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we know that good wins mean good news for us in the long term. Recommendation we consider to be our most effective form of advertising (sorry Hi-Fi Choice and other magazines). But recommendations from those persons who really appreciate the quality of music are the ones we value the most. So whether it is Hi-Fi Choice Music Centres, or what have you, we are in the music business . . . not TV's, not portable radios, not music centres, not calculators . . . Hi-Fi equipment is our speciality. Come and try us. . .

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Every year Toshiba ploughs a vast amount of money into research for new ideas and methods. Last year the amount was £35 million.

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A.D. Solid is a remarkable combination of plastic and stone and its transmission of noise and vibration is one of the lowest of all materials known to man.

Which makes it ideal for turntable bases and loudspeaker units.

A.D. Solid is an integral part of the construction of the magnificent Toshiba SR-370 turntable, and the SS-470 loudspeakers.

It is also incorporated in the SR-255 turntable pictured above, making this turntable one of the most sophisticated you can buy at the price. (Suggested retail price is £114.50.)

But A.D. Solid is just one of the features which make the SR-255 such good value. It also has a direct drive DC servo-motor, die-cast aluminium platter, and thick rubber-mounted, acoustic insulating feet with coil-springs.

The rubber mat is heavier than average, again as an anti-vibration measure.

You can see how thick it is from the photograph.

The tone-arm is a static-balance, S-shaped arm capable of tracking high performance cartridges.

The cartridge shown is the Toshiba C55M dual-magnet, suggested retail price £7.95 inc. VAT.

The arm has spring-adjustable bias compensation and direct-reading, tracking-weight adjustment. There is also an integral cue-ing device, oil damped.

The SR-255 is the least expensive direct-drive turntable in the Toshiba range, giving an indication of the range quality.

Toshiba also offers a choice of belt-driven turntables, so whatever you're looking for, at whatever price, your local Toshiba dealer probably has the answer.

He'll certainly be pleased to arrange a demonstration for you.

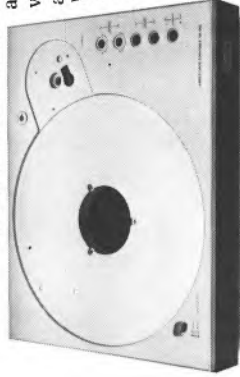
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This year, when you read 'higher power,' it usually means inferior sound.

Some hi-fi manufacturers seem to be in the fashion business. Every year another step closer to reality. New models. New designs. And always more and more power. Supposedly at no extra cost.

But to give you all this and more for the same is impossible. Even to stand still is expensive. Something has to be sacrificed.

All too often, it's quality. Compare the new with the old. Perhaps the components are cheaper. The finish is not all that it was.

But, almost certainly, the power output will have increased. From necessity. To get anything approaching a reasonable sound, the amplifier has to be driven with more and more in reserve. Because there is more distortion, introduced by the savings made elsewhere.

Put quite simply, power isn't everything. And sometimes it's nothing. Remember the old valve amplifier? Often with an output of no more than fifteen watts. It did the job because it could be driven to the full. But cheap transistors can't. So you end up paying for power you can't use.

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Like all Settons, the RS440 receiver is equipped with sophisticated protection circuits. Using power relays, these offer virtually unconditional protection to the electronics. Visual confirmation is provided by a security panel fitted to the front of the unit. Other features include three tone controls, for bass, middle and treble. And the direct coupled OCL power amplