equipment, however, will have to be used in conjunction with an attenuator lead or adapter.

Let me say straight away that the signal to noise performance of the tuner section is quite remarkable and far better than any actual transmission could ever be, provided a reasonable signal is received. Even weak ones are noticeably less hissy than average. The frequency response was excellent and the multiplex filtering superb. The distortion levels on the re-test sample were very low indeed and the crosstalk quite amazing at middle frequencies but only average at high ones. Unfortunately the first sample had been apparently 'specially aligned for the review' and this had been done incorrectly, but after investigation it would appear that those aligned in the factory are good. The RF section had a superb sensitivity performance and RF intermodulation was virtually completely absent (ratio measured was 82dB!). Of all the tuner measurements the only one which could possibly be criticised was the marginally below average image response. The tuning was very well liked, being smooth and simple to set. An aerial attenuator switch giving 20dB cut is fitted but this seems rather redundant!

Although this model generally performed very well and the tuner section was quite remarkable, even testing my own test equipment, it is certainly not cheap and so is only moderately good value for money. I discovered a serious flaw in the importer's alignment procedures and as a result they are prepared to re-align any receiver that has been serviced by them in the last 2 years. This is serious for them, but their attitude is clearly extremely helpful. This problem would not arise if the equipment was not unsealed when delivered to the retailer. Otherwise only the discriminator and crosstalk presets might need re-adjustment. No amateur transmissions gave any trouble to this receiver—most commendable.



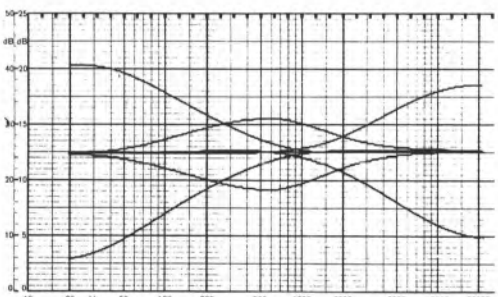
Amplifier

Av. Power output both channels driven	62.5W
Power output single channel driven	66W
Power output tone burst average	70W
Idle DC out worst case	6mv
Turn on/off Max. DC (swing worst case)	100mv
Damping Factor L= –R	43/45%
IM 10w L/R	0.006/0.015%
IM 100mw L/R	0.06/0.06%
IM 1% output watts L/R	42/42W
Av. IM distortion pickup input/record out	0.004%
Av. Harmonic Distortion 0.1% (power cut)	59W
Power Bandwidth L/R 0.1%	<10Hz–42kHz/<10Hz–42kHz
Av. Pickup impedance	45KΩ
Pickup sensitivity	2.5mv
Pickup clipping	120mv
Pickup capacitance	95pf
Auxiliary impedance	125KΩ
Auxiliary sensitivity	215mv
Tape impedance one/two	125KΩ/130KΩ
Tape sensitivity one/two	215mv/220mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	720mv
Max level from pickup (RO)	640mv
Tape output impedance DIN Av.	–
Tape output impedance phono Av	50Ω
Av. Pickup noise ref 8mv record output socket unw	77dB
Av. Pickup noise ref 8mv record output socket CCIR	72dB
Amp output noise @ 0 volume unw	275μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	94.5dB
Worst weighted noise Aux in/L out S/N ratio	77.5dB

Tuner

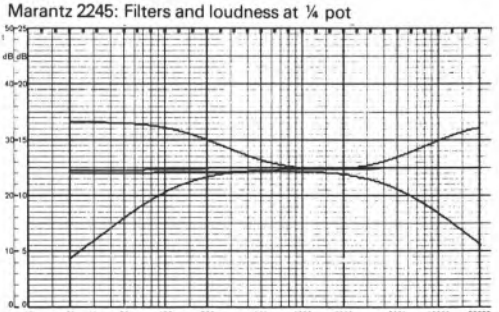
Mono RF sensitivity 30dB IHF	0.85μv
Mono RF sensitivity 50dB IHF	2μv
Stereo RF sensitivity 50dB IHF	27μv
IM RF	82.5dB
Adjacent Channel worst figure	–1dB
Alternate Channel worst figure	none
Image Response	73dB
Capture Ratio	2dB
AM Reject	55.5dB
Mono distortion 100% 1kHz centre tune worst case	0.14%
Optimum tune mono Average	0.14%
Stereo L= –R centre tune L	0.12%
Stereo L= –R centre tune R	0.15%
Av. Stereo R= –L centre tune	0.55%
MPX filter reject worst fig. @ 19kHz	76dB
MPX filter reject worst fig @ 38kHz	61dB
X talk centre tune worst fig. 1kHz	46dB
X talk centre tune worst fig. 10kHz	31.5dB
Optimum tune 1kHz L/R	54.5/46dB
FR Frequency response stereo –1dB L/R	28Hz–15.2K/28Hz–14.8K
FR Frequency response stereo 3dB L/R	13.5Hz–15.8K/15.5K
Error @ 15kHz L/R	–0.5/–0.5dB
Limit threshold	0.55μv
Mute threshold	4.2μv
Av. Stereo S/N weighted 100μv/1mV	55/74dB
Av. Stereo unw 1mV	79.5dB
Av. Mono weighted 1mV	85.5dB
RRP Ex VAT	£347.00

Occasionally discounted



Marantz 2245: Tone controls

Marantz 2245: Filters and loudness at ¼ pot



(Tested on 50dB scale)

NAD 140

Telydyne Limited, High Street, Houghton Regis, Bedfordshire LU5 2BR. 0582 603151

The new Acoustic Dimension (NAD) 140 gives up to 36W per channel continuous into 8 ohms and thus will certainly be loud enough for the majority of users. A 3 core mains lead, a separate earth terminal and a switched AC outlet socket are provided. Pick-up and tape in/out sockets are of phono type, but 5 pole DIN sockets are mounted for the auxiliary function and also duplicate the tape connections. None of the front panel level controls have centre indents but tone (bass and treble), balance and volume all felt pretty smooth. A treble roll off button is provided but no rumble filter. Other push buttons are loudness, mute, tape monitor, mono/stereo. Two pairs of loudspeakers (main and remote can be selected, and the remote pair can be switched into a 'pseudo quad' mode. (R—L through rear speakers). The unit is housed in a wooden case with metal ventilation panels on the top and bottom. The front is well styled. Terminals are provided for 75 ohm and 300 ohm aerial inputs (FM) and a separate terminal for AM (MW). A ferrite rod for AM is also incorporated and has the usual rather useless up and down movement. Quite clearly the receiver is very basic and also simple to operate. Tape dubbing and headphone jacks are mounted on the front panel.

The amplifier sounded very good indeed within its own output limitations, although a tendency towards soggy bass was noted. However the damping factor measured very well and the half power bandwidth extended to 32kHz. Intermodulation and harmonic distortion measurements measured extremely favourably. Since we were all very concerned about the inconsistency between good lab measurements and poor low bass audible performance, further examination with swept two tone IM tests eventually revealed that indeed there was a slight problem at very low frequencies (below 100Hz), and this almost certainly explains the rather soggy bass sound quality. The output noise levels were good, but some hiss was introduced when the volume control was at 2 o'clock, thus showing that the tone control curcuit was noisy. A slight idle DC voltage was continually noted on both outputs but should not cause significant trouble. I must commend the excellent tracking of all the controls, showing that close tolerance components have been used here. An adequate amount of variation was provided by the tone controls and the treble roll off cut 6dB per octave from 6.5kHz. The pick-up pre-amplifier performance was good having about the right input impedance and very low noise. The clipping margin however was not fully satisfactory. Pick-up and tuner stereo outputs were compatible in level on the record output sockets. A DIN output socket includes an attenuator on the record side and gives a compatible level for DIN inputs. The distortion performance on the tuner section measured fairly well and the frequency response and crosstalk were both excellent. The decoder provided only an average S/N ratio and weak stereo signals were appreciably more hissy than average, although strong ones were satisfactory.

The RF performance was very variable, the RF sensitivities being good for mono but poor for stereo. The IF breakthrough figure was not too good, but the RF intermod performance was superb and one of the best measured. The limiting threshold was disappointing as were the adjacent and alternate channel responses. Quite appalling was the radiation of some 6mV of local oscillator frequency into the aerial and this could cause whistles in neighbour's installations, which might baffle them appreciably! Both tuning and signal strength meters are provided. Unfortunately the AM rejection measured rather badly at only 42dB.

The performance of this receiver is frankly extremely difficult to weight up for some parameters measured excellently whilst others were so disappointing. I feel that the price asked is much too high and this may finally affect the choice, for it cannot be said to be even reasonable value for money. If the tuner hiss levels had been better and the adjacent and alternate channel performance more selective, the unit might have been recommendable, but as it stands, it cannot be. Electromagnetic compatibility was very bad at VHF but good at lower frequencies and trouble may well be experienced from very local VHF amateur radio transmissions.

Picture unavailable at time of going to Press

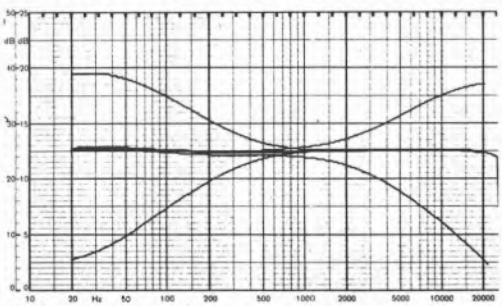
Amplifier

Av. Power output both channels driven	36.5W
Power output single channel driven	42W
Power output tone burst average	45W
Idle DC out worst case	47mv
Turn on/off Max. DC (swing worst case)	9.2v
Damping Factor L= –R	35/35%
IM 10w L/R	0.02/0.036%
IM 100mw L/R	0.02/0.02%
IM 1% output watts L/R	26/26W
Av. IM distortion pickup input/record out	0.033%
Av. Harmonic Distortion 0.1% (power cut)	34W
Power Bandwidth L/R 0.1%	<10Hz–30kHz/<10Hz–32kHz
Av. Pickup impedance	54KΩ
Pickup sensitivity	2.6mv
Pickup clipping	59mv
Pickup capacitance	175pf
Auxiliary impedance	28KΩ
Auxiliary sensitivity	224mv
Tape impedance	44KΩ
Tape sensitivity	224mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	845mv
Max level from pickup (RO)	638mv
Tape output impedance DIN Av	8.7KΩ
Tape output impedance phono Av	2.2KΩ
Av. Pickup noise ref 8mv record output socket unw	71dB
Av. Pickup noise ref 8mv record output socket CCIR	72.5dB
Amp output noise @ 0 volume unw	640μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	89dB
Worst weighted noise Aux in/L out S/N ratio	76dB

Tuner

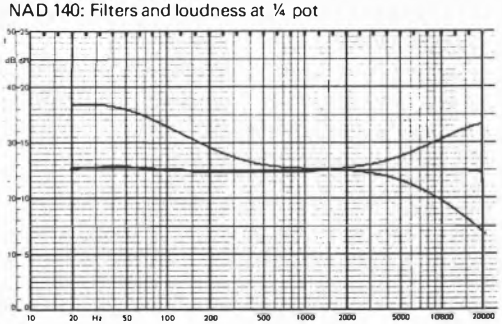
Mono RF sensitivity 30dB IHF	1.5μv
Mono RF sensitivity 50dB IHF	3.5μv
Stereo RF sensitivity 50dB IHF	50μv
IM RF	87.5dB
Adjacent Channel worst figure	–4dB
Alternate Channel worst figure	45dB
Image Response	78dB
Capture Ratio	1.75dB
AM Reject	42dB
Mono distortion 100% 1kHz centre tune worst case	0.44%
Optimum tune mono Average	0.29%
Stereo L= –R centre tune L	0.33%
Stereo L= –R centre tune R	0.32%
Av. Stereo R= –L centre tune	0.33%
MPX filter reject worst fig. @ 19kHz	56dB
MPX filter reject worst fig. @ 38kHz	39dB
X talk centre tune worst fig 1kHz	46dB
X talk centre tune worst fig. 10kHz	37.5dB
Optimum tune 1kHz L/R	60/60dB
FR Frequency response stereo –1dB L/R	15Hz–15K/14.7K
FR Frequency response stereo 3dB L/R	10Hz–15.6K/15.3K
Error @ 15kHz L/R	–1/–2dB
Limit threshold	2.5μv
Mute threshold	6.3μv
Av. Stereo S/N weighted 100μv/1mV	46/63dB
Av. Stereo unw 1mV	65dB
Av. Mono weighted 1mV	71.5dB
RRP Ex VAT	£187.00

Occasionally discounted



NAD 140: Tone controls

NAD 140: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Pioneer SX434

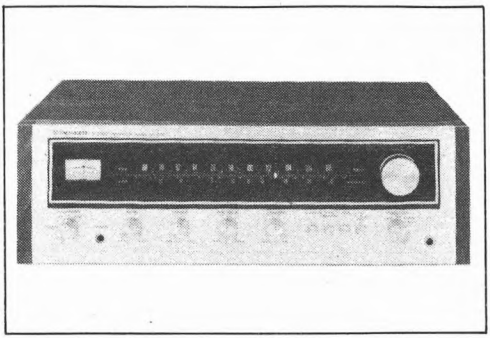
Shriro (UK) Limited, Unit 5b, The Ridgeway, Iver, Bucks. 0753-65 2222

Already acclaimed as being excellent value for money in other publications, and confirmed by our tests. Although specified at only 16W per channel we measured 21W per channel (both driven). A 3 core mains lead is now normally supplied and the AC outlet sockets are now blocked off in accordance with the latest safety recommendations. Two switchable pairs of loudspeakers can be connected to screw terminals and a headphone socket is also provided. The bass and treble controls have 11 evenly steeped positions and the balance control has a centre indent. Loudness, tape monitor, mono/stereo and FM muting buttons are included. An input switch selects pick-up, AM (MW), FM auto, and auxiliary. Pick-up auxiliary and tape in/out sockets are phonos but these are complemented by a 5-pole DIN for tape interconnection with DIN standard recorders. Tuning was very smooth, but slight backlash was noted. It was also slightly difficult to tune into stereo quickly. A ferrite rod is included for AM and terminals for 75 and 300 ohm and external AM aerials. A microphone jack is also provided.

The general sound quality within its power limitation was very good, although low bass frequencies tended to be slightly soggy. The damping factor, however, measured reasonably well. High frequencies were not quite as open as from our standard, but the overall sound was most acceptable. The IM and harmonic distortion measurements were good but the half power bandwidth for 0.1% only extended to 11kHz, (this explains slight lack of HF openness), although no crossover distortion was heard. The signal to noise ratio of the main amp was good but the pick-up input had slight hum, although the hiss level was very low. Headphones operated well. All the controls tracked pretty well and whilst the bass control had adequate variation the treble one did not allow for sufficient cut, especially with the absence of a treble roll off switch. The loudness control worked well. The pick-up input impedance is rather high, and some cartridges might be a little shrill. Clipping levels were satisfactory and the level was compatible with that from the tuner. Record in and out impedances on phone and DIN sockets were satisfactory but the microphone input impedance was very high and its sensitivity very poor (you will have to almost shout into some microphones to get full room volume).

The signal to noise ratios on both weak and strong RF signals measured very well (remarkable for a budget tuner). The frequency response was very good but the MPX filter was very poor and so a cassette recorder including its own MPX filter will be essential. All the distortion measurements were good. The sound quality reproduced was excellent for the price although just a slight marginal roughness was noted at full deviation. The crosstalk figures were incredibly good. The RF sensitivities in mono and stereo measured very well as did IF breakthrough and image response. Adjacent and alternate channel selectivities were adequate and at its price the RF front end was rather better than one might expect. The dial frequency accuracy was reasonable, thus finally endorsing a very good opinion of the entire tuner section.

Undoubtedly this receiver is exceptionally good value for money and can be very strongly recommended indeed if you do not require more than a potential of 20W per channel. Naturally it does not offer the facilities that more expensive models have, but if you require a simple but effective receiver this should suit the bill. Interconnection with external equipment including most recorders presented no problems and the tone controls were very well liked if only a normal range of adjustment is required. Note, though, an absence of filters. The only serious problems which might be encountered is the bad electromagnetic compatibility at low frequencies, but this should be fairly easy to cure with ferrite rings in mains and loudspeaker leads. Its good reputation seems to be now fully justified.



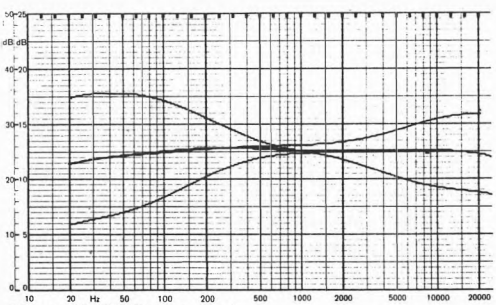
Amplifier

Av. Power output both channels driven	21.1W
Power output single channel driven	24.5W
Power output tone burst average	23.8W
Idle DC out worst case	15mv
Turn on/off Max. DC (swing worst case)	6.5v
Damping Factor L= −R	28/28%
IM 10w L/R	0.32/0.32%
IM 100mw L/R	0.03/0.03%
IM 1% output watts L/R	15.1/15.1W
Av. IM distortion pickup input/record out	0.018%
Av. Harmonic Distortion 0.1% (power cut)	18.75W
Power Bandwidth L/R 0.1%	<10Hz−11kHz/<10Hz−11kHz
Av. Pickup impedance	60KΩ
Pickup sensitivity	7mv
Pickup clipping	88mv
Pickup capacitance	63pf
Auxiliary impedance	86KΩ
Auxiliary sensitivity	208mv
Tape impedance	100KΩ
Tape sensitivity	208mv
Mic impedance	100KΩ
Mic sensitivity	14.3mv
Mic clipping	330mv
Max level from tuner (RO)	520mv
Max level from pickup (RO)	270mv
Tape output impedance DIN Av	82KΩ
Tape output impedance phono Av	4.4KΩ
Av. Pickup noise ref 8mv record output socket unw	69dB
Av. Pickup noise ref 8mv record output socket CCIR	72dB
Amp output noise @ 0 volume unw	1.6mv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	89.8dB
Worst weighted noise Aux in/L out S/N ratio	80dB

Tuner

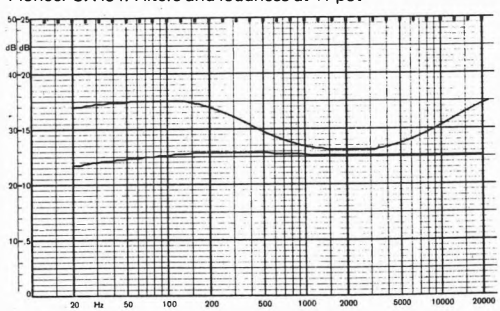
Mono RF sensitivity 30dB IHF	1.2μv
Mono RF sensitivity 50dB IHF	4.2μv
Stereo RF sensitivity 50dB IHF	19μv
IM RF	69.3dB
Adjacent Channel worst figure	1dB
Alternate Channel worst figure	46dB
Image Response	72.7dB
Capture Ratio	1.25dB
AM Reject	51dB
Mono distortion 100% 1kHz centre tune worst case	0.4%
Optimum tune mono Average	0.25%
Stereo L= −R centre tune L	0.33%
Stereo L= −R centre tune R	0.36%
Av. Stereo R= −L centre tune	0.34%
MPX filter reject worst fig. @ 19kHz	36dB
MPX filter reject worst fig. @ 38kHz	38dB
X talk centre tune worst fig. 1kHz	46.5dB
X talk centre tune worst fig. 10kHz	36dB
Optimum tune 1kHz L/R	70/50dB
FR Frequency response stereo −1dB L/R	16Hz−12.3K/11.3K
FR Frequency response stereo 3dB L/R	7Hz−17.7K/17.3K
Error @ 15kHz L/R	−2/−2.25dB
Limit threshold	0.7μv
Mute threshold	0.8μv
Av. Stereo S/N weighted 100μv/1mV	57.5/64dB
Av. Stereo unw 1mV	70.5dB
Av. Mono weighted 1mV	68.5dB
RRP Ex VAT	£134.80

Normally substantially discounted



Pioneer SX434: Tone controls

Pioneer SX434: Filters and loudness at ¼ pot



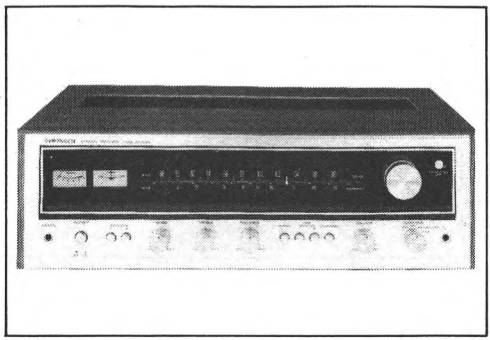
(Tested on 50dB scale)

Relatively low powered giving only 20W per channel continuous into 8 ohms. A 3 core mains lead and an independent earth terminal are provided but there are no AC outlet sockets (in accordance with new safety recommendations). Pick-up, auxiliary, tape 1 and tape 2 connections are on phono sockets, the latter being duplicated with a 5 pole DIN one. 75 and 300 ohm FM aerial terminals are complemented by AM for medium wave and a ferrite rod with a fairly sensible hinge is also included for AM reception. The case is basically wooden but has a metal ventilation grill and a metal bottom. The front panel styling is excellent, very neat with all the controls being easy to operate. The tone controls have 11 stepped positions and the balance control a centre indent. Two pairs of speakers (independently switchable) can be connected to rather awkward screw terminals on the back. Push buttons control mono/stereo, tape monitor 1 and 2, FM mute and loudness functions. No filters are incorporated. An input selector switch chooses medium wave, FM, pick-up/microphone and auxiliary inputs, the microphone facility being achieved on insertion of a jack into a front panel socket. One headphone socket is also included. A dubbing facility is provided from tape 1 to tape 2 by depressing both tape monitor buttons, in which case tape 2 is monitored by the amplifier.

The harmonic distortion performance measured fairly well up to the full output of the amplifier but the IM distortion was around the 0.1% point at all intermediate levels. The half power bandwidth measured very badly, particularly on the left channel for 0.1% but improved substantially when remeasured for 0.3%. The damping factor measured very poorly. In subjective listening tests we all thought the mid and high frequency performance good but noted a rather soggy bass end. Although the general output noise was low, the tone control section did bring in some hiss when the volume control was at 2 o'clock. Although the tracking of the tone and loudness controls was very good, the volume control swung up to 2dB from one channel to another and was thus not quite up to average. Although the bass control had quite a wide range of variation, the treble control was very inadequate, boosting and cutting no more than 6dB maximum at 10kHz, and this is poor considering the receiver does not incorporate a treble roll off button. The loudness control however was satisfactory. The RIAA pre-amp performed very well having a good input impedance, low noise and particularly low hum. At the record output socket the levels were fully compatible with those from the tuner section. The headphone output was satisfactory for both 8 ohm and 600 ohm models. The DIN socket is compatible with DIN inputs. Auxiliary and tape in and out impedances, sensitivities and clipping margins were excellent. No DC output problems were experienced.

The signal to noise performance of the tuner section measured well on strong signals, and very well on comparatively weak ones. The tuner distortion levels all measured extremely well and the general sound quality produced was very clean indeed but a little 'over present' between 6 and 10kHz. The frequency response in fact measured extremely well but the MPX filtering was very poor. The crosstalk performance was clearly superb both subjectively and as measured at all frequencies. The RF input sensitivity measurements were quite remarkably good, 50dB stereo UnW being obtained at only 18uV! The adjacent and alternate channel selectivities were pretty good but the image response and the RF intermodulation figures were rather poor. Both IF rejection and AM suppression were very good. The tuning dial was very accurate but some backlash was noted on the tuning. The limiting threshold was excellent.

Quite clearly this receiver sounded subjectively rather better than some of the lab. measurements might suggest, although the excellent sound quality of the tuner was confirmed by such tests. Apart from the rather poor RF intermodulation figure, the tuner section is particularly good. The lack of variation on the treble control clearly must be heavily criticised but nevertheless this unit seems good value for money. It can certainly be recommended, but look at alternatives before making your choice. Whilst the electromagnetic compatibility was poor at VHF, it was extremely bad at LF, thus preventing the equipment from being used close to any amateur radio transmitters without serious trouble developing. Perhaps an improvement could be made by ferrite ring suppression but possibly something else may have to be done to cure the problem.



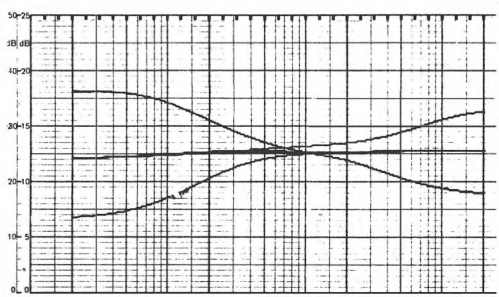
Amplifier

Av. Power output both channels driven	21W
Power output single channel driven	24W
Power output tone burst average	29W
Idle DC out worst case	0.0mv
Turn on/off Max. DC (swing worst case)	4.4v
Damping Factor L= −R	13/25%
IM 10w L/R	0.125/0.085%
IM 100mw L/R	0.1/0.068%
IM 1% output watts L/R	14/16.25
Av. IM distortion pickup input/record out	0.005%
Av. Harmonic Distortion 0.1% (power cut)	18.5W
Power Bandwidth L/R 0.3%	<10Hz–13.5kHz/<10Hz–30kHz
Av. Pickup impedance	50KΩ
Pickup sensitivity	2.2mv
Pickup clipping	105mv
Pickup capacitance	45pf
Auxiliary impedance	80KΩ
Auxiliary sensitivity	129mv
Tape impedance	80KΩ
Tape sensitivity	129mv
Mic impedance	77KΩ
Mic sensitivity	6.2mv
Mic clipping	296mv
Max level from tuner (RO)	575mv
Max level from pickup (RO)	420mv
Tape output impedance DIN Av	80KΩ
Tape output impedance phono Av	3.4KΩ
Av. Pickup noise ref 8mv record output socket unw	76dB
Av. Pickup noise ref 8mv record output socket CCIR	71dB
Amp output noise @ 0 volume unw	295μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	86dB
Worst weighted noise Aux in/L out S/N ratio	75.6dB

Tuner

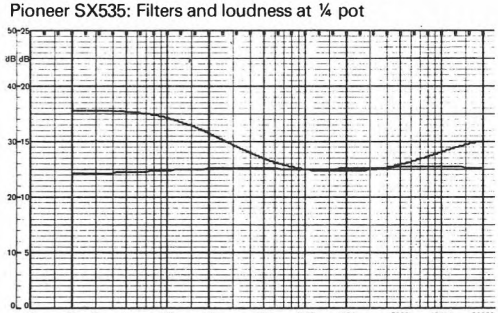
Mono RF sensitivity 30dB IHF	0.75μv
Mono RF sensitivity 50dB IHF	1.7μv
Stereo RF sensitivity 50dB IHF	18μv
IM RF	72.6dB
Adjacent Channel worst figure	3dB
Alternate Channel worst figure	52dB
Image Response	64.8dB
Capture Ratio	1dB
AM Reject	60dB
Mono distortion 100% 1kHz centre tune worst case	0.21%
Optimum tune mono Average	0.13%
Stereo L= −R centre tune L	0.18%
Stereo L= −R centre tune R	0.18%
Av. Stereo R= −L centre tune	0.25%
MPX filter reject worst fig. @ 19kHz	35.5dB
MPX filter reject worst fig. @ 38kHz	48.5dB
X talk centre tune worst fig. 1kHz	48dB
X talk centre tune worst fig. 10kHz	36dB
Optimum tune 1kHz L/R	58/48dB
FR Frequency response stereo −1dB L/R	16Hz–12.8K/12K
FR Frequency response stereo 3dB L/R	8Hz–16.8K/16K
Error @ 15kHz L/R	−2/−2.5dB
Limit threshold	0.55μv
Mute threshold	0.8μv
Av. Stereo S/N weighted 100μv/1mV	56/64dB
Av. Stereo unw 1mV	72dB
Av. Mono weighted 1mV	68.5dB
RRP Ex VAT	£184.78

Normally substantially discounted



Pioneer SX535: Tone controls

Pioneer SX535: Filters and loudness at ¼ pot



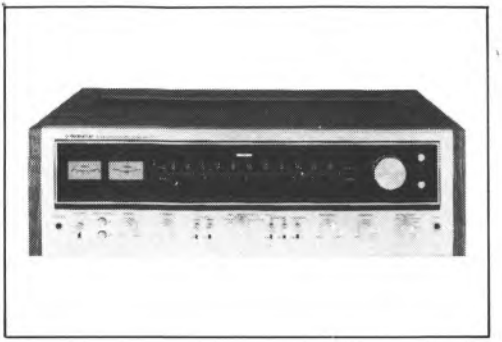
(Tested on 50dB scale)

A fairly powerful receiver with up to 46W per channel (both driven) and some excellent ergonomic features. A 3 core mains lead and a separate earth terminal are provided. Two loudspeaker pairs (switchable) can be connected to terminals on the rear (we would have preferred spring loaded locks here). All the normal inputs and record outputs are on phono sockets, but of the two tape recorder interconnection sockets, tape 2 is duplicated with a 5-pole DIN. A function switch selects between auxiliary, microphone, pick-up, FM and AM. All the controls are very smooth and the balance control has a useful centre indent. Both tone controls have 11 evenly stepped positions and this is excellent. A convenient switch selects the source for tape record, so that it is possible to tape an FM broadcast independently, whilst listening to a record, for example (rare but very useful). Push buttons are provided for FM muting and mono/stereo whilst lever switches incorporate loudness, tape monitors 1/2 and low and high frequency roll offs. The well ventilated wooden case has a metal cover underneath and the entire receiver is extremely well styled and easy to use, although the tuning had to be set very carefully for stereo programmes to switch on the decoder properly, slight backlash being noted on the tuning knob. Centre zero for tuning and RF level meters are provided. A ferrite rod on the rear is provided with a rather poor swivel allowing only limited angle setting.

The amplifier section sounded excellent and gave a most impressive performance generally into BC3 speakers. The IM distortion figures were only average and increased slightly at lower levels, although no crossover distortion was heard. The harmonic distortion measurements were good and the half power bandwidth was superb, extending to at least 50kHz. No output DC problems were encountered. The damping factor was good but the equipment did run fairly warm and might give trouble in an enclosed space. All the signal to noise ratios throughout the pre-amp and amplifier were excellent. All the controls tracked extremely well. The tone controls had adequate variation anf the rumble and HF filters rolled off at 6dB/octave from 125/4kHz respectively. The headphone jack gave an adequate level for all normal types of headphone. The RIAA response was excellent as was the pick up input impedance, capacitance, and clipping margin. The input and output impedances were very compatible with phont and DIN standard recorders etc. The mic input was just a little insensitive and had a rather high impedance and was not really full satisfactory.

The general signal to noise ratios of the tuner section all measured pretty well. The distortion figures were really excellent and the frequency response was also excellent. Crosstalk measured very well but degraded slightly at higher frequencies The RF input sensitivities were all excellent. The image response IF rejections measured exceptionally well but the alternate channel response and RF IM ratio were only average. The tuner was well liked and the tuning indication accurate.

If this receiver is purchased at a good discount, it would be very good value for money. It can be safely recommended and gave a generally very pleasant sound quality. The stepped tone controls and the tape recording source switch must be highly commended and I am surprised that more models do not incorporate a tuner to tape path allowing recording whilst records are being heard. The electromagnetic compatibility whilst being satisfactory on VHF was rather poor at low frequencies. Very local medium wave transmitters or amateur radio low frequency transmissions are likely to cause a problem.



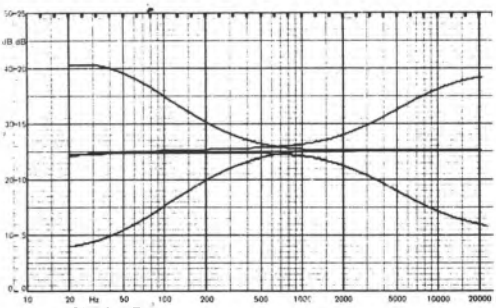
Amplifier

Av. Power output both channels driven	46W
Power output single channel driven	54W
Power output tone burst average	56W
Idle DC out worst case	2mv
Turn on/off Max. DC (swing worst case)	250mv
Damping Factor L= −R	39/34%
IM 10w L/R	0.065/0.07%
IM 100mw L/R	0.22/0.22%
IM 1% output watts L/R	32/32W
Av. IM distortion pickup input/record out	0.01%
Av. Harmonic Distortion 0.1% (power cut)	42.8W
Power Bandwidth L/R 0.1%	<10Hz−>50kHz/<10Hz−>50kHz
Av. Pickup impedance	51KΩ
Pickup sensitivity	2.5mv
Pickup clipping	170mv
Pickup capacitance	50pf
Auxiliary impedance	84KΩ
Auxiliary sensitivity	152mv
Tape impedance one/two	84KΩ/102KΩ
Tape sensitivity one/two	152mv/152mv
Mic impedance	51KΩ
Mic sensitivity	2.6mv
Mic clipping	55mv
Max level from tuner (RO)	600mv
Max level from pickup (RO)	487.5mv
Tape output impedance DIN Av	80KΩ
Tape output impedance phono Av	2.2KΩ
Av. Pickup noise ref 8mv record output socket unw	77dB
Av. Pickup noise ref 8mv record output socket CCIR	71dB
Amp output noise @ 0 volume unw	250μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	91dB
Worst weighted noise Aux in/L out S/N ratio	81.6dB

Tuner

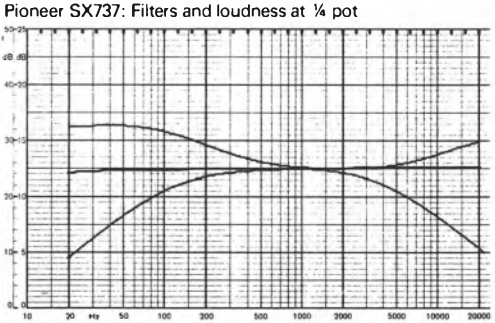
Mono RF sensitivity 30dB IHF	1.1μv
Mono RF sensitivity 50dB IHF	2.7μv
Stereo RF sensitivity 50dB IHF	20μv
IM RF	73.7dB
Adjacent Channel worst figure	3dB
Alternate Channel worst figure	49dB
Image Response	none
Capture Ratio	1.5dB
AM Reject	42dB
Mono distortion 100% 1kHz centre tune worst case	0.15%
Optimum tune mono Average	0.08%
Stereo L= −R centre tune L	0.09%
Stereo L= −R centre tune R	0.11%
Av. Stereo R= −L centre tune	0.21%
MPX filter reject worst fig. @ 19kHz	35.5dB
MPX filter reject worst fig. @ 38kHz	37dB
X talk centre tune worst fig. 1kHz	39dB
X talk centre tune worst fig. 10kHz	32.5dB
Optimum tune 1kHz L/R	43.5/41dB
FR Frequency response stereo −1dB L/R	13Hz−13.6K/13K
FR Frequency response stereo 3dB L/R	6Hz−18kHz/18K
Error @ 15kHz L/R	−1.5/−1.75dB
Limit threshold	0.5μv
Mute threshold	0.65μv
Av. Stereo S/N weighted 100μv/1mV	54/63.5dB
Av. Stereo unw 1mV	70dB
Av. Mono weighted 1mV	68.5dB
RRP Ex VAT	£266.78

Normally substantially discounted



Pioneer SX737: Tone controls

Pioneer SX737: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Pioneer SX 1010

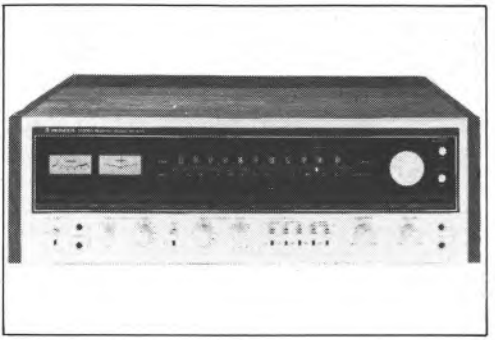
Shriro (UK) Limited, Unit 5b, The Ridgeway, Iver, Bucks. 0753-65 2222

The largest in the Pioneer range, giving 112V per channel in to any or all of three loudspeaker output pairs, which are connected by effective spring loaded clamps. A heavy duty three core mains lead and two separate earth terminals are provided, but there are no AC outlets. The ferrite rod for AM reception has a cup and ball joint which allows it to be directed in to any desired plane. Except for one 5 pole DIN socket for interconnection with tape recorder 2, all inputs and tape in/outs are on phono sockets, and include pick ups 1 and 2, auxiliary, two basic tape in/outs, a Dolby noise reduction in/out break point, a four channel in/out break point and the main amplifier break points, with appropriate shorting bars. 75 and 300 ohm FM aerial terminals are complemented by an AM one. A 25/50/75 uSec tuner de-emphasis switch is provided, which might one day be of use! The case is large and wide, mostly wood, but with metal ventilation panel and base plate. 11 stepped position controls permit adequate variation at 100Hz and 10kHz, and these are complemented by 5 step controls for 50Hz and 20kHz respectively, a tone cancel switch also being provided. 6dB per octave roll off switches cut 3dB at 90Hz/3kHz for rumble and treble roll off respectively. Further switches control tape switching/loudness, audio, mute, mono/stereo, FM mute and illumination dim. Input selection is also on a series of large buttons. Lever switches are provided for Dolby noise reduction (external), 4 channel (external), monitor tape 1 and 2 and tape dubbing. Two microphone input jacks and two headphone jacks are also incorporated. Signal strength and tuning meters are provided, and the tuning knob is very smooth, though unfortunately slight backlash was noted.

The subjective sound quality was excellent, and in particular had an openness and clarity, with a solidity of bass, which was quite rare. The IM and harmonic distortion measurements were all excellent, and the half power bandwidth extended from below 10kHz to above 50kHz on both channels. All the s/n ratios of the pre-amplifier and amplifier measured well. The output damping factor measured very well, and there were no DC output probtected. The volume control tracking was not too good, but the tone control and filter tracking were excellent. A very wide range of response variation was possible, and the tone controls were highly commendable. The RIAA input impedance and clipping margins were very good, and the pick up and the tuner outputs were compatible on the tape record output sockets with DIN or phone recorders.

The tuner section's performance was very good on weaker stations, and good on strong ones both in mono and stereo, and the frequency response measured very well. The multiplex filter was excellent. Whilst the mono distortion figures were very good, the stereo ones were rather average, and some distortion was noted subjectively in the crosstalk. Slight 'splat' was noticed in the clock test and speech roughness was detected in stereo. The crosstalk, however, did measure exceptionally well even at high frequencies. RF sensitivity figures were very good, and the adjacent and alternate channel selectivities excellent. The other front end and IF measurements were very good, except a rather poor AM rejection figure, which could possibly be caused by discriminator misalignment. This may also explain the higher distortion figures noted as compared with another sample I reviewed some 18 months ago, which had a maximum distortion of .4%, and generally was considerably better.

Even if purchased at a discount this receiver is very expensive. Whilst the amplifier section and RF section of the tuner were excellent, it would appear that the stereo tuner distortion was not quite as good as it might have been. Assuming then that other samples might be better in this respect, the receiver can be recommended if you are prepared to pay the price, though other receivers in the survey did seem to offer better value for money either by giving more watts for the same cost or fewer watts for much less cost. To be fair, though, I was very impressed with it generally. Whilst the electromagnetic compatibility was very poor at VHF, it was so bad at LF that a local transmission picked up by the RIAA inputs had the distinction of giving 100W output per channel before the amplifier's protection circuits cut in. This problem is so severe that the receiver cannot be recommended for use anywhere near MW or other lower frequency transmitters, either commercial or amateur. Pioneer in Japan must sort out this problem.



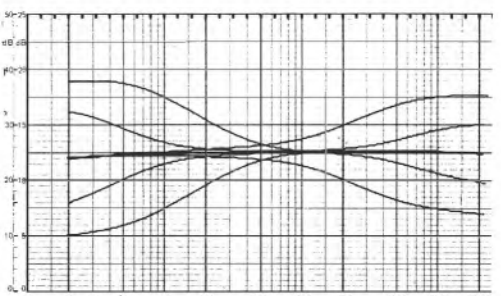
Amplifier

Av. Power output both channels driven	112.5W
Power output single channel driven	128W
Power output tone burst average	144W
Idle DC out worst case	1.8mv
Turn on/off Max. DC (swing worst case)	50mv
Damping Factor L= –R	42/44%
IM 10w L/R	0.03/0.028%
IM 100mw L/R	0.05/0.05%
IM 1% output watts L/R	85/85W
Av. IM distortion pickup input/record out	0.009%
Av. Harmonic Distortion 0.1% (power cut)	108.9W
Power Bandwidth L/R 0.1%	>10Hz–50kHz/>10Hz–50kHz
Av. Pickup impedance one/two	51KΩ/51KΩ
Pickup sensitivity one/two	2.6mv/2.6mv
Pickup clipping one/two	250mv/250mv
Pickup capacitance one/two	100pf/100pf
Auxiliary impedance	85KΩ
Auxiliary sensitivity	150mv
Tape impedance one/two	85KΩ/85KΩ
Tape sensitivity one/two	150mv/150mv
Mic impedance one/two	51KΩ/51KΩ
Mic sensitivity one/two	1.86mv/1.86mv
Mic clipping one/two	200mv/200mv
Max level from tuner (RO)	520mv
Max level from pickup (RO)	412.5mv
Tape output impedance DIN Av	79KΩ
Tape output impedance phono Av	<5Ω
Av. Pickup noise ref 8mv record output socket unw	73dB
Av. Pickup noise ref 8mv record output socket CCIR	71.5dB
Amp output noise @ 0 volume unw	900μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	90dB
Worst weighted noise Aux in/L out S/N ratio	82dB

Tuner

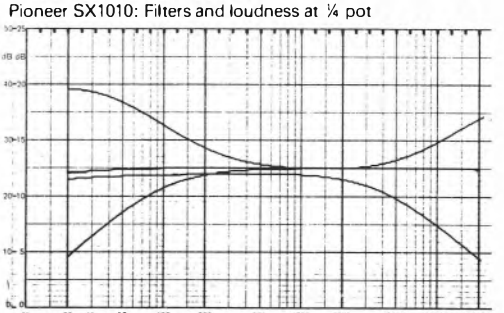
Mono RF sensitivity 30dB IHF	0.9μv
Mono RF sensitivity 50dB IHF	2.5μv
Stereo RF sensitivity 50dB IHF	25μv
IM RF	75.9dB
Adjacent Channel worst figure	2dB
Alternate Channel worst figure	none
Image Response	none
Capture Ratio	1.5dB
AM Reject	46dB
Mono distortion 100% 1kHz centre tune worst case	0.14%
Optimum tune mono Average	0.12%
Stereo L= –R centre tune L	0.72%
Stereo L= –R centre tune R	0.69%
Av. Stereo R= –L centre tune	0.14%
MPX filter reject worst fig. @ 19kHz	68dB
MPX filter reject worst fig. @ 38kHz	none
X talk centre tune worst fig. 1kHz	40dB
X talk centre tune worst fig. 10kHz	38dB
Optimum tune 1kHz L/R	39/38dB
FR Frequency response stereo –1dB L/R	22Hz–12.6K/11.3K
FR Frequency response stereo 3dB L/R	11.6Hz–15.1K/15.3K
Error @ 15kHz L/R	–2.5/–2.5dB
Limit threshold	0.6μv
Mute threshold	1μv
Av. Stereo S/N weighted 100μv/1mV	53.5/64dB
Av. Stereo unw 1mV	66dB
Av. Mono weighted 1mV	69.5dB
RRP Ex VAT	£467.22

Normally substantially discounted



Pioneer SX1010: Tone controls

Pioneer SX1010: Filters and loudness at ¼ pot

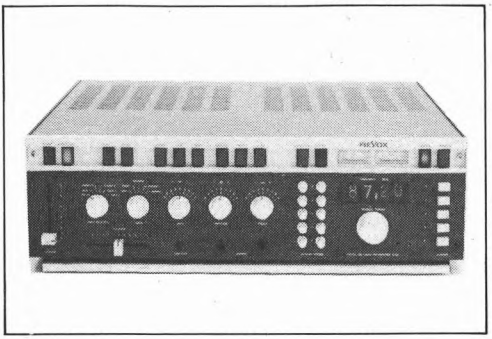


(Tested on 50dB scale)

Unusually, there is no power amplifier section, since it is intended to operate with any suitable high quality stereo power amplifier. A two core mains lead only is provided, and there is a rather inconvenient banana type earth socket. Phono in/out connections include pick ups 1 and 2, auxiliary, tape recorders 1/2 in and out, and power amplifier outputs 1 and 2, but there are no AC outlet sockets. Two additional sockets are provided on the back, which are 5 pole DIN, again for connecting an external main amplifier. There is a remote control socket, a professional BNC coax socket for nominal 60 ohm aerials, and a 300 ohm 2 pin socket also for FM. No AM facility is provided. The case is metal with wooden side cheeks and plastic feet. Although no power amplifier is included the size is about the same as the average complete receiver. The tuner section incorporates five pre-set stations and one tuning knob, which locks every 50kHz across band 2, by means of a crystal controlled tuning system, and so tuning across the band is achieved in frequency jerks, which I found very irritating, although extremely accurate when a station is found. Each pre-set works in conjunction with a mHz and a kHz control, the latter again tuning in 50kHz jumps. Buttons are included for FM mute, stereo/mono and noise filter (stereo hf narrowing). Two meters are incorporated, one for tuning indication and one for signal strength. Frequency is indicated with an LED display, which is bright and easy to read. The pre-amp section incorporates a vertical slide fader main gain control, a side-ways balance fader with no centre indent, and bass, presence and treble controls, having nine evenly stepped positions each. The input selector complements a control which selects stereo, stereo reverse, mono, left or right. Push buttons switch power, and remote operation, with an accessory which controls volume, balance, loudness and station pre-set selectors remotely. Also tape monitors 1/2, loudness, rumble filter, treble filter and binaural output 1 and output 2 switching are provided.

A binaural button enhances stereo reproduction over headphones, for which two jack sockets are provided. The main outputs clipping at 6V have a 430 ohm source impedance. The main fader tracking was good, down to 30dB, but extremely bad between −30 and −50, a maximum error of 6dB being noted. The tone controls tracked well though, but the balance control could only swing each channel 18dB with respect to the other (totally inadequate). The tone controls were liked very much, and had a reasonable range of adjustment, the mid range centering on 3kHz. The treble filter cut −3dB at 7.5kHz, thence 12dB per octave, whilst the rumble filter was −3dB at 50Hz and approached 18dB per octave. The loudness control worked well. Pre-sets are incorporated for pick up, auxiliary and tape input level control, and adequate output levels were present on the tape feed sockets. The pick up pre-amplifier noise was pretty low, and the response extremely flat, with an ideal input impedance. The intermodulation distortion was very low, and the clipping margins depended on pre-set positions. No DIN sockets are provided for tape feeds. All the other input impedances were reasonable, (but note clipping pre-set positions).

The weighted s/n ratios of the tuner were rather poor on strong stations, but relatively good for weak ones and Revox must improve the hiss level of their stereo decoder. The distortion levels, whilst being basically good, were not when the tuning meter indicated centre tune, and probably the discriminator was incorrectly aligned. Crosstalk was very good at 1kHz but only average at 10kHz. Frequency response was superb, but the MPX filter was rather poor on one channel. Front end sensitivities were incredibly good, particularly on weak stereo. IF reject, image and AM reject were all excellent. The adjacent and alternate channel selectivities were clearly the best measure in the survey. The RF IM ratio at 74dB is considered only good for such an expensive tuner. This model is clearly extremely well designed, and gave some superb quality reproduction from the tuner but with poor stereo hiss. Two other samples were also hissy. However, the RF front end performance is almost exemplary, and this recommends it, but only for real enthusiasts who want to listen to weak stations more often than stronger ones. Its price is so high and the s/n ratio so disappointing that it cannot be regarded as good value for money. The electromagnetic compatibility was really excellent.



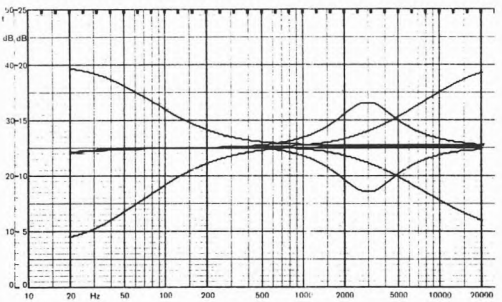
Amplifier

Av. Power output both channels driven	–
Power output single channel driven	–
Power output tone burst average	–
Idle DC out worst case	–
Turn on/off Max. DC (swing worst case)	–
Damping Factor L= –R	–
IM 10w L/R	–
IM 100mw L/R	–
IM 1% output watts L/R	–
Av. IM distortion pickup input/record out	0.015%
Av. Harmonic Distortion 0.1% (power cut)	–
Power Bandwidth L/R 0.1%	–
Av. Pickup impedance one/two	52KΩ/52KΩ
Pickup sensitivity one/two	<6mv/<6mv
Pickup clipping one/two	>58mv/>58mv
Pickup capacitance one/two	115pf/115pf
Auxiliary impedance	120KΩ
Auxiliary sensitivity	360mv
Tape impedance one/two	100KΩ/100KΩ
Tape sensitivity one/two	<360mv/<360mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	360mv
Max level from pickup (RO)	750mv*
Tape output impedance DIN Av	–
Tape output impedance phono Av	2.2KΩ
Av. Pickup noise ref 8mv record output socket unw	71dB
Av. Pickup noise ref 8mv record output socket CCIR	71dB
Amp output noise @ 0 volume unw	–
Av. Amp output noise @ 0 volume CCIR S/N ratio	–
Worst weighted noise Aux in/L out S/N ratio	–

Tuner

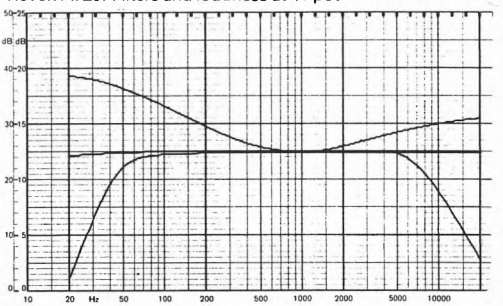
Mono RF sensitivity 30dB IHF	0.8μv
Mono RF sensitivity 50dB IHF	1.7μv
Stereo RF sensitivity 50dB IHF	15μv
IM RF	74dB
Adjacent Channel worst figure	16dB
Alternate Channel worst figure	none
Image Response	none
Capture Ratio	2dB
AM Reject	60dB
Mono distortion 100% 1kHz centre tune worst case	0.12%
Optimum tune mono Average	0.09%
Stereo L= –R centre tune L	0.4%
Stereo L= –R centre tune R	0.4%
Av. Stereo R= –L centre tune	0.42%
MPX filter reject worst fig. @ 19kHz	51dB
MPX filter reject worst fig. @ 38kHz	69dB
X talk centre tune worst fig. 1kHz	42.5dB
X talk centre tune worst fig. 10kHz	31.5dB
Optimum tune 1kHz L/R	44/43
FR Frequency response stereo –1dB L/R	12Hz–15.6K/15.6K
FR Frequency response stereo 3dB L/R	6Hz–17.2K/17.3K
Error @ 15kHz L/R	–0.5/–0.5dB
Limit threshold	0.5μv
Mute threshold	7μv
Av. Stereo S/N weighted 100μv/1mV	54.5/59dB
Av. Stereo unw 1mV	67dB
Av. Mono weighted 1mV	64.5dB
RRP Ex VAT	£650.00

Not normally discounted



Revox A720: Tone controls

Revox A720: Filters and loudness at ¼ pot



(Tested on 50dB scale)

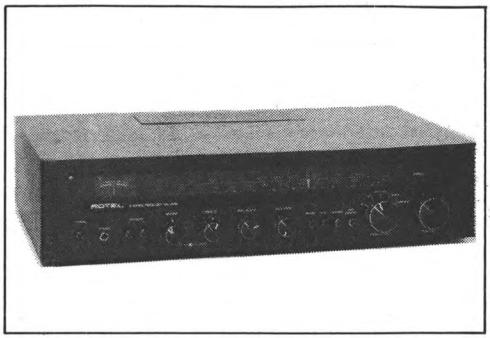
Rank Audio Products Limited, PO Box 70, Great West Road, Brentford, Middlesex. 01-568 9222

Some very useful ergonomic features are included. Output is up to 28W per channel. Switched outputs for two loudspeaker pairs are provided, the second pair being switchable to pseudo-quad. The 3 core mains lead feeds through to two switched AC outlet sockets which are covered with special plates carrying an appropriate safety warning (excellent). All input and output sockets are DIN types. Inputs include aux (tape send), FM auto/mono, AM (MW), and phono. Buttons include tape monitor, loudness, treble roll off and muting. A normal volume control is complemented by a centre indented balance control, and these were both very smooth. Bass and treble controls usefully had 11 switched positions, and, although friction ganged, one channel could be altered with respect to the other if required (excellent facility). The tuning knob ran smoothly with no backlash and the unit is housed in a completely wooden case with a very attractively styled front panel. A ferrite rod is provided for AM, and an RMA coaxial socket for 75 ohm and a 300 ohm balanced socket for FM. An earth terminal is also provided on the back panel. Amplifier break points on phonos are provided, fitted with U shaped through links.

The amplifier produced a surprisingly clean and transparent sound quality up to output clipping, although some slight crossover distortion was noticeable at exceptionally quiet listening levels. The damping factor measured fairly well, although some very slight boominess was noted at low frequencies. Although the general noise performance was good, the pickup input was just slightly hissier than average but adequate. The RIAA input impedance was rather too high at 59k ohms and care will have to be taken in choosing a cartridge that will not sound slightly shrill. At the record output socket the pickup output level was slightly lower than that of the tuner. No clipping problems were noted here. Aux. and tape in and out impedances were all compatible with European DIN standards, but not quite enough output level was given for some Japanese DIN inputs, which might thus add slight hiss. Volume, tone controls and filter tracked extremely well and the tone controls had smooth variation steps, which is most commendable. The treble roll off cuts at 6dB per octave above 3kHz. Although the amplifier sounded well the IM distortion figures were not too good and also 0.1% THD was reached at only 10W (only just over 1/3 power). However 1% IM distortion was not reached until 20W output. The RIAA response was good. A rather high running temperature was noted, making it advisable to avoid an enclosed space for the receiver. The half power bandwidth measured excellently, extending to 20/40kHz on left and right channels respectively.

The audio performance of the tuner section measured exceptionally well having very low noise indeed on high level RF inputs and with remarkably low distortion. Crosstalk was very good at middle frequencies and good at high ones. The subjective quality on a very difficult test programme supported the most favourable opinion here, the frequency response also measuring well. The multiplex filter, however, was not too good. The RF sensitivities were fairly good, but most of the general RF measurements were only fair, though quite acceptable provided the tuner is not used in strong signal strength areas for picking up weak distant stations. The image and IF breakthroughs were not too good. The dial accuracy was pretty good and both centre zero tuning and signal strength meters are incorporated. Excellent, then, on stronger signals, but not so good and slightly hissy on weak stereo ones.

Weighing up the general performance of this receiver with its very modest cost, considering excellent ergonomics, I must recommend it strongly as one of the best budget buys, especially if you are only interested in receiving your main local and network stations. Particularly commendable is the tuner's good audio performance and the delightful separate tone controls, which can be adjusted separately for each channel if required. Some interference was caused at all positions of the volume control by low frequency local amateur radio transmissions. It would almost certainly be reasonably simple to eradicate this using ferrite rings. Excellent value for money.



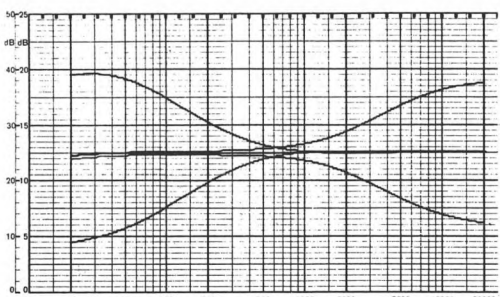
Amplifier

Av. Power output both channels driven	28W
Power output single channel driven	32W
Power output tone burst average	36W
Idle DC out worst case	38mv
Turn on/off Max. DC (swing worst case)	4.4v
Damping Factor L= −R	22/27%
IM 10w L/R	0.44/0.38%
IM 100mw L/R	0.16/0.17%
IM 1% output watts L/R	20.3/19.2W
Av. IM distortion pickup input/record out	0.08%
Av. Harmonic Distortion 0.1% (power cut)	9.5W*
Power Bandwidth L/R 0.1%	13Hz–20kHz/13Hz–40kHz
Av. Pickup impedance	59KΩ
Pickup sensitivity	2.7mv
Pickup clipping	95mv
Pickup capacitance	140pf
Auxiliary impedance	55KΩ
Auxiliary sensitivity	153mv
Tape impedance	66KΩ
Tape sensitivity	153mv
Mic impedance	—
Mic sensitivity	—
Mic clipping	—
Max level from tuner (RO)	29.5mv
Max level from pickup (RO)	17.25mv
Tape output impedance DIN Av	89KΩ
Tape output impedance phono Av	—
Av. Pickup noise ref 8mv record output socket unw	71dB
Av. Pickup noise ref 8mv record output socket CCIR	67dB
Amp output noise @ 0 volume unw	425μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	89dB
Worst weighted noise Aux in/L out S/N ratio	79.7dB

Tuner

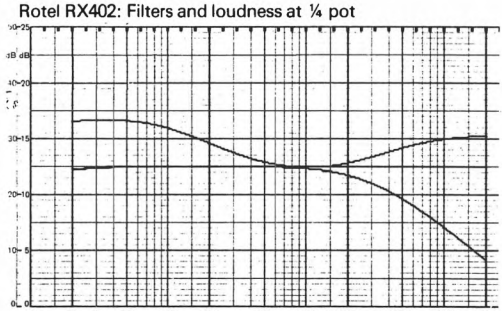
Mono RF sensitivity 30dB IHF	1.8μv
Mono RF sensitivity 50dB IHF	3.5μv
Stereo RF sensitivity 50dB IHF	40μv
IM RF	63.8dB
Adjacent Channel worst figure	−1dB
Alternate Channel worst figure	54dB
Image Response	57.8dB
Capture Ratio	3dB
AM Reject	67dB
Mono distortion 100% 1kHz centre tune worst case	0.16%
Optimum tune mono Average	0.15%
Stereo L= −R centre tune L	0.12%
Stereo L= −R centre tune R	0.1%
Av. Stereo R= −L centre tune	0.33%
MPX filter reject worst fig. @ 19kHz	44dB
MPX filter reject worst fig. @ 38kHz	>80dB
X talk centre tune worst fig. 1kHz	34.5dB
X talk centre tune worst fig. 10kHz	32dB
Optimum tune 1kHz L/R	48/49dB
FR Frequency response stereo −1dB L/R	37Hz–13.4K/13.5K
FR Frequency response stereo 3dB L/R	19Hz–14.6K/14.7K
Error @ 15kHz L/R	−3.5/−3.5dB
Limit threshold	1μv
Mute threshold	8μv
Av. Stereo S/N weighted 100μv/1mV	49/66dB
Av. Stereo unw 1mV	68.5dB
Av. Mono weighted 1mV	73dB
RRP Ex VAT	£142.00

Normally substantially discounted



Rotel RX402: Tone controls

Rotel RX402: Filters and loudness at ¼ pot



(Tested on 50dB scale)

This receiver gave 36/38W respectively on the 2 output channels, both driven. A 3 core mains lead and two switched AC outlets are provided, the latter being underneath a fixing plate. It has a separate earth terminal. All the input and output sockets are DIN types and include provision for driving two pairs of speakers (any combination available including quasi-quad). The smooth volume control has the balance control behind it, incorporating a centre indent. Like the model 402 the tone controls have 11 stepped positions and the two channels are friction locked, allowing independent variation. A selector switch chooses auxiliary 1, auxiliary 2, FM, AM (MW), phono 1 and phono 2, whilst buttons include tape monitors 1 and 2, loudness, mono/stereo, treble roll off, tone control defeat, audio mute and FM mute. The main case is wooden and some edges are extremely badly finished, since I personally acquired some splinters in my fingers from our sample. The underneath incorporates a metal screening tray. RMA coaxial 75 ohm and 300 ohm sockets are provided for FM and a ferrite rod with an additional external aerial socket for medium wave reception. A dubbing facility is provided by depressing both tape monitor buttons. The tuning was slightly spongy and some backlash was noted.

The amplifier section sounded pretty good at intermediate and high levels but some roughness was noted at very low levels, which affected string tone for example. The general ergonomics were very fine indeed and the tone controls deserve special praise, since they worked and tracked well, as did the volume and balance controls. IM distortion performance was reasonable and harmonic distortion satisfactory. General noise performance was quite good, although the pick-up input was not quite optimum, its impedance being just a little high (59k ohm) and the output on the DIN socket only just adequate for European DIN equipment. This output level was 5dB below that of the tuner and this might be annoying. Other input and output levels were satisfactory. No rumble filter was included and the treble roll off was at 6dB per octave above 4kHz. The damping factor was quite good and no output DC problems were experienced. This equipment is only suitable for interconnection with external DIN recorders. The half power bandwidth was quite good extending to 15.5kHz average.

The tuner performance was generally very good having an exceptionally flat frequency response with an excellent signal to noise ratio on both weak and strong stations. Crosstalk performance was well above average but distortion performance rather average even if very adequate. RF performance was extremely good in all respects with the sole exception of a rather poor adjacent channel selectivity and thus strong stations at 200 rather than 400kHz away from the required frequency could well cause interference. The dial accuracy was reasonable and two meters are provided for centre zero tuning and the RF signal strength.

At the typical discount price this receiver seems reasonably good value, since the tuner section performed well, particularly with respect to noise and response. This was especially remarkable, since the MPX filter was also good. The amplifier was really excellent ergonomically but some slight crossover distortion was noticed. It can be recommended but I suggest a comparison with other models at around the same price. Good value, then, at discount. Unfortunately, this receiver was very prone to interference from local low frequency radio transmissions, whether amateur or medium wave/broadcasting ones. It is not a good choice, if you live within a few hundred yards of a known radio amateur who is using long wire or high frequency beam antennas, or within a few miles of a powerful BBC or IBA MW transmitter. Remedial action, however, should be possible with appropriate experimentation.

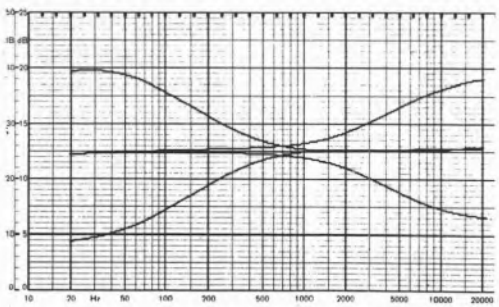
Amplifier

Av. Power output both channels driven	37W
Power output single channel driven	44.2W
Power output tone burst average	52.7W
Idle DC out worst case	21mv
Turn on/off Max. DC (swing worst case)	3.25v
Damping Factor L= −R	30/24%
IM 10w L/R	0.11/0.18%
IM 100mw L/R	0.13/0.13%
IM 1% output watts L/R	27.4/25.6W
Av. IM distortion pickup input/record out	0.077%
Av. Harmonic Distortion 0.1% (power cut)	36W
Power Bandwidth L/R 0.1%	<10Hz−14kHz/<10Hz−17kHz
Av. Pickup impedance one/two	58KΩ/58KΩ
Pickup sensitivity one/two	2.8mv/2.8mv
Pickup clipping one/two	110mv/110mv
Pickup capacitance one/two	175pf/175pf
Auxiliary impedance one/two	51KΩ/51KΩ
Auxiliary sensitivity one/two	150mv/150mv
Tape impedance one/two	60KΩ/70KΩ
Tape sensitivity one/two	150mv/150mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	36mv
Max level from pickup (RO)	17mv
Tape output impedance DIN Av	90KΩ
Tape output impedance phono Av	–
Av. Pickup noise ref 8mv record output socket unw	68.5dB
Av. Pickup noise ref 8mv record output socket CCIR	67dB
Amp output noise @ 0 volume unw	385μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	88.5dB
Worst weighted noise Aux in/L out S/N ratio	79dB

Tuner

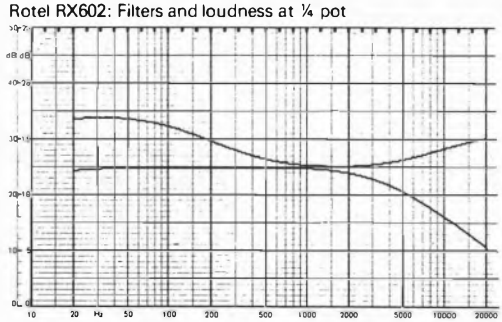
Mono RF sensitivity 30dB IHF	1μv
Mono RF sensitivity 50dB IHF	2.1μv
Stereo RF sensitivity 50dB IHF	25μv
IM RF	77dB
Adjacent Channel worst figure	−10dB
Alternate Channel worst figure	none
Image Response	82.3dB
Capture Ratio	3.25dB
AM Reject	54dB
Mono distortion 100% 1kHz centre tune worst case	0.55%
Optimum tune mono Average	0.36%
Stereo L= −R centre tune L	0.4%
Stereo L= −R centre tune R	0.42%
Av. Stereo R= −L centre tune	0.5%
MPX filter reject worst fig. @ 19kHz	54dB
MPX filter reject worst fig. @ 38kHz	>80dB
X talk centre tune worst fig. 1kHz	42dB
X talk centre tune worst fig. 10kHz	34dB
Optimum tune 1kHz L/R	46/47dB
FR Frequency response stereo −1dB L/R	30Hz−16K/16.2K
FR Frequency response stereo 3dB L/R	16Hz−16.5K/16.7K
Error @ 15kHz L/R	0/0dB
Limit threshold	0.55μv
Mute threshold	5μv
Av. Stereo S/N weighted 100μv/1mV	53/67.5dB
Av. Stereo unw 1mV	73.5dB
Av. Mono weighted 1mV	70dB
RRP Ex VAT	£186.00

Normally substantially discounted



Rotel RX602: Tone controls

Rotel RX602: Filters and loudness at ¼ pot



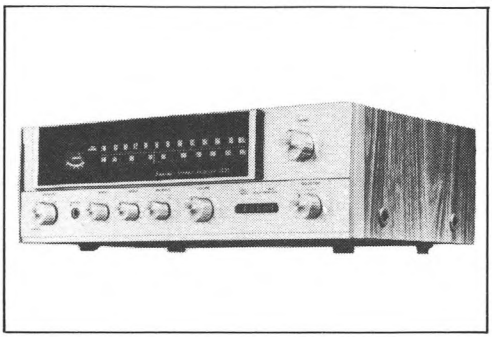
(Tested on 50dB scale)

This budget model gives 14W per channel (both driven) and includes only basic facilities. It has switched outputs to two pairs of loudspeakers (spring loaded connectors). The two 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. Base, 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 bandwidth did not measure too well. The IM distortion performance was reasonably low. No output DC problems were encountered. The s/n ratios measured relatively well, although some noise was introduced when the volume control was increased to its flat out position, and this was a little higher than average. 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 probably more important than an excellent crosstalk figure. The RF input sensitivities were all remarkably good for a budget tuner. The adjacent and alternate channel selectors were very good, as were the IF rejection and local oscillator radiation measurements. The image response was appallingly bad (only −45dB), and thus some problems could be experienced by users near low aircraft flight paths. A single RF strength meter is provided, which has to serve for a tuning indicator, and the tuning dial was pretty accurate. The tuning knob felt smooth and had no backlash. Despite a few poorish measurements this receiver was very well liked, producing excellent stereo radio signals. It is very simple to use, and can be recommended strongly as a budget buy which despite its minor failings shows up some much poorer buys which we noted.

Excellent value for money, then, particularly for the amazingly good tuner performance. Although the electromagnetic compatibility at low frequencies was good, it was exceptionally bad at VHF, and thus severe interference would be caused if any local amateur transmitted on very high frequencies whilst you are listening to gramophone records. A solution to this problem, though, should not be difficult to find.



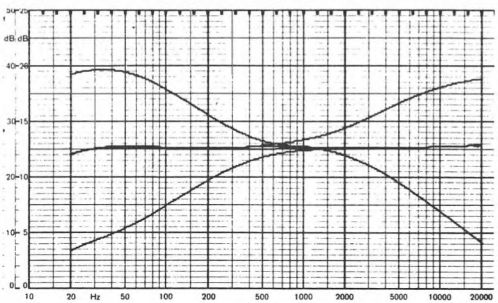
Amplifier

Av. Power output both channels driven	13.8W
Power output single channel driven	16.5W
Power output tone burst average	20.5W
Idle DC out worst case	–
Turn on/off Max. DC (swing worst case)	3.2v
Damping Factor L= –R	13.6/15.1
IM 10w L/R	2.1/2.3%
IM 100mw L/R	0.29/0.31%
IM 1% output watts L/R	9.7/9.7W
Av. IM distortion pickup input/record out	0.004%
Av. Harmonic Distortion 0.1% (power cut)	12.5W
Power Bandwidth L/R 0.1%	16Hz–7.5kHz/25Hz–13.5kHz
Av. Pickup impedance	46KΩ
Pickup sensitivity	2.1mv
Pickup clipping	110mv
Pickup capacitance	160pf
Auxiliary impedance	110KΩ
Auxiliary sensitivity	115mv
Tape impedance	140KΩ
Tape sensitivity	115mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	900mv
Max level from pickup (RO)	390mv
Tape output impedance DIN Av	80KΩ
Tape output impedance phono Av	836KΩ
Av. Pickup noise ref 8mv record output socket unw	75dB
Av. Pickup noise ref 8mv record output socket CCIR	71dB
Amp output noise @ 0 volume unw	800μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	88.4dB
Worst weighted noise Aux in/L out S/N ratio	66dB

Tuner

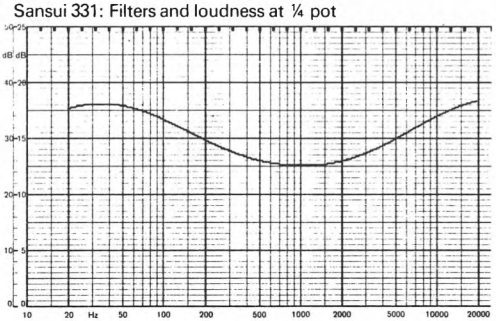
Mono RF sensitivity 30dB IHF	1.5μv
Mono RF sensitivity 50dB IHF	3.2μv
Stereo RF sensitivity 50dB IHF	23μv
IM RF	70.5dB
Adjacent Channel worst figure	1dB
Alternate Channel worst figure	56dB
Image Response	45dB
Capture Ratio	3dB
AM Reject	53dB
Mono distortion 100% 1kHz centre tune worst case	0.32%
Optimum tune mono Average	0.32%
Stereo L= –R centre tune L	0.28%
Stereo L= –R centre tune R	0.28%
Av. Stereo R= –L centre tune	0.19%
MPX filter reject worst fig. @ 19kHz	36.5dB
MPX filter reject worst fig. @ 38kHz	77dB
X talk centre tune worst fig. 1kHz	26dB
X talk centre tune worst fig. 10kHz	30dB
Optimum tune 1kHz L/R	32/32dB
FR Frequency response stereo –1dB L/R	7Hz–14.4K/14.3K
FR Frequency response stereo 3dB L/R	3Hz–18K/18.1K
Error @ 15kHz L/R	–1.25/–1.25dB
Limit threshold	1.1μv
Mute threshold	–
Av. Stereo S/N weighted 100μv/1mV	51.5/70dB
Av. Stereo unw 1mV	72dB
Av. Mono weighted 1mV	75dB
RRP Ex VAT	£106.50

Normally substantially discounted



Sansui 331: Tone controls

Sansui 331: Filters and loudness at ¼ pot



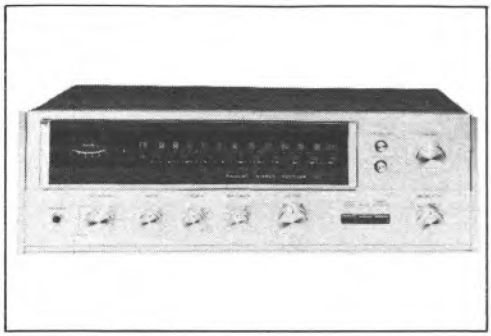
(Tested on 50dB scale)

It would appear to be an uprated version of the model 331, having very similar facilities. 22W per channel are available (both driven) in to 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. The mains lead is only two core, but an earth terminal is provided, as are two AC sockets (one unswitched). Pick up, auxiliary, and tape in/out sockets are phono but tape is also duplicated on a 5 pole DIN type having an appropriate source impedance for DIN recorders. 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, being somewhat larger than the other knobs. 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 pullout lever is provided for AM reception, and terminals allow connection of external 75 and 300 ohm FM aerials, or AM ones. The receiver is housed in a metal cabinet, and has adequate ventilation slots. 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, although the latter was quite good at the high frequency end. This, however, was measured for 0.1%, and undoubtedly the measurements would have been better for 0.3%. The intermodulation distortion measurements showed a clear increase at lower levels, although satisfactory at higher ones, and some crossover distortion was just audible on extremely quiet music. In context, this would not be too serious. 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 an ideal input impedance, excellent clipping margin and extremely low measured intermod distortion. Auxiliary and phone tape in and out levels and impedances were optimum, and the tape output levels on the DIN socket were comparable with most DIN recorders. 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 without complications.

The tuner's signal to noise ratio on stronger stereo signals and all mono ones was realy 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, and the clock test fared well. 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, began to roll of below 60Hz being −3dB at 35Hz—not really worrying, but possibly due to some misalignment of the bass control internally. 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 very odd, showing bad tracking somewhere, presumably, since wildly different figures were obtained from the two sides. 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 s/n ratio of the tuner on local signals, and the generally good sound performance on such signals. Although I rate the unit as pretty good value for money, it was a slight disappointment. The 331 seemed better in many respects, although its output power is lower. Some interference would be noticed from local amateur radio VHF transmissions, but the receiver was completely clear from low frequency interference. A reasonable buy, then, but look at its competitors.



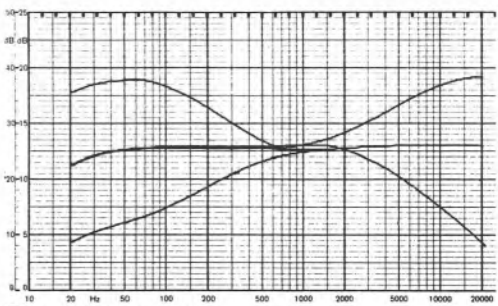
Amplifier

Av. Power output both channels driven	21.5W
Power output single channel driven	24.5W
Power output tone burst average	26W
Idle DC out worst case	<100μv
Turn on/off Max. DC (swing worst case)	1.5v
Damping Factor L= –R	26/26%
IM 10w L/R	0.19/0.18%
IM 100mw L/R	0.54/0.45%
IM 1% output watts L/R	14/14W
Av. IM distortion pickup input/record out	0.005%
Av. Harmonic Distortion 0.1% (power cut)	19.5W
Power Bandwidth L/R 0.1%	70Hz–19kHz/100Hz–13.35kHz
Av. Pickup impedance	52.5KΩ
Pickup sensitivity	1.85mv
Pickup clipping	128mv
Pickup capacitance	12pf
Auxiliary impedance	117KΩ
Auxiliary sensitivity	118.8mv
Tape impedance	153KΩ
Tape sensitivity	118.8mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	710mv
Max level from pickup (RO)	435mv
Tape output impedance DIN Av	79KΩ
Tape output impedance phono Av	590Ω
Av. Pickup noise ref 8mv record output socket unw	75dB
Av. Pickup noise ref 8mv record output socket CCIR	72dB
Amp output noise @ 0 volume unw	400μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	82.4dB
Worst weighted noise Aux in/L out S/N ratio	78dB

Tuner

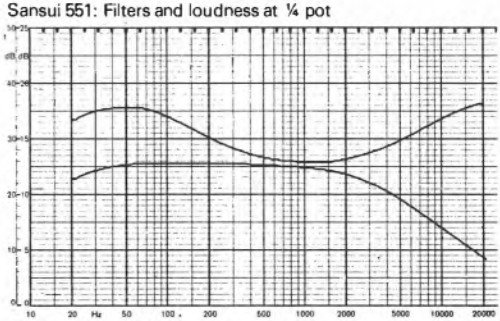
Mono RF sensitivity 30dB IHF	1.1μv
Mono RF sensitivity 50dB IHF	2.5μv
Stereo RF sensitivity 50dB IHF	32μv
IM RF	71.2dB
Adjacent Channel worst figure	–3dB
Alternate Channel worst figure	34dB
Image Response	59.2dB
Capture Ratio	3.5dB
AM Reject	54dB
Mono distortion 100% 1kHz centre tune worst case	0.29%
Optimum tune mono Average	0.25%
Stereo L= –R centre tune L	0.6%
Stereo L= –R centre tune R	0.62%
Av. Stereo R= –L centre tune	0.6%
MPX filter reject worst fig. @ 19kHz	57.5dB
MPX filter reject worst fig. @ 38kHz	47.5dB
X talk centre tune worst fig. 1kHz	38dB
X talk centre tune worst fig. 10kHz	37dB
Optimum tune 1kHz L/R	39/42dB
FR Frequency response stereo –1dB L/R	69Hz–14K/13.6K
FR Frequency response stereo 3dB L/R	37Hz–15.2K/15.1K
Error @ 15kHz L/R	–2.5/–2.5dB
Limit threshold	0.9μv
Mute threshold	13μv
Av. Stereo S/N weighted 100μv/1mV	49/67dB
Av. Stereo unw 1mV	69dB
Av. Mono weighted 1mV	70.5dB
RRP Ex VAT	£139.34

Normally substantially discounted



Sansui 551: Tone controls

Sansui 551: Filters and loudness at ¼ pot



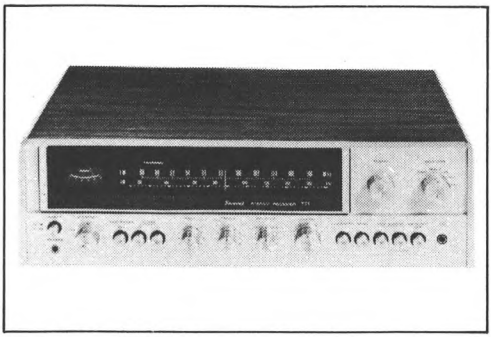
(Tested on 50dB scale)

Clearly a middle of the range receiver, giving some 47W output per channel (both driven). Three pairs of loudspeakers can be interconnected using spring lock terminals. A switch selects either a single pair, or a combination of a main pair with one remote pair. Headphone and mic jacks are provided on the front panel, the latter inserting the signal in to the phono pre-amp circuit. Only a two core mains lead is provided, and two AC outlet sockets, one unswitched. A separate earth terminal is fitted, though. Phono sockets are provided on the rear for pick up, auxiliary 1 and 2, and tape in/out 1 and 2, tape 1 being duplicated on a 5 pole DIN socket. 75 and 300 ohm aerial terminals for FM and a terminal and ferrite rod for AM (MW) are incorporated. Along the rear panel are some long and well styled heat sinks. The main case is wooden with ventilation slots, but the base plate is metal. The equipment ran fairly warm after a while, but would probably be satisfactory in an enclosed space. Front panel controls are very well styled, and the bass and treble ones have 11 stepped positions, although the steps were not particularly even from one to another, the end ones being rather violent. The balance control had a centre indent, and the large volume control was extremely smooth in operation. Push buttons include loudness, tape monitor 1 and 2, audio, mute, rumble and treble roll offs, and FM mute, and a front panel switch selects auxiliary 1 or 2, pick up, FM auto and MW inputs.

This amplifier is a typical example of one which measured very badly but sounded rather well, thus proving the danger of attaching too much importancec to very low distortion figures in amplifiers. The IM distortion measured at most levels around 0.5%, but this did not rise greatly even at 1mW. Again the harmonic distortion did not drop as low as 0.1% at any normal level, and was generally around 0.2%. The half power band width, measured at 0.3%, extended from 15Hz to an average of 22kHz, and thus in fact was very good. I must assume that relatively little negative feedback was employed round the final amplifier, and probably transient intermodulation distortion was very low, thus giving a generally excellent impression of the amplifier subjectively. The damping factor was excellent, and no DC output problems were experienced, the amplifier output circuit being relay protected. Very slight hum and hiss were audible on the output if an ear was placed close to the speaker. The hiss became more noticeable with the volume control at 2 o'clock. All the controls tracked reasonably well. The tone controls offered a wide range of adjustment, and the bass and treble roll offs cut at 6dB per octave from 150Hz/3kHz respectively, the rumble filter thus being a little vicious. The headphone socket did not allow 8 ohm headphones to be driven very hard without clipping, the series resistor being slightly too high in value. The pick up pre-amplifier was quiet and worked very well, giving a reasonably compatible output on the record sockets. The auxiliary and tape in and out impedances and sensitivities were all quite normal.

The tuner's general s/n ratios and distortion levels measured exceptionally well. Frequency response showed a 1dB shelf down from 6.5kHz and a fall off became −4dB at 15kHz. The MPX filter was extremely good, whilst crosstalk was good at 1kHz, it was poor at 10kHz (only 20dB) and this would probably be better after readjustment. All the RF sensitivities measured superbly well, and I must particularly commend the adjacent and alternate channel selectivities, as well as the virtual absence of IF breakthrough, and local oscillation radiation. The image response and RF intermodulation distortion were only fair, but the capture ratio was a remarkable 0.75dB. The limiting threshold was also praiseworthy at 0.5uV. Only a signal strength meter is provided.

This is frankly rather a difficult receiver to sum up, for whilst the amplifier measurements were not at all satisfactory it actually sounded pretty good. Despite the poor HF crosstalk figure, the tuner section is extremely good, although extreme high frequencies were slightly more attenuated than usual. The RF performance in general is almost astonishing. You are strongly advised to hear this receiver before purchase, but nevertheless it seems quite good value for money. Quite bad interference was induced in to the amplifier from local VHF amateur transmissions. Recommended, then, but with a degree of caution.



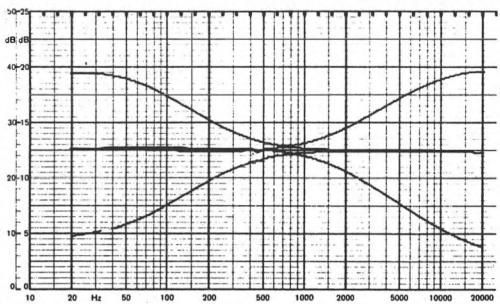
Amplifier

Av. Power output both channels driven	47W
Power output single channel driven	55W
Power output tone burst average	56.4W
Idle DC out worst case	18mv
Turn on/off Max. DC (swing worst case)	200mv
Damping Factor L= –R	42/41%
IM 10w L/R	0.44/0.4%
IM 100mw L/R	0.77/0.82%
IM 1% output watts L/R	35.3/34W
Av. IM distortion pickup input/record out	0.02%
Av. Harmonic Distortion 0.1% (power cut)	none*
Power Bandwidth L/R 0.3%	15Hz–20kHz/14Hz–25kHz
Av. Pickup impedance	44KΩ
Pickup sensitivity	2.7mv
Pickup clipping	255mv
Pickup capacitance	100pf
Auxiliary impedance one/two	74KΩ/74KΩ
Auxiliary sensitivity one/two	104.7/104.7mv
Tape impedance one/two	100KΩ/100KΩ
Tape sensitivity one/two	104.7mv/104.7mv
Mic impedance	9.6KΩ
Mic sensitivity	2.8mv
Mic clipping	187mv
Max level from tuner (RO)	520mv
Max level from pickup (RO)	285mv
Tape output impedance DIN Av	65KΩ
Tape output impedance phono Av	850Ω
Av. Pickup noise ref 8mv record output socket unw	72dB
Av. Pickup noise ref 8mv record output socket CCIR	71dB
Amp output noise @ 0 volume unw	900μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	84.2dB
Worst weighted noise Aux in/L out S/N ratio	73.3dB

Tuner

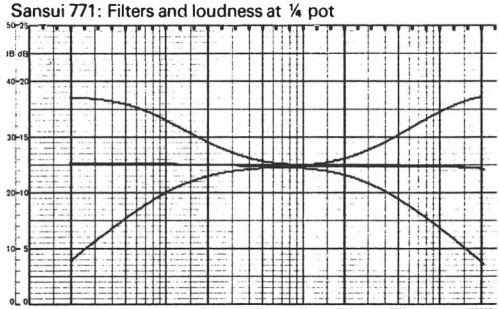
Mono RF sensitivity 30dB IHF	0.8μv
Mono RF sensitivity 50dB IHF	1.6μv
Stereo RF sensitivity 50dB IHF	20μv
IM RF	70.9dB
Adjacent Channel worst figure	4dB
Alternate Channel worst figure	none
Image Response	73.5dB
Capture Ratio	0.75dB
AM Reject	56.6dB
Mono distortion 100% 1kHz centre tune worst case	0.27%
Optimum tune mono Average	0.21%
Stereo L= –R centre tune L	0.3%
Stereo L= –R centre tune R	0.23%
Av. Stereo R= –L centre tune	0.21%
MPX filter reject worst fig. @ 19kHz	59dB
MPX filter reject worst fig. @ 38kHz	64dB
X talk centre tune worst fig. 1kHz	34.5dB
X talk centre tune worst fig. 10kHz	20.5dB
Optimum tune 1kHz L/R	39/39dB
FR Frequency response stereo –1dB L/R	22Hz–6.5K/6K
FR Frequency response stereo 3dB L/R	10Hz–14.4K/14.5K
Error @ 15kHz L/R	–4/–4dB
Limit threshold	0.52μv
Mute threshold	5μv
Av. Stereo S/N weighted 100μv/1mV	54.5/68dB
Av. Stereo unw 1mV	64.5dB
Av. Mono weighted 1mV	69dB
RRP Ex VAT	£221.69

Normally substantially discounted



Sansui 771: Tone controls

Sansui 771: Filters and loudness at ¼ pot



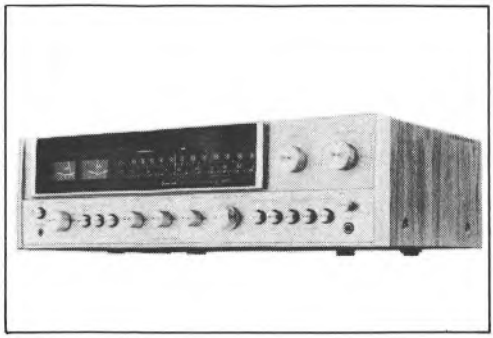
(Tested on 50dB scale)

Despite its reasonable size, this delivered 78W per channel, transient peaking at 100W. Three switched pairs of loudspeakers can be connected by spring loaded clamps, and the mains lead is two core, a separate earth terminal being provided. A ferrite rod mounted at the rear pulls out on an extending arm, but its angle cannot be varied (rather silly). 75 and 300 ohm FM aerial terminals and an AM one are included. One pick up input, two auxiliaries and two external tape recorders can be connected with phono sockets, a 5 pole DIN socket also being available for tape one. Front panel controls include bass, mid and treble 11 stepped position rotaries, and a volume control in front of, and concentric with, a centre indented balance control. A separate mic input pot with its associated jack socket can be mixed in to the general inputs. An input selector switches appropriate functions. Push buttons operate FM mute, tape monitor 1/2, mono/stereo, loudness, rumble and treble roll offs, and audio mute. The wooden case with a metal base plate has adequate ventilation slots, allowing the running temperature to be kept relatively cool. Signal strength and tuning meters are provided, and the tuning knob turned smoothly, but with slight backlash.

The amplifier sounded very good, but some slight lack of punch in the bass region was noted (very subjective, though). The half power band width was good, extending to well above 20kHz, and the intermodulation and harmonic distortion measurements were very good at intermediate and high levels, but just began to creep up at low ones, and very slight crossover distortion was noted. The damping factor measured very well. No DC output problems were encountered. The amplifier's s/n ratio was fairly good, but slight noise might be audible on headphones. All the controls tracked extremely well. The tone controls had a very adequate range of adjustment, and we all particularly liked the steps, and the addition of a mid frequency control. The rumble and treble roll offs cut at 6dB octave from 150Hz/3kHz respectively (rumble cut from too high a frequency). The RIAA input pre amplifier was very quiet, but, as seems usual with several Sansui products, had a rather low input impedance. Although the clipping margin was excellent, the level was rather below that of the tuner's output on the record output sockets. The microphone input had just adequate sensitivity, but the other input and output levels and impedances were all quite reasonable.

Whilst the hiss performance of the tuner section was extremely good, unfortunately the hum level was frankly rather poor, and this might be noticeable on programmes having a wide dynamic range (perhaps our sample was unlucky). Whilst the frequency response was pretty good, the bass rolled off from 35Hz (−3dB), which is satisfactory in practice, but unfortunately from a specification point of view. Whilst mono distortion figures were excellent, the stero ones were higher that average, and this clearly led to slight roughness particularly on speech at high deviations. Crosstalk figures were excellent. The multiplex filter was very good, and the dial accuracy also excellent. RF sensitivities were all quite remarkably good. The adjacent and alternate channel performance was also excellent, but perhaps the adjacent channel figure shows that the slightly limited total IF bandwidth might be contributing to the poor stereo distortion figures. The RF IM ratio was adequate, whilst the remaining RF measurements were all very good.

The general amplifier performance was pretty good, and it is useful to have such high power available at a relatively modest cost. The tuner's stereo distortion, however, was rather disappointing, although quite possibly acceptable to many potential users. The excellent facilities and very good RF performance must contribute to my recommending this model as pretty good value for money, particularly if you want a very high power capability. If this is not necessary, I suggest an examination of the alternatives. The electromagnetic compatibility was excellent, and thus most useful for providing high power in proximity to transmitters.



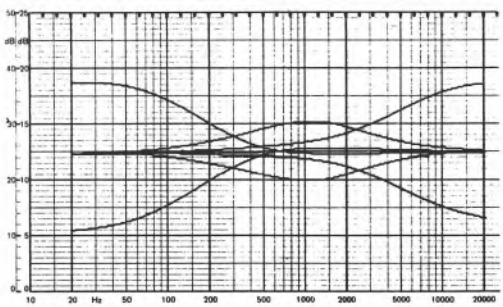
Amplifier

Av. Power output both channels driven	78W
Power output single channel driven	88W
Power output tone burst average	100W
Idle DC out worst case	33mv
Turn on/off Max. DC (swing worst case)	800mv
Damping Factor L= −R	41/40%
IM 10w L/R	0.045/0.04%
IM 100mw L/R	0.11/0.12%
IM 1% output watts L/R	53/53W
Av. IM distortion pickup input/record out	0.015%
Av. Harmonic Distortion 0.1% (power cut)	72W
Power Bandwidth L/R 0.1%	<10Hz–40kHz/<10Hz–22kHz
Av. Pickup impedance	36KΩ
Pickup sensitivity	2.5mv
Pickup clipping	250mv
Pickup capacitance	90pf
Auxiliary impedance one/two	56KΩ/56KΩ
Auxiliary sensitivity one/two	97.5mv/97.5mv
Tape impedance one/two	70KΩ/70KΩ
Tape sensitivity one/two	97.5mv/97.5mv
Mic impedance	14.4K
Mic sensitivity	3.25mv
Mic clipping	335mv
Max level from tuner (RO)	560mv
Max level from pickup (RO)	255mv
Tape output impedance DIN Av	64KΩ
Tape output impedance phono Av	290Ω
Av. Pickup noise ref 8mv record output socket unw	76dB
Av. Pickup noise ref 8mv record output socket CCIR	71.5dB
Amp output noise @ 0 volume unw	750μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	87.5dB
Worst weighted noise Aux in/L out S/N ratio	77.8dB

Tuner

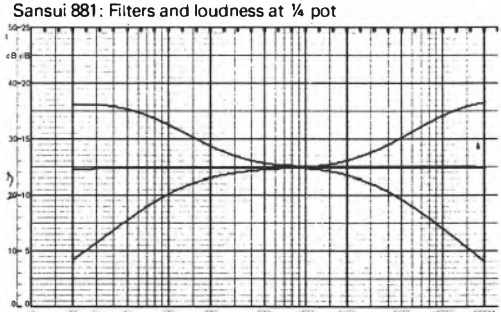
Mono RF sensitivity 30dB IHF	0.7μv
Mono RF sensitivity 50dB IHF	1.8μv
Stereo RF sensitivity 50dB IHF	22μv
IM RF	72dB
Adjacent Channel worst figure	8dB
Alternate Channel worst figure	none
Image Response	83dB
Capture Ratio	1.5dB
AM Reject	59dB
Mono distortion 100% 1kHz centre tune worst case	0.21%
Optimum tune mono Average	0.16%
Stereo L= −R centre tune L	0.7%
Stereo L= −R centre tune R	0.6%
Av. Stereo R= −L centre tune	0.14%
MPX filter reject worst fig. @ 19kHz	65dB
MPX filter reject worst fig. @ 38kHz	68dB
X talk centre tune worst fig. 1kHz	40dB
X talk centre tune worst fig. 10kHz	37dB
Optimum tune 1kHz L/R	50/41dB
FR Frequency response stereo −1dB L/R	74Hz–11.3K/11.8K
FR Frequency response stereo 3dB L/R	33Hz–15.3K/15K
Error @ 15kHz L/R	−2.25/−3dB
Limit threshold	0.4μv
Mute threshold	8μv
Av. Stereo S/N weighted 100μv/1mV	55/71dB
Av. Stereo unw 1mV	61dB
Av. Mono weighted 1mV	70dB
RRP Ex VAT	£286.78

Normally substantially discounted



Sansui 881: Tone controls

Sansui 881: Filters and loudness at ¼ pot



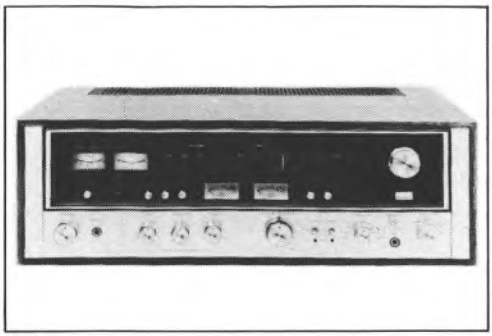
(Tested on 50dB scale)

Very powerful, giving up to 95W per channel (both driven) in to main and either of two remote pairs of loudspeakers (switchable). The 8080 is very similar to the 9090, but the 11 stepped position bass and treble controls 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. The two core mains lead is complemented by a separate earth terminal, and two AC outlets (one unswitched). A ferrite rod antenna for AM (MW) has an excellent ball and cup joint allowing it to be positioned at any angle. A separate AM aerial terminal is also provided, as are 75 and 300 ohm FM aerial inputs. Volume and balance controls are concentric, the latter having a centre indent, and effectively ringing the back of the volume control. A rotary switch selects phono, 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. A large wooden case includes a metal ventilation panel and base plate. All the controls felt very smooth, and the receiver was easy to use. The tuning control was very smooth, and had a good flywheel action.

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 bandwidth only extended (for 0.1%) to 13kHz. No DC output problems were experienced, and the damping factor was one of the best measured. A slight hiss was audible on the output, which became just noticeable at a distance from the speaker if the treble control was fully advanced. Adequate level was available for supplying many headphones in parallel if necessary, although slight hiss might be noticed on just one pair. All the controls worked well, except the loudness which showed a difference in gain at one frequency of 2.5dB. The tone controls offered adequate variation but failed to give a considerable range of adjustment at the ends of the audio spectrum. The mid control was useful, varying 1.5kHz by ±5dB. The rumble and treble roll offs cut at 6dB per octave from 150Hz/3kHz respectively. The rumble cut was rather abrupt. The RIAA input had a rather low impedance, which would suit cartridges such as the Shure V15 Mk. 111, although some others might show a considerable 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 running temperature on a heavy duty cycle reached a rather alarming 125°F, and so the receiver should not be used in an enclosed space.

The s/n 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 really noticeable in practice). The distortion performance was pretty 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 superbly well. The adjacent and alternate channel selectivities were excellent, as were all the other RF measurements, although the intermod performance was just good.

This receiver performed in general very well, but it clearly outclassed by the Sansui 9090 which only costs about 10% more. However, it is only fair to say that I still consider it reasonable value for money, and it can be recommended. The electromagnetic compatibility was excellent at lower frequencies and pretty good at high ones.



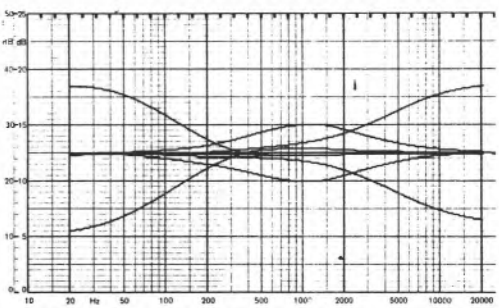
Amplifier

Av. Power output both channels driven	95W
Power output single channel driven	105W
Power output tone burst average	121.3W
Idle DC out worst case	<50μv
Turn on/off Max. DC (swing worst case)	100mv
Damping Factor L= −R	50/42%
IM 10w L/R	0.035/0.06%
IM 100mw L/R	0.08/0.085%
IM 1% output watts L/R	69/69W
Av. IM distortion pickup input/record out	0.015%
Av. Harmonic Distortion 0.1% (power cut)	87.8W
Power Bandwidth L/R 0.1%	<10Hz–13kHz/<10Hz–13kHz
Av. Pickup impedance	34.5KΩ
Pickup sensitivity	2.75mv
Pickup clipping	245mv
Pickup capacitance	45pf
Auxiliary impedance	51KΩ
Auxiliary sensitivity	96.25mv
Tape impedance one/two	65KΩ/65KΩ
Tape sensitivity one/two	96.25mv/96.25mv
Mic impedance	15KΩ
Mic sensitivity	2.75mv
Mic clipping	320mv
Max level from tuner (RO)	320mv
Max level from pickup (RO)	247.5mv
Tape output impedance DIN Av	65KΩ
Tape output impedance phono Av	300Ω
Av. Pickup noise ref 8mv record output socket unw	73.5dB
Av. Pickup noise ref 8mv record output socket CCIR	71dB
Amp output noise @ 0 volume unw	700μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	87dB
Worst weighted noise Aux in/L out S/N ratio	88.4dB

Tuner

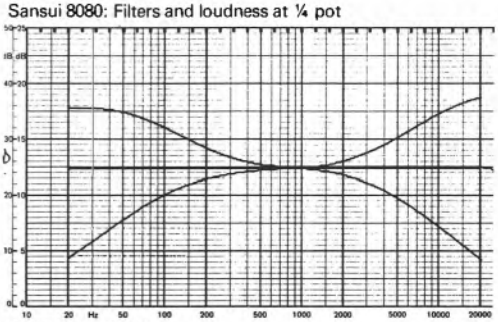
Mono RF sensitivity 30dB IHF	0.9μv
Mono RF sensitivity 50dB IHF	1.7μv
Stereo RF sensitivity 50dB IHF	20μv
IM RF	76dB
Adjacent Channel worst figure	9dB
Alternate Channel worst figure	none
Image Response	84dB
Capture Ratio	1.25dB
AM Reject	59.5dB
Mono distortion 100% 1kHz centre tune worst case	0.21%
Optimum tune mono Average	0.2%
Stereo L= −R centre tune L	0.46%
Stereo L= −R centre tune R	0.4%
Av. Stereo R= −L centre tune	0.2%
MPX filter reject worst fig. @ 19kHz	61dB
MPX filter reject worst fig. @ 38kHz	>80dB
X talk centre tune worst fig. 1kHz	40dB
X talk centre tune worst fig. 10kHz	30.5dB
Optimum tune 1kHz L/R	50/50dB
FR Frequency response stereo −1dB L/R	34Hz–3.6K/12.8K
FR Frequency response stereo 3dB L/R	18Hz–15.1K/15.7K
Error @ 15kHz L/R	−3/−1.75dB
Limit threshold	0.6μv
Mute threshold	16μv
Av. Stereo S/N weighted 100μv/1mV	56/68dB
Av. Stereo unw 1mV	65.5dB
Av. Mono weighted 1mV	68dB
RRP Ex VAT	£362.27

Normally substantially discounted



Sansui 8080: Tone controls

Sansui 8080: Filters and loudness at ¼ pot



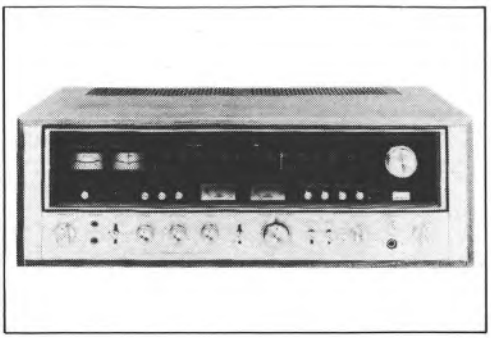
(Tested on 50dB scale)

Not only the largest receiver in the Sansui range, the 9090 also had the highest power output of any receiver in the survey (144W). Three pairs of loudspeakers can be connected using spring loaded lever clamps, and can be switched either singly or with a choice of the second or third pair with the first, but not all three. Two stereo headphone jacks are included. The volume control is concentrically mounted with the balance control, which has a centre indent, and this operated smoothly and independantly, but some might prefer the balance to be separate. Eleven evenly stepped mid, bass and treble controls 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 into the main system. The input selector switch chooses pick up, auxiliary, Dolby FM adaptor, FM auto, and AM (MW), for which a ferrite rod antenna is provided at the back, which can be pointed in virtually any direction for optimum pick up. A two core mains lead is complemented by a separate earth terminal, and there are two AC outlets, one switched and one unswitched. All inputs and tape recorder connections are on phonos, with tape 2 duplicated on a 5 pole DIN. The receiver is extremely 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 (probably internal pre-set error). All the other tone controls and filters tracked extremely well, but the loudness control was not quite compatible between channels. Towards the bottom of its travel the volume control went very marginally out of step. All the input and tape out levels and impedances were very compatible, although the RIAA input was too 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 exceptional low noise. IMF crosstalk measured very well, but was poorer at HF, although adequate. The response showed a 1dB shelf down above 4.5kHz, but 15kHz was only −2.75dB. The RF performance was virtually exemplary, having excellent sensitivities, and IF bandwidth shape, and good rejection. 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 pretty 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. We were all most enthusiastic about this product, and recommend it strongly. Almost no interference was produced from nearby transmitters in to any of the circuitry.



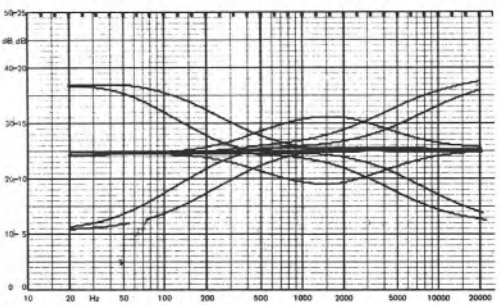
Amplifier

Av. Power output both channels driven	144W
Power output single channel driven	162W
Power output tone burst average	170W
Idle DC out worst case	70mv
Turn on/off Max. DC (swing worst case)	2v
Damping Factor L= –R	40/41%
IM 10w L/R	0.023/0.027%
IM 100mw L/R	0.08/0.04%
IM 1% output watts L/R	98/98W
Av. IM distortion pickup input/record out	0.032%
Av. Harmonic Distortion 0.1% (power cut)	136W
Power Bandwidth L/R 0.1%	<10Hz–55kHz/<10Hz–55kHz
Av. Pickup impedance	34KΩ
Pickup sensitivity	3mv
Pickup clipping	240mv
Pickup capacitance	47pf
Auxiliary impedance	50KΩ
Auxiliary sensitivity	100mv
Tape impedance	61KΩ
Tape sensitivity	100mv
Mic impedance	15KΩ
Mic sensitivity	3.4mv
Mic clipping	200mv
Max level from tuner (RO)	310mv
Max level from pickup (RO)	240mv
Tape output impedance DIN Av	65KΩ
Tape output impedance phono Av	330Ω
Av. Pickup noise ref 8mv record output socket unw	74.5dB
Av. Pickup noise ref 8mv record output socket CCIR	73dB
Amp output noise @ 0 volume unw	1.8mv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	88dB
Worst weighted noise Aux in/L out S/N ratio	80dB

Tuner

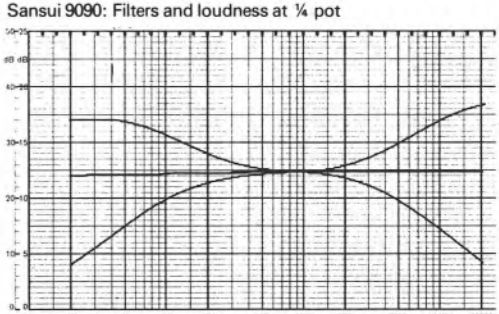
Mono RF sensitivity 30dB IHF	1.1μv
Mono RF sensitivity 50dB IHF	1.9μv
Stereo RF sensitivity 50dB IHF	22μv
IM RF	72dB
Adjacent Channel worst figure	8dB
Alternate Channel worst figure	none
Image Response	83dB
Capture Ratio	1.5dB
AM Reject	55.5dB
Mono distortion 100% 1kHz centre tune worst case	0.14%
Optimum tune mono Average	0.09%
Stereo L= –R centre tune L	0.2%
Stereo L= –R centre tune R	0.22%
Av. Stereo R= –L centre tune	0.21%
MPX filter reject worst fig. @ 19kHz	64dB
MPX filter reject worst fig. @ 38kHz	75dB
X talk centre tune worst fig. 1kHz	40dB
X talk centre tune worst fig. 10kHz	30dB
Optimum tune 1kHz L/R	52/52dB
FR Frequency response stereo –1dB L/R	34Hz–4.3kHz/34Hz–3.4K
FR Frequency response stereo 3dB L/R	18Hz–15.5kHz/18Hz–15K
Error @ 15kHz L/R	–2.5/–3dB
Limit threshold	0.7μv
Mute threshold	4.5μv
Av. Stereo S/N weighted 100μv/1mV	59/73dB
Av. Stereo unw 1mV	69.5dB
Av. Mono weighted 1mV	73.5dB
RRP Ex VAT	£398.32

Normally substantially discounted



Sansui 9090: Tone controls

Sansui 9090: Filters and loudness at ¼ pot



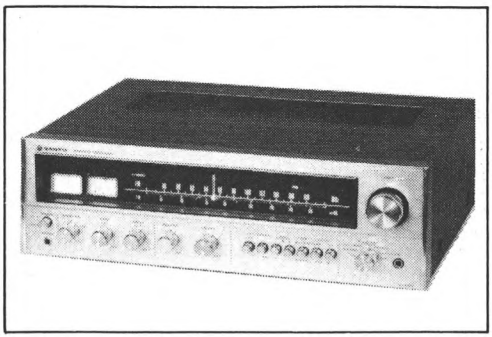
(Tested on 50dB scale)

Housed in a wooden case with metal base plate and one large metal grill on the top, this delivers 35W per channel (both driven). Two loudspeaker pairs (switchable) can be connected to spring lock connectors. A ferrite rod is provided with a rather flimsy arm for AM (MW) reception, together with a terminal for an external antenna. Additional terminals for 75 ohm and 300 ohm FM aerials are included. A heavy duty 3 core mains lead is complemented by a separate earth terminal. Phone sockets are provided for pick-ups 1/2, auxiliary, tape recorder 1 and 2 in and out. A 5 pole DIN socket is also provided for tape 1 and is DIN compatible. Phono sockets with shorting bars are included for insertion of external equalisation etc., immediately before the main amplifier. A front panel function switch selects pick-up 1 or 2, AM, FM mono, FM stereo, microphone or aux. Push buttons provide FM and audio muting, mono/stereo, tape monitors 1/2, including a dubbing facility, rumble roll off and finally loudness. The volume control was smooth and the balance control had no centre indent but was otherwise satisfactory. Treble and bass controls had 11 evenly stepped positions giving a wide range of adjustment. Centre zero tuning and FM signal strength meters are provided. The tuning knob was smooth but had slight backlash. The front panel is attractively designed and the receiver was easy to use.

The amplifer section gave a slightly dull but otherwise good sound quality, although the bass lacked slight body. The 0.1% half power bandwidth measured appallingly badly, extending to only 3.5kHz and even at 0.3% it only reached 13kHz and this was almost certainly the reason for the dull transient sound quality. The IM distortion, however, measured quite reasonably. The harmonic measurements were good at middle frequencies but deteriorated at very low and very high ones. The damping factor measured very well and no DC output problems were experienced. All the signal to noise ratios of the pre-amp and amplifier sections were satisfactory and adequate volume was given into headphones. All the controls tracked well. The bass and treble controls were particularly liked and the rumble filter is most commendable, cutting very steeply at about 18dB per octave below 70Hz. The loudness control lifted the bass adequately at levels but did not seem to affect the treble end much. The pick-up input circuitry had the correct impedance, but quite a high capacitance, and the clipping margin was excellent. The output levels to the recorder were compatible with those from the tuner, but the source impedance presented on the phono sockets by the pick-up pre-amplifier was rather high at 15k ohms, although much lower from the tuner (3.5k ohms). Other input and output levels were satisfactory. Although as usual the mic sensitivity was too poor for many applications. The amplifier's running temperature is rather on the warm side, and so operation in an enclosed space might present a problem.

The signal to noise ratios of the tuner were excellent as far as hiss was concerned but a slight hum was audible on wide dynamic range programmes. The distortion performance was in general only fair and R—L distortion was well over 1% at full deviation. Since it improved fairly considerably when the tuner was off-set slightly, the discriminator was almost certainly poorly aligned. It was necessary, however, to tune very carefully for optimum results, since bad splat was introduced on treble transients when other than perfectly optimally tuned. This ties in with the excellent adjacent and alternate channel selectivities. The crosstalk measured rather badly, but again improved on retuning to good figures, thus again showing bad alignment. The frequency response was superb. The MPX filter was excellent, notwithstanding the incredible response to 15kHz. The RF sensitivities measured remarkably well, in particular 50dB stereo S/N UnW at 17uV! All the other RF measurements were very good, and the dial frequency accuracy was excellent. Some exceptionally fine measurements, then, on this tuner but Sanyo must improve the hum level and the discriminator/decoder alignment.

Having weighed up all its pros and cons, this receiver seems good value for money, and potentially excellent if the tuner hum and decoder problems could be attended to, and provided that you can accept a slight dulling of transients (perhaps another sample might be better). It can be recommended, and the tone controls and superb tuner RF performance are certainly excellent points. Electromagnetic compatibility was very good.

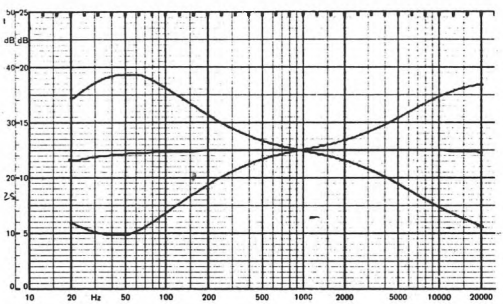


Amplifier

Av. Power output both channels driven	35W
Power output single channel driven	43W
Power output tone ourst average	50W
Idle DC out worst case	15mv
Turn on/off Max. DC (swing worst case)	1.5v
Damping Factor L= –R	40/38%
IM 10w L/R	0.095/0.078%
IM 100mw L/R	0.05/0.05%
IM 1% output watts L/R	25.5/25.5W
Av. IM distortion pickup input/record out	0.03%
Av. Harmonic Distortion 0.1% (power cut)	32W
Power Bandwidth L/R 0.3%	12.5Hz–13kHz/12.5Hz–13kHz
Av. Pickup impedance one/two	50KΩ/50KΩ
Pickup sensitivity one/two	2.3mv/2.3mv
Pickup clipping one/two	148mv/148mv
Pickup capacitance one/two	220pf/220pf
Auxiliary impedance	94KΩ
Auxiliary sensitivity	181mv
Tape impedance one/two	95KΩ/95KΩ
Tape sensitivity one/two	193mv/184mv
Mic impedance	25KΩ
Mic sensitivity	2.5mv
Mic clipping	150mv
Max level from tuner (RO)	610mv
Max level from pickup (RO)	555mv
Tape output impedance DIN Av	152KΩ
Tape output impedance phono Av	15KΩ
Av. Pickup noise ref 8mv record output socket unw	73dB
Av. Pickup noise ref 8mv record output socket CCIR	71dB
Amp output noise @ 0 volume unw	800μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	84dB
Worst weighted noise Aux in/L out S/N ratio	81dB

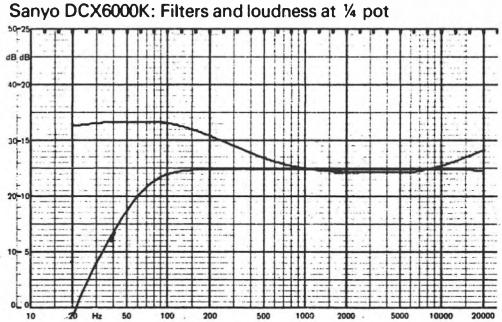
Tuner

Mono RF sensitivity 30dB IHF	1μv
Mono RF sensitivity 50dB IHF	2μv
Stereo RF sensitivity 50dB IHF	17μv
IM RF	74dB
Adjacent Channel worst figure	8dB
Alternate Channel worst figure	none
Image Response	none
Capture Ratio	1.5dB
AM Reject	74dB
Mono distortion 100% 1kHz centre tune worst case	0.3%
Optimum tune mono Average	0.11%
Stereo L= –R centre tune L	0.4%
Stereo L= –R centre tune R	0.6%
Av. Stereo R= –L centre tune	1.1%
MPX filter reject worst fig. @ 19kHz	66dB
MPX filter reject worst fig. @ 38kHz	62dB
X talk centre tune worst fig. 1kHz	26dB
X talk centre tune worst fig. 10kHz	25dB
Optimum tune 1kHz L/R	45/44dB
FR Frequency response stereo –1dB L/R	15Hz–13.2K/14.4K
FR Frequency response stereo 3dB L/R	7Hz–15.8K/15.8K
Error @ 15kHz L/R	–1.25/–1.25dB
Limit threshold	0.55μv
Mute threshold	5.5μv
Av. Stereo S/N weighted 100μv/1mV	55/72dB
Av. Stereo unw 1mV	65dB
Av. Mono weighted 1mV	73.5dB
Typical retail selling price Ex VAT	£123.20



Sanyo DCX6000K: Tone controls

Sanyo DCX6000K: Filters and loudness at ¼ pot



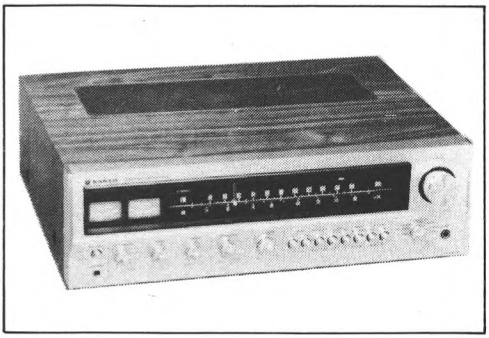
(Tested on 50dB scale)

Very handsomely styled, this 43W-per-channel receiver has a wooden case with a metal bottom panel. A three core mains lead and an independent earth terminal are provided. Two selectable pairs of speaker systems can be connected by spring loaded clamps, and inputs and tape outputs are on phono sockets. Phono break points are available immediately before the main amplifier, and shorting bars are provided for normal use. A ferrite rod aerial for AM (MW) is mounted on a very flimsy piece of metal, and this is most unimpressive. 75 and 300 ohm aerial terminals are provided for FM, and one for AM. The bass and treble controls have 11 stepped positions which give an even and wide variation. The balance control has no centre indent, but is satisfactory, as is the volume control. Selector switches choose phono 1 or 2, microphone, auxiliary, FM mono or stereo and AM inputs. Push buttons provide FM and audio muting, stereo/mono, tape monitor 1 and 2, loudness, and rumble and treble roll offs. Microphone and headphone jacks are mounted on the front panel. The receiver seemed to operate at rather a high temperature, since after a while our thermometer registered 110°F, and so the equipment is not recomrnended for use in an enclosed space.

Although the intermodulation and harmonic distortion measurements at high levels measured well, neither I nor my colleagues liked the sound quality, which seemed to 'shout', producing, for some reason, too much presence and hardness. This was particularly noticeable at louder volumes. The sound became muffled when the programme was very quiet, and some slight blurring of string tone was noticed, and almost certainly transient intermodulation distortion was present. The output amplifier noise was just a little higher than average, although it certainly was not a problem. The half power bandwidth for 0.1% only reached 3kHz on one channel, but 3.5kHz on the other, whilst for 0.3% THD both channels managed to reach just over 9kHz. This must be regarded as a rather poor performance. The tracking of all the controls was very good. The rumble filter cuts very steeply below 65Hz, which is unusually good, but unfortunately the treble roll off is only 6dB per octave from 6kHz. The RIAA input had a slightly higher than optimum impedance, and a very high capacitance, which however will suite some cartridges. The input clipping margin was extremely good here, as was the RIAA pre-amplifier noise performance. The output on the tape recorder socket was some 3dB higher than that typically produced from the tuner.

The tuner's distortion performance left a lot to be desired, since the R−L figures showed well over 1% at full deviation, which contributed to higher than average figures for L+R. The frequency response was excellent. The s/n performance was really fine, and clearly one of the best in the survey. The crosstalk and multiplex filter performance measured well. The RF sensitivities were most commendable, in particular the 50dB unweighted stereo figure of 19uV. The capture ratio and adjacent and alternate channels measured pretty well, and the RF intermodulation, AM reject, IF reject and image response measured excellently. What a pity that such a potentially excellent tuner is spoiled by the somewhat high distortion figures achieved in the discriminator/decoder section.

Quite clearly this receiver has many good points, and in particular the RF and some AF measurements of the tuner, and the general ergonomics of the amplifier. However, I cannot accept noticeable distortion, and I did not like the sound quality of the amplifier, which may be partially blamed on the very poor half power bandwidth, and possibly the production of transient intermodulation distortion. Perhaps other samples might be better though. If these points could be attended to, the receiver could be quite a good buy, but as it stands it cannot really be recommended.

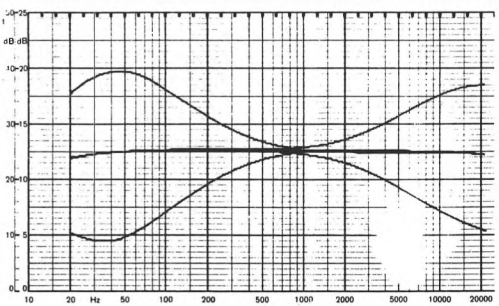


Amplifier

Av. Power output both channels driven	42.5W
Power output single channel driven	52.5W
Power output tone burst average	64W
Idle DC out worst case	19mv
Turn on/off Max. DC (swing worst case)	2v
Damping Factor L= −R	40/37%
IM 10w L/R	0.033/0.038%
IM 100mw L/R	0.052/0.048%
IM 1% output watts L/R	43/34W
Av. IM distortion pickup input/record out	0.03%
Av. Harmonic Distortion 0.1% (power cut)	40W
Power Bandwidth L/R 0.3%	<10Hz–9.8kHz/<10Hz–9.2kHz
Av. Pickup impedance one/two	52KΩ/52KΩ
Pickup sensitivity one/two	2.2mv/2.2mv
Pickup clipping one/two	154mv/154mv
Pickup capacitance one/two.	250pf/250pf
Auxiliary impedance	85KΩ
Auxiliary sensitivity	170mv
Tape impedance one/two	88KΩ/88KΩ
Tape sensitivity one/two	170mv/170mv
Mic impedance	25KΩ
Mic sensitivity	2.2mv
Mic clipping	150mv
Max level from tuner (RO)	500mv
Max level from pickup (RO)	580mv
Tape output impedance DIN Av.	152KΩ
Tape output impedance phono Av	14.5KΩ
Av. Pickup noise ref 8mv record output socket unw	70dB
Av. Pickup noise ref 8mv record output socket CCIR	70dB
Amp output noise @ 0 volume unw	800μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	83dB
Worst weighted noise Aux in/L out S/N ratio	80.7dB

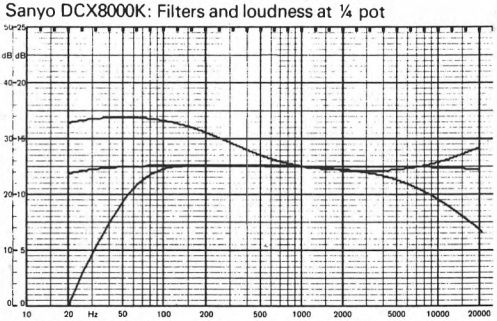
Tuner

Mono RF sensitivity 30dB IHF	0.8μv
Mono RF sensitivity 50dB IHF	1.8μv
Stereo RF sensitivity 50dB IHF	19μv
IM RF	84.9dB
Adjacent Channel worst figure	7dB
Alternate Channel worst figure	55dB
Image Response	none
Capture Ratio	1.5dB
AM Reject	68dB
Mono distortion 100% 1kHz centre tune worst case	0.54%
Optimum tune mono Average	0.23%
Stereo L= −R centre tune L	0.57%
Stereo L= −R centre tune R	0.46%
Av. Stereo R= −L centre tune	1%
MPX filter reject worst fig. @ 19kHz	63dB
MPX filter reject worst fig. @ 38kHz	62dB
X talk centre tune worst fig. 1kHz	34.5dB
X talk centre tune worst fig. 10kHz	32dB
Optimum tune 1kHz L/R	49/52dB
FR Frequency response stereo −1dB L/R	13Hz–15K/14.7K
FR Frequency response stereo 3dB L/R	6Hz–15.7K/15.7K
Error @ 15kHz L/R	−1dB/−1.25dB
Limit threshold	0.5μv
Mute threshold	6μv
Av. Stereo S/N weighted 100μv/1mV	55.5/72.5dB
Av. Stereo unw 1mV	65.5dB
Av. Mono weighted 1mV	71.5dB
Typical retail selling price Ex VAT	£136.60



Sanyo DCX8000K: Tone controls

Sanyo DCX8000K: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Sonab 3000

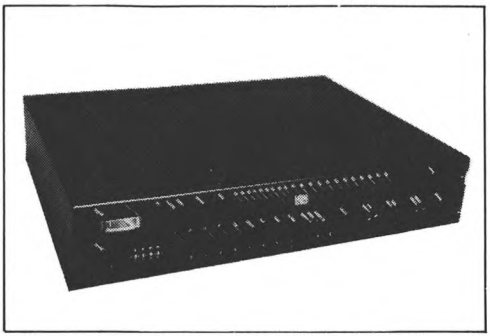
Sonab (UK) Limited, 214 Harlequin Avenue, Brentford, Middlesex TW8 9EW. 01-568 2952

As with most Sonab products, this is most unusually styled and will be either strongly liked or disliked by potential users. It gives up to 34W per channel in to two pairs of loudspeakers which can be operated in a pseudo-quad mode if required. Only a two core mains lead is provided, and the receiver has no earth terminal. All the input and output sockets, including the loudspeaker connections, are appropriate DIN types. Three 5 pole DINS are provided for phono, auxiliary and tape in/out. A 75 ohm RMA coax socket and a 300 ohm balanced one allow connection of an FM aerial. The receiver is remarkably small for its power rating, and is neatly housed in a metal case. Four pre set stations are incorporated, each with a very small edge-wise vertical tuning wheel for setting the required frequencies. A 5th push button brings in a horizontal tuning wheel for FM, and this moves a cursor along a horizontal scale. It position can be easily felt by blind people. Further push buttons choose phono, auxiliary and tape monitor inputs, and others select a high frequency roll off, the required speaker systems, AFC, muting and mono/stereo functions. The main operating rotary controls are very oddly shaped, and include normal, balance and volume controls, and a control labelled 'tone balance' which boosts bass and cuts top one way whilst cutting bass and boosting top the other—thus surprisingly doing exactly what it says. An additional control varies the bass independently. A headphone jack is incorporated on the front panel.

The IM and harmonic distortion measurements were all pretty good, and were remarkably consistent at low, medium and high levels. The half power bandwidth was relatively poor for 0.1%, extending from 30Hz to only 12kHz. The sound quality however was good, although somehow different, the bass sounding slightly down, and possibly both treble and bass very marginally more distorted than the standard (a highly subjective judgement). The damping factor was not particularly good, and a rather higher than average DC pulse was noted in to the loudspeakers when the equipment was switched on, but this would probably not cause trouble. The output noise level was very slightly hissy, but perfectly acceptable, and fortunately 8 ohm headphones are sufficiently attenuated for the hiss not to be too noticeable. The noise level increased slightly when the volume was raised to 3 o'clock. All the controls tracked fairly well, and quite a reasonable amount of response variation was possible, although a user would at first find difficulty in getting used to the very unusual method of variation. The treble roll off cut at 6dB/octave from 7kHz. Loudness control is incorporated, which worked adequately but could not be switched out (ridiculous). The RIAA pre-amplifier input had a rather high impedance, and some hum and hiss were developed. Other levels, etc., are compatible with external DIN equipment.

The tuner's noise levels were very satisfactory, some hum and hiss being noticeable. The frequency response, however, was excellent. The multiplex filter was virtually totally ineffective, and about the worst breakthrough measurements were noted. The distortion measurements were very satisfactory, but whilst crosstalk was good in one direction it was poor in the other. The RF input sensitivities were below average, although the adjacent and alternate channel selectivities were excellent. IF breakthrough measured well, but all the other RF measurements were fairly average. A signal strength meter was provided.

This very odd looking machine might well be purchased on appearance by some, with the knowledge that the performance is acceptable, although I could not personally put up with the insensitive tuner having a noiser than average output. The four pre-set stations are a distinct advantage, and worked well. Its full price is clearly rather expensive, but if you can get a good discount it would seem to be reasonable value for money. I consider it essential for you to try it before purchase, since it is so individual. Electromagnetic compatibility was extremely poor at VHF, but very good at LF.



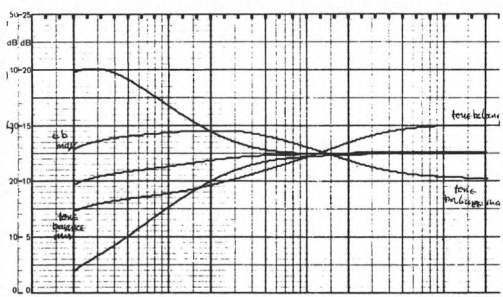
Amplifier

Av. Power output both channels driven	34W
Power output single channel driven	37.2W
Power output tone burst average	40W
Idle DC out worst case	<200μv
Turn on/off Max. DC (swing worst case)	8v
Damping Factor L= –R	21/21%
IM 10w L/R	0.16/0.13%
IM 100mw L/R	0.12/0.1%
IM 1% output watts L/R	21/23W
Av. IM distortion pickup input/record out	0.042%
Av. Harmonic Distortion 0.1% (power cut)	31W
Power Bandwidth L/R 0.1%	25Hz–12kHz/30Hz–13kHz
Av. Pickup impedance	66KΩ
Pickup sensitivity	2mv
Pickup clipping	125mv
Pickup capacitance	140pf
Auxiliary impedance	260KΩ
Auxiliary sensitivity	264mv
Tape impedance	270KΩ
Tape sensitivity	99mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	46mv
Max level from pickup (RO)	135mv
Tape output impedance DIN Av..	17KΩ
Tape output impedance phono Av	–
Av. Pickup noise ref 8mv record output socket unw	63.5dB
Av. Pickup noise ref 8mv record output socket CCIR	68dB
Amp output noise @ 0 volume unw	790μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	81dB
Worst weighted noise Aux in/L out S/N ratio	74.8dB

Tuner

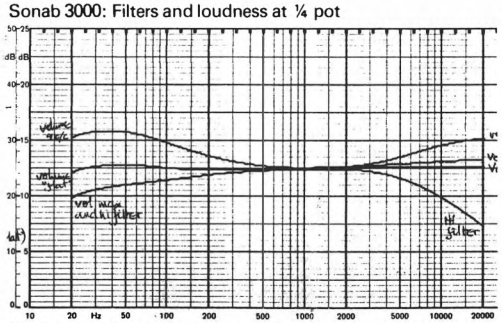
Mono RF sensitivity 30dB IHF	2.8μv
Mono RF sensitivity 50dB IHF	10μv
Stereo RF sensitivity 50dB IHF	42μv
IM RF	64dB
Adjacent Channel worst figure	5dB
Alternate Channel worst figure	55dB
Image Response	59dB
Capture Ratio	1.75dB
AM Reject	58dB
Mono distortion 100% 1kHz centre tune worst case	0.6%
Optimum tune mono Average	0.2%
Stereo L= –R centre tune L	0.3%
Stereo L= –R centre tune R	0.3%
Av. Stereo R= –L centre tune	0.4%
MPX filter reject worst fig. @ 19kHz	32dB
MPX filter reject worst fig. @ 38kHz	32dB
X talk centre tune worst fig. 1kHz	30dB
X talk centre tune worst fig. 10kHz	28dB
Optimum tune 1kHz L/R	30/45dB
FR Frequency response stereo –1dB L/R	9.5Hz–17.5K/17.5K
FR Frequency response stereo 3dB L/R	4.5Hz–19K/19K
Error @ 15kHz L/R	+0.75/+75dB
Limit threshold	1.9μv
Mute threshold	3μv
Av. Stereo S/N weighted 100μv/1mV	47/59.5dB
Av. Stereo unw 1mV	60dB
Av. Mono weighted 1mV	64dB
RRP Ex VAT	£195.00

Not normally discounted



Sonab 3000: Tone controls

Sonab 3000: Filters and loudness at ¼ pot



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Sony 7015

Sony (UK) Limited, Pyrene House, Sunbury Cross, Sunbury On Thames, Middlesex. Sunbury On Thames 87644

A modest little receiver, but well styled and very simple to operate. It delivered 20W per channel (both driven) in to either or both of 2 loudspeaker pairs, which can be connected on ordinary screw terminals on the rear. An IEC mains input socket is provided with an apropriate separate mains lead, and this is most commendable. Aerial terminals are provided with an appropriate separate mains lead, also for an external AM aerial, but there is no ferrite rod for AM. A selector switch allows for pick up, FM or AM tuner, auxiliary or mic (jack on front panel) to be fed through to the amplifier. A stereo headphone jack is also provided. Rotary bass and treble controls, having no centre indents, are complemented by a large volume control with sections for left and right which are friction locked, thus avoiding the necessity for a separate balance control. In practice this was found extremely annoying, since the rear part had to be grasped whilst moving the front part, if a balance change was necessary. Loudness, FM mute, mono/stereo and tape monitor buttons are also on the front panel, but no filters are incorporated. The tuning knob was smooth and well liked, but unfortunately had slight backlash. The wooden case has ventilation slots towards the rear, a metal base plate and plastic feet. Phono sockets are on the rear for pick up, auxiliary and tape in/out connections, the last being duplicated with a 5 pole DIN.

The harmonic distortion measurements were good, and the IM distortion was quite fair. The half power bandwidth was amazingly good for a budget amplifier, and at 0.1% it extended from below 10Hz to above 25kHz. The general sound quality was extremely good with the amplifier's limitations, although a slight lack of 'punch' in the bass was noted. The damping factor measured rather poorly, but was acceptable nevertheless. The s/n performance of the entire amplifier and pre-amplifier section was very good indeed, and most creditable on a budget receiver. No DC output problems were experienced. Despite the volume controls being independent, they tracked extremely well, as did both the bass and treble controls. The tone controls had a very inadequate range of adjustment, particularly of boost, although the loudness control worked well at lower volume settings.

The treble control in particular should also have had more cut available, since no filters are incorporated. The RIAA input had an impedance which was on the low side, but this will suit quite a number of cartridges, particularly the moving magnet types. The input clipping margin, however, is barely adequate, and 6dB more head room would be a lot better. The output level, however, was well compatible with that from the tuner at the record output sockets. Record output levels were compatible with DIN recorders. The phono record socket impedance was just a little high at 8k ohms. Auxiliary and tape sensitivities were adequate. The microphone input sensitivity was rather poor, and so you may have to speak rather close to a moving coil microphone to obtain adequate output volume. The auxiliary input clipped at 3.5V input, and this may be rather unfortunate for some applications. Commendable was the transient output power performance since the amplifier gave not far short of double power with only one channel driven (tone burst).

The s/n ratio of the tuner was not very good (rather hissy) but the frequency response was excellent. The distortion levels were very low, and MF crosstalk was very good, although deteriorating at HF. RF sensitivities were fair at the price but the adjacent and alternate channels were good. RF intermodulation was excellent, as was IF breakthrough. Other RF measurements were only fair. No tuning or RF level meters were provided.

Although this simple receiver has a few failings, it sounded surprisingly good and seemed very reliable. The tuner, although a little noisy, had an otherwise good performance, and therefore the receiver must be regarded as good value for money. Definitely a good buy, but check against the competition, which is considerable. Electromagnetic compatibility is excellent at low frequencies and very good at VHF.

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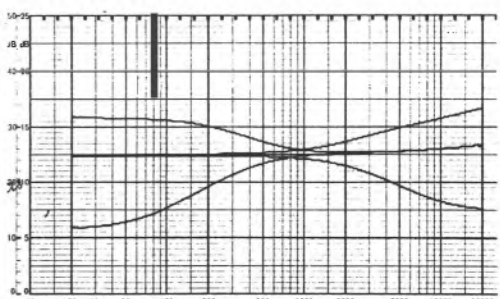
Amplifier

Av. Power output both channels driven	20.5W
Power output single channel driven	25.4W
Power output tone burst average	37.6W
Idle DC out worst case	27.5mv
Turn on/off Max. DC (swing worst case)	5v
Damping Factor L= –R	17/15%
IM 10w L/R	0.28/0.29%
IM 100mw L/R	0.23/0.23%
IM 1% output watts L/R	14.5/14.5W
Av. IM distortion pickup input/record out	0.055%
Av. Harmonic Distortion 0.1% (power cut)	18W
Power Bandwidth L/R 0.1%	<10Hz–25kHz/<10Hz–30kHz
Av. Pickup impedance	40KΩ
Pickup sensitivity	2.3mv
Pickup clipping	40mv
Pickup capacitance	90pf
Auxiliary impedance	104KΩ
Auxiliary sensitivity	206.5mv
Tape impedance	137KΩ
Tape sensitivity	239.7mv
Mic impedance	21KΩ
Mic sensitivity	2mv
Mic clipping	34mv
Max level from tuner (RO)	540mv
Max level from pickup (RO)	502mv
Tape output impedance DIN Av	70KΩ
Tape output impedance phono Av	8KΩ
Av. Pickup noise ref 8mv record output socket unw	77dB
Av. Pickup noise ref 8mv record output socket CCIR	73dB
Amp output noise @ 0 volume unw	340μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	94.5dB
Worst weighted noise Aux in/L out S/N ratio	75.3dB

Tuner

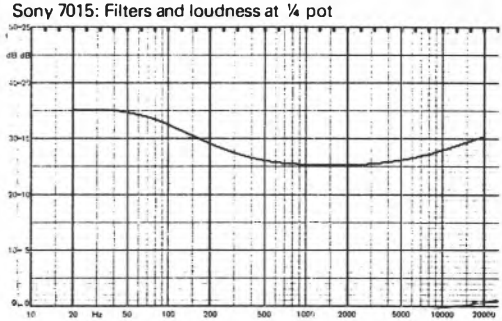
Mono RF sensitivity 30dB IHF	2.5μv
Mono RF sensitivity 50dB IHF	4.1μv
Stereo RF sensitivity 50dB IHF	50μv
IM RF	74dB
Adjacent Channel worst figure	Udb
Alternate Channel worst figure	52dB
Image Response	55.5dB
Capture Ratio	2.25dB
AM Reject	58dB
Mono distortion 100% 1kHz centre tune worst case	0.16%
Optimum tune mono Average	0.16%
Stereo L= –R centre tune L	0.3%
Stereo L= –R centre tune R	0.31%
Av. Stereo R= –L centre tune	0.19%
MPX filter reject worst fig. @ 19kHz	51dB
MPX filter reject worst fig. @ 38kHz	59dB
X talk centre tune worst fig. 1kHz	37dB
X talk centre tune worst fig. 10kHz	24.5dB
Optimum tune 1kHz L/R	38/40dB
FR Frequency response stereo –1dB L/R	18Hz–10.2K/11.5K
FR Frequency response stereo 3dB L/R	8Hz–16K/16.1K
Error @ 15kHz L/R	–2.25/–1.25dB
Limit threshold	1.1μv
Mute threshold	1.4μv
Av. Stereo S/N weighted 100μv/1mV	47/59dB
Av. Stereo unw 1mV	65dB
Av. Mono weighted 1mV	65dB
RRP Ex VAT	£111.99

Occasionally discounted



Sony 7015: Tone controls

Sony 7015: Filters and loudness at ¼ pot



(Tested at 50db noise)

Tandberg TR 220

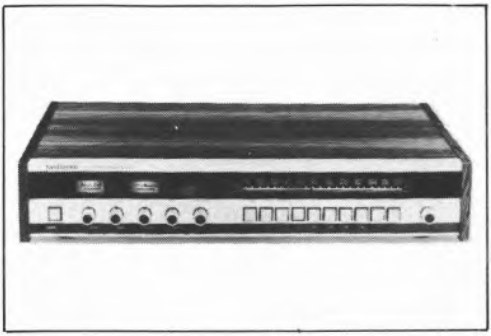
Farnell Tandberg Limited, 81 Kirkstall Road, Leeds LS3 1HR.
0532 35111

A low powered receiver which gives only 15W per channel into 2 selectable pairs of loudspeakers. DIN sockets are provided throughout for loudspeakers, audio inputs and tape. Push buttons on the front select pick-up, auxiliary, tape monitor, FM tune and 4 preset FM stations. The auxiliary socket can also be used for interconnection with a recorder but cannot be monitored whilst recording, although the normal tape socket can be. Additional push buttons select mute, AFC, tape monitor, loudness, mono/stereo, rumble filter and treble filter. All the rotary controls are very small and have small pointers. None of the controls have centre indents. An RMA coaxial 75 ohm socket is complemented by a 300 ohm one for external FM aerial. The mains lead is 3 core and no separate earth terminal is provided. The wooden case has a metal base plate.

Strictly within its power limitation the amplifier sounded very clean, particularly at the treble end, although bass frequencies were just a little boomy. However the damping factor was satisfactory. The half power bandwidth whilst being excellent on one channel was poor on the other one and this may be due to differences in component tolerances. A rather nasty 12V DC pulse was noted each time the amplifier was switched on, although this only lasted for 0.2s. The signal to noise ratios throughout were very satisfactory. A very adequate level was available for driving headphones, which worked well. All the controls tracked very well and the tone controls had an almost excessive range available. The treble filter cut 3dB at 7kHz and approached 12dB per octave (excellent) whilst the rumble roll-off was 3dB down at 65Hz, but only cut at 6dB per octave. The RIAA input impedance was optimum, but its clipping margin was only just about adequate, and possibly very efficient magnetic cartridges could begin to give trouble. The pick-up output level was very compatible with DIN equipment but the tuner's output level here was a little high for some European DIN models (NB. this equipment can only be interconnected with external DIN recorders). The auxiliary input clipped at 4V. The rotary controls were considered rather cramped, although a user would probably get used to them.

The tuner's signal to noise ratios were comparitively very good on weak signals, but about average on strong ones, although the noise that was present was primarily hiss. Provided tuning was accomplished very carefully, the distortion levels were remarkably low and the sound reproduction quality therefore very good indeed. A centre tuning indicator meter is complemented by an RF signal strength one, which also indicates approximate frequency when preset stations are selected. The crosstalk measured very well and the frequency response superbly well, although the MPX filter also achieved a remarkable notch at 19kHz, a rare combination showing an exceptionally well designed filter. The RF input sensitivities were very remarkable indeed on such an inexpensive receiver and this is credit to Tandberg. The other RF measurements were excellent except RF intermodulation and image response, which were both below average unfortunately. The tuning dial accuracy was adequate. The rate of tuning was rather too fast making it not too easy to find a weaker station quickly. The preset stations, however, worked excellently.

The provision of these preset stations and the general excellent tuner performance combined with a pretty good amplifier recommends this receiver fairly strongly. Note, though, that the maximum output power is rather limited, thus restricting its normal use to either relatively smaller rooms or with rather sensitive loudspeakers that may not necessarily be too good. It is clearly good value for money, and as a new model should do well. Electromagnetic compatibility was excellent on low frequencies but just beginning to create a problem on VHF with very strong transmitters operating in the immediate vicinity (within 100ft). A good but relatively simple little receiver which will give a lot of pleasure to its users.



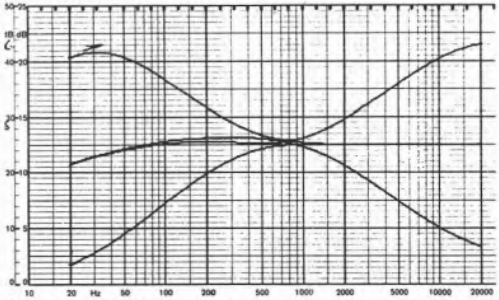
Amplifier

Av. Power output both channels driven	15W
Power output single channel driven	18W
Power output tone burst average	18.5W
Idle DC out worst case	–
Turn on/off Max. DC (swing worst case)	12v
Damping Factor L= –R	23/22%
IM 10w L/R	0.6/0.42%
IM 100mw L/R	0.08/0.09%
IM 1% output watts L/R	10.6/10.4W
Av. IM distortion pickup input/record out	0.1%
Av. Harmonic Distortion 0.1% (power cut)	13.8W
Power Bandwidth L/R 0.1%	11Hz–30kHz/12.5Hz–10.5kHz
Av. Pickup impedance	48KΩ
Pickup sensitivity	2.75mv
Pickup clipping	52mv
Pickup capacitance	40pf
Auxiliary impedance	63KΩ
Auxiliary sensitivity	145mv
Tape impedance	28KΩ
Tape sensitivity	138mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	48mv
Max level from pickup (RO)	19.3mv
Tape output impedance DIN Av	36KΩ
Tape output impedance phono Av	–
Av. Pickup noise ref 8mv record output socket unw	74dB
Av. Pickup noise ref 8mv record output socket CCIR	67dB
Amp output noise @ 0 volume unw	330μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	87dB
Worst weighted noise Aux in/L out S/N ratio	82.5dB

Tuner

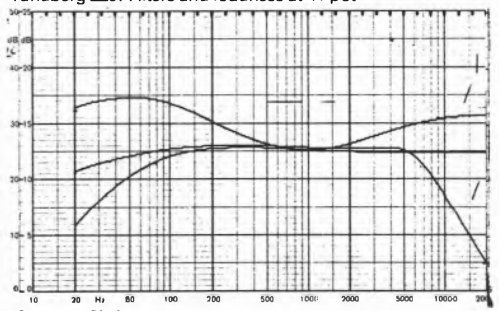
Mono RF sensitivity 30dB IHF	0.8μv
Mono RF sensitivity 50dB IHF	2.3μv
Stereo RF sensitivity 50dB IHF	19μv
IM RF	66dB
Adjacent Channel worst figure	13dB
Alternate Channel worst figure	16dB
Image Response	63.5dB
Capture Ratio	1.5dB
AM Reject	60dB
Mono distortion 100% 1kHz centre tune worst case	0.27%
Optimum tune mono Average	0.25%
Stereo L= –R centre tune L	0.21%
Stereo L= –R centre tune R	0.25%
Av. Stereo R= –L centre tune	0.39%
MPX filter reject worst fig. @ 19kHz	61dB
MPX filter reject worst fig. @ 38kHz	45dB
X talk centre tune worst fig. 1kHz	35.5dB
X talk centre tune worst fig. 10kHz	38dB
Optimum tune 1kHz L/R	42/37dB
FR Frequency response stereo –1dB L/R	36Hz–16.7K/16.7K
FR Frequency response stereo 3dB L/R	16Hz–17.3K/17.2K
Error @ 15kHz L/R	+1.25/+1dB
Limit threshold	0.5μv
Mute threshold	1.3μv
Av. Stereo S/N weighted 100μv/1mV	54.5/62.5dB
Av. Stereo unw 1mV	68dB
Av. Mono weighted 1mV	66.5dB
RRP Ex VAT	£130.00

Occasionally discounted



Tandberg 220: Tone controls

Tandberg 220: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Tandberg 1040P

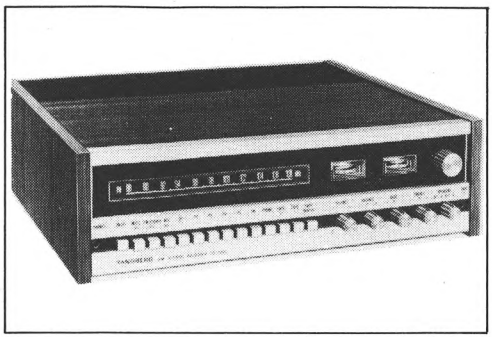
Farnell Tandberg Limited, 81 Kirkstall Road, Leeds LS3 1HR.
0532 35111

A powerful but relatively compact machine delivering up to 48W (both channels driven) into two selectable pairs of loudspeakers. A 3 core mains lead is provided with an independent earth terminal and also two AC outlet sockets (one unswitched). A 75 ohm RMA coax socket and a 300 ohm balanced one are fitted for FM aerial connections and the receiver incorporates 5 pre-settable FM stations as well as a normal tuning position. Very conveniently all phono sockets are duplicated by DIN ones on the rear panel for pick-up and two tape recorders, one of these inputs could be used for auxiliary. A dubbing facility is provided together with monitoring, either machine's output. Furthermore, equalisation can be applied either in the dubbing process or before tape recording. Input selection is on a row of push buttons, which also control mains on/off, mute, FM stereo/mono and AFC. All the rotary audio controls are very small and slightly stiff but have clear mechanical pointers. The balance control has no centre indent. The bass and treble controls allow independent variation of the two channels, each concentrically mounted so that it is possible to turn both channels up together, however they are not satisfactorily friction locked. A spring loaded flap at the bottom of the front panel exposes 5 preset station frequency selectors, stereo mono left and mono right buttons, a loudness on/off control, a rumble filter, two high frequency filters and the preamplifier/record function. Unfortunately this facility only works into an independent stereo jack socket. The manual tuning control was smooth but the tuning rate was rather fast (not enough band spread). The receiver is housed in a wooden case with a metal ventilation grill and a metal base plate.

The amplifier quality was very good indeed, having a transparency which was well liked although the sound was marginally on the bright side. The IM and harmonic distortion measurements were good and the half power bandwidth for 0.1% extended to at least 20kHz. The signal to noise ratios throughout the equipment were very good and the damping factor was excellent. No DC output problems were encountered. Headphones worked well. The tone, filter and volume control trackings were only just adequate, since it was quite difficult to adjust the bass and treble controls for equal effect on both channels and this was noticeable subjectively. An almost excessive range of adjustment of bass and treble was possible. The rumble filter cutting 3dB at 70Hz rolled off at 12dB per octave (excellent) whilst the treble filters rolled off from 8kHz, one being 6dB whilst the other was 12dB/octave. (if both used, 18dB/octave). This facility was very good indeed. The loudness control was quite effective. The pick-up input has the optimum input impedance and its clipping point depends upon the position of a user preset, underneath the bottom. The output level even at maximum sensitivity is well below that of the tuner's on the record output sockets, the latter giving in excess of 1V out. Although the DIN socket attenuates this level, it might be slightly too high for one or two European DIN recorders, although satisfactory for almost all models.

The tuner section have good comparative signal to noise ratios on weak signals but was only average although very adequate on strong ones. The distortion and crosstalk measurements were excellent and the general sound quality very good indeed on the aerial test. The frequency response was also excellent, as was the MPX filter. The tuning scale was accurate. The RF input sensitivities all measured very well—in particular stereo 50db UnW was 20uV. The adjacent and alternate channel selectivities almost achieved text book perfection and other RF measurements were all good, except image response (only a slight problem near flight paths) and the RF intermodulation ratio of 63dB (bettered by many).

Although this is a fairly expensive receiver it includes so many useful and interesting facilities, that I must consider it good value for money. These facilities include preset stations and independent tone controls for each channel, as well as comprehensive dubbing modes. Almost all the tuner measurements were excellent and the reproduced sound quality well above average. I can strongly recommend it for those who require the specialised functions. Since the electromagnetic compatibility was also excellent this receiver is likely to give a lot of pleasure to its purchasers.



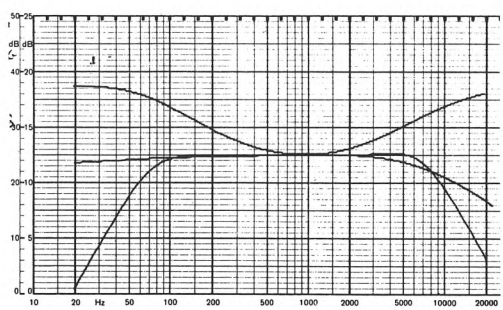
Amplifier

Av. Power output both channels driven	48.5W
Power output single channel driven	55W
Power output tone burst average	64W
Idle DC out worst case	13mv
Turn on/off Max. DC (swing worst case)	350mv
Damping Factor L= –R	42/45%
IM 10w L/R	0.1/0.05%
IM 100mw L/R	0.05/0.05%
IM 1% output watts L/R	34.5/36W
Av. IM distortion pickup input/record out	0.004%
Av. Harmonic Distortion 0.1% (power cut)	44.6W
Power Bandwidth L/R 0.1%	<10Hz–20kHz/<10Hz–32kHz
Av. Pickup impedance one/two	47KΩ/47KΩ
Pickup sensitivity one/two	2.2mv/2.2mv
Pickup clipping one/two	30mv/30mv*
Pickup capacitance one/two	10pf/10pf
Auxiliary impedance	–
Auxiliary sensitivity	–
Tape impedance one/two	25KΩ/25KΩ
Tape sensitivity one/two	139mv/139mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	1.3v
Max level from pickup (RO)	533mv
Tape output impedance DIN Av	36KΩ
Tape output impedance phono Av	1.1KΩ
Av. Pickup noise ref 8mv record output socket unw	68dB
Av. Pickup noise ref 8mv record output socket CCIR	71.5dB
Amp output noise @ 0 volume unw	550μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	88.5dB
Worst weighted noise Aux in/L out S/N ratio	80.3dB

Tuner

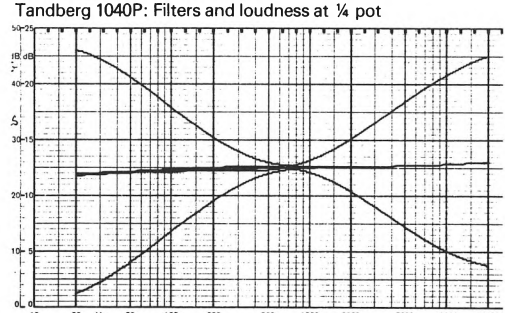
Mono RF sensitivity 30dB IHF	1.3μv
Mono RF sensitivity 50dB IHF	2.2μv
Stereo RF sensitivity 50dB IHF	20μv
IM RF	62.8dB
Adjacent Channel worst figure	16dB
Alternate Channel worst figure	none
Image Response	58.5dB
Capture Ratio	1.5dB
AM Reject	61dB
Mono distortion 100% 1kHz centre tune worst case	0.18%
Optimum tune mono Average	0.14%
Stereo L= –R centre tune L	0.18%
Stereo L= –R centre tune R	0.13%
Av. Stereo R= –L centre tune	0.2%
MPX filter reject worst fig. @ 19kHz	60dB
MPX filter reject worst fig. @ 38kHz	69dB
X talk centre tune worst fig. 1kHz	51dB
X talk centre tune worst fig. 10kHz	45dB
Optimum tune 1kHz L/R	52/59dB
FR Frequency response stereo –1dB L/R	40Hz–14.8K/14.8K
FR Frequency response stereo 3dB L/R	20Hz–15.8K/15.8K
Error @ 15kHz L/R	–1.5/–1.25dB
Limit threshold	0.8μv
Mute threshold	1.2μv
Av. Stereo S/N weighted 100μv/1mV	55.5/62.5dB
Av. Stereo unw 1mV	68dB
Av. Mono weighted 1mV	67dB
RRP Ex VAT	£209.00

Occasionally discounted



Tandberg 1040P: Tone controls

Tandberg 1040P: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Tandberg 2075

Farnell Tandberg Limited, 81 Kirkstall Road, Leeds LS3 1HR. 0532 35111

The largest receiver in the Tandberg range, producing up to 88W per channel (both driven). The outputs can be switched through to either A, B or C or combination of B or C with A. The loudspeaker outputs are on screw terminals (not good enough on an expensive receiver). A 3 core mains lead with an independent earth terminal is provided. We noted that the loudspeaker output switch was very wibbly wobbly. Inputs are duplicated on phono and DIN sockets and incorporate two pick-ups and connections for two tape recorders. Pick-up 1 and both tape inputs have preset level controls on the rear. A ferrite rod for AM can be swung into any horizontal direction, and for FM a 75 ohm RMA coaxial socket is complemented by a 300 ohm balanced one. Phono break points with shorting bars allow insertion of external equalisation, etc., immediately before the main amplifier. None of the rotary controls have centre indents and some of the knobs pull off rather easily. Bass. mid and treble controls allow independent variation between channels and are not friction locked. Preset buttons select the following functions: FM mono/stereo, FM muting, light dim, FM 25uS de-emphasis/normal, tape copying and monitoring in either direction, loudness, mono L, mono R, mono L + R and full stereo. Also incorporated are rumble and two treble filters, and a facility for switching the tone control section to a recorder out jack socket for specialised dubbing applications. A further push button changes the metering to read power output instead of their more usual tuning and RF signal strength functions. All inputs and tape monitoring are selected by large square push buttons. All the push buttons illuminate when selected. The tuning knob ran very smoothly ir.deed. The unit is housed in a large wooden case with a metal ventilation grill and base plate. The receiver runs very warm when driven hard.

The harmonic and intermodulation distortion performance of the amplifier section measured well and the sound quality was very good indeed, although some difficulty was experienced in obtaining absolutely stable high frequency images, as compared to their positions on our standard amplifier. We feel this is due to the tone controls being very loose and difficult to set accurately. The sound quality into the Spendor BC3's was however excellent on all material. The damping factor was remarkably good and the half power response excellent, extending to 25kHz. All the signal to noise ratios throughout were excellent, and good quality was obtained from headphones. No DC output problems were experienced. An extremely wide range of variation is available from the tone controls and in my opinion this is almost excessive, particularly if an attempt is made to boost too much treble in the special dubbing mode used before taping. The rumble filter cuts at 12dB per octave, being −3dB at 85Hz, and this turnover frequency is surely too high. The treble filters cut 3dB at 7kHz and 8.5kHz, with slopes of 6 and 12dB/octave respectively. Both can be used together if required. The loudness control worked well. The RIAA input impedances were optimum but the clipping margins were only just adequate (but N.B. preset on pick-up 1). The pick-up output was again rather lower than the tuner's level on the record out sockets. The tape inputs had adequate sensitivity but will clip at 2.5V unless their input presets are reduced in gain. The DIN output impedance was satisfactory, attenuating the phono output level by approximately 26dB into a 10k ohm DIN input.

The signal to noise ratios of the tuner section were superb and in particular weak stereo signals were less noisy than average. The crosstalk and distortion measurements were quite remarkably good and the reproduced sound quality was superb throughout all the tests. The frequency response was also extremely flat and yet again the MPX filter rejected pilot to −60dB ref. full output level. The tuning scale was extremely accurate. The RF input sensitivities were remarkably good and the adjacent and alternate channel exemplary. All the other RF measurements were excellent, except the image response, which was only fair. Quite clearly then the tuner section offers a really remarkable performance.

This receiver is, in my opinion, extremely expensive, although it does offer some fascinating facilities and a very fine overall performance. It can be recommended strongly if you have a healthy bank balance, but despite its general excellence I really cannot say that it is good value for money, for this must depend on your personal definitions of the term. If money is no object then you will probably be very happy indeed with this receiver. Electromagnetic compatibility was rather poor at LF and local VHF transmissions might also create problems.

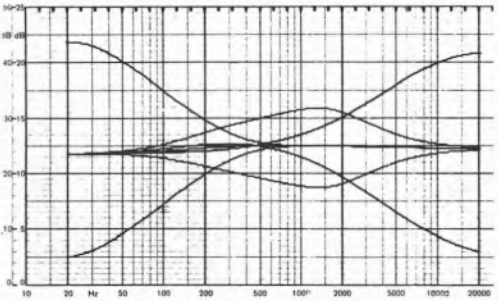
Amplifier

Av. Power output both channels driven	89W
Power output single channel driven	94.5W
Power output tone burst average	121W
Idle DC out worst case	8.5mv
Turn on/off Max. DC (swing worst case)	200mv
Damping Factor L= –R	57/54%
IM 10w L/R	0.08/0.07%
IM 100mw L/R	0.055/0.056%
IM 1% output watts L/R	60.5/60.5W
Av. IM distortion pickup input/record out	0.015%
Av. Harmonic Distortion 0.1% (power cut)	81.9W
Power Bandwidth L/R 0.1%	<10Hz–25kHz/<10Hz–22kHz
Av. Pickup impedance one/two	47KΩ/47KΩ
Pickup sensitivity one/two	2.6mv/4mv
Pickup clipping one/two	36mv/60mv
Pickup capacitance one/two	4pf/10pf
Auxiliary impedance	–
Auxiliary sensitivity	–
Tape impedance one/two	27KΩ/27KΩ
Tape sensitivity one/two	175.5/175.5mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	730mv
Max level from pickup (RO)	435mv
Tape output impedance DIN Av	36KΩ
Tape output impedance phono Av	1KΩ
Av. Pickup noise ref 8mv record output socket unw	76dB
Av. Pickup noise ref 8mv record output socket CCIR	71.5dB
Amp output noise @ 0 volume unw	500μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	90.2dB
Worst weighted noise Aux in/L out S/N ratio	78.8dB

Tuner

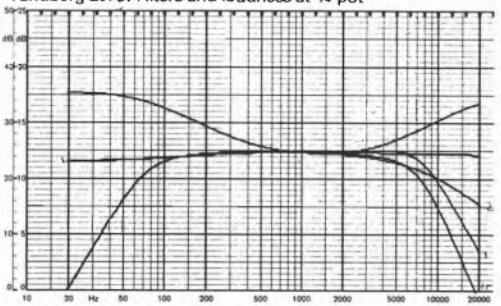
Mono RF sensitivity 30dB IHF	0.8μv
Mono RF sensitivity 50dB IHF	1.6μv
Stereo RF sensitivity 50dB IHF	18μv
IM RF	81dB
Adjacent Channel worst figure	8dB
Alternate Channel worst figure	none
Image Response	66dB
Capture Ratio	2dB
AM Reject	59dB
Mono distortion 100% 1kHz centre tune worst case	0.32%
Optimum tune mono Average	0.14%
Stereo L= –R centre tune L	0.23%
Stereo L= –R centre tune R	0.23%
Av. Stereo R= –L centre tune	0.18%
MPX filter reject worst fig. @ 19kHz	60dB
MPX filter reject worst fig. @ 38kHz	>80dB
X talk centre tune worst fig. 1kHz	49dB
X talk centre tune worst fig. 10kHz	40dB
Optimum tune 1kHz L/R	56/55.5dB
FR Frequency response stereo –1dB L/R	28Hz–15.1K/15.8K
FR Frequency response stereo 3dB L/R	15Hz–15.7K/16K
Error @ 15kHz L/R	–0.5/+0.5dB
Limit threshold	0.45μv
Mute threshold	15μv
Av. Stereo S/N weighted 100μv/1mV	56/68dB
Av. Stereo unw 1mV	72dB
Av. Mono weighted 1mV	72dB
RRP Ex VAT	£360.00

Occasionally discounted



Tandberg 2075: Tone controls

Tandberg 2075: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Technics 5150

National Panasonic (UK) Limited, 107/109 Whitby Road, Slough, Bucks. Slough 34522

The smallest Technics receiver in the survey, delivering 19W per channel in to 8 ohms in to two switchable pairs of loudspeakers. The screw terminals for these are labelled main and remote. A three core mains lead and an earth terminal are provided. Pick up, auxiliary and tape in and out sockets are on phonos, tape also being duplicated on a 5 pole DIN. 75 and 300 ohm FM aerial terminals are complemented by an AM one. Only very basic facilities are incorporated; in addition to the usual bass and treble controls, and balance and volume (none indented), push buttons select tape monitor, loudness and mono/stereo. No filters are included. The tuning drive incorporates a fly wheel, and feels very smooth, with no backlash. Only an RF signal strength meter is provided. The main case is wooden, with ventilation grill and a metal base plate.

The amplifier sounded reasonable at high levels, within its power rating, but at very low levels the sound seemed to expand downwards, thus showing signs of crossover distortion. It was also slightly 'fuzzy' when quiet. Although the damping factor was quite good, bass frequencies sounded rather soggy, and this was possibly due to the very poor half power bandwidth, .1% averaging only 175Hz to 8kHz. Bass guitar sounded pretty poor with no punch, for example. The IM distortion rose fairly steeply at 100mW and below, although the harmonic distortion measured quite well. A 9V DC pulse was noted on the right hand channel on switch on, and this lasted for half a second, which could eventually strain very small loudspeaker units, although more normal ones would not be affected. The noise levels of the amplifier throughout were generally good, but a sample fault showed intermittent severe degradation. Headphones worked well. The treble and volume controls did not track particularly well, although the bass control was good. Both tone controls, though, had a good level of adjustment which is most important, since no filters are incorporated. The loudness control only boosted bass frequencies, but adequately, and I personally prefer this, although loudness controls do give an odd idea of balance anyway. The pick up input had only just an adequate clipping margin, and a marginally less than optimum input impedance although the output level was compatible with that of the tuner, and the auxiliary and tape in and out impedances and sensitivities were adequate.

The s/n ratios of the tuner section measured very well indeed, shaming many far more expensive receivers. Particularly commended was the relatively low hiss on weak stereo signals. The frequency response was extremely good, and actually went down to 4Hz at the bass end, which does seem a trifle optimistic! Again, the distortion performance measured so well, and the sound quality reproduction was so good, that I got the impression of a far more sophisticated tuner. The crosstalk also was superb. The RF sensitivities all measured very well, and the adjacent and alternate channel selectivities were fine. Unfortunately, the RF intermodulation distortion ratio was somewhat poor at 66dB, and in some locations it may be necessary to use an aerial attenuator of up to 12dB if you are fairly close to a local or network FM transmitter. Adding this, will, of course, deteriorate the hiss performance on weak stations. The image response was not too good, but other RF measurements were very satisfactory. Provided that your aerial is giving the optimum signal strength, this receiver should give superb audio quality on the main FM programmes. If you live well away from any transmitters, it will also give you good performance on distant ones.

It must be remembered that this receiver includes only the barest essentials, and whilst the tuner performance is in general excellent the amplifier itself has very little power in reserve, if any, at very low and high frequencies. It would perform well, though, in small systems with fairly sensitive speakers. It can thus be recommended, but note the reservations. Although Technics equipment is not normally available at a discount, this model is still good value for money. The electromagnetic compatibility was very good indeed and Technics must be commended for this. What a pity that the half power bandwidth was so relatively disappointing, but many users will find this little receiver just what they want. It is also so well styled.

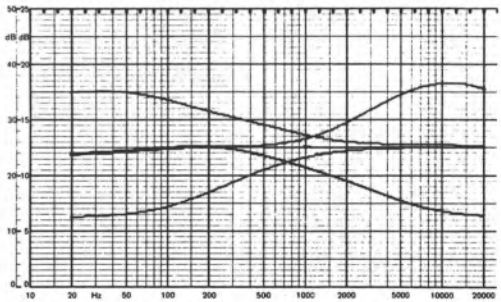
Amplifier

Av. Power output both channels driven	19W
Power output single channel driven	22W
Power output tone burst average	22.6W
Idle DC out worst case	33mv
Turn on/off Max. DC (swing worst case)	9v
Damping Factor L= –R	25/24%
IM 10w L/R	0.23/0.21%
IM 100mw L/R	0.7/0.84%
IM 1% output watts L/R	13.8/12.5W
Av. IM distortion pickup input/record out	0.016%
Av. Harmonic Distortion 0.1% (power cut)	16.8W
Power Bandwidth L/R 0.1%	150Hz–5kHz/210Hz–12.2kHz
Av. Pickup impedance	43.5KΩ
Pickup sensitivity	2.34mv
Pickup clipping	67mv
Pickup capacitance	250pf
Auxiliary impedance	63KΩ
Auxiliary sensitivity	185mv
Tape impedance	71KΩ
Tape sensitivity	185mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	690mv
Max level from pickup (RO)	525mv
Tape output impedance DIN Av	81KΩ
Tape output impedance phono Av	175Ω
Av. Pickup noise ref 8mv record output socket unw	72dB
Av. Pickup noise ref 8mv record output socket CCIR	72.5dB
Amp output noise @ 0 volume unw	>32μv* 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	>110*dB
Worst weighted noise Aux in/L out S/N ratio	>89.8*dB

Tuner

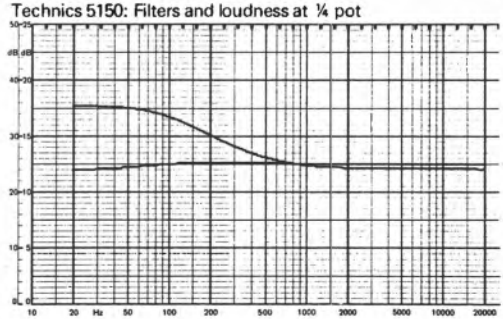
Mono RF sensitivity 30dB IHF	0.9μv
Mono RF sensitivity 50dB IHF	2.5μv
Stereo RF sensitivity 50dB IHF	27μv
IM RF	66dB
Adjacent Channel worst figure	4dB
Alternate Channel worst figure	none
Image Response	66.9dB
Capture Ratio	1.25dB
AM Reject	61dB
Mono distortion 100% 1kHz centre tune worst case	0.19%
Optimum tune mono Average	0.15%
Stereo L= –R centre tune L	0.11%
Stereo L= –R centre tune R	0.13%
Av. Stereo R= –L centre tune	0.21%
MPX filter reject worst fig. @ 19kHz	33.5dB
MPX filter reject worst fig. @ 38kHz	55dB
X talk centre tune worst fig. 1kHz	44.5dB
X talk centre tune worst fig. 10kHz	40dB
Optimum tune 1kHz L/R	55/56.5dB
FR Frequency response stereo –1dB L/R	4Hz–13.6K/14.2K
FR Frequency response stereo 3dB L/R	17.5K/17.4K
Error @ 15kHz L/R	–1.5/–1.25dB
Limit threshold	1.5μv
Mute threshold	none
Av. Stereo S/N weighted 100μv/1mV	54/69dB
Av. Stereo unw 1mV	75dB
Av. Mono weighted 1mV	72dB
RRP Ex VAT	£111.96

Not normally discounted



Technics 5150: Tone controls

Technics 5150: Filters and loudness at ¼ pot



(Tested on 50dB scale)

This gives up to 31W per channel into two loudspeaker pairs (switchable), which can be connected on screw terminals at the rear. A ferrite rod can be rotated through only 90° horizontally for AM. Input terminals are provided for 75 ohm and 300 ohm FM aerials and an additional terminal for an external AM one. Phone sockets are provided for pick-up input, auxiliary and tape in/out 1 and 2, tape 1 being duplicated on a 5 pole DIN socket. A 3 core mains lead is provided but no earth terminal other than the aerial one. The unit is housed in a wooden case with metal base plate and includes a metal grill towards the back of the top. The controls (none has a centre indent) include bass, treble, balance and volume. An input switch selects pick-up, aux, FM or AM tuner. Push buttons operate FM muting, loudness, tape monitors 1/2, mono/stereo and power on/off. No filters are included. The receiver is extremely well styled and the tuning knob feels excellent and has a good flywheel action and no backlash (excellent). A headphone jack is provided on the front panel.

The amplifier sounded extremely good, although just a little forward at high frequencies. No crossover distortion was detected and the bass end was particularly well controlled. The intermodulation and harmonic distortion measurements were good and the half power bandwidth extended up to 28kHz. The damping factor was good and all the measurements suported the good subjective impression. The signal to noise ratios throughout measured well and ample volume was available for headphones. No DC problems on the output were experienced. The control tracking was satisfactory and the tone controls provided a reasonable range of variation, but no filters are incorporated. The loudness control only boosted bass at low volumes, which I do not consider a failing. The pick-up input impedance was a little low and had a rather high capacity which would suit some cartridges but not others (measuring around 250pf at 10kHz). The clipping margin was only just adequate for low output cartridges and some trouble could be experienced from high output types (eg. Ortofon with transformer). Input and output impedances elsewhere were all satisfactory and the DIN tape output was compatible with all DIN spec. recorders.

The signal to noise ratios from the tuner section were excellent and the distortion levels measured very low indeed. The crosstalk measurements were almost incredible even at high frequencies. The frequency response was very good. The MPX filtering, though, was only just adequate. The tuning scale accuracy was satisfactory. RF input sensitivities were very good and the adjacent and alternate channel selectivities measured well. IF reject, capture ratio and AM rejection were all very good, the other RF measurements being average.

Technics equipment is not normally available at a discount but nevertheless this receiver is clearly reasonable value for money, since it was well aligned and gave generally a pretty good performance. Electromagnetic compatibility was poor at VHF but very good at lower frequencies. This model can be clearly recommended and, with the small reservations mentioned, should give trouble-free operation.

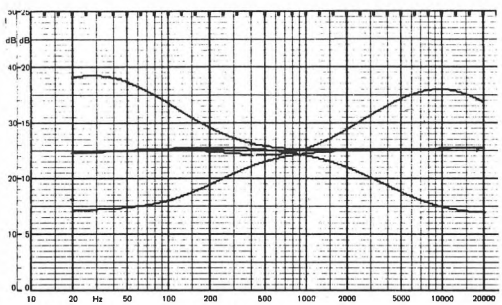
Amplifier

Av. Power output both channels driven	31W
Power output single channel driven	36W
Power output tone burst average	44W
Idle DC out worst case	21mv
Turn on/off Max. DC (swing worst case)	7.5v
Damping Factor L= –R	29/29%
IM 10w L/R	0.01/0.01%
IM 100mw L/R	0.07/0.12%
IM 1% output watts L/R	22/22W
Av. IM distortion pickup input/record out	0.028%
Av. Harmonic Distortion 0.1% (power cut)	28.5W
Power Bandwidth L/R 0.1%	12Hz–28kHz/<10Hz–30kHz
Av. Pickup impedance	41KΩ
Pickup sensitivity	2.21mv
Pickup clipping	50mv
Pickup capacitance	280pf
Auxiliary impedance	67KΩ
Auxiliary sensitivity	200mv
Tape impedance one/two	75KΩ/75KΩ
Tape sensitivity one/two	200mv/200mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	660mv
Max level from pickup (RO)	690mv
Tape output impedance DIN Av	82KΩ
Tape output impedance phono Av	345Ω
Av. Pickup noise ref 8mv record output socket unw	75dB
Av. Pickup noise ref 8mv record output socket CCIR	72.5dB
Amp output noise @ 0 volume unw	390μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	87.5dB
Worst weighted noise Aux in/L out S/N ratio	79dB

Tuner

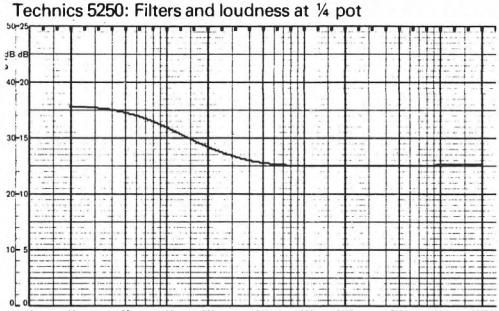
Mono RF sensitivity 30dB IHF	1.1μv
Mono RF sensitivity 50dB IHF	1.8μv
Stereo RF sensitivity 50dB IHF	21μv
IM RF	71.2dB
Adjacent Channel worst figure	14dB
Alternate Channel worst figure	55dB
Image Response	66.4dB
Capture Ratio	1.25dB
AM Reject	59.5dB
Mono distortion 100% 1kHz centre tune worst case	0.38%
Optimum tune mono Average	0.12%
Stereo L= –R centre tune L	0.24%
Stereo L= –R centre tune R	0.24%
Av. Stereo R= –L centre tune	0.1%
MPX filter reject worst fig. @ 19kHz	46dB
MPX filter reject worst fig. @ 38kHz	54dB
X talk centre tune worst fig. 1kHz	50.5dB
X talk centre tune worst fig. 10kHz	42dB
Optimum tune 1kHz L/R	53/61dB
FR Frequency response stereo –1dB L/R	12Hz–13.7K/13.4K
FR Frequency response stereo 3dB L/R	6Hz–15.5K/15.6K
Error @ 15kHz L/R	–2/–2.25dB
Limit threshold	0.5μv
Mute threshold	1μv
Av. Stereo S/N weighted 100μv/1mV	55/69dB
Av. Stereo unw 1mV	69dB
Av. Mono weighted 1mV	70.5dB
RRP Ex VAT	£135.96

Not normally discounted



Technics 5250: Tone controls

Technics 5250: Filters and loudness at ¼ pot



(Tested on 50dB scale)

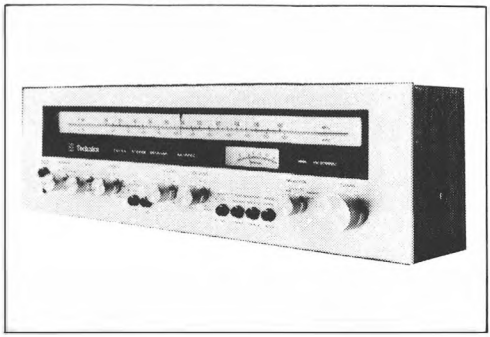
Technics 5350

National Panasonic (UK) Limited, 107/109 Whitby Road, Slough, Bucks. Slough 34522

The largest Technics receiver submitted for this survey, giving 34.5W per channel (both driven). Two pairs of loudspeakers (selectable) can be connected on ordinary screw terminals, and a three core mains lead is provided, but there is no separate earth terminal, other than an aerial one. A ferrite rod for AM can be rotated through 90° and terminals are provided for 75 and 300 ohm FM aerial connections, with a separate AM one. Phone socket inputs are included for pick up, auxiliary and tape 1/2 in/out, tape 1 being duplicated on a 5 pole DIN socket. This receiver is similarly styled to the other two models in the range which are in this survey. Front panel controls include volume, balance, bass and treble. None of these have centre indents, and the balance control shifts the image rather suddenly at the ends of its travel. The input switch selects pick up, AM or FM radio, or auxiliary. Push buttons are provided for mono/stereo, tape monitors 1 and 2, treble roll off, loudness, FM muting and mains on/off. A dubbing facility is provided for tape 1 to tape 2, by depressing both monitor buttons. A stereo jack provides sufficient volume at good quality for 8 ohm headphones, but inadequate for 600 ohm ones. The tuning knob and mechansim were very smooth indeed, and had an excellent fly wheel action with no backlash. The unit is attractively styled in a wooden case with metal ventilation grill and base plate.

The amplifier in general sounded rather brittle and string tone tended to be slightly scratchy, particularly at lower volumes. The harmonic distortion measurements were good, but IM distortion began to rise at lower levels. The half power band width for 0.1% extended to 22kHz and this is excellent. The damping factor measured pretty well. Some DC was noted on the output when the equipment was switched on, and this might strain very small loudspeakers. The s/n ratio throughout the amplifier and pre-amplifier were good. All the controls tracked very well, except that a slight discrepancy was noted at maximum bass cut. The bass and treble controls allow a reasonable range of adjustment, and the loudness control boosted bass only (as with other Technics models). The treble roll off cut 3dB at 7kHz and thence 6dB/octave. The pick up input had a rather low impedance, and the clipping margin was barely adequate, particularly with high output cartridges. The pick up output level was compatible with that of the tuner on the record out sockets, and these had the appropriate sensitivities and levels to match DIN and phono recorders.

The signal to noise ratios of the tuner section measured very well indeed on stronger signals, and were about average on weaker ones. The distortion and crosstalk measurements were very good indeed, although subjectively very slight splash was noticed in the crosstalk channel on speech transmitted at a high deviation, but this should not be audible in context. The frequency response was good. The multiplex filter was not very effective. The tuning scale accuracy was excellent. The RF input sensitivities were very good, and the adjacent and alternate channel selectivities measured well, thus allowing the tuner to pick out weak stations close to stronger ones. The RF intermodulation ratio was 72dB (pretty good). The IF breakthrough and image response were fair and the capture ratio excellent. Only a signal strength meter in incorated. Whilst the tuner performance was excellent, the amplifier sounded brittle, although many would be perfectly happy with it. Considering the lack of facilities provided, I must unfortunately suggest that the receiver is only fair value for money. An examination of the many alternatives offering the same power output should confirm this. Whilst the electromagnetic compatibility was very good at low frequencies, annoyance would be caused by VHF transmissions in the neighbourhood at normal listening levels.



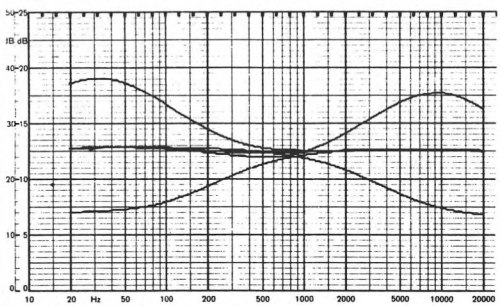
Amplifier

Av. Power output both channels driven	34.5W
Power output single channel driven	40W
Power output tone burst average	42W
Idle DC out worst case	33.6mv
Turn on/off Max. DC (swing worst case)	8v
Damping Factor L= −R	30/30.5%
IM 10w L/R	0.072/0.044%
IM 100mw L/R	0.21/0.23%
IM 1% output watts L/R	24.5/24.5W
Av. IM distortion pickup input/record out	0.01%
Av. Harmonic Distortion 0.1% (power cut)	32W
Power Bandwidth L/R 0.1%	13Hz–20kHz/11Hz–21kHz
Av. Pickup impedance	41KΩ
Pickup sensitivity	1.8mv
Pickup clipping	55mv
Pickup capacitance	285pf
Auxiliary impedance	66KΩ
Auxiliary sensitivity	163mv
Tape impedance one/two	75KΩ/75KΩ
Tape sensitivity one/two	163mv/163mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	650mv
Max level from pickup (RO)	615mv
Tape output impedance DIN Av	82KΩ
Tape output impedance phono Av	350Ω
Av. Pickup noise ref 8mv record output socket unw	76dB
Av. Pickup noise ref 8mv record output socket CCIR	72dB
Amp output noise @ 0 volume unw	350μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	89.6dB
Worst weighted noise Aux in/L out S/N ratio	77.2dB

Tuner

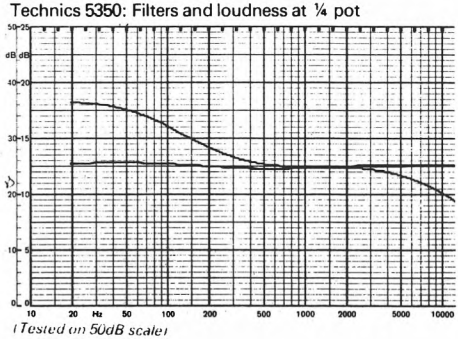
Mono RF sensitivity 30dB IHF	0.9μv
Mono RF sensitivity 50dB IHF	2.2μv
Stereo RF sensitivity 50dB IHF	25μv
IM RF	72dB
Adjacent Channel worst figure	4dB
Alternate Channel worst figure	none
Image Response	67dB
Capture Ratio	0.8dB
AM Reject	64dB
Mono distortion 100% 1kHz centre tune worst case	0.19%
Optimum tune mono Average	0.17%
Stereo L= −R centre tune L	0.28%
Stereo L= −R centre tune R	0.25%
Av. Stereo R= −L centre tune	0.18%
MPX filter reject worst fig. @ 19kHz	41dB
MPX filter reject worst fig. @ 38kHz	46dB
X talk centre tune worst fig. 1kHz	49dB
X talk centre tune worst fig. 10kHz	37dB
Optimum tune 1kHz L/R	68.5/52.5dB
FR Frequency response stereo −1dB L/R	12Hz–13K/13.7K
FR Frequency response stereo 3dB L/R	6Hz–15.3K/16K
Error @ 15kHz L/R	−2.5/−2dB
Limit threshold	0.6μv
Mute threshold	2.7μv
Av. Stereo S/N weighted 100μv/1mV	52/68dB
Av. Stereo unw 1mV	70dB
Av. Mono weighted 1mV	70dB
RRP Ex VAT	£167.96

Not normally discounted



Technics 5350: Tone controls

Technics 5350: Filters and loudness at ¼ pot



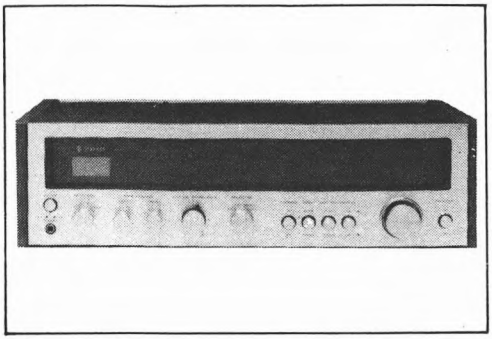
(Tested on 50dB scale)

The smallest Trio in this survey, giving just 15W per channel (both driven) into two switched pairs of loudspeakers. A ferrite rod is provided for AM reception, rotatable through 180°, together with a special terminal for a separate aerial. For FM aerials a pair of terminals has a centre taped earth connection, thus allowing 75 ohm aerial connection (live inner to one 300 ohm terminal, braid to earth). A three core mains lead is complemented by a separate earth terminal near the pick up input, and the latter, with auxiliary and tape input and output connections are on phono sockets. Tape connection is also duplicated with a 5 pole DIN socket, with appropriate output attenuation for compatibility. The metal case has wooden side cheeks, and the syling is quite attractive. Bass, treble and balance controls have centre indents. The balance control has a lever behind the smooth volume control allowing easy adjustment. Push buttons are provided for operating treble roll off, tape monitor, mono/stereo, loudness and FM muting functions. The tuning knob and assembly were very smooth and the tuning dial accuracy was excellent. Only a signal strength meter is provided. An input switch selects AM or FM radio, phono or auxiliary. Although the receiver is modestly priced, I was very pleased to see the centre indent controls, which help make this model very easy to use.

The amplifier's quality was slightly edgy at high frequencies, and bass ones tended to be a little cardboardy and boomy, and I suggest that the rather poor damping is contributing to this. The half power bandwidth only extended down to 60Hz, and whilst one channel achieved 5kHz the other only attained 2kHz at 0.1%. This very poor measurement must obviously contribute to the below average sound quality of the amplifier. The IM measurements were fairly good at normal levels. The harmonic distortion measurements showed one channel to be well below par since 0.1% distortion at 1kHz was reached at only 8W, although the 1% point was approximately the same as that of the other channel (right hand channel also had poor half power band width). No DC output problems were encountered. The signal to noise ratios were satisfactory on the re-test sample, but the first gave a slight roar, audible only very close to the speaker. The treble and volume controls tracked rather badly, the latter actually showing a 3.3dB swing in the top 30dB of travel. The bass control and treble roll off however were satisfactory in this respect. Neither the bass nor treble control had adequate variation available, and the treble roll off cutting at 6dB/octave was −3dB at 4kHz. The pick up input had an optimum impedance and good clipping margin, but the level on the tape out sockets was nearly 6dB lower than that from the tuner, and this is rather unfortunate. Input and output impedances and sensitivities were all satisfactory.

The tuner's frequency response began to roll off from 8kHz, but was only 3.5dB down at 15kHz, though it nevertheless sounded slightly muffled compared with the standard. Some hum was present on the tuner's output, although the hiss level was extremely low on stronger input signals. Weak ones were a little hissy. The crosstalk figures were fairly good. The general distortion performance was very good indeed on mono and centre channel stereo signals, but distortion increased gradually on signals getting progressively away from centre, and 1% distortion was noted on out of phase signals at peak deviation. Subjectively, this is not too serious. The multiplex filter was very poor. The RF sensitivities were just adequate, but satisfactory for the reception of mono and stronger stereo signals. IF breakthrough and AM reject measured very well, whilst the adjacent and alternate channel selectivities and other RF measurements were rather average. The image response was very poor, and trouble could be experienced near flight paths.

Although this was a pleasant receiver to use, the hum on the tuner and the other failings cannot really recommend it since there are so many better buys. The elctromagnetic compatibility was poor at VHF and reasonable at LF. Rather below average value for money.



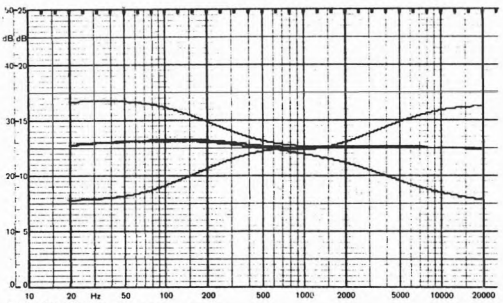
Amplifier

Av. Power output both channels driven	15.1W
Power output single channel driven	18W
Power output tone burst average	18W
Idle DC out worst case	14mv
Turn on/off Max. DC (swing worst case)	4v
Damping Factor L= −R	18/15%
IM 10w L/R	0.4/0.44%
IM 100mw L/R	0.17/0.14%
IM 1% output watts L/R	11/10.8W
Av. IM distortion pickup input/record out	0.012%
Av. Harmonic Distortion 0.1% (power cut)	9.2W*
Power Bandwidth L/R 0.1%	55Hz−5kHz/60Hz−2kHz
Av. Pickup impedance	52KΩ
Pickup sensitivity	2.1mv
Pickup clipping	150mv
Pickup capacitance	185pf
Auxiliary impedance	60KΩ
Auxiliary sensitivity	123mv
Tape impedance	69KΩ
Tape sensitivity	123mv
Mic impedance	—
Mic sensitivity	—
Mic clipping	—
Max level from tuner (RO)	1v
Max level from pickup (RO)	427.5mv
Tape output impedance DIN Av	80KΩ
Tape output impedance phono Av	3.1KΩ
Av. Pickup noise ref 8mv record output socket unw	73dB
Av. Pickup noise ref 8mv record output socket CCIR	70dB
Amp output noise @ 0 volume unw	770μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	86dB
Worst weighted noise Aux in/L out S/N ratio	80.8dB

Tuner

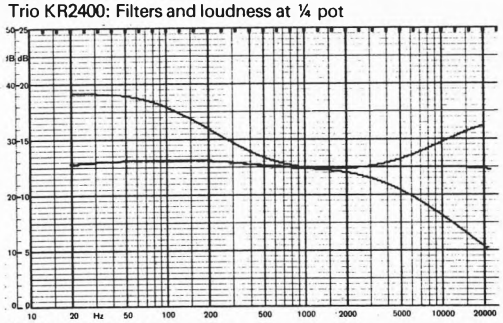
Mono RF sensitivity 30dB IHF	2.1μv
Mono RF sensitivity 50dB IHF	3μv
Stereo RF sensitivity 50dB IHF	42μv
IM RF	65.6dB
Adjacent Channel worst figure	0dB
Alternate Channel worst figure	40dB
Image Response	47dB
Capture Ratio	3.5dB
AM Reject	67dB
Mono distortion 100% 1kHz centre tune worst case	0.09%
Optimum tune mono Average	0.08%
Stereo L= −R centre tune L	0.08%
Stereo L= −R centre tune R	0.07%
Av. Stereo R= −L centre tune	0.88%
MPX filter reject worst fig. @ 19kHz	36dB
MPX filter reject worst fig. @ 38kHz	57dB
X talk centre tune worst fig. 1kHz	37dB
X talk centre tune worst fig. 10kHz	32dB
Optimum tune 1kHz L/R	41/46dB
FR Frequency response stereo −1dB L/R	7Hz−8.9K/8.7K
FR Frequency response stereo 3dB L/R	3.5Hz−13.8K/13.7K
Error @ 15kHz L/R	−3.5/−3.5dB
Limit threshold	2μv
Mute threshold	6μv
Av. Stereo S/N weighted 100μv/1mV	49/68dB
Av. Stereo unw 1mV	55dB
Av. Mono weighted 1mV	77dB
RRP Ex VAT	£120.00

Occasionally discounted



Trio KR2400: Tone controls

Trio KR2400: Filters and loudness at ¼ pot



(Tested on 50dB scale)

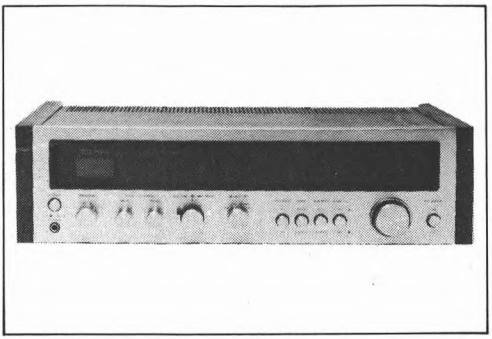
Trio KR3400

B H Morris & Co. Limited, The Hyde, Hendon, London NW9 6JJ. 01-205 6441

Virtually identical in appearance to the model 2400, having exactly the same facilities, but giving up to 28W per channel, both driven (see 2400 review for details). The amplifier section sounded rather better than that on the 2400, but it still reproduced sounds that were rather bright and fluffy in the top, and with bass frequencies again rather cardboardy. In this case, however, it is only fair to comment that many users would not be particularly aware of these failings unless a comparison were made with a better amplifier. The half power bandwidth was again restricted at the treble end, but this time to 4.3/9kHz on the two channels respectively for 0.1%, but lower frequencies fared much better, the same half power distortion being reached as low as 20Hz. The IM and harmonic distortion measurements were very much better than those on the 2400, and so I must comment that criticisms of the amplifier are based mainly on the subjective quality, although the half power bandwidth was still poor. The damping factor measured slightly below average. The signal to noise ratios of the pre-amplifier and amplifier sections were very good. All the controls worked well, and indeed much better than those of the 2400, but unfortunately again did not have a sufficient range of adjustments. The treble roll off switch provided 3dB cut at 4.5kHz, and thence 6dB/octave reduction. The RIAA pre-amplifier's input impedance was optimum, and an excellent clipping margin was provided, but the output level on the recorder sockets was some 6dB lower than the output level from the tuner. Auxiliary, tape in and out, inpedances and sensitivities were all compatible with associated equipment, to both DIN and normal phono standards.

The signal to noise ratios of the tuner section were very good on stronger signals, but some hiss was noted on weak ones. The frequency response was slightly uneven at the top end, the left channel being 2.5dB down at 15kHz, whilst the right was 4.5dB down. Both channels exhibited an external bass roll off (−3dB at 40Hz), not serious but unusual. The cross talk performance was good when tuned to the centre of the carrier, but became excellent when tuned slightly off centre. All the distortion measurements were excellent, although as with the 2400 R-L was just a little on the high side, but again not too serious. The subjective sound quality was good, even at fairly high deviations. The multiplex filter was poor. The RF input sensitivities were good in mono, but only fair in stereo. The adjacent and alternate channel selectivities were satisfactory, and I must commend the excellent RF intermodulation distortion ratio of 77.5dB. The image response was poor, but the other RF measurements were all good. From all these measurements it is clear that the tuner can be used in strong signal strength areas for picking up relatively weak stations without any trouble other than being slightly hissy when in stereo. The tuning scale accuracy was fairly good, and only an RF signal strength meter is incorporated.

Although this receiver is clearly better value for money than the 2400, I am sorry that I have to say that it only represents average value when weighing up the amplifier's performance against the fairly good tuner performance. Slight backlash was noted on the tuning assembly. Unfortunately for Trio, there are too many competitive models offering more facilities at the same cost, or similar ones for less, despite the fact that my colleagues and I are attracted to the styling and ergonomics. Electromagnetic compatibility was very good on both LF and VHF, and thus this receiver should not create a problem if it is used near local amateur radio stations.



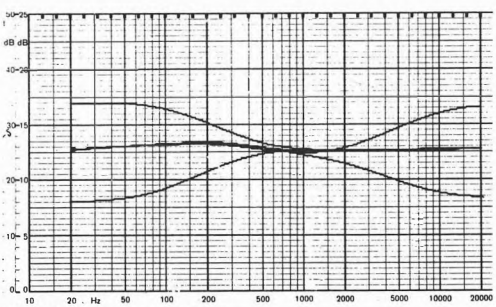
Amplifier

Av. Power output both channels driven	28W
Power output single channel driven	32.5W
Power output tone burst average	32.5W
Idle DC out worst case	68mv
Turn on/off Max. DC (swing worst case)	5v
Damping Factor L= –R	23/18%
IM 10w L/R	0.07/0.09%
IM 100mw L/R	0.06/0.07%
IM 1% output watts L/R	19.5/19.9W
Av. IM distortion pickup input/record out	0.0075%
Av. Harmonic Distortion 0.1% (power cut)	25.2W
Power Bandwidth L/R 0.1%	18Hz–4.3kHz/20Hz–9kHz
Av. Pickup impedance	52KΩ
Pickup sensitivity	3.1mv
Pickup clipping	150mv
Pickup capacitance	190pf
Auxiliary impedance	58KΩ
Auxiliary sensitivity	178mv
Tape impedance	66KΩ
Tape sensitivity	178mv
Mic impedance	–
Mic sensitivity	–
Mic clipping	–
Max level from tuner (RO)	1.1v
Max level from pickup (RO)	412mv
Tape output impedance DIN Av	80KΩ
Tape output impedance phono Av	3KΩ
Av. Pickup noise ref 8mv record output socket unw	73dB
Av. Pickup noise ref 8mv record output socket CCIR	69dB
Amp output noise @ 0 volume unw	500μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	89.2dB
Worst weighted noise Aux in/L out S/N ratio	83.5dB

Tuner

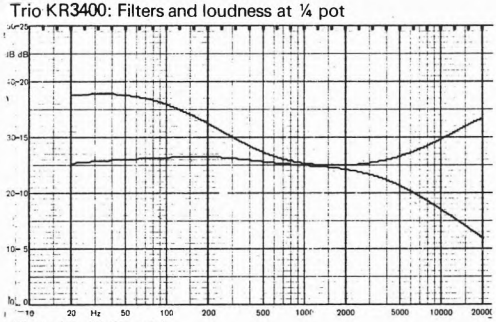
Mono RF sensitivity 30dB IHF	1.5μv
Mono RF sensitivity 50dB IHF	3μv
Stereo RF sensitivity 50dB IHF	38μv
IM RF	77.5dB
Adjacent Channel worst figure	1.5dB
Alternate Channel worst figure	47dB
Image Response	54.5dB
Capture Ratio	1.5dB
AM Reject	61.5dB
Mono distortion 100% 1kHz centre tune worst case	0.24%
Optimum tune mono Average	0.19%
Stereo L= –R centre tune L	0.19%
Stereo L= –R centre tune R	0.16%
Av. Stereo R= –L centre tune	0.8%
MPX filter reject worst fig. @ 19kHz	35dB
MPX filter reject worst fig. @ 38kHz	59dB
X talk centre tune worst fig. 1kHz	34dB
X talk centre tune worst fig. 10kHz	35.5dB
Optimum tune 1kHz L/R	57/50dB
FR Frequency response stereo –1dB L/R	80Hz–11K/7.6K
FR Frequency response stereo 3dB L/R	38Hz–15.7K/12.7K
Error @ 15kHz L/R	–2.5/–4.5dB
Limit threshold	1.3μv
Mute threshold	–
Av. Stereo S/N weighted 100μv/1mV	49/66dB
Av. Stereo unw 1mV	63dB
Av. Mono weighted 1mV	72dB
RRP Ex VAT	£147.20

Occasionally discounted



Trio KR3400: Tone controls

Trio KR3400: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Trio KR 5400

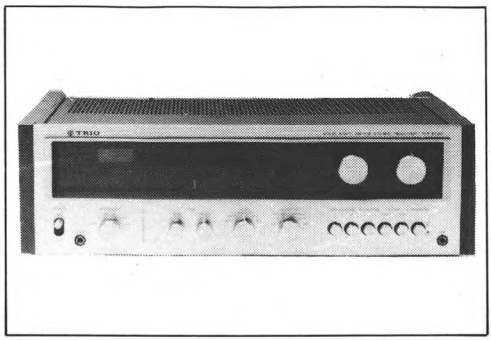
B H Morris & Co. Limited, The Hyde, Hendon, London NW9 6JJ. 01-205 6441

This receiver gives 40W per channel (both driven) into any of three pairs of loudspeakers or alternatively the main pair with either remote pair (not all three pairs). Spring loaded push lock connectors are provided for loudspeaker connections. A ferrite rod which can be rotated through 180° is provided for AM (MW) reception and a separate external aerial connection terminal is complemented by 75 ohm and 300 ohm ones for FM. Phono sockets are included for pick-ups 1 and 2, auxiliary and tape 1 and 2 in/out connections, tape 1 also being duplicated on a 5 pole DIN socket. A 3 core mains lead is complemented by a separate earth terminal. The unit is housed in a metal case having wooden side cheeks and is most attractively styled. The large volume control has a centre indented balance control lever operating around and behind it, and bass and treble controls are also centre indented. A source selection switch chooses AM or FM radio, pick-ups 1 or 2, auxiliary and microphone input functions, the last having a jack socket on the front. A further switch selects left or right only, stereo or stereo reversed or mixed mono. Push buttons operate loudness, treble roll off, rumble roll off, FM muting and tape monitors 1 and 2. Tape copying can be achieved by depressing both tape monitor buttons (tape 1 to tape 2). A stereo headphone jack gives adequate volume for all types of headphone. The tuning control ran very smoothly but slight backlash was noted. Only a signal strength meter was incorporated. The case attained a rather warm temperature when the amplifier was driven hard, although the receiver would probably not get too hot in a reasonably ventilated enclosed space.

The amplifier's sound quality was pretty good, although rather brighter than our standard. It gave a slightly muddy upper bass sound and did not quite have the punch needed for efficient reproduction of bass guitars. Nevertheless, a generally good sound quality was reproduced but with slight signs of crossover distortion. The half power bandwidth measured well and the intermodulation distortion was very low indeed at higher levels, but just began to creep up slightly at lower ones, although still pretty good. Harmonic distortion was satisfactory. The damping factor measured well. No DC output problems were experienced, the output circuit being very efficiently safety-relay controlled (short circuit protection excellent). The noise levels throughout the pre-amplifier and amplifier were good, although when the volume control was at 2 o'clock very slight hiss was audible from the speakers. All the tone controls and filters tracked well but the volume control tracking was just adequate. The tone controls gave just less than an average amount of variation, but this is reasonable since bass and treble roll offs are provided. The rumble filter cut 3dB at 125Hz continuing at 6dB per octave, as did the treble roll off with a 3dB point at 3kHz. The loudness control was satisfactory. The pick-up output level on the record output sockets was some 8dB below that of the tuner and this might be rather annoying since the recorder's input gain controls would have to be changed appropriately. The RIAA input impedance was about optimum and a very adequate clipping margin was measured. Auxiliary tape input and output impedances and sensitivities were all satisfactory. The microphone input sensitivity was rather poor but the input might be useful occasionally.

The signal to noise ratios of the tuner section were excellent on strong signals but weak stereo ones reproduced with more than average hiss. The hum levels here were all very low indeed. All the distortion and crosstalk measurements were superb and the sound quality on strong stereo signals from this tuner section was very fine indeed. Whilst the frequency response at the treble end was excellent, the bass response fell by 1dB at 68Hz on one channel, reaching −3dB by 32Hz. In practice, though, this was not even noticed subjectively. The dial accuracy was excellent but the tuning knob had some backlash, although its operation was smooth. The MPX filter was inadequate. The RF input sensitivities were very poor, considering the cost of this receiver and they should have been at least 8dB better. But adjacent and alternate channel selectivities were excellent. The capture ratio was very good and the remainder of the RF measurements were satisfactory, although the image response was not really adequate. The limiting threshold at 3uV would suggest that some circuit had too low a gain.

The basic tuner section presented a very fine quality sound to the amplifier and some good facilities are provided. It can be recommended provided Trio improve the tuner's input sensitivity (probably mis-alignment). The review is based on a re-test sample, since the first tuner failed to switch properly into stereo. EC poor at VHF but excellent at LF.



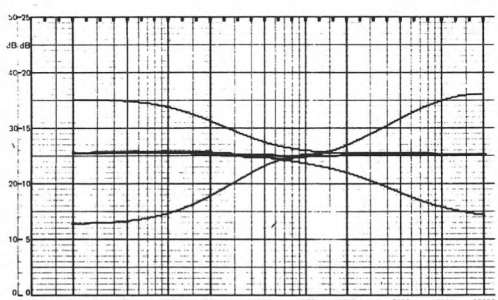
Amplifier

Av. Power output both channels driven	40W
Power output single channel driven	46W
Power output tone burst average	49W
Idle DC out worst case	22mv
Turn on/off Max. DC (swing worst case)	–
Damping Factor L= –R	30/31%
IM 10w L/R	0.02/0.023%
IM 100mw L/R	0.06/0.06%
IM 1% output watts L/R	30/30W
Av. IM distortion pickup input/record out	0.005%
Av. Harmonic Distortion 0.1% (power cut)	36.5W
Power Bandwidth L/R 0.1%	<10Hz–30kHz/<10Hz–17.5kHz
Av. Pickup impedance one/two	53KΩ/53KΩ
Pickup sensitivity one/two	2.8mv/2.8mv
Pickup clipping one/two	127mv/127mv
Pickup capacitance one/two	100pf/100pf
Auxiliary impedance	42KΩ
Auxiliary sensitivity	188mv
Tape impedance one/two	48KΩ/48KΩ
Tape sensitivity one/two	197mv/197mv
Mic impedance	26.5K
Mic sensitivity	2.8mv
Mic clipping	131mv
Max level from tuner (RO)	1.45v
Max level from pickup (RO)	480mv
Tape output impedance DIN Av	81KΩ
Tape output impedance phono Av	450Ω
Av. Pickup noise ref 8mv record output socket unw	73dB
Av. Pickup noise ref 8mv record output socket CCIR	70dB
Amp output noise @ 0 volume unw	430μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	84.6dB
Worst weighted noise Aux in/L out S/N ratio	81dB

Tuner

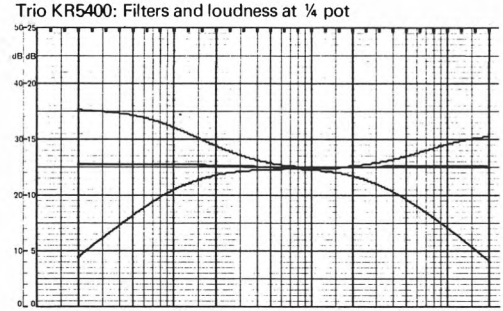
Mono RF sensitivity 30dB IHF	3.2μv
Mono RF sensitivity 50dB IHF	5μv
Stereo RF sensitivity 50dB IHF	50μv
IM RF	63.8dB
Adjacent Channel worst figure	4dB
Alternate Channel worst figure	none
Image Response	52.2dB
Capture Ratio	1dB
AM Reject	55dB
Mono distortion 100% 1kHz centre tune worst case	0.18%
Optimum tune mono Average	0.12%
Stereo L= –R centre tune L	0.1%
Stereo L= –R centre tune R	0.11%
Av. Stereo R= –L centre tune	0.17%
MPX filter reject worst fig. @ 19kHz	40dB
MPX filter reject worst fig. @ 38kHz	48dB
X talk centre tune worst fig. 1kHz	46dB
X talk centre tune worst fig. 10kHz	44dB
Optimum tune 1kHz L/R	46.5/51dB
FR Frequency response stereo –1dB L/R	57Hz–14.9K/14.6K
FR Frequency response stereo 3dB L/R	30Hz–16.4K/16.2K
Error @ 15kHz L/R	–1/–1.25dB
Limit threshold	3μv
Mute threshold	20μv
Av. Stereo S/N weighted 100μv/1mV	48/66dB
Av. Stereo unw 1mV	68dB
Av. Mono weighted 1mV	72dB
RRP Ex VAT	£212.80

Occasionally discounted



Trio KR5400: Tone controls

Trio KR5400: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Trio KR7400

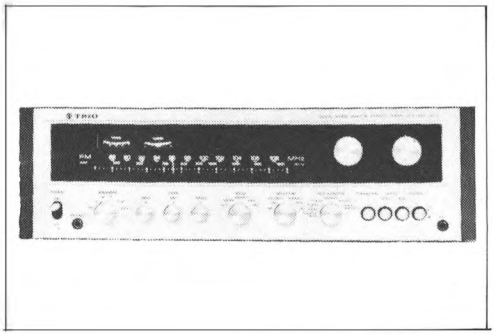
B H Morris & Co. Limited, The Hyde, Hendon, London NW9 6JJ. 01-205 6441

The largest Trio receiver reviewed in this survey. It can give up to 73.5W per channel (both driven) into combinations of three pairs of loudspeakers. The input and output facilities are identical to those on the model 5400 with the exception that one switched and two unswitched mains outlet sockets are provided. As with the mdoel 5400, it has provision for insertion of an independent 4 channel adapter, and this can be operated completely separately from any tape functions. The front panel includes bass, mid and treble controls, all having centre indents. The large and smooth volume control incorporated a lever type balance control behind and around it, and this also has a centre indent. The input selector and output mode switches are identical to those on the 5400, but a useful tape dubbing switch is added, which permits copying in either direction, and monitoring either recorder at will during this process. Push buttons provide FM muting, loudness, rumble and treble roll offs. Jack sockets are provided for microphone input and headphone output (plenty of volume available here). The metal cabinet is provided with wooden side cheeks, and adequate ventilation slots allow cool running. Centre zero tuning and RF signal strength meters are included. The tuning assembly unfortunately had noticeable backlash, thus making it a little difficult to tune stereo signals in rapidly, if perfect tuning is required. Nevertheless, the tuning knob ran pretty smoothly.

The sound quality of the amplifier section was very good indeed up to its full output, and only the faintest suspicions of crossover distortion were noted at very low levels. Bass frequencies had plenty of punch, and the treble end was stable and transparent. The half power bandwidth did not measure too well for 0.1%, but the amplifier had such a good power reserve that this was not really noticed subjectively. A more extended power response was noted at a higher distortion level. The intermodulation distortion figures were very good, and the harmonic distortion was pretty low. The damping factor was good, and no DC problems were experienced at all, the output circuit being well protected on switch on/off, and also against short circuits. The signal to noise ratios of the pre-amplifier and amplifier sections were all very satisfactory. The volume control tracked well down to −30dB but was not so good below this. The tone control tracking could only be said to be adequate but probably the slight mistracking would be almost unnoticed. The tone controls allowed a very wide range of adjustment to be achieved, the mid control peaking at 750Hz. The rumble roll off cut at 6dB per octave from 150Hz (frequency too high) whereas the treble roll off was −3dB at 3.5kHz, also falling by 6dB/octave. The loudness control was very satisfactory. The RIAA pre-amplifier had the correct input impedance and a good clipping margin but provided approximately 4dB lower level on the record out sockets than the tuner did on an equivalent programme. Auxiliary and tape levels and impedances were about optimum, and both DIN and phono standard recorders could be interconnected without compatibility problems. The mic input was, as usual, rather insensitive.

The tuner's signal to noise ratios all measured extremely well. In particular, strong stereo signals were reproduced with virtually no audible hiss at all. The distortion and crosstalk measurements were all very good, and the latter improved to superb figures with slight re-tuning. The frequency response was excellent and the tuner produced a superb sound quality on very high quality inputs. The multiplex filter and RF input sensitivity figures were all excellent and the adjacent and alternate channel measurements were very good. The RF intermodulation performance was a little disappointing and the local oscillator radiation on the aerial might disturb other nearby receivers. Other RF measurements, though, were very satisfactory. The dial accuracy was adequate.

If discounted, this receiver will be a good buy, and can be recommended as it produces an excellent sound quality, particularly from the tuner. It gives a considerable output power and good output quality at all levels. Electromagnetic compatibility was poor at VHF but very good at LF.



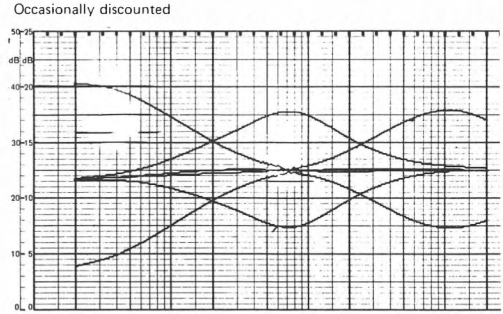
Amplifier

Av. Power output both channels driven	73.7W
Power output single channel driven	81.3W
Power output tone burst average	91.5W
Idle DC out worst case	13.7mv
Turn on/off Max. DC (swing worst case)	<50μv
Damping Factor L= −R	29/30%
IM 10w L/R	0.095/0.11%
IM 100mw L/R	0.065/0.07%
IM 1% output watts L/R	50/51W
Av. IM distortion pickup input/record out	0.05%
Av. Harmonic Distortion 0.1% (power cut)	66.1W
Power Bandwidth L/R 0.1%	<10Hz–5.5kHz/<10Hz–4.5kHz
Av. Pickup impedance one/two	55KΩ/55KΩ
Pickup sensitivity one/two	3.1mv/3.1mv
Pickup clipping one/two	116mv/116mv
Pickup capacitance one/two	140pf/140pf
Auxiliary impedance	41KΩ
Auxiliary sensitivity	195mv
Tape impedance one/two	46KΩ/46KΩ
Tape sensitivity one/two	195mv/195mv
Mic impedance	27KΩ
Mic sensitivity	3.1mv
Mic clipping	124mv
Max level from tuner (RO)	840mv
Max level from pickup (RO)	427.5mv
Tape output impedance DIN Av	79KΩ
Tape output impedance phono Av	80Ω
Av. Pickup noise ref 8mv record output socket unw	71dB
Av. Pickup noise ref 8mv record output socket CCIR	70dB
Amp output noise @ 0 volume unw	280μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	93.5dB
Worst weighted noise Aux in/L out S/N ratio	90.8dB

Tuner

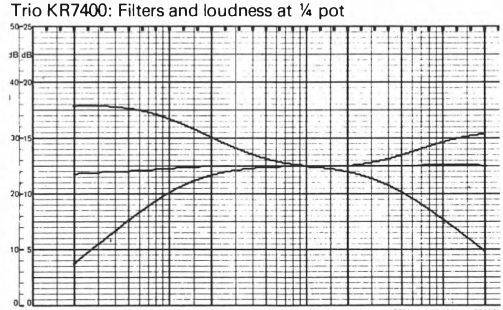
Mono RF sensitivity 30dB IHF	1μv
Mono RF sensitivity 50dB IHF	1.8μv
Stereo RF sensitivity 50dB IHF	24μv
IM RF	68dB
Adjacent Channel worst figure	3dB
Alternate Channel worst figure	none
Image Response	84dB
Capture Ratio	1.5dB
AM Reject	63dB
Mono distortion 100% 1kHz centre tune worst case	0.27%
Optimum tune mono Average	0.24%
Stereo L= −R centre tune L	0.24%
Stereo L= −R centre tune R	0.24%
Av. Stereo R= −L centre tune	0.12%
MPX filter reject worst fig. @ 19kHz	58dB
MPX filter reject worst fig. @ 38kHz	>80dB
X talk centre tune worst fig. 1kHz	37dB
X talk centre tune worst fig. 10kHz	35dB
Optimum tune 1kHz L/R	49/48dB
FR Frequency response stereo −1dB L/R	3Hz–12.2K/12.2K
FR Frequency response stereo 3dB L/R	2.5Hz–15.8K/15.8K
Error @ 15kHz L/R	−1/−1dB
Limit threshold	0.6μv
Mute threshold	4μv
Av. Stereo S/N weighted 100μv/1mV	53.5/72dB
Av. Stereo unw 1mV	72dB
Av. Mono weighted 1mV	76dB
RRP Ex VAT	£294.40

Occasionally discounted



Trio KR7400: Tone controls

Trio KR7400: Filters and loudness at ¼ pot



(Tested on 50dB scale)

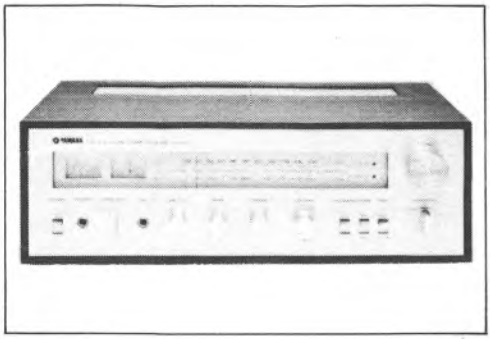
Natural Sound Systems Limited, Strathcona Road, North Wembley, Middlesex HA9 8QL. 01-904 0141

This model can deliver up to 19.5W per channel (both driven) into either or both of two loudspeaker pairs. These are connected with spring loaded lock clamps. The mains lead is only 2 core and both unswitched and switched AC outlets are provided, together with a separate earth terminal. Phono sockets are incorporated for pick-up and auxiliary inputs and normal in and out connections to a tape recorder. An independent pair of phono sockets allows the user to obtain a feed from after the tone control and pre-amp section, thus allowing a limited copying facility. A ferrite rod having 180° swing is provided as are terminals for 300 ohm and 75 ohm FM aerials, and an external AM one. No 5 pole DIN socket is included, and so DIN recorders will need a special attenuator lead or adaptor for providing the appropriate levels. The receiver is extremely well presented both ergonomically and stylistically, and is housed in a well made wooden cabinet fitted with a ventilation grill. The volume control is a concentric split one, the 2 halves being well friction locked, and thus no separate balance control is included. A separate microphone gain control wth switch mixes in to the main audio section, and a jack socket for this is adjacent to it. Bass and treble controls are smooth, but have no centre indents. They both tend to have more rate of change at the ends of their tracks than at the centre. An input switch selects auxiliary, pick-up, FM muting, normal FM and AM input functions. Three lever switches operate loudness, mono/stereo, and tape monitoring function. The tuning knob runs very smoothly and was well liked. Meters are provided for tuning indication and signal strength.

Within its power limitation the amplifier sounded well, although at low levels we noticed a suspicion of crossover distortion. The half power bandwidth extended to beyond 40kHz at the treble end, but down to 22Hz at the bass end, and bass frequencies did sound very slightly lacking, although it was difficult to say why. The damping factor was excellent. The intermodulation distortion measurements were excellent. The harmonic distortion too measured very low indeed. Of particular interest was the fact that both amplifier sections gave an almost identical performance in all respects and this shows excellent quality control here. A jack socket provided ample levels for headphone listening. No DC problems were encountered. I must particularly commend the receiver's excellent signal to noise ratios on the pre-amp and amp sections. The tracking of bass treble and volume controls was extremely good, particularly since the volume controls were only friction locked. The tone controls had a pretty good range of adjustment but no bass or treble roll offs are provided. The loudness control did not give quite as much boost as average when the gain controls were at a quarter. The RIAA pre-amp input impedance was very slightly high, but the clipping margin was excellent. Its output level was perfectly compatible with that from the tuner on the record output sockets (excellent). Auxiliary and tape in/out impedances and sensitivities were all very compatible with external phono standard equipment.

The distortion performance of the tuner section was rather average on the normal measurements, but very bad indeed on R-L, rising to an alarming 7% at full difference channel deviation. High frequency sounds were slightly blurred and transients were not quite as clean as they should have been. The crosstalk performance was rather poor and below average. The signal to noise ratios here measured very well and weak signals were reproduced with lower than average hiss. The frequency response was good and perhaps I should comment that the general reproduced quality was very good at normal levels and it is only maximum broadcast peaks that show up the decoder's failings. The multiplex filter gave quite a good rejection. The dial accuracy was adequate, but that of many receivers was better. The RF sensitivity was very good. The adjacent and alternative selectivities measured well. In particular the RF IM ratio was excellent at 81dB. Other measurements were average, except the image response which was poor.

Despite its smart appearance and good ergonomics I am afraid that I must consider this receiver slightly poor value for money, unless it is purchased at a discount, which is rather unlikely. If Yamaha could improve the tuner distortion and provide one or two extra facilities, such as filters for example, it might be reasonable value. However I must applaud the excellent electro magnetic compatibility, absolutely no trouble being experienced from powerful local transmitters.



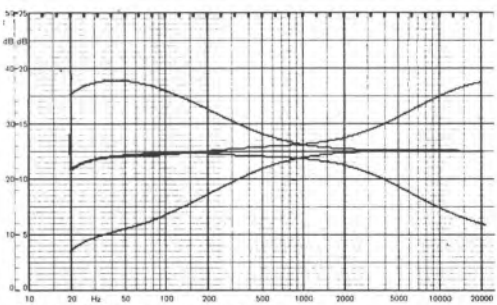
Amplifier

Av. Power output both channels driven	19.5W
Power output single channel driven	22.5W
Power output tone burst average	25W
Idle DC out worst case	2.8mv
Turn on/off Max. DC (swing worst case)	3.5v
Damping Factor L= –R	40/40%
IM 10w L/R	0.07/0.05%
IM 100mw L/R	0.02/0.02%
IM 1% output watts L/R	13.8/13.8W
Av. IM distortion pickup input/record out	0.005%
Av. Harmonic Distortion 0.1% (power cut)	18W
Power Bandwidth L/R 0.1%	22Hz–50kHz/22Hz–45kHz
Av. Pickup impedance	55KΩ
Pickup sensitivity	3mv
Pickup clipping	130mv
Pickup capacitance	112pf
Auxiliary impedance	140KΩ
Auxiliary sensitivity	143mv
Tape impedance	140KΩ
Tape sensitivity	143mv
Mic impedance	49KΩ
Mic sensitivity	3mv
Mic clipping	380mv
Max level from tuner (RO)	495mv
Max level from pickup (RO)	330mv
Tape output impedance DIN Av	—
Tape output impedance phono Av	1.3KΩ
Av. Pickup noise ref 8mv record output socket unw	75dB
Av. Pickup noise ref 8mv record output socket CCIR	71dB
Amp output noise @ 0 volume unw	300μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	89dB
Worst weighted noise Aux in/L out S/N ratio	82dB

Tuner

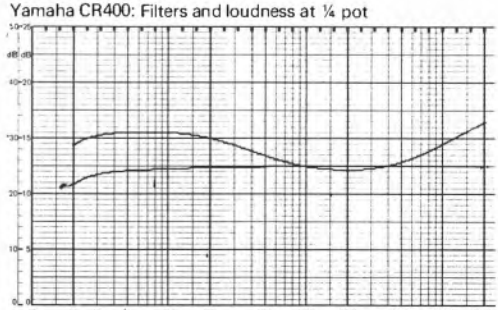
Mono RF sensitivity 30dB IHF	0.8μv
Mono RF sensitivity 50dB IHF	2.5μv
Stereo RF sensitivity 50dB IHF	25μv
IM RF	81dB
Adjacent Channel worst figure	4dB
Alternate Channel worst figure	none
Image Response	57.8dB
Capture Ratio	2dB
AM Reject	63.5dB
Mono distortion 100% 1kHz centre tune worst case	0.6%
Optimum tune mono Average	0.39%
Stereo L= –R centre tune L	0.55%
Stereo L= –R centre tune R	0.65%
Av. Stereo R= –L centre tune	0.7%
MPX filter reject worst fig. @ 19kHz	46dB
MPX filter reject worst fig. @ 38kHz	>80dB
X talk centre tune worst fig. 1kHz	26dB
X talk centre tune worst fig. 10kHz	22dB
Optimum tune 1kHz L/R	26.5/27dB
FR Frequency response stereo –1dB L/R	24Hz–13.5K/14.2K
FR Frequency response stereo 3dB L/R	13Hz–15.3K/15.6K
Error @ 15kHz L/R	–2.5/–2dB
Limit threshold	0.5μv
Mute threshold	4μv
Av. Stereo S/N weighted 100μv/1mV	54/65dB
Av. Stereo unw 1mV	68dB
Av. Mono weighted 1mV	68.5dB
RRP Ex VAT	£141.60

Not normally discounted



Yamaha CR400: Tone controls

Yamaha CR400: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Yamaha CR 600

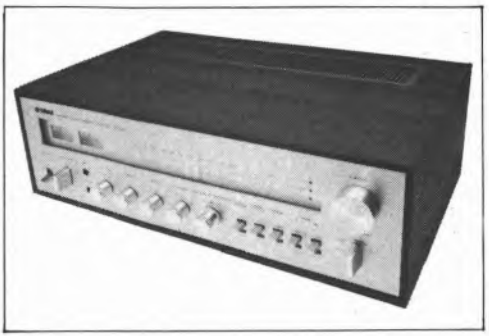
Natural Sound Systems Limited, Strathcona Road, North Wembley, Middlesex HA9 8QL. 01-904 0141

Yamaha's middle of the range model giving 45W per channel into 2 pairs of loudspeakers (switchable) and these are connected through on spring lock clamps. A 2 core mains lead is fitted with a separate earth terminal and two unswitched AC outlets are complemented by two switched ones. A ferrite rod antenna, which can be turned through a 180° angle, is complemented by an external AM aerial terminal, and additional terminals are provided for 75 ohm or 300 ohm FM aerials. Two pick-up inputs, one auxiliary, and in and out sockets for two recorders are supplied, and also phono break points with a bypass switch inserting immediately prior to the main amplifier section. This can be used for external equalisation etc. All the sockets are phono types, no DIN ones being provided. The reciever is housed in a very attractive wooden case fitted with a metal ventilation grill. The input function switch selects the appropriate feed to the pre-amplifier. The volume control is concentrically mounted with a centre indented balance control and both these were very smooth. The bass and treble controls have 11 very evenly stepped positions, and the loudness control also had 11 steps allowing its effect to be varied at will, (excellent if you like it). A separate microphone gain control has an associated jack socket. Lever switches operate rumble roll off, treble roll off, mono/stereo and tape monitors 1 and 2. These allow copying from 1 to 2 if required. As with all Yamaha products the tuning assembly ran very smoothly indeed and was a delight to use. A stereo jack socket provided an ample level for all normal headphones.

The amplifier gave pretty good reproduction at normal levels and if there was a slight failing, then it would be that of a suspicion of crossover distortion at very low levels and a tendency to brittleness and slight fuzziness at high frequencies. The sound quality was pretty close to our standard however. Whilst the half power bandwidth was incredibly good at the high frequency end, it only reached 45Hz at the low end for 0.1% distortion. The intermodulation and harmonic distortion measurements were very good and the damping factor was really excellent. No DC output problems were noted and in any case the outputs are effectively relay protected against short circuits and switching on/off transients. The signal to noise ratios of the pre-amp and amplifier sections were excellent. All the controls tracked well. The bass control allowed a good range of adjustment, but the treble control did not allow quite enough variation. Whilst the rumble filter cut 12dB per octave below 50Hz, the treble roll off only cut at 6dB per octave from 7kHz. The loudness control was excellent. The RIAA input impedance was optimum but the capacity seemed rather high. Its clipping margin was excellent but the output level on the record socket was significantly lower than that produced by the tuner. Auxiliary and tape impedances and sensitivities were excellent for interconnection with external phono standard recorders, etc. The mic input impedance was high, but its sensitivity was rather poor unless high impedance microphones are used.

The tuner's decoder performance was not too good, since some transient distortion was noted in the clock test and on musical transients throughout our test programme. A slight high pitched hum was audible on the tuner's output, but its hiss level was very low. The distortion performance could only be said to be fair since there was a considerable contribution of distortion from the difference channel. It was presumably this failing which casued the roughness on programme peaks previously referred to. The frequency response was pretty good though. The crosstalk performance was adequate when the receiver was centre tuned, but improved when off tuned, but this then dramatically degraded the transient performance, further. The MPX filter was not really adequate by today's standards, although relatively few recorders would give trouble. The tuning scale was extremely accurate. The RF sensitivities measured superbly well and the adjacent and alternate channel selectivities were very good. The RF IM ratio, image response and IF breakthrough all measured well but the capture ratio and local oscillator radiation were only average. The AFC is permanently on until the tuning knob is touched by hand.

At its price the tuner's sound quality is not quite good enough. The amplifier was pretty good and the ergonomics and styling excellent. Electromagnetic compatibility was once again an object lesson, since the receiver gave absolutely no trouble in close proximity to local amateur transmissions.



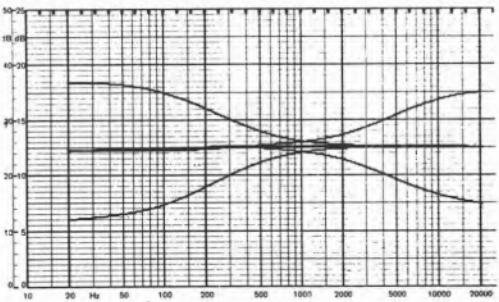
Amplifier

Av. Power output both channels driven	45W
Power output single channel driven	51.5W
Power output tone burst average	56.5W
Idle DC out worst case	17mv
Turn on/off Max. DC (swing worst case)	–
Damping Factor L= –R	46/49%
IM 10w L/R	0.03/0.03%
IM 100mw L/R	0.022/0.022%
IM 1% output watts L/R	32/32W
Av. IM distortion pickup input/record out	0.004%
Av. Harmonic Distortion 0.1% (power cut)	42.8W
Power Bandwidth L/R 0.1%	45Hz–75kHz/45Hz–75kHz
Av. Pickup impedance one/two	45KΩ/45KΩ
Pickup sensitivity one/two	3.6mv/3.6mv
Pickup clipping one/two	138mv/138mv
Pickup capacitance one/two	400pf/400pf
Auxiliary impedance	60KΩ
Auxiliary sensitivity	156mv
Tape impedance one/two	60KΩ/60KΩ
Tape sensitivity one/two	156mv/156mv
Mic impedance	42KΩ
Mic sensitivity	3.6mv
Mic clipping	345mv
Max level from tuner (RO)	600mv
Max level from pickup (RO)	330mv
Tape output impedance DIN Av	–
Tape output impedance phono Av	1.5KΩ
Av. Pickup noise ref 8mv record output socket unw	76dB
Av. Pickup noise ref 8mv record output socket CCIR	72dB
Amp output noise @ 0 volume unw	455μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	89.9dB
Worst weighted noise Aux in/L out S/N ratio	84dB

Tuner

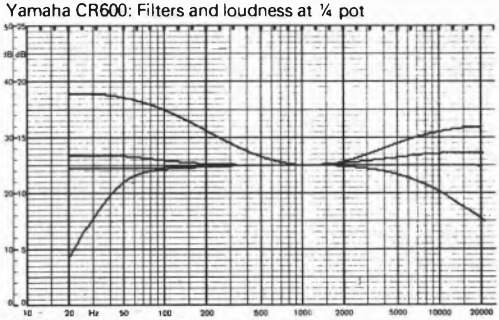
Mono RF sensitivity 30dB IHF	7μv
Mono RF sensitivity 50dB IHF	1.4μv
Stereo RF sensitivity 50dB IHF	17μv
IM RF	77dB
Adjacent Channel worst figure	6dB
Alternate Channel worst figure	none
Image Response	none
Capture Ratio	1.75dB
AM Reject	60.5dB
Mono distortion 100% 1kHz centre tune worst case	0.44%
Optimum tune mono Average	0.2%
Stereo L= –R centre tune L	0.4%
Stereo L= –R centre tune R	0.36%
Av. Stereo R= –L centre tune	1.2%
MPX filter reject worst fig. @ 19kHz	42dB
MPX filter reject worst fig. @ 38kHz	61dB
X talk centre tune worst fig. 1kHz	30dB
X talk centre tune worst fig. 10kHz	30dB
Optimum tune 1kHz L/R	44/35.5dB
FR Frequency response stereo –1dB L/R	8Hz–13.4K/13.5K
FR Frequency response stereo 3dB L/R	5Hz–15.1K/15K
Error @ 15kHz L/R	–3/–3dB
Limit threshold	0.5μv
Mute threshold	2.5μv
Av. Stereo S/N weighted 100μv/1mV	56.5/66dB
Av. Stereo unw 1mV	67dB
Av. Mono weighted 1mV	72dB
RRP Ex VAT	£204.00

Not normally discounted



Yamaha CR600: Tone controls

Yamaha CR600: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Yamaha CR 800

Natural Sound Systems Limited, Strathcona Road, North Wembley, Middlesex HA9 8QL. 01-904 0141

This 60W per channel receiver has identical external facilities to the 600 (see review for details). The 800, as is common with all Yamahas, is beautifully styled and easy to use. It ran rather warm when driven hard, and thus would require good external ventilation if used in an enclosed space, as otherwise the heat produced would almost certainly warp records etc. close to it. The front panel controls are basically very similar to those of the CR600, but a comprehensive tape dubbing switch is incorporated, which allows copying in either direction, as well as normal monitoring. The only other apparent difference is that the rumble filter can be switched to either of two turnover frequencies, rumble cut being below either 70Hz or 20Hz at 12dB/octave. The treble roll off attenuated at 6dB per octave from 7kHz. When operated in the other direction the treble roll off switch gives stereo narrowing at high frequencies on stereo radio programmes.

The amplifier produced a very clear overall sound quality, which was slightly on the bright side, but well liked. The bass frequencies appeared well damped, and reproduced with plenty of punch when appropriate. Slight signs of crossover distortion were noted at very low listening levels, but the problem would almost certainly not be noticeable in practice. The half power band width performance measured at 0.1% was excellent. The harmonic and intermodulation distortion measurements were very good indeed, and at 10W in particular, below 0.01% i.m. measured s.m.p.t.e. was noted. The damping factor was excellent, and no DC feed problems were noted, the amplifier outputs being relay protected in any case. Preamplifier and signal to noise performance was very good throughout. The volume control did not track as well as it should, although the tone and filter controls tracked well. The bass control offered a wide range of variation, but the treble control was only just adequate, although the steps of both were very even and the controls were a delight to use. The rumble filter was superb, but why can't the treble roll off be a real filter? The RIAA input impedance was optimum, and the clipping margin excellent, but the output on the record sockets was a few dB below that given by the tuner. The auxiliary and tape input and output sensitivities and impedances were all compatible with phono standard external equipment.

The tuner section's signal to noise ratio was excellent, and in particular weak stations reproduced with lower than average hiss being audible. The frequency response was superb over the entire audio range to 15kHz. The cross talk measurements were outstanding and in particular almost no distortion was noted on a cross talk channel from a fully deviated signal on the opposite one. The basic distortion measurements were rather average in general. It is quite clear here that Yamaha could afford to lower the audio level passed through the decoder by a few dB whilst still preserving a very good signal to noise ratio. Nevertheless, the sound quality reproduced by the tuner was subjectively very good indeed. The multiplex filter was superb. Limiting threshold and RF sensitivities were quite outstandingly good, and in particular very weak stereo signals could be reproduced with acceptable results. The adjacent and alternate channel selectivities measured well. The image response and IF breakthrough and capture ratio measurements were very good, and considering the excellent RF sensitivity, the RF IM ratio was good. No local oscillator radiation could possibly create a problem here. Centre tuning and RF signal strength meters are incorporated. The tuning knob when touched switches off AFC for ease of tuning.

Although this receiver is pretty expensive, its general performance was very good, even making allowances for the tuner's distortion figures. Its styling and ergonomics are so good that it will undoubtedly attract purchasers, and I feel I can recommend this model. I consider it reasonable value for money, particularly since its electromagnetic compatibility was truly excellent.

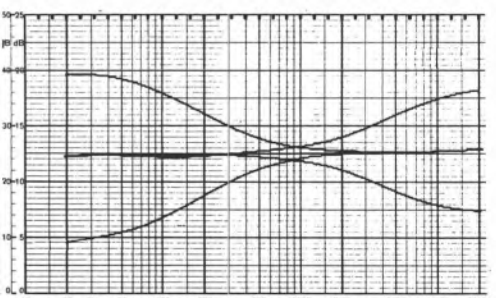
Amplifier

Av. Power output both channels driven	60W
Power output single channel driven	68W
Power output tone burst average	81W
Idle DC out worst case	17mv
Turn on/off Max. DC (swing worst case)	<50mv
Damping Factor L= −R	45/46%
IM 10w L/R	0.006/0.007%
IM 100mw L/R	0.025/0.025%
IM 1% output watts L/R	42.8/42.8W
Av. IM distortion pickup input/record out	0.003%
Av. Harmonic Distortion 0.1% (power cut)	56.5W
Power Bandwidth L/R 0.1%	<10Hz–35kHz/<10Hz–35kHz
Av. Pickup impedance one/two	50KΩ/50KΩ
Pickup sensitivity one/two	2.8mv/2.8mv
Pickup clipping one/two	255mv/255mv
Pickup capacitance one/two	160pf/160pf
Auxiliary impedance	61KΩ
Auxiliary sensitivity	144mv
Tape impedance one/two	61KΩ/61KΩ
Tape sensitivity one/two	144mv/144mv
Mic impedance	50KΩ
Mic sensitivity	2.8mv
Mic clipping	930mv
Max level from tuner (RO)	615mv
Max level from pickup (RO)	360mv
Tape output impedance DIN Av	–
Tape output impedance phono Av	2.1KΩ
Av. Pickup noise ref 8mv record output socket unw	72.5dB
Av. Pickup noise ref 8mv record output socket CCIR	73dB
Amp output noise @ 0 volume unw	470μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	89.5dB
Worst weighted noise Aux in/L out S/N ratio	82.1dB

Tuner

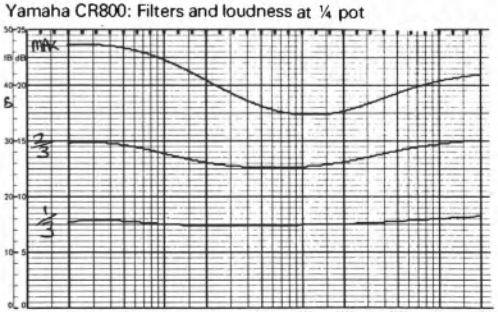
Mono RF sensitivity 30dB IHF	0.65μv
Mono RF sensitivity 50dB IHF	1.4μv
Stereo RF sensitivity 50dB IHF	16μv
IM RF	73.7dB
Adjacent Channel worst figure	7dB
Alternate Channel worst figure	50dB
Image Response	none
Capture Ratio	1.25dB
AM Reject	62dB
Mono distortion 100% 1kHz centre tune worst case	0.64%
Optimum tune mono Average	0.6%
Stereo L= −R centre tune L	0.5%
Stereo L= −R centre tune R	0.55%
Av. Stereo R= −L centre tune	0.38%
MPX filter reject worst fig. @ 19kHz	66dB
MPX filter reject worst fig. @ 38kHz	68.5dB
X talk centre tune worst fig. 1kHz	50dB
X talk centre tune worst fig. 10kHz	34dB
Optimum tune 1kHz L/R	53/50dB
FR Frequency response stereo −1dB L/R	15Hz–15.7K/12.6K
FR Frequency response stereo 3d8 L/R	7Hz–16.3K/16.1K
Error @ 15kHz L/R	−0.5/−1.25dB
Limit threshold	0.4μv
Mute threshold	2.1μv
Av. Stereo S/N weighted 100μv/1mV	56.5/72dB
Av. Stereo unw 1mV	73dB
Av. Mono weighted 1mV	79dB
RRP Ex VAT	£266.40

Not normally discounted



Yamaha CR800: Tone controls

Yamaha CR800: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Yamaha CR1000

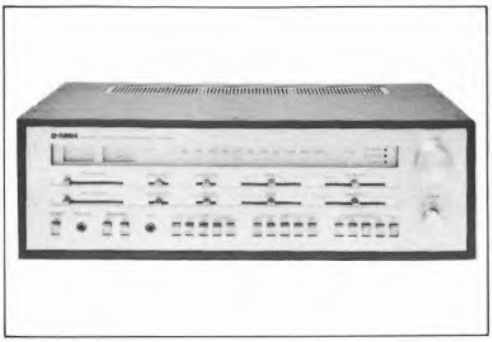
Natural Sound Systems Limited, Strathcona Road, North Wembley, Middlesex HA9 8QL. 01-904 0141

The largest in the Yamaha range, delivering 86W per channel (both driven) into two switchable pairs of loudspeaker outputs, available on spring loaded locks for ease of connection. The mains lead is 2 core, and feeds through to two switched and two unswitched mains outlet sockets. An unusual coaxial socket is provided for 75 ohm FM aerial connection but fortunately this is duplicated with 75 ohm and 300 ohm FM aerial terminals. (Yamaha should change the socket to a more normal type.) Phono sockets throughout are used for audio connections, and inputs include pick-ups 1 and 2, auxiliary 1 and 2, and input and output connections to two separate tape recorders. Front panel controls allow monitoring of either recorder or, alternatively, copying from either one to the other. Phono break points are provided for insertion of external equipment immediately prior to the main amplifier. Two earth terminals are provided on the rear. Pick-up input 1 has three switched impedances of 28k ohms, 41k ohms and 62k ohms (as measured). The receiver is very heavy and is mounted in a large wooden case with a metal ventilation grill, and even when pushed hard it only attained a warm temperature. The general styling is most impressive, but the ergonomics are highly personal and clearly many will find the controls fascinating and helpful, whilst others will at first be confused. All the tone controls are ganged and have 11 stepped positions on a horizontal click stop slider arrangement, which worked well. The loudness control was similar, allowing its effect to be gradually increased as desired. The balance control was a centre indented normal horizontal slider. The turnover frequencies of the tone controls can be set at 250 or 500Hz for bass, and 2.5kHz and 5kHz for treble. The rumble filter cutting at 12dB per octave rolls off steeply below either 20Hz or 50Hz (excellent). The treble filter is switchable at 7kHz and 14kHz for 3dB points. A rather small rotary volume control is provided but a separate slider microphone gain control is also incorporated. An additional slider operates FM muting level. A row of neat lever paddles select inputs, operate tape functions and also mono/stereo combinations, and loudness switch. Stereo jacks are provided for microphone and headphone connections and adequate volume was given for the latter. The tuning mechanism is a delight to use and the dial accuracy superb. Signal strength and tuning meters are provided.

The amplifier's reproduction quality was clearly good but it must be judged by the highest standards, because of the price. Some bass sogginess was clearly audible to all of us. The treble end was liked. Very extensive IM sweep tests were made which confirmed the results of the listening tests. In particular they showed a relatively poor IM performance at the bass end. The half power bandwidth for 0.1% was very good, extending to at least 20kHz. Harmonics distortion and SMPTE IM distortion measured well, but the latter began to increase slightly at low levels. The damping factor was excellent. No DC output problems were noted (output circuits relay protected). The signal to noise ratios throughout were excellent. The volume control tracked rather poorly below −30dB. The remaining controls tracked well. The tone controls all provided excellent variation. The pick-up input amplifier had an excellent clipping margin and its output level was well compatible with that of the tuner. All the input and monitoring functions are FET switched to avoid clicks. Auxiliary and tape in/out impedances and sensitivities were very compatible (nb. but not directly with DIN standard equipment).

The signal to noise ratios of the tuner were superb. The distortion measurements were in general very good, but full deviation of R-L was rather poor. But in practice this is not too serious in this case. The crosstalk measurements were average and adequate. The frequency response was very good whilst the MPX filter was excellent. RF input sensitivities were superb. Adjacent and alternate channel selectivities, image response, IF breakthrough, capture ratio and AM rejection measurements were excellent, RF IM ratio was good. The limit threshold also measured well. The tuner section gave excellent results on both the test and normal broadcast programmes. The tuning knob when touched switches off AFC for ease of tuning.

This is a very expensive receiver and whilst it gives a very good quality, a few others were cheaper at a discount. Stylistically, though, Yamaha must be strongly commended, and the electromagnetic compatibility was remarkably good. It can be said to be fair value for money and can be recommended if you are not concerned with price.



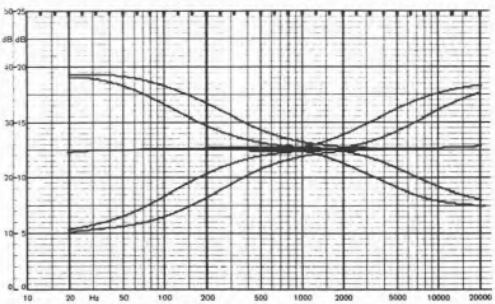
Amplifier

Av. Power output both channels driven	86W
Power output single channel driven	98.7W
Power output tone burst average	116W
Idle DC out worst case	5mv
Turn on/off Max. DC (swing worst case)	–
Damping Factor L= –R	50/47%
IM 10w L/R	0.045/0.04%
IM 100mw L/R	0.075/0.08%
IM 1% output watts L/R	60.5/60.5W
Av. IM distortion pickup input/record out	0.004%
Av. Harmonic Distortion 0.1% (power cut)	81.2W
Power Bandwidth L/R 0.1%	<10Hz–33kHz/<10Hz–20kHz
Av. Pickup impedance one/two/three/four	27KΩ/41KΩ/62KΩ/40KΩ
Pickup sensitivity one/two	3.3mv/3.3mv
Pickup clipping one/two	270mv/270mv
Pickup capacitance one/two	180pf/180pf
Auxiliary impedance one/two	55KΩ/55KΩ
Auxiliary sensitivity one/two	158mv/158mv
Tape impedance one/two	63KΩ/63KΩ
Tape sensitivity one/two	158mv/158mv
Mic impedance	43KΩ
Mic sensitivity	3.3mv
Mic clipping	320mv
Max level from tuner (RO)	520mv
Max level from pickup (RO)	337mv
Tape output impedance DIN Av	–
Tape output impedance phono Av	2.4KΩ
Av. Pickup noise ref 8mv record output socket unw	72.5dB
Av. Pickup noise ref 8mv record output socket CCIR	71dB
Amp output noise @ 0 volume unw	440μv 20/20kHz
Av. Amp output noise @ 0 volume CCIR S/N ratio	91dB
Worst weighted noise Aux in/L out S/N ratio	83.8dB

Tuner

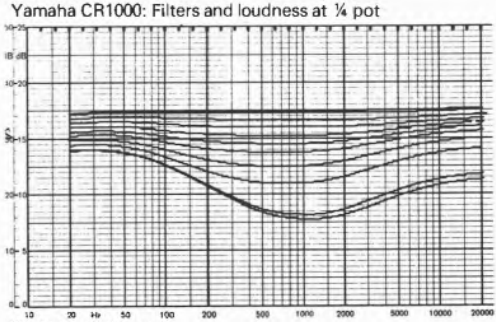
Mono RF sensitivity 30dB IHF	0.75μv
Mono RF sensitivity 50dB IHF	1.5μv
Stereo RF sensitivity 50dB IHF	18μv
IM RF	74.5dB
Adjacent Channel worst figure	8dB
Alternate Channel worst figure	none
Image Response	none
Capture Ratio	1dB
AM Reject	60dB
Mono distortion 100% 1kHz centre tune worst case	0.18%
Optimum tune mono Average	0.18%
Stereo L= –R centre tune L	0.15%
Stereo L= –R centre tune R	0.15%
Av. Stereo R= –L centre tune	0.7%
MPX filter reject worst fig. @ 19kHz	65dB
MPX filter reject worst fig. @ 38kHz	>80dB
X talk centre tune worst fig. 1kHz	33dB
X talk centre tune worst fig. 10kHz	32dB
Optimum tune 1kHz L/R	35/33.5dB
FR Frequency response stereo –1dB L/R	9Hz–12.6K/11.5K
FR Frequency response stereo 3dB L/R	5Hz–16.2K/16K
Error @ 15kHz L/R	–1.75/–1.5dB
Limit threshold	0.5μv
Mute threshold	2.5μv→14μv
Av. Stereo S/N weighted 100μv/1mV	55/71dB
Av. Stereo unw 1mV	75.5dB
Av. Mono weighted 1mV	78dB
RRP Ex VAT	£399.20

Not normally discounted



Yamaha CR1000: Tone controls

Yamaha CR1000: Filters and loudness at ¼ pot



(Tested on 50dB scale)

Alpha FR 6000 The tuner section switched into mono when centre tuned but did manage stereo when tuned either side! It's alignment was so poor that considerable distortion was produced. Crosstalk was poor and unfortunately so many other faults showed up that the test was aborted. Disliked and not recommended.

Alpha RF 8000 This receiver reproduced slight hum from the amplifier and its sound quality was strongly disliked, crossover distortion being noted. The bass end was muddy and distorted, and the sound generally spread and did not have good definition. The tuner had intolerable hum. The discriminator was badly aligned. All loud sounds seemed to splash badly. The tuner had poor limiting, poor sensitivity and the receiver was strongly disliked by all of us. Not recommended.

Audiotronics LR 4040X Severe frequency response anomalies between the two output channels of the tuner were noted. Considerable distortion was produced and the signal to noise ratio was poor. The discriminator and decoder sections were clearly badly aligned. EMC was very poor. Not recommended. Audiotronics have now announced withdrawal of this model.

Audiotronics 2500X The tuner section had a rather bad hum audible on the output. Stereo crosstalk was so bad that it was subjectively estimated at about 6dB! The tuner's frequency response was quite alarming and we gained the impression that there was no de-emphasis at all! Noticeable splashing and bonking was audible on high level transients. The amplifier section was quite reasonable. Audiotronics have now withdrawn this model from sale.

B & O 901 The tuner section audibly distorted high frequency transients. The response seemed down at high frequencies and some poor crosstalk at these frequencies was noted. Slight distortion was noted on speech at full deviation and bad distortion was noted in the crosstalk, when speech was transmitted on only one channel. The tuner was found difficult to tune. Slight misalignment of the discriminator was noted. This receiver does not appear to represent good value for money and was therefore aborted. EMC was pretty good.

Dansk SD 2100/2 The tuner section produced noticeable hum and was rather hissy. Crosstalk was very poor. Some out-of-phase problems were present on the decoder's output (badly aligned). The power amplifier was quite good but this receiver was aborted from the laboratory tests. Not recommended. EMC was very good.

Howland West Audio R100 Rather bad hum was noticed on the tuner output. The frequency response was not very good. RF intermodulation was very bad and spurii were heard all over band 2. This receiver was therefore aborted from the lab. tests. RF sensitivity appeared poor on the aerial test. EMC on low frequencies was very bad.

Luxman 600 This receiver had to be completely aborted because Capital Radio (MW) was audible all the time on any FM input receiver by the tuner. Clearly it had some bad breakthrough problems, possibly due to poor earth routing. EMC was absolutely diabolical at low frequencies, an amateur transmission on 1.9MHz completely muting the FM receiver! Most unfortunate.

Marantz 2015 The FM tuner hiss was so poor, and clearly the worst of any receiver in the test, that it had to be aborted. A re-test sample kindly supplied by the importer was only 1dB better, so was also aborted from lab. tests.

NAD 160A The tuner performance was subjectively rather average and some bad splashing was noted on speech, spreading the sibilants, for example, across the sound stage. High frequencies appeared to be artificially boosted in the difference channel (R-L) and thus general programmes were artificially widened at HF. This receiver is in my opinion so overpriced that it represents poor value for money. It was therefore excluded from the lab. tests. EMC was rather poor.

Nikko 4030 It is a pity that this tuner's distortion performance let the receiver down rather badly. The stereo distortion measured orders of several per cent on left, right and difference channels, although the mono performance was acceptable. Distortion was noticed subjectively in the gong test, particularly in the cross talk channel, and speech gave clearly audible distortion. The amplifier section

reproduced pop music fairly well within its power limitation, but some cross over distortion was noted in quiet sections of an orchestral recording. It is felt that since other receivers at a similar price offer a significantly better performance, a lengthy review would be unjustified. It would seem that Nikko must have either a quality control or design problem, and I sincerely hope that perhaps the receivers sent for review were not typical. Unfortunately, the 4030 had no monitor tape button, which restricted its usefulness quite appreciably.

Nikko 5050 The sound quality reproduced from the review sample was most disappointing. Quite severe crossover distortion was clearly audible and slight 'pumping' was noticed at intermediate levels, which seemed to be frequency selective. When fairly loud some form of transient instability and distortion was reproduced. The tuner section sometimes reproduced high frequency transients very badly when extreme left or right, giving slight cracking and splat on the opposite channel. Measurements showed the amplifier's intermodulation distortion to be very poor indeed at 10W and 10mW, and so a lengthier review is omitted. The cross talk figure also measured very badly (only 24dB at 1kHz).

Nikko STA 7070 The first sample had one of the tuner output channels almost dead (subjectively about −30dB). The second sample did in fact work but had such a poor hum that it was also aborted. Most unfortunately, bad distortion was noted in the crosstalk. EMC was very bad indeed on VHF.

Nikko STA 8080 The tuning section had such a poor hum level that on this ground alone it just had to be aborted from lab. tests. Some sibilant splashing was noted on speech. EMC was poor at VHF. Not recommended.

Philips 22RH 741 Even if the tuner and amplifier sections had performed satisfactorily this receiver would have been aborted from lab tests because of very poor value for money. However, the power output of only 6W per channel into 4 ohms (Philips spec.) is in any case inadequate for normal domestic requirements. Programme reproduced with a clothy, muddy and rather dirty sound quality. Severe distortion was introduced by the tuner even at 25% deviation. At 100% deviation the distortion was frankly disgraceful. The only signal that was relatively undistorted was R-L at 100%. The tuner also had some odd response anomalies. AFC action was quite excessive making it impossible to tune in other than the strongest local stations. Unfortunately and quite clearly Philips should never have submitted this sample anyway, which was aborted from lab. tests. The only thing we liked about this receiver was that its EMC was excellent.

Rotel RX 102 The RF sensitivities and limiting threshold were very poor indeed. The amplifier, however, was well liked. Cracking was noticed on high frequency transients (tuner), and some LF bonking was also noticed. Speech reproduced with spitching and the sound reproduced from the tuner was overwide (bad decoder alignment). Not recommended. VHF EMC was very poor.

Rotel RX 152 Distortion of the tuner section was very poor and transients produced splats and bonks! Some response anomalies were noted. Some bad radio frequency intermodulation distortion was heard, spurii appearing all over band 2. There was a tendency towards instability when the tone controls were turned fully to the boost position. Not recommended, then, but at least the EMC was fairly good.

Rotel RX 202 Although this model is very inexpensive it just cannot be recommended since the tuner section had very high measured distortion, poor crosstalk at HF and a very poor noise performance on weak stereo signals, although it was satisfactory in this respect on strong ones. The adjacent and alternate channel performances were exceptionally poor in particular, as was the capture ratio (5dB). The amplifier section, however, was adequate. It is felt that just a few pounds more spent would be very well worth while and so this receiver has only been mentioned briefly (for basic quality parameters see jumbo chart).

Sansui 661 Rather average in general performance and bass frequencies were reproduced with a somewhat cardboardy quality. Since there are other Sansui receivers which performed better subjectively, this one was omitted from lab tests. EMC was very bad at LF and poor at VHF.

Sanyo DCX 2000K Some severe response anom-

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alies were noted from the tuner section, which thus produced a very shrill and unacceptable sound quality. Some HF distortion and splat were noted on the tuner's output, especially on high frequency transients. High frequency positioning was poor. Some spurii were noticed on band 2 during the aerial test. Aborted from lab. tests and unfortunately not recommended. EMC was poor at LF.

Sanyo DCX 4000K The tone controls (11 stepped switched positions) had a very uneven law, which provided little variation, until the end steps were reached. Very bad HF crosstalk was noted on the tuner section. The crosstalk noticeably affected stereo positioning. Some RF IM was noted on the aerial test. The general alignment of the tuner was poor and therefore the receiver was aborted from lab. tests. Not recommended. EMC was rather poor at VHF.

Sonab 4000-3 Some distortion was noticed on the tuner section's output and it was very difficult to tune for even reasonable sound quality on high frequency transients. When the tuner was tuned to its indicated correct position, splashing and splat were noticed. The rate of tuning was much too fast and the tuning knob was far too small. The discriminator section was clearly out of alignment and although complete lab. tests were made the receiver can only deserve a short review since the competition was too fierce. EMC was pretty good.

Sonab 7000 Some hum was originally noted when this was first tested, but Sonab have introduced a modification to put it right if users complain! This was done in our case. The amplifier sound quality was not particularly liked and it tended to 'shout' when loud. EMC was very bad indeed at low frequencies. I consider this receiver rather overpriced. Automatic frequency control was so vicious that it was virtually impossible to tune in weak signals. After careful consideration this receiver was omitted from lab. tests, but it was nevertheless a borderline case. Not recommended, though.

Sony 7025 The tuner section had very poor RF sensitivity and so this receiver was omitted from lab. tests. EMC was very poor at VHF. There are too many other models in this survey which performed far better at the same price.

Sony 7035 The limiting threshold was very poor and the RF sensitivities very unsatisfactory. Although complete lab. tests were made, I feel that the receiver represents rather poor value for money and hence justifies only brief comments. EMC was very bad on VHF but good on LF. A disappointment. The amplifier section was rather average.

Trio KR 4400 When delivered this receiver had the wrong de-emphasis and this was put right on my premises by the importer. The RF input sensitivity was rather poor. I consider that this receiver is somewhat overpriced and so after careful consideration the tuner was aborted from the main lab. tests, although its general RF performance was checked. EMC was excellent.

Trio KR 6400 The first sample would not switch into stereo at all on normal stereo FM transmisisons. The second sample did, but the general tuner performance was rather inadequate, considering the high price asked, and since I feel that this model is overpriced it was aborted from lab. tests. EMC on VHF was rather poor.

Wharfedale SXP The amplifier section was audibly inferior to average and bass frequencies were rather muddy, high ones also being on the scratchy side. We all felt that this receiver did not sound as good as the Leak 2000, which is also a Rank product and since the prices are nearly identical this receiver was aborted from lab. tests. EMC was very good.

Yamaha CR 450 The amplifier section was good, but the tuner's RF sensitivity was rather poor. Some distortion was noticed on the tuner's output, particularly at high frequencies (some spitch and splat heard). On the aerial test I suggested that either the tuner's RF sensitivity was poor or my aerial had been struck by lightning! Forgive this sarcasm, but frankly at this price it is only fair to expect a better RF performance, and this was aborted although a marginal case. This was the only Yamaha receiver which had other than excellent EMC properties. It was unfortunately very poor in this respect.

All results and conclusions published in 'Hi-Fi Choice' are based on the findings made from the models supplied. It should be remembered that other samples could give poorer or better results, although every effort has been made to ensure both consistency and accuracy.

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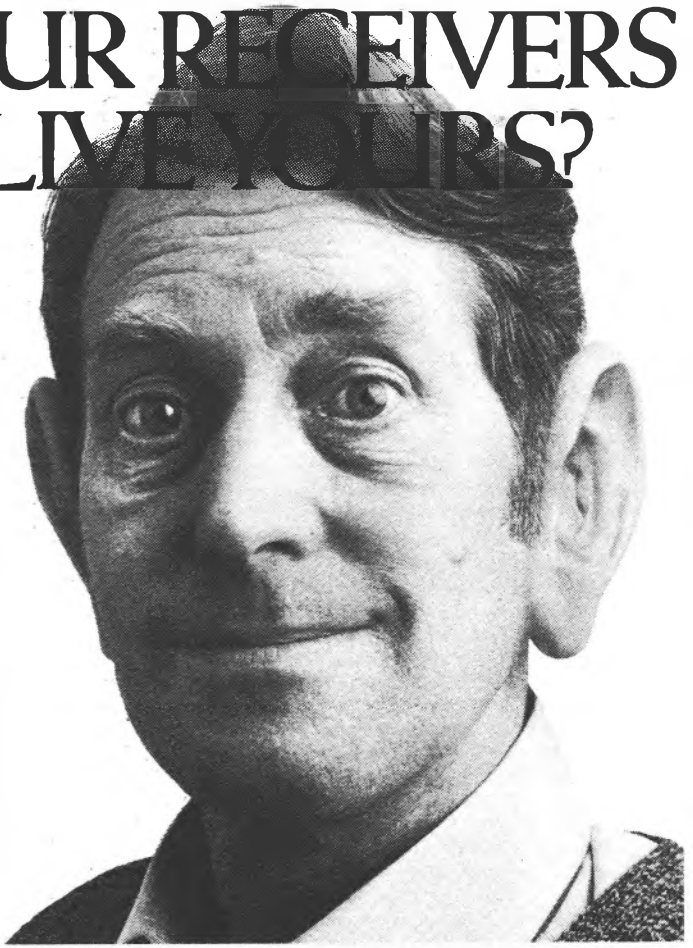

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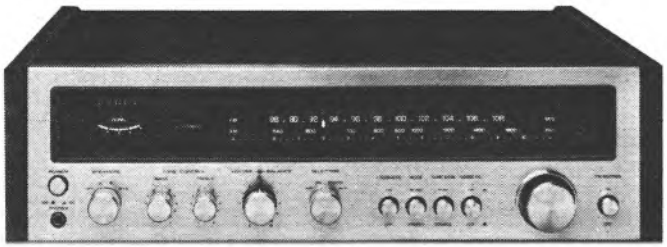

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After completing all the tests and having written all the reviews, we can certainly see far more clearly the good and bad points of the models surveyed. It would be unwise to look at any individual test report and make a purchase based on just that, since a particular receiver may offer a generally good performance at a reasonable price but there are others that may well offer better value for money, either by providing more facilities at the same cost or the same facilities for less.

Of the 85 receivers surveyed, most of them had amplifier and pre-amplifier sections which gave good sound reproduction, although experts would undoubtedly be able to hear minor differences in quality. I have taken as my criterion throughout, in making recommendations, whether or not the sound quality is good in isolation rather than in comparison, unless other models offer equal facilities but marginally better sound quality at the same price. In the final analysis a choice should probably be made with regard to the tuner performance and the general ergonomics and facilities provided, whilst excluding receivers which had clear amplifier failings. To help you assess the relative importance of the different sections of a receiver I will comment on each individual group of measurements and relate these to their importance in practice.

The Tuner Section

Most of the receivers could accommodate 75 and 300 ohm FM aerial inputs, but a few had 300 ohms only. It is most important to match the aerial correctly into the receiver. Many 75 ohm/300 ohm external transformers are not very efficient and will lose 2 or 3dB of signal. Consequently, a 300 ohm aerial installation will be better for a 300 ohm only input. The RF sensitivity is only of particular importance if you want good reception of weak signals. In the London area you should, on any receiver, be able to easily obtain BBC Radio 2, 3 and 4 as well as Radio London, Capital Radio and LBC. Additionally, a good receiver should enable you to receive Radio Medway, Radio Oxford and possibly Radio Solent.

Naturally the terrain around your immediate locality is important, as is the quality of the aerial installation. Should you purchase a remotely operated rotator unit you will be able to obtain considerable enjoyment. Such a unit may only cost £35 or so, but could double the number of stations that you can pick sufficiently well for pleasurable listening. When a tropospheric duct

opening presents itself, usually when atmospheric pressure is at its highest, a good tuner should be able to sort out many interesting continental stations as well. In fact, under these circumstances band 2 can almost become like medium wave was 25 years ago, particularly if your location is relatively high up above sea level.

Check comments made on weak stereo reception, and note the 50dB unweighted signal to noise measurement on stereo. Compare this with the 100uV stereo weighted S/N. The best tuners require significantly less than 25uV for 50dB UnW. S/N, and at 100uV their weighted S/N should be better than 53dB or so. The adjacent and alternate channel selectivities are important if you wish to receive weak signals close to very strong ones, and the performance of different receivers was extremely variable here. The alternate channel selectivity should be better than 50dB for reasonable results, and better than 55dB is classed in this survey as being negligible or 'none'. Although we could have measured beyond this point, we did not want to send too high a level into the tuners as they might have been harmed by excessive input levels. Image response is only of importance if you live very close to an airport, or right underneath a well used aircraft flight path. A poor figure can be ignored if you do not see many aircraft around during the day. Capture ratio normally is not too important, but in some locations it is of great importance if you receive two stations of comparable strength on the same frequency. IF rejection is only of importance if you are fairly close to a commercial short wave transmitting station, embassy, etc., that frequently transmits on or close to 10.7MHz. These transmissions can be morse code, teleprinter or speech, and all might cause a problem. Local oscillator radiation only affects other sets in the neighbourhood. Just a few receivers could cause interference to others.

RF intermodulation distortion will normally only be of significance if you receive a pretty healthy and strong signal from at least two programmes. Unfortunately a good aerial installation in the average urban area probably will do just this and mine produces approximately 12mV from Wrotham when pointing straight at it. On average, good systems tested produced signals from 1mV to 10mV and many receivers will need watching in this respect. Do not forget that if a particular receiver is extremely sensitive, but has a poor RF IM ratio, a coaxial RF attenuator can be used to reduce the sensitivity, and thus the onset of the problem, whilst still maintaining adequate sensitivity for most purposes.

A poor limiting threshold figure normally indicates poor sensitivity or inadequate gain in the IF stages. In such cases a tuner's general performance might not be audibly as good even on stronger stations. Mute thresholds, both mono and stereo, are so variable and are so much a matter of opinion that I have not paid too much attention to differences. Too low a mute threshold will tend to keep the receiver open most of the time, whereas too high a threshold will only allow the strongest stations to be heard. The tuning meter, if aligned correctly, is much better than an RF signal strength one, but note remarks made both in the introduction and in the individual reviews. Too many receivers had poorly aligned discriminators and so a particular centre zero reading may not necessarily be optimum. Obviously one sample is likely to be different from another for any particular model. The tuning dial accuracy of almost all the receivers was far better than I had expected. You can check this very simply by comparing the indicated frequency with the advertised one for your local strong stations. Do not forget to check local radio stations, for these are in general higher in frequency than the BBC networks.

Unfortunately almost all the receivers that were given short reviews had relatively poor tuner sections, and it is largely for this reason that they were critised so heavily. In particular we were very disappointed with receivers that had poor or significantly below average weighted S/N ratios. The Marantz 2015 was by far the worst in this respect, but we were amazed to see that the Revox 720 was comparatively poor considering its price. This is particularly unfortunate, since in other respects the Revox was so good.

The effectiveness of the multiplex filter is only important if you have a recorder that does not itself include one. Fortunately most modern cassette recorders do. Pilot tone breakthrough is more likely to cause whistles, etc., on slow tape speeds than faster speeds employed on reel to reel recorders. So avoid, if necessary, receivers having a poor breakthrough, if your recorder does not have a filter itself.

Some types of distortion were clearly audible subjectively but were rather difficult to measure, and so note carefully any subjective comments with respect to 'splashing', 'bonking' and 'splat'. These all tend to be transient phenomena rather than continuous, and so only show up easily in subjective tests. Surprisingly, a few tuners having distortion levels at full deviation as high as 0.5% could audibly sound slightly better than some with significantly better figures. In general, though, tuners with consistently low distortion provided a good sound quality. When they did not, it was usually distortion being heard in the crosstalk channel, and occasionally merits comment.

Mention of crosstalk takes into acount not only the measured figures, but also the subjective results. Therefore sometimes I may appear to be inconsistent when I recommend a tuner which has poorer crosstalk than average. In these cases, although the measurements were bad, subjectively they were insignificant, because no distortion was audible in the crosstalk. Theoretically a crosstalk figure of 25dB at 1kHz, with 20dB at 10kHz, would be adequate, but in practice a poor crosstalk measurement often pointed to poor quality.

Some tuners, such as the Alpha 8000, Audiotronics 2500, Dansk 2100/2 and Howland West R100 had clearly audible hum, which was noticeable either all the time or in quieter passages. I am afraid this is unforgivable, and manufacturers must pay more attention to the subjective effect of hum, rather than obtaining a passable measurement, which in itself may not indicate the nature of the hum. Many tuners had a remarkably flat frequency response. Just a few had a built-in low frequency cut below 50Hz and in practice this is not particularly important. What is important, though, is that the FM de-emphasis should be correct and several tuners had errors here (e.g. Trio model 4400, Sanyo DCX 2000, Audiotronics LR4040X, Aiwa 7500 and Goodmans Module 90).

It is surprising that a relatively small droop of 5dB or so at 15kHz can be noticeable, particularly if there is also an error at 10kHz. Sometimes the poor response is caused by a cheap multiplex filter being incorporated, which starts cutting at too low a frequency. I must commend models having a flat response at 15kHz, but which also have excellent rejection at 19kHz. One or two tuners were up in response at 7kHz or so (e.g. Goodmans Module 90). In these cases you are advised to choose a loudspeaker system which does not have peakiness in this region, because then the anomaly will not be so audible.

I have occasionally commented on backlash, and this refers to the tuning assembly. Do not be too concerned about this, for once you have found the station and tuned it in correctly, it will not of course concern you, the problem being purely noted when you are tuning in.

I cannot recommend too strongly those manufacturers who incorporate preset stations. I find it incomprehensible that so many receivers omit this facility, in particular Japanese makes. After extensive enquiries I heard that Japanese listeners do not seem to appreciate preset station controls, but European users must certainly do. Only Armstrong, Goodmans, Sonab, B & O, Tandberg and Revox incorporated preset stations. After considering the above you will see that I cannot recommend such receivers as the Trio 4400 and Sony 7025 models, both of which had very poor RF sensitivities. They may well perform adequately on strong signals but if their competition is better on weak ones, then obviously they cannot be recommended. Some receivers, including the Philips and Sonab 7000, had such strong AFC actions as to render them virtually useless for picking out other than very strong stations. Once again this has been criticised heavily. The following models had the worst local oscillator radiation problems: NAD 140, Trio 7400 and Goodmans 120.

IF breakthrough was a particular problem in the Akai 1030, NAD 140, JVC 5525 LX, Audiotronics 2626, Akai 1020 and Rotel 402, and because of poor alternate channel I cannot recommend Atron 220, Nikko STA 4030, Rotel 202 or Nikko 5050. Severe RF intermodulation distortion was present on the Howland West R100, Aiwa 7500 and Rotel RX 152.

Pre-Amplifier and Amplifier Sections

Provision of good tone controls and filters is important, and I must particularly recommend those receivers employing effective evenly stepped tone controls, usually having 11 different positions. This allows for an optimum response to be obtained from different records or tapes. After determining tone control positions, why not make note of them on the record sleeve or tape box for future reference?

I was horrified to find after the tests had been

completed that so many receivers had such poor filtering, both of low and high frequencies. Many rumble filters were unusable, since they cut too much bass within the audio spectrum, whereas many filters did not do any more than a good tone control can do. Once again, then, I must state that filters cutting at only 6dB per octave should surely not be called filters at all, and manufacturers must be encouraged to adopt cut offs of at least 12dB/octave. Particularly commendable were most of the receivers employing bass, mid and treble controls, and especially those offering different turn-over points. It is such a pity that the JVC's excellent graphic equaliser was let down by its poor tuner performance, for the graphic section was most impressive in its operation. Most receiver had their tone control sections after the tape monitor switch, but the Armstrong and Tandberg 1040P and 2075, for example, could allow tone control before recording. Great care should be taken if such controls are adjusted during recording, for a tape can be so easily overloaded at very low or very high frequencies.

Several receivers did not offer compatible levels when the pick-up level was compared with that from the tuner section. This is not serious if you are prepared to re-adjust the levels of your tape recorder, but nevertheless I have criticised it, as it shows a lack of thought in design as well as a minor inconvenience in operation. The pick-up input clipping performance was usually excellent, but B & O in particular must be criticised for an inadequate margin on their receivers, and in particular their model 4000. In other respects this model was very good indeed, and it is therefore a pity that a final recommendation has had to be omitted because of the input clipping problem. Do not forget that pick-ups with a very low output will not cause anywhere near so much of a clipping problem as does a high output cartridge, but more noise is audible from a low output cartridge since it has to be amplified more. In general the RIAA responses were excellent, and only rarely was a problem found, one of the worst cases being the Akai 1020. Since they promised to attend to the problem immediately, however, their receiver can be recommended, but check that you do not buy 'old stock'. The importers, Rank, are further prepared to modify sets that are found deficient here.

Many receivers had only phono sockets incorporated for connecting external recorders. You will almost certainly have to use a special adapter lead incorporating attenuation, if you wish to interconnect such receivers with DIN standard recording equipment. Similarly, receivers having only DIN sockets incorporated almost certainly will not give enough level into other than DIN inputs, and furthermore it is almost certain that a severe high frequency loss will be apparent when the recordings are played back, since the recordings themselves could be as much as 6dB down at 10kHz because of the recording mismatch. If you are attracted to a receiver incorporating only DIN sockets for interconnection, then you are strongly advised to avoid other than DIN standard recorders, unless the receiver has appropriate switching. Comments on these are made in the individual reviews.

Most microphone inputs were very poorly designed, and frequently passed through the pick-up pre-amplifier to offset the RIAA response. Sometimes the manufacturer introduces an appropriate bass cut and treble boost passively before the pre-amp, thus losing level and introducing noise. If you are likely to require the microphone input function, then insist on trying it in the shop. Speak at least 6" away from the microphone after setting a level, and see how much noise is audible on the loudspeakers. If you do not hear rumble and hiss, but you do have adequate sensitivity from a high impedance microphone, then it should be satisfactory. In general the microphone input circuits on recorders are far better than those found on the receivers.

Some auxiliary inputs clipped at rather a low level. If you wish to use these in conjunction with external equipment, check that such equipment will not cause overload of the receiver. Several receivers, including Revox and B & O, have attenuators built in to bring a high external level down to one compatible with the receiver's sensitivity.

Comments are made on control tracking. Normally you will not notice minor tracking inadequacies, but some receivers had errors of several dB in the part of the track which will most frequently be used. Since so many receivers were excellent here, it seems only fair to expect a good performance—at least in the top 30dB. By far the worst tracking was noted in the Revox 720, although this was in the bottom section of the slider. A definite swing would be detected, though, as the volume was

reduced to a low level, and I do not consider a severe failing excusable. Most of the higher power receivers and some others had 'break points' immediately prior to the main amplifier section. These can be used to drive an external graphic equaliser which will allow you to make a permanent correction for your loudspeaker system and listening room inadequacies. You could also insert a three head tape recorder with monitoring here, particularly if you want to perform elaborate dubbing functions. A break point could also be used in association with quadraphonic control systems, or will allow just the main amplifier to be used in semi professional applications.

The choice of a receiver will largely be dependent on the volume you require to drive your loudspeakers. This will be determined not only by the maximum level that you require in your room, but also the sensitivity of your loudspeakers. In general, higher quality loudspeakers are less efficient than budget ones, but this is not always true. Usually 20W per channel will be adequate for a small room, even with less sensitive speakers. If you like to reproduce music at a realistic volume though, or you want to have a 'rave up party', you will be advised to choose a receiver capable of at least 45W per channel, particularly if you wish also to connect extension speakers. Do not forget that 45W is not that much louder than 20W and so if you want very loud reproduction and you have powerful speakers, you may need 60W or more per channel. Although such a system may blow you out of house and home on loud pop music, you could very well use almost the full potentiality of the system on wide dynamic range music, since although the peak power for 99% of the time may be only a few watts the occasional crash of cymbals or singer's sibilant may actually peak very much higher. Even slight amplifier clipping can be audible. There is one danger in having a high power amplifier that must be mentioned. Misuse may not only damage loudspeakers, but may also damage your own hearing, if you consistently play loud music at a high volume level. Beware of too much level into headphones and also remember that your neighbours may not appreciate your favourite music! If you intend to use your equipment occasionally for reproducing music in halls, then allow for a considerable increase in available power over that which you deem necessary for use at home. As a general guide it is probably better to go for a receiver having at least 50% more power availability than you think might be necessary, since you may wish to change your loudspeakers in the future to less sensitive ones.

In the reviews I have frequently stressed the importance of our subjective listening tests. I obviously cannot guarantee that different samples will behave similarly, but in most cases my comments have tied up extremely well with elaborate tests. You may very well not hear some of the problems that have been outlined, but remember that your children may well hear them. Although I have sharp ears, I am now 42, and obviously my younger colleagues can hear some of the problems even more clearly than I can. I frequently used my children as 'guinea pigs', and I was very surprised to find that they too were coming out with words like 'rough' or 'screechy'. Younger people are much more sensitive to hiss than most older folk and so this should be borne in mind when noting remarks concerning the hiss performance of tuner sections. Distortion, too, is relatively less noticeable as you grow older, and I suggest that many of the remarks may need to be watered down slightly where appropriate.

Finally . . .

. . . perhaps the most important conclusion is that we have all noted a dramatic improvement in the quality of tuners and receivers introduced recently. Designers have indeed realised in many cases the importance of subjective listening tests as the sound of an amplifier will frequently not tally with normal laboratory measurements. Most of the receivers reviewed are so much better than models introduced perhaps seven years ago that you may well find purchasing a new receiver will open up a new dimension for you. Stereo radio provides such a good sound source that surely it is worth while spending a few extra pounds, in order to receive it really well. You can only make good recordings if the tuner section is good and, when a purchase is made, you are likely to lose quite a lot of money if you feel you have made a mistake, which may take you some months to realise. Since you will want to use the receiver for many years to come, why not regard it as an investment, and spend as much as you can possibly afford, rather than the minimum that you can get away with? Do this and you are less likely to be disappointed.

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In weighing up the relative value for money of the best receivers surveyed, I felt it necessary to judge this by examining typically discounted prices, which are not necessarily the very best available, but those which can be obtained easily from many reputable dealers. I appreciate that some retailers may be a little 'prickly' if they are asking a higher price. Here I must justify the range of discounts by stating that a good dealer, offering less discount, may well have better demonstration facilities and offer a better and more convenient after-sales service than one who may, in the main, deal with mail order, although having a shop counter. If you live outside a large urban area you will probably find it less easy to obtain a substantial discount over the counter. Using a mail order company creates the risk of having to return any unsatisfactory equipment, which may be extremely inconvenient. Quite frankly, many will consider it worth while to accept a lower discount and deal with a local shop purely for the sake of convenience and service.

Some recommended retail prices are obviously grossly inflated. Specifically, I was not able to find advertisements for any shop retailing ranges such as Pioneer and Sansui, let alone many others, at full recommended retail prices. A common tactic used by some manufacturers and importers is to provide an artificial RRP, thus enabling retailers to quote big discounts, thereby giving the impression of amazing value for money, which is not necessarily the case. However, there can be no doubt that when much good equipment is bought at a substantial discount it really does offer excellent value. Beware, though, of cases where heavy discounts are offered on equipment which may actually be obsolescent or even obsolete.

Prices and discounting seem to fall into three categories. The first category, including Technics and B & O, incorporates receivers on which no advertised discount is offered. It is possible that you might be offered a token discount for cash, although this may be somewhat difficult to obtain. The second category includes receivers where as much as 10% is occasionally offered, although once again many dealers will not offer any discount at all. Yamaha, Marantz, Luxman, Sonab, Tandberg and Armstrong, for example, can be included in this category. The third category includes makes which can carry discounts quite normally varying from 10% to as much as 35%, and prices seen in advertisements can differ by as much as 15%. It is here that you must think twice before accepting the largest discount.

For convenience it would seem reasonable to divide the receivers into three basic categories, the first of which are typically discounted to prices below £130 plus VAT. The second category includes models with prices between £130 up to £225 plus VAT. The final category includes all the really expensive receivers, which naturally have the more esoteric facilities and, in general, far higher available power outputs. These cost in excess of £225 plus VAT.

In the cheapest category two receivers, the **Sansui 331** and the **Pioneer SX 434**, were remarkably good value for money and generally worked well. Both have similar facilities, but the Pioneer included tone controls with 11 click steps. It would not be fair, though, to favour one above the other, and despite their relatively low cost I would be happy to use either. In this respect I should make it clear that one important consideration in the recommendation of models in this section is that my colleagues and I would be prepared to use all the recommended equipment without reservation.

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Where all equipment is backed by a 2 years guarantee covering parts and labour. Every item is checked, tested and supplied with free leads and plugs.
Any item can be exchanged within 2 weeks of purchase. And you can count on a lifetime service from the service department on our premises.

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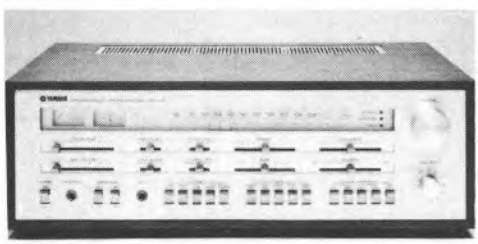
Where you can count on quality from a company famous for musical instruments since 1887 — and still make 15,000 pianos a month.

CR 1000 Tuner-amp

The ultimate. Spectacular FM and stereo performance aimed at the connoisseur. Lavishly equipped by genuinely useful features like Yamaha's exclusive auto-touch tuning. Guaranteed output 70w. rms per channel, typical output 90 watts.



CR 800 Tuner-amp

The ideal alternative to the CR 1000 for those who don't need its massive output (50 watts guaranteed, 63 watts typical per channel).

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PRESTON: Guild Hall Arcade, Preston PR1 1HR Tel: (0772) 59264

The **Sony 7015** was very basic but nevertheless offered a relatively good performance, and can also be recommended, since it should also be found at well under £100 plus VAT. The **Rotel RX 402** is almost in a class of its own, for despite its very modest cost it offers independent tone control of left and right channels with 11 stepped positions. We all liked this model, which seems to offer excellent value. The **Akai 1020** offered some excellent facilities again including 11 stepped position tone controls, is very well styled and can be strongly recommended—but check that the receiver has only recently been delivered to the shop, since earlier models will have the small error in the bass response of the pick-up input, referred to in the review.

Three receivers in the budget class offered pre-selected station positions, and for this they must be highly commended. The cheapest is the **Goodmans Module 90**. Although it is very good value for money, its tuner response is a little shrill (NB. review for other reservations) and it had slider controls, which we rather disliked. This receiver is mentioned, though, since there will be many people who want the pre-select facility at a very modest cost and who will also like the controls. The **Tandberg 220** was very well liked and the pre-select stations worked well. The sound quality produced was excellent. The **Armstrong** FM version, the **Model 625**, although not actually tested in the survey, is identical to the model 626 (see below) but includes 6 FM pre-selected stations instead of 3 FM and 3 AM ones in the 626. The model 625 price clearly brings it into the budget category and is good value for money, since it had such excellent general facilities, including superb filters. Note, though, some minor reservations in the 626 review, which apply equally to the 625. It is quite impossible to specifically recommend any one model above another in this category, since the facilities offered all seem to be proportional to the typical discount prices. A careful examination of the reviews and a demonstration of the models that you favour is recommended, and it may well be that ergonomics and styling will affect your choice. Finally, you may also be influenced by the available output power and in this respect the Armstrong 625, giving 45W average, the Rotel 402, the Akai 1020 and Goodmans Module 90 all with around 28W per channel give the highest powers.

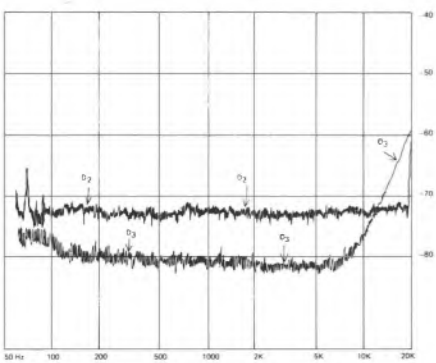
In the mid price category the **Technics 5250** offers only basic facilities but nevertheless has provision for connecting two separate tape recorders. It does not have any filters but is very well styled and performed excellently, with only minor reservations. It would seem to be very good value for money and as the cheapest receiver in the mid price category can be safely recommended. If you want good AM reception the **Armstrong 626** would seem to be a good bet with its relatively high output power capability. The AM section worked extremely well on MW and LW, but the AM bandwidth was too narrow. It can be safely recommended, but see review for details of its comprehensive facilities. The **Goodmans Module 150** not only has preset stations, but also gives a very high maximum power output, which certainly recommends it for many applications. You are advised to make sure that the model you intend to purchase has been recently delivered, since at the time of writing certain points noted on both test samples have resulted in the manufacturer promising to improve quality control, particularly with respect to the tuner's hiss level and response (hiss satisfactory on the second sample only), and also the amplifier's tone burst characteristic. If you get a good sample, it will be excellent value for money. Goodmans have promised to use 5% components in future for FM de-emphasis, and have now found the design fault to be in the muting circuit, which had been producing transient distortion. The circuit is now being modified.

The **Tandberg 1040P**, which was very much liked by all of us, incorporates preset stations and a pretty high output power potential. Its excellent styling and very full facilities certainly recommend it strongly. The **Pioneer SX 737** again was well liked and offered excellent facilities. In particular I must commend very strongly indeed its facility for switching the tuner through to the tape recorder, whilst at the same time allowing records to be played through the main system. It is most odd that this provision is not available in so many other models. Fortunately its ergonomics and sound quality are also excellent. The **Marantz 2230** was another model that we all liked, but it is essential to check that the model has not been through the importers' service department prior to the 1st March 1976, because unfortunately Pyser have been using an incorrect procedure for aligning discriminators and decoders.

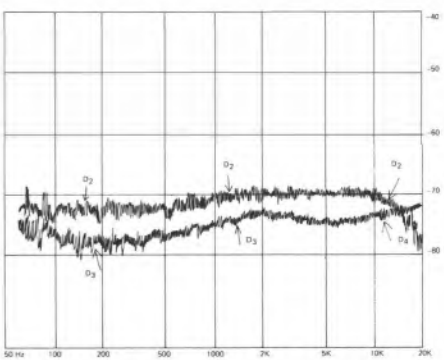
They have acknowledged this and agreed to put right any tuner that has been previously misaligned by them. There is only a very slight chance indeed, though, that this has happened on a brand new tuner, since only a relatively small sample of them are normally bench tested. (Such small sample checking is quite normal with every importer). If you already own a Marantz tuner which has been serviced by them fairly recently, you are recommended to contact them by phone and I am sure you will find them helpful. The Marantz 2230 incidentally has a particularly fine tuner section, and now that its price has been slightly reduced, it offers very good value for money. The price reduction has been achieved by the importers making arrangements to purchase direct from Japan, rather than via 'middle men' in the United States. Finally in this section I must recommend the **Luxman 800** for its generally excellent sound quality and very full facilities, particularly with the provision of separate stepped tone controls for each channel. Note, though, the absence of a normal balance control (see review).

In the most expensive section it is clear that you

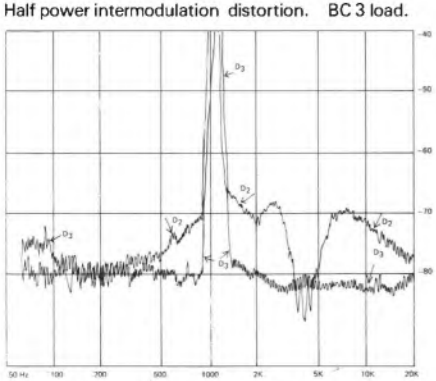
'Brand X'
Power amplifier.
Half power intermodulation distortion.
Resistive load 8 ohms.



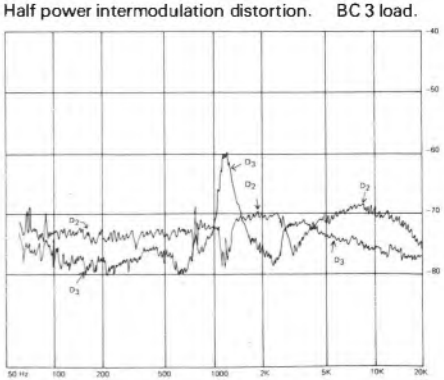
Sansui 9090
Power amplifier
Half power intermodulation distortion.
Resistive load 8 ohms.



Half power intermodulation distortion. BC 3 load.



Half power intermodulation distortion. BC 3 load.



are not necesarily going to get better quality than from receivers in the middle price category. You will be paying mainly for a higher output potential and general ergonomics, styling and special facilities. My own clear favourite in this class is the **Sansui 9090**, which offered excellent facilities but surprisingly lacked one or two that were present in competing models. However, extensive listening and laboratory tests showed the 9090 amplifier section to be virtually beyond reproach, clearly sounding better than many famous high power amplifier designs, which we have also used for comparisons throughout the tests. For the interest of readers I am including special pen chart recordings of the swept intermodultation distortion performance from low to very high frequencies and it will be seen that, despite the very arduous test, the results were astounding on both $2f_1-f_2$ and f_1-f_2 plots. The first chart shows plots on a famous hi-fi amplifier taken into an 8 ohm purely resistive load, whilst the second chart shows the same amplifier's performance, at a marginally lower level, taken into a very complex loudspeaker crossover load with associated resistors and inductors added to stimulate the appropriate loudspeaker units that would be connected. The third pen chart shows the performance of the Sansui 9090 into a pure 8 ohm load, whilst the fourth shows its performance into the same loudspeaker crossover, etc., representing closely a complete loudspeaker system (actually a Spendor BC3). The results speak for themselves, and I am sorry that under no circumstances am I prepared to disclose the name of the 'brand X' amplifier. The pen charts, incidentally, were taken at exactly half power (measured at 1kHz into the relevant load). I was surprised to find the Sansui receiver so much cheaper than some of its competition, especially when considering its incredible maximum tone burst power output—of the order of 170W per channel and 140W continuous rating.

Another receiver in this top class is the **Yamaha CR 800**, which performed well and was well liked by all of us. It is a pity that we could not justify its inclusion into the middle price bracket, for at a slightly lower price it would then have been stiff competition for the top end of this middle bracket. Nevertheless the Yamaha CR 800 is recommended. The **Trio 7400** was also well liked. Despite its relatively high output power capability and excellent ergonomics it is a little overpriced, but will be found frequently discounted. One particular reservation was the tuner's backlash, which made accurate tuning a little difficult—recommended, though, for its many good features. The **Marantz 2245** offered an excellent tuner performance with good general facilities, and although pretty expensive was rated reasonable value. Its discounted price is marginally below that of the Sansui 9090 and it can be recommended. The **Tandberg 2075** had some most comprehensive switching, dubbing and tone control circuitry and will attract many who like to play around with tape recording as well as having a really good quality general set-up. Its styling is good if its price rather high, but is still reasonable considering the excellent facilities. Finally I should mention the costly **Yamaha CR 1000**. This model offers an amazing variety of controls and gave pretty good quality, although judging by the very highest standards it was not quite as good as some of us expected. This frankly surprised us all and is mentioned here, since other samples could well sound better. Its styling, too, must be said to be magnificent, but its choice will require a general liking for the type of controls incorporated.

I have tried in this book to look pretty deeply into the relative qualities and performance parameters of all the models tested, but I trust the reader will understand that other samples could be different from the ones tested. I may well have missed some minor points, and it may be a surprise if I say that even a whole week of work on an individual receiver would not necessarily reveal all its failings and good points. New test methods are constantly emerging, and the most important problem in the past has been the correlation between laboratory measurements and what we actually hear. Unfortunately, space does not permit a lengthier explanation of the two tone swept intermodulation test, which my colleagues and I have been using on many of the amplifier sections. One further test method, which has only recently emerged, is a spectrum analysis of transient intermodulation distortion products induced into an amplifier by passing through it an active of white noise from 10kHz to 20kHz. A linear examination, using constant swept band width from low frequencies up to 10kHz, and comparing this between input and output, would seem to be very useful. Possibly reviewers in the future may pay less heed to the more mundane measuring methods, but only time will tell.

Any concept of an 'ideal' receiver is naturally conditional upon cost. In this section, though, I make suggestions of facilities and performance that should be expected from a receiver costing around £150 with discount plus VAT. All points relate specifically to UK use only and I exclude facilities that may be popular in other countries but generally unwanted here.

The following parameters are suggested briefly as a guide line:—

Aerial input socket should be a 75 ohm coaxial type and, if a *ferrite rod* is fitted for AM, it should be possible to swing this easily through 180°. Additional terminals for FM and AM would not normally be required. *Mono IHF RF sensitivity* for 30dB better than 1.5uV, *stereo* 50dB UnW better than 25uV. *Acjacent channel selectivity* better than 10dB, and *alternate* better than 55dB. *Local oscillator radiation* less than 100uV. *Image response and IF breakthrough* better than —80dB. *AM rejection* better than 60dB. *Limiting threshold* below 1uV. *Muting* between 2uV and 5uV, if not variable. *Auto stereo switch* at approximately 10uV, but *manual switching* independently is desirable. *Capture ratio* better than 1.5dB, *RF IM ratio* better than 75dB.

Tuner frequency response ±1dB from 40Hz to 14.5kHz ref. 1kHz on both channels. *MPX filtering* not to give MPX tones out at a higher level than —50dB (ref. 100% mod). *Distortion* at 100% mod. below 0.25% at 1kHz in mono and all stereo measurements including difference channel. *Crosstalk* better than 36dB at 1kHz and 30dB at 10kHz with no distortion of any kind audible when full modulation of a programme is applied to either channel only, the crosstalk signal just sounding like a very muffled version of the main channel. *CCIR weighted noise* in stereo at 100uV better than —54dB and at 1mV better than —65dB ref. full mod and unity filter gain at 1kHz. *Hum components* on audio output below —70dB.

Tuner should give optimum results when *centre tuning meter*, provided, indicates correctly. I do not consider an RF signal strength meter essential. *Tuning indication* accurate to within 100kHz and *tuning mechanism* smooth with fairly slow rate of tuning, but with fly wheel action (Technics and Yamaha ideal here). *At least 5 preset stations* included and if possible an extra one for medium wave. *Output level* from tuner section should appear on tape recorder feed at around 500mV on phono sockets, or at 20mV into external 10k ohm load to optimise hiss and hum performance. *Phono socket output impedance* here not higher than 5k ohms.

RIAA pick-up pre-amplifier input to have input impedance of 47k ohms ±10% and not have a capacitance of more than 100pF, with sensitivity to give approximately the same level from records as tuner gives from record output sockets. *Input clipping* not to occur below 100mV at 1kHz. *RIAA compensation* within ±1dB from 30Hz to 15kHz ref. 1kHz. *CCIR weighted noise* better than 70dB on record output terminals reference the level obtained from input signal of 8mV at 1KHz. *Hum components* not to be inferior to —70dB. *Frequency response* to fall as rapidly as possible below 30Hz on pick-up input. *Auxiliary and tape inputs* ought to have input impedance of around 50k ohms and be capable of accepting input levels up to at least 5V without clipping. Ideally both a *5 pole DIN socket* and *phono sockets* should be provided for recorder interconnections, with *input selector switch* complemented by a *toggle switch* allowing tuner to be fed direct to recorder output sockets independently from position of main selector switch. *No crosstalk* between switching functions should be present. *Tone controls* should have 11 evenly stepped positions and vary by 2dB per step of boost and cut at 50Hz/10kHz respectively. *A loudness control* if fitted should boost bass appreciable more than treble at low volumes, but have no effect in the top 30dB of volume control action. *A rumble filter* is desirable which cuts 12dB per octave below about 60Hz but ideally also has a second position cutting 6dB per octave below 80Hz. The latter alone is not adequate. *Treble filter* should cut by at least 12dB per octave from 6kHz but preferably have two positions, 5kHz and 8kHz. *Mono/stereo switch* operating on all inputs is essential. *Balance control* must have a centre indent and, if tone controls are normally rotary ones, they should have indents too, or alternatively a cancel button. *Volume control* very

smooth and slightly 'silky and oily', also slightly larger than the other controls. *Maximum output capability* of about 50W per channel to be available into 2 pairs of loudspeakers with connections via spring loaded locks. *Distortion figures* of all types to be as low as possible here and attention to a subjective performance is vital, since the amplifier must sound excellent, into loudspeakers having impedances as low as 4 ohms and as high as 25 ohms at various frequencies.

Amplifier should be capable of delivering its maximum output under all conditions into impedances from 3 ohms to 8 ohms at all audio frequencies and give at least 20V into high impedances. *Output amplifier* to have weighted signal to noise ratio of at least 85dB, not deteriorating by more than 6dB when volume control is in any other position than minimum, this measurement being taken when auxiliary input is selected. *Damping factor* better than 30 and idle DC below 25mV. *Output circuitry* to be relay protected against short circuits and no switch on/off transients audible on loudspeakers. *Amplifier response* basically flat from 20Hz to 20kHz within 2dB with full power available across this bandwidth.

The *complete receiver* should be really well presented and its ergonomics carefully considered, with *case* well ventilated and the temperature not rising in service to more than 10 degrees Farenheit (5 degrees Centigrade) above room temperature. *A 3 core heavy duty mains lead* should be provided of at least 2 metres and a *separate earth terminal* situated near the pick-up input sockets. Any *AC outlet sockets* ought to be shuttered in accordance with latest recommendations. Ideally a switch marked 8 ohms/600 ohms should be provided for *headphone connection* and two stereo jack sockets incorporated for these. The available level of headphones should be limited by appropriate resistors, so that no damage to headphones or human ears will result in normal usage.

I have attempted to detail above the facilities which I consider essential in a really good receiver and, provided all these are incorporated with the performance parameters that I have recommended, then in order of priority the following additional facilities might well be entertained: —

1) Interconnection between two tape recorders with associated dubbing switching.

2) Concentric independent control of bass and treble with possibly the inclusion of a mid frequency control that should not have too great a range of adjustment.

3) Stereo panoramic narrowing/widening control to correct sources that are inappropriately presented in width.

4) Switched turnover frequencies for bass and treble.

5) Microphone input of at least 250uV sensitivity having an input impedance of around 2k ohms. This should preferably be available in stereo on two jack sockets, having a switch to change one socket to both channels for mono. Preferably this should mix in with the output of the selector switch and thus be present on the tape recorder feed.

6) A second pick-up input is useful if two separate turntables are in use, one of them perhaps being an autochanger for party use, etc.

7) Switch to enable pseudo-quad to be obtained into two pairs of loudspeakers.

8) Insert point after input selector switch for incorporating external quadraphonic matrix decoder. This position allows decoding of disc, tuner or tape replay inputs.

9) Presets might be added to attenuate input levels for auxiliary and tape, so that they can then be compatible in level with other inputs.

One important consideration in the design of the output stage of the amplifier section is choice of output transistors. Too many manufacturers try to get away with using inexpensive ones which give a relatively poor power response, particularly into low impedances. In my opinion, several pounds' worth of components should be used in this stage alone, which after all actually delivers the power to the loudspeakers which give you a sound frequently more dependent on these transistors than anything else in the amplifier circuit. Many designers have concentrated on obtaining very low distortion figures, whilst ignoring factors directly affecting subjective performance. They should question whether they are in fact using too much feedback in an attempt to improve an amplifier which is basically poor without feedback. It is better to design a really good amplifier with low forward distortion before feedback is added. Finally, more care must be taken in the design of the power supply to give it as low an output impedance as possible. This should also materially improve transient performance.

KEY

Please use appropriate definition

A Excellent/No problems encountered
B Very good/Very slight reservations
C Good/Slight reservations/Average
D Fair/Definite reservations/Below average
E Poor/More serious reservations/Well below average
F Bad/Very serious reservations/Very inadequate

	Aiwa AX 7500	Akai 1020	Akai 1030	Armstrong 626	Audiotronic 2626	B+O 2000	B+O 4000	Goodmans 90	Goodmans 120	Goodmans 150	Atron 220	Harman Kardon 330	Harman Kardon 430	Hitachi SR502	JVC VR 5525	L+G 3400G	L+G 3600	Leak 1800	Leak 2000	Luxman 800	Marantz 2220	Marantz 2230	Marantz 2245	NAD 140	Nikko 4030	Nikko 5050
30dB 1HF RF sens.	B	D	D	C	C	C	B	E	C	B	C	C	D	D	D	C	C	B	B	C	B	B	A	C	C	B
50dB S/N Stereo UNW RF sens.	B	E	E	E	C	B	A	E	C	B	D	D	E	D	D	E	C	B	B	D	B	C	B	E	E	C
100μv Stereo CCIR S/N	B	E	E	D	D	B	B	E	C	B	D	D	E	D	C	D	D	C	B	D	B	C	B	E	D	D
1mv Stereo CCIR S/N	A	C	C	D	C	B	A	C	A	C	A	B	B	B	A	C	A	D	C	A	C	A	A	B	D	C
RF IM	E	D	B	C	A	B	A	C	B	A	E	E	E	E	B	F	F	B	C	C	B	A	A	D	B	C
Alt/Adj selectivity	F	D	B	E	C	B	B	D	C	B	F	C	A	E	B	A	C	E	E	B	C	B	B	E	F	F
Image reject	F	F	F	E	F	C	C	B	B	A	F	F	F	F	E	C	A	F	F	A	A	C	C	A	F	E
IF reject	A	D	D	A	D	A	A	A	A	A	D	A	B	A	D	A	C	C	B	A	A	A	A	D	B	A
Capture ratio	A	A	C	C	F	C	B	A	E	C	E	B	C	B	C	C	E	A	B	B	D	B	C	C	D	D
AM reject	D	B	B	D	D	B	B	B	D	C	A	A	B	A	B	B	B	B	C	A	B	B	B	D	B	A
Limit threshold	A	C	F	B	B	B	B	F	F	A	B	A	B	D	F	B	B	A	A	B	A	A	A	F	E	B
Muting facility	B	B	A	B	B	B	F	B	F	C	B	F	A	D	B	B	C	D	A	D	D	C	D	C	B	C
Cross talk	D	B	B	B	C	B	A	C	C	B	C	B	B	C	F	C	C	A	A	B	A	A	A	A	F	F
Mono distortion	C	A	A	C*	B	B	D	C	B	B	E	B	B	B	B	A	A	B	B	B	B	A	A	C	B	B
Stereo distortion	C	A	B	C*	B	B	D	A	E*	B	E	B	A	A	F	B	B	A	C	A	A	B	B	B	F	C
OIN compatability	A	A	A	A	A	B	B	C	C	B	A	F	B	A	A	A	A	A	A	A	F	F	F	B	A	A
Phono compatability	B	B	B	B	A	D	D	D	D	D	B	A	B	A	B	B	B	D	C	B	A	A	A	A	C	C
MPX filter	A	B	B	A	D	B	E	E	E	A	E	B	B	E	D	D	C	A	A	A	A	A	A	E	A	B
Local oscillator radiation	A	A	A	A	C	A	A	A	E	C	C	A	C	A	A	A	C	A	C	A	C	A	A	E	C	A
Tuning accuracy	C	C	C	C	C	E	C	C	C	E	C	C	C	C	A	C	E	C	C	A	C	C	C	E	C	C
Tuning ergonomics	B	B	B	B	E	A	B	D	E	B	E	C	B	E	C	C	D	C	C	E	B	B	B	C	D	C
Number of pre-sets	0	0	0	6	0	5	6	4	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Frequency response	F	E	F	B	D	D	A	F*	C	B	D	B	B	D	F	C	C	A	B	C	A	A	A	B	B	B
Tuning indicator	A	A	A	A	A	C	C	C	E	E	A	E	E	E	A	E	A	E	A	A	A	A	A	A	A	A
FM Aerial sockets	C	C	C	A	C	A	A	E	A	A	C	E	E	E	C	C	C	A	A	C	C	C	C	C	C	C
AM section	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Rumble filter	E	D	D	C	/	/	C	B	A	A	F	/	C	/	/	/	E	D	/	C	E	D	E	/	/	/
Treble filter	/	D	D	A	D	/	D	D	B	B	C	/	C	/	D	/	C	C	B	C	C	C	C	C	/	/
Tone controls	B	B	B	E	E	E	E	E	E	E	E	E	E	E	A	E	E	D	D	B	A	A	A	E	E	E
RIAA input	C	C*	A	C	B	E	E	C	D	B	C	C	B	C	C	C	C	B	A	C	B	A	A	C	D	C
Output power	34	28	47.5	45*	30	32.5	43	30	40.5	74.5	24.5	21	28	26	28	22	33	23	30	44.5	29.5	40.5	62.5	36.5	21	22
Distortion	D	B	B	B	C	B	A	C	B	C*	D	C	B	B	B	C	B	B	C	B	B	B	B	B	E	D
Amplifier noise	A	B	B	C	A	A	A	D*	A	B	C	C	B	D	B	A	A	B	B	B	A	C	B	B	A	B
Input clipping	C	A	A	C	A	C	C	D	C	C	A	D	A	C	C	A	A	A	A	A	A	A	A	A	A	A
Damping factor	B	A	B	A	A	A	C	B	A	B	C	A	B	B	A	C	C	A	A	C	A	C	A	B	D	E
Idle DC	A	A	D	A	C	A	A	B	B	A	B	A	A	A	A	A	D	C	A	A	A	A	A	B	A	C
On/Off transient	B	D	D	B	B	C	C	D	C	A	B	D	B	A	B	B	C	C	B	A	A	C	A	C	B	C
Headphones	B	B	B	B	B	B	B	A	D	D	D	A	D	B	B	D	D	B	D	D	D	D	D	B	D	D
½power bandwidth	B	C	A	C	B	C	C	D	B	B	B	C	B	F	C	A	A	C	B	A	A	C	A	A	E*	A
No. of loudspeaker pairs	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	1	2	2	2	3	2	2	2	2	2	2
Control tracking	A	D	C	D	C	C	B	B	D	B	D	B	B	C	A	A	A	B	B	C	B	C	C	A	A	A
EMC	E	A	A	E	A	A	C	C	E	A	D	B	A	D	E	B	C	A	B	A	B	A	A	E	A	B
Balance control	A	C	C	C	A	C	C	E	D	C	D	D	C	C	A	C	C	A	A	D	A	C	C	D	D	C
AC supply	B	A	A	A	A	D	D	A	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	B	B
MIC input	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO
Subjective sound quality	D	B	C	C	D	D	B	C	C	C*	D	B	B	C	D	C	B	C	C	A	B	A	A	B	F*	E
Value for money	D	A	B	B*	C	D	D	B	C	A	C	C	C	C	C	D	D	C	C	B	B	B	C	D	E	F

Pioneer 434	Pioneer 535	Pioneer 737	Pioneer 1010	Revox A720	Rotel 202	Rotel 402	Rotel 602	Sansui 331	Sansui 551	Sansui 771	Sansui 881	Sansui 8080	Sansui 9090	Sanyo 6000	Sanyo 8000	Sonab 3000	Sonab 4000-3	Sony 7015	Sony 7035	Tandberg TR220	Tandberg TR1040	Tandberg TR2075	Technics SA5150	Technics SA5250	Technics SA5350	Trio 2400	Trio 3400	Trio 5400	Trio 7400	Yamaha CR400	Yamaha CR600	Yamaha CR800	Yamaha CR1000
B	A	B	A	A	C	C	B	C	B	A	A	A	B	B	A	E	B	D	F	A	B	A	A	B	A	D	C	E	B	A	A	A	A
A	A	B	B	A	E	D	B	B	C	B	B	B	B	A	A	D	B	E	C	A	B	A	B	B	B	D	C	E	B	B	A	A	A
A	B	B	B	B	E	D	C	C	D	B	B	B	A	B	B	D	B	D	D	B	B	B	B	B	C	D	D	D	B	B	A	A	B
B	B	B	B	D	A	A	A	A	A	A	A	A	A	A	A	D	B	D	A	B	B	A	A	A	A	A	A	A	A	B	A	A	A
C	C	B	B	B	C	E	B	C	C	C	C	B	C	B	A	E	C	B	C	D	E	A	D	C	C	D	A	E	D	A	B	B	B
E	C	C	B	A	F	B	D	C	E	B	A	A	A	B	B	B	B	C	D	A	A	A	C	A	C	D	E	B	C	B	A	B	A
C	E	A	A	A	F	F	A	F	F	B	A	A	A	A	A	F	E	F	F	E	F	D	D	D	D	F	F	F	A	F	A	A	A
A	A	A	A	A	C	D	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	C	A	B	C	A	D	A	A	A
B	B	C	C	C	F	E	E	E	E	A	C	B	C	C	C	C	D	D	C	C	C	C	B	B	A	E	C	B	C	C	C	B	B
C	B	D	D	B	A	A	C	C	C	B	B	B	B	A	A	B	B	B	B	B	A	B	A	B	A	A	A	C	A	A	A	A	B
A	A	A	A	A	F	B	A	B	A	A	A	A	A	A	A	C	A	B	F	A	A	A	D	A	A	D	B	E	A	A	A	A	A
D	C	D	C	D	F	D	D	F	D	D	D	D	D	D	D	C	F	D	D	B	D	D	F	D	B	D	F	D	D	D	C	C	C
B	A	A	B	A	E	A	A	B	B	C	B	A	A	C	B	C	C	B	E	A	A	A	A	A	B	B	A	A	A	D	D	A	B
B	A	A	A	A	D	A	C	B	B	B	A	B	A	B	C	C	D	A	B	B	A	B	A	B	A	A	B	A	B	C	C	D	A
B	A	A	D	B	E	A	B	A	C	A	C	B	A	D*	C	B	E	B	B	B	A	A	A	A	A	C	B	A	A	F*	C	C	B
A	A	A	A	F	A	A	A	A	A	A	A	A	A	A	A	C	C	A	A	B	B	B	A	A	A	B	B	B	B	F	F	F	F
C	A	A	A	B	D	D	D	B	A	B	C	C	C	D	D	D	D	C	C	D	A	A	A	A	A	A	A	A	A	B	B	B	B
E	E	E	A	B	E	C	A	E	B	A	A	A	A	A	A	E	E	B	D	C	A	A	E	C	D	E	E	E	A	C	D	A	A
A	A	A	A	A	A	A	A	A	C	A	A	A	A	A	C	A	C	E	C	A	A	A	A	A	A	A	A	A	E	A	C	A	A
C	C	C	C	A	E	C	C	C	C	C	C	C	C	C	C	C	E	C	E	C	C	A	C	C	C	A	C	A	C	C	A	A	A
C	C	C	D	B	D	B	C	B	D	B	C	B	C	C	B	A	B	C	B	B	C	B	B	B	B	B	B	C	D	B	B	B	B
0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	4	3	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0
E	B	B	C	A	B	D	A	B	D	D	D	C	C	B	B	A	C	B	C	B	B	A	B	C	C	D	D	C	A	C	C	A	B
A	A	A	A	A	E	A	A	E	E	E	A	A	A	A	A	E	E	E	A	A	A	A	E	E	E	E	E	E	A	A	A	A	A
C	C	C	C	A	A	A	A	C	C	C	C	C	C	C	C	A	A	C	C	A	A	A	C	C	C	C	C	C	C	C	C	C	C
YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO
/	/	D	C	A	/	/	/	/	/	E	E	E	E	B	B	/	/	/	/	B	B	B	/	/	/	/	D	F	/	A	A	A	A
/	/	C	D	B	D	D	C	/	D	D	D	D	D	/	C	C	B	/	C	B	A	A	/	/	C	C	C	D	D	/	C	C	C
E	E	B	B	A	E	B	B	E	E	B	A	A	A	B	B	F	E	F	E	E	D	C	E	E	E	D	F	D	C	E	B	B	B
B	A	A	B	A	D	C	C	B	A	B	C*	C*	C*	C	C	D	C	C	C	C	A	A	C	C	C	C	C	B	B	B	C	B	A
21	21	46	112	/	18 5	28	37	14	21 5	47	78	95	144	35	42.5	34	47½	20 5	26	15	48.5	89	19	31	34.5	15	28	40	74	19.5	45	60	86
B	B	B	A	A	C	C	B	B	C	C	C	B	A	B	C	C	C	B	C	B	A	A	C	B	C	D	C	B	B	B	B	B	B
A	B	A	A	/	B	B	B	C	B	C	B	A	A	A	B	C	B	B	D	A	A	B	B*	B	B	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	C	C	D	D	A	A	A	A	A	A	A	A	A	A	A
B	D	A	A	/	A	C	B	E	B	A	A	A	A	A	A	C	B	D	B	C	A	A	C	B	B	D	D	B	B	A	A	A	A
A	A	A	A	/	A	B	A	A	A	A	B	A	C	A	A	A	B	B	A	A	A	A	B	A	B	A	C	A	A	A	A	A	A
C	B	A	A	/	C	B	B	B	B	A	A	A	B	B	C	B	C	B	D	A	A	C	C	C	B	C	A	A	B	A	A	A	A
B	B	B	D	A	D	D	D	D	D	D	B	B	D	D	D	D	B	D	D	D	D	A	D	B	D	D	D	B	B	B	B	B	B
C	D	A	A	A	E	A	E	D	C	B	A	C	A	E	D	C	A	A	C	B	A	A	F	A	B	E	D	A	B	A	A	A	A
2	2	2	3	0	2	2	2	2	2	3	3	3	3	2	2	2	2	2	2	2	2	3	2	2	2	2	2	3	3	2	2	2	2
B	C	A	D	D	C	A	A	D	B	C	A	B	D	A	B	B	A	B	A	B	C	C	D	B	B	D	B	B	D	B	B	C	D
D	E	D	E	B	C	C	C	E	D	C	A	B	B	B	E	E	B	B	E	B	B	C	A	D	C	D	A	D	C	A	A	A	A
A	A	A	A	D	C	A	A	C	D	A	A	A	B	C	C	C	C	D	D	C	D	C	C	C	D	B	B	B	B	D	A	A	B
B	A	A	A	B	A	A	A	B	B	B	B	B	B	A	A	D	C	A	A	C	A	A	C	C	C	A	A	A	A	B	B	B	B
YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES	NO	NO	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
B	B	A	B	B	E	B	B	B	B	B	B	B	A	C	C	C	C	B	C	B	A	A	C	A	B	D	C	B	B	C	C	B	A
A	C	B	D	E	D	A	C	A	B	C	C	C	B	C	D	C	C	B	D	A	B	D	C	B	C	C	C	D	C	C	C	B	D

If you do not find a definition of any particular terminology, please look at the relevant headings in the introduction to this publication.

AFC: automatic frequency control. This holds the tuner steady on a required station.
AM: Amplitude modulation radio frequency signals, such as are found on long, medium and short wave broadcasts for public consumption. Also used for sound on band 1/111 TV. In this system the amplitude of the RF carrier is varied in proportion to the audio signal applied.
AUXILIARY INPUT: an input for connecting various types of equipment such as TV sound tuners, external mixers, and play back tape recorders.
BACKLASH: see *tuning ergonomics* section.
CAPACITANCE (CAPACITOR): a componnt or its equivalent in a circuit which has the effect of reducing the impedance as the frequency is raised. A high capacitance offers a lower impedance path than a low one.
CHIP: refers to an integrated circuit component.
CLIPPING: this refers to the level above which bad distortion becomes evident, due to a circuit being overloaded by being overdriven.
CROSS TALK: 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 60Hz.
DECIBEL: 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.
DISCRETE: refers to a circuit with separate transistors as opposed to an integrated one.
DISTORTION: any introduction of spurious or unnatural tones generated in electronic circuits which are not present in the original signal.
DIN COMPATABILITY: 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.
EARTH LOOP: a situation produced, usually in interconnecting equipment, but 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: this refers to the necessary change in frequency response of an amplifier required so that an overall flat frequency response can be obtained.
FET: Field Effect Transistor. Acts more like a triode valve used to, rather than a normal type of transistor.
FM: frequency modulation. A system of RF intermodulation 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.
FADERS: most volume controls in the past have been of a rotary type, but in recent years these have frequently been replaced by levels acting up or down or even sideways to adjust level or response.
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 suprisingly 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 and SW).
FREQUENCY RESPONSE: the accuracy with which an amplifier or recorder reproduces high notes and low notes at the same intensity as middle notes. In particular it refers to a reproduction of such intensities identical to the intensities that would be measured on the input. It is usually expressed as being a range over which the medium has a fairly constant response with respect to the level at the middle frequencies, ie. one lying between 333Hz and 1kHz.
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 or interference 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.
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: see *tone controls* and *balance controls* section.
INDUCTANCE: the reciprocal of capacitance. The impedance increases with frequency and can be tuned with a capacitance to resonate at a particular frequency. It will then present either a very high impedance (parallel) or an extremely low one (series).
MICROSECONDS (uS): 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 attentuation at supersonic frequencies to decrease interference encountered with the outputs from stereo FM tuners.
MUTE: a device which cuts programmes either manually or automatically. FM muting cuts the output from a tuner unless an acceptable signal strength transmission is tuned in.
OHMS (Ω): 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.
PHONO (LINE) SOCKETS: these sockets are coaxial and accept a special plug (termed 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.
RIAA: see *pick-up pre-amplifier* section.

Test Equipment used by Angus McKenzie Facilities Ltd for this Survey

2 B & K 2010 Heterodyne Analysers
B & K 2112 Spectrometer
B & K 2307 Logarithmic Chart Recorder
B & K 2426 AC Auto range voltmeter
B & K Sound Pressure Level Meter type 2203
B & K Intermodulation Analyser type 1902
B & K Harmonic Analyser type 1901
B & K Measuring Bridge type 1607
B & K RF voltmeter type 2006 with FET Probe
Hewlett Packard 3310B Function Generator
Hewlett Packard 3575AGain/Phase Meter
Hewlett Packard 182C Oscilloscope
Hewlett Packard 5381A Frequency Counter
Hewlett Packard 3580 Audio Spectrum Analyser
Hewlett Packard 970A Digital Meter
Hewlett Packard 8012B Pulse Generator
Hewlett Packard Signal Generator type 8640B (RF)
Hewlett Packard RF Spectrum Analyser type 8558B
Hewlett Packard Active fet. probe type 1120A
Hewlett Packard millivolt meter type 400FL
Hewlett Packard Distortion Analyser type 334A
Hewlett Packard logarithmic converter type 7562A
Bryans Instruments XY Plotter
Telequipment DM64 Storage Oscilloscope
Telequipment Oscilloscope DM83
Telefunken FM Modulator 3130/2
Sound Technology 1400A Low Distortion Oscillator
Sound Technology 1700A Distortion Meter
Sound Technology FM Generator/stereo encoder
Sound Technology Signal conditioner type 1100A
Revox A700 Tape Recorder
A301 Dolby Noise Reduction System
Spendor BC1 and BC3 Loudspeakers
Cawkell 1471 Active Band Pass Filter Set
Amcron IMA Intermodulation Analyser
Fluke Auto Range Digital Multimeter
Technics SU9600 Pre-amplifier
Technics SE9600 Amplifier
Amber 4550 Realtime Spectrum Analyser
Levell DC Millivolt Meter
Levell AC Millivolt Meter
Levell Laboratory Pre-Amplifier type TA 605
Attentuators by: Marconi, Bradley, Hatfield, Greenpar, etc.
Marconi FM Deviation and Modulation Meter
Marconi special RF hybrid transformer
Marconi RF amplifier type TF 2175
Quad 405 current dump amplifer
B & O loudspeaker comparator unit
Sansui SR717 turntable fitted with Shure V15/111
Telemax TD4 frequency standard RF oscillator
Transmitting equipment by Trio, Yaesu, Fischer
Radiometer Generator/encoder type SMG1
Muirhead 0.1% decade resistance box
Racal Frequency counter type 9875
Amcron Laboratory amplifier DC300A and pre-amp
Rohde & Schwarz RF power meter
Wayne Kerr VHF Admittance Bridge B901
Wayne Autobalance Universal Bridge B642
Levell decade resistance box R601
AMF Laboratory Multiplex filter
AMF Laboratory CCIR filter
AMF RIAA Record equaliser
AMF 500W variac/transformer
Yamaha CT 7000 FM Tuner
Yamaha N 645 Loudspeakers

Glossary of Terms continued

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.

RUMBLE: low frequency extraneous noise introduced either into the medium source (disc or tuner) or by record turntable bearings (etc).

TONE BURST: a short pulse of a frequency applied to a circuit, usually repeated every second or so.

UNITY GAIN: this refers to a circuit in which the output level is identical to the input one, although the impedances may be different.

UNWEIGHTED NOISE: noise that is measured with a flat response over a band width sufficient to encompass all frequencies heard by the human ear.

VOLT: usually quoted as a route mean square. 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 the voltage times the 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.

1kHz: this frequency used to be referred to as 1KC or 1000c/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.

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.

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GARRARD SME AIWA
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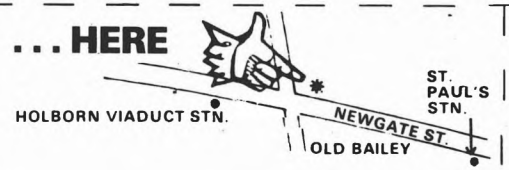
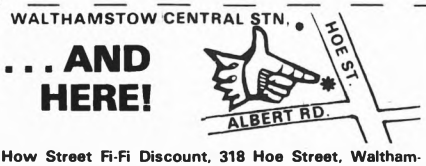


The Crazy Discount House, 119 Newgate Street, London EC1. (3 mins from St. Paul's Underground Station—Central Line).



How Street Fi-Fi Discount, 318 Hoe Street, Walthamstow, London E17 9PX. (5 mins Walthamstow Central Underground Station—Victoria Line).

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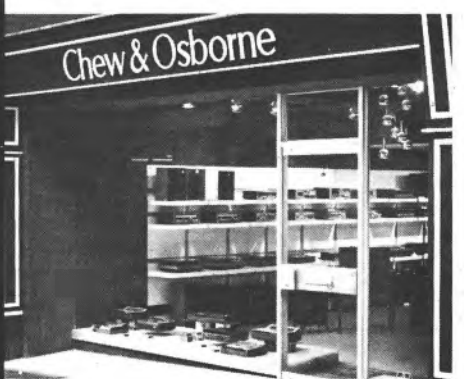

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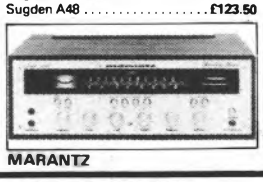

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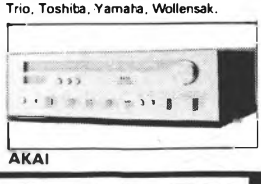

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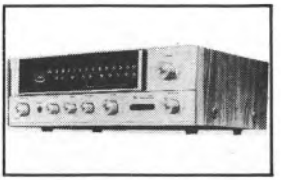

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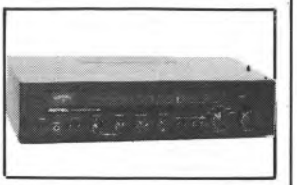

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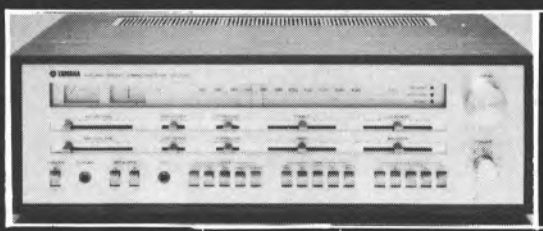

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Mrs Bean's Top Three

YAMAHA CR1000 • LUX L1500 TRIO KR9400

(Oh, and for the man who wants pre-sets, the Tandberg 2075)

The above are our favourite receivers. Each one has something to recommend it over the others under certain circumstances. For example, the Yamaha is undoubtedly the best tuner, the Trio the best amplifier, and the Lux probably the best compromise.

Of course, everyone does not need such power and facilities as these beauties offer. For those with more modest needs, but who still require the best quality, we have pleasure in presenting our own short list of value for money items. Starting cheap and rising: Yamaha CR200, Trio KR3400, Fisher 222, Trio KR5400, Yamaha CR450, Rotel (yes!!) 802, Lux L800, Trio KR7400.

(Psst—how about the new Sugden receiver when available? It should justify the patience. Phone us to discover why it's well worth waiting for.)

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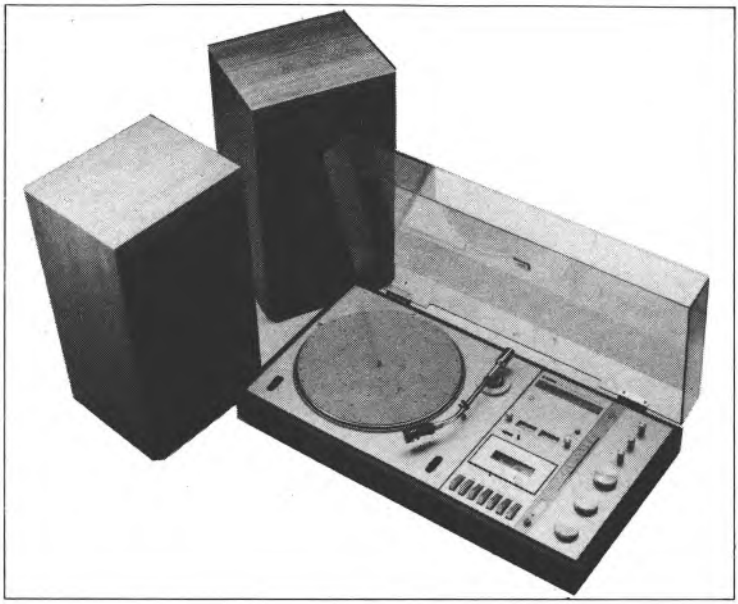

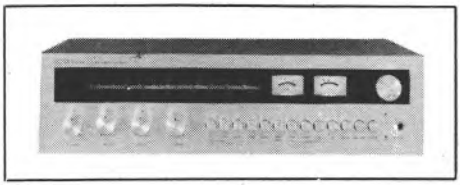

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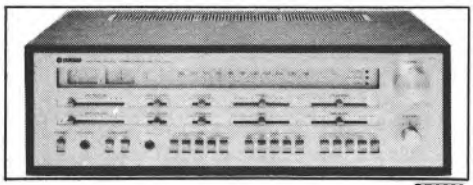

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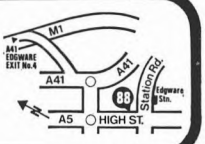

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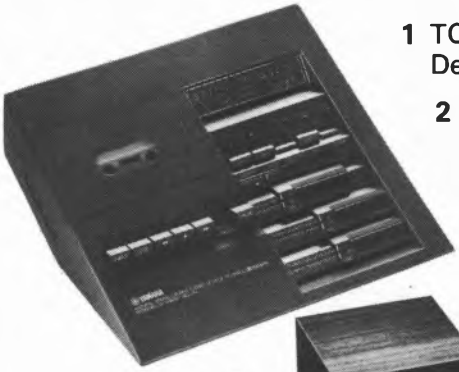

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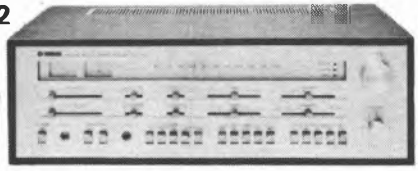

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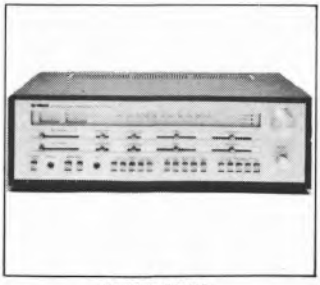
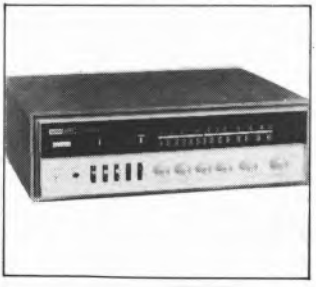


YAMAHA CR1000



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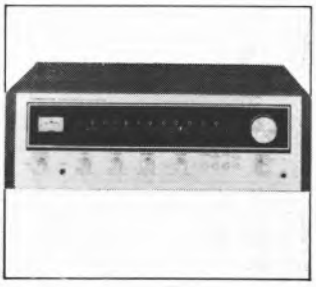

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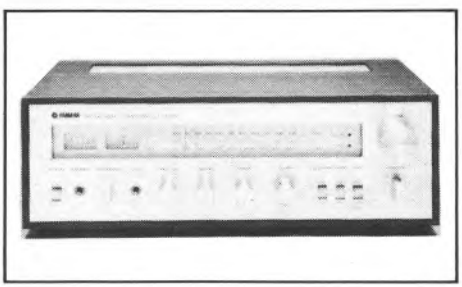
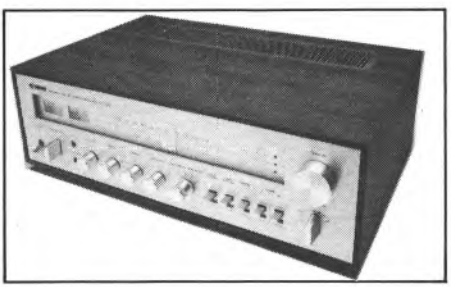

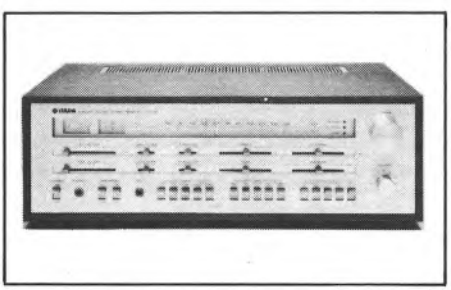

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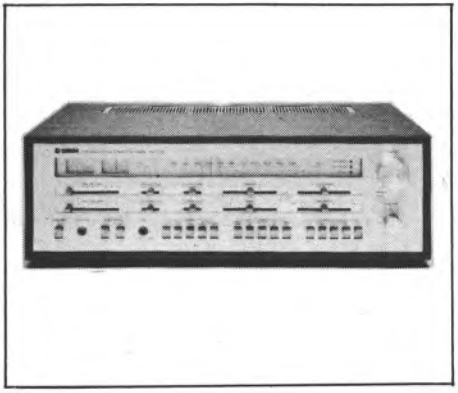

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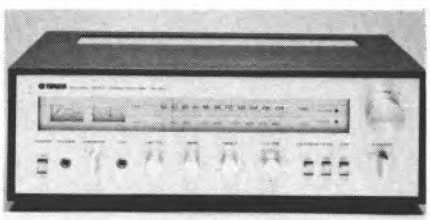
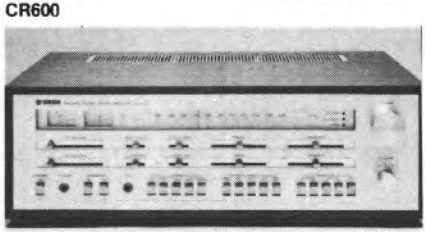


CR400

CR600

CR800



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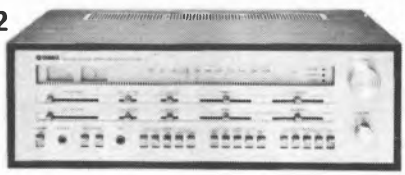

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All manufacturers and distributors of stereo tuner amplifiers with a recommended retail price in excess of £125 including VAT are requested to submit samples to Angus McKenzie Facilities Limited direct. However all paper work, including dispatch notes etc., should be made out to Aquarius Publications Limited c/o the Laboratories. All technical enquiries should be made direct to Angus McKenzie Facilities Limited (01-349 0511), but other enquiries should be made to Richard Howell (01-434 1644). It will, of course, be realised that once again time is of the essence in this project.

The publishers feel that it is in the interest of the entire trade and readership for all models to be represented in this project. Definite reference will be made to any models requested but not received, since there have already been many readers' enquiries concerning one or two cassette recorders, not surveyed in Hi-Fi Choice No. 1.

Each tuner amplifier submitted to the laboratories must include full instructions and service data (including circuits), any necessary antenna plugs and other special extras, in addition to two monochrome photographs suitable for publication.

Each model received will be given a lengthy subjective listening test prior to any laboratory test. A replacement will be requested if a severe fault condition is noticed at this stage, and no charge will be made by the Laboratories for any first abortive test. If, however, after part or all the Laboratory tests have been completed on a tuner amplifier that did not appear to have basic faults at the time tests commenced and Angus McKenzie Facilities Limited feel that the tested sample is not typical in performance, the supplier will be invited to re-submit an extra sample for testing. Because of the high cost of the general test programme, the supplier will be asked to bear the cost of a re-test, which will be charged at the normal rates of Angus McKenzie Facilities Ltd for such work. Naturally if a supplier is satisfied with the original findings, these can be allowed to stand and no mention will be made that the supplier was asked to submit a further sample. However, if a re-test does occur at the manufacturer's expense, a brief mention will be made in the text together with the reasons for which the re-test was deemed to be necessary.

TEST PROGRAMME

After testing a sample of machines, Angus McKenzie Facilities Limited will submit copies of the entire test programme to all suppliers, who will then be invited to comment within seven days. Angus McKenzie Facilities Limited will consider any comments, and although they will be prepared to make alterations to the procedures where applicable, they reserve the right to take the final decision as to employed procedures. An additional seven days will be allocated for discussions on procedures, and it is hoped that any differences can be resolved in this time.

The suppliers will be responsible for the insurance of all equipment loaned for review during the time that equipment is away from the supplier's premises. They also ask the supplier's indulgence in a request that equipment retained if possible for a period of at least four weeks after publication, so that any readers' queries resulting can be resolved.

All suppliers will be shown the reviews and data by request to Angus McKenzie Facilities Limited at the Laboratory premises. Copies of such material, however, will not be made available before publication.

Neither the publishers nor Angus McKenzie Facilities Limited can be held responsible in any way whatsoever for any errors or omissions contained in the publication. Naturally, the Laboratory will take all reasonable steps to ensure the impartiality and accuracy of conclusions made. Every attempt will be made, therefore, to make the publication fully representative of the tuner amplifier scene, since they realise that this publication will clearly have both influence and far-reaching consequences in the future designs of equipment.

It is intended also that the publication will be made available in a similar format in other countries, and the publishers reserve the right to publish relevant data overseas with, however, the full knowledge of suppliers at the time.

New models, not available anywhere at the commencement of the tests can, in exceptional circumstances, be submitted up to January 1st, 1976 for inclusion at the sole discretion of the publishers. Therefore, the publishers would appreciate knowledge of any such models, which will be held in complete confidence, as soon as possible to facilitate internal production arrangements.

It is understood that the price will, of course, be a contributory factor in determining the value for money of any particular unit, and naturally less expensive models will not be expected to perform to as high a standard as more expensive models. In this context the publishers will also bear in mind typical retail price in addition to those claimed as recommended retail prices.

The above is a reprint of the explanation and conditions circulated to manufacturers and agents when invitations were made for the submission of test samples for this survey.

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Errata

Due to an editor's oversight, certain items were omitted from, or changed in, the final copy for this book. The reader's attention is drawn to the following additions which cover the more important points.

All reviews: for amplifier test results—Damping factor L=R . . . . X/Y% please read L/R . . . . X/Y.

P.30 Telephone no. for Engineering Information Dept. of the BBC—580 4468 ext 2921.

P.168 *CR 400 review.* Bearing in mind also the slight blurring of high frequencies and transients, I must consider this receiver relatively poor value for money. The microphone input was also rather insensitive, but a high impedance microphone, if used, might give just enough level on speech for it to be useful.

P. 170 *CR 600 review.* We consider that Yamaha should again look into their decoder design, for frankly at its price the tuner's sound quality is not good enough. This receiver does not represent, in my opinion, good value for money, and I would advise you to look at, and listen to it first if you are contemplating purchase. This review is based on a second sample, the first one also having similar tuner hum and distortion problems.

P. 172 *CR 800 review.* The CR 800 will be a unit attractive to many potential purchasers, offering fine styling and good general performance. Nevertheless, I suggest that you investigate carefully the alternatives, which might offer better value for money, although the choice is obviously personal.

P. 174 *CR 1000 review.* In summary, for the enthusiast not concerned with price, the CR 1000 with its individual appearance might well be of great interest. However, we were not universally impressed with the sound of the power amplifier (treble sometimes disliked), and also the microphone input (high impedance) was too insensitive. All results refer to a second sample, since the first one had a minor failure during test, although it was similar in most other respects.

P. 170 The following short review was omitted: *Yamaha CR 200.* The RF sensitivity and limiting threshold were so bad that the receiver was aborted from lab tests. Two samples were checked and both had the same problems. Although this receiver is reasonably priced, unfortunately it has too much competition. Too many other brands similarly priced had better performance.
EMC was excellent.

P. 191 *Best Buys.* In comparison to its closest competition at the very highest priced end of the market, the Yamaha CR 1000 is bettered in some important respects, and its choice will require a very large bank balance as well as a general liking for the type of controls incorporated.

BY ANGUS McKENZIE · £1

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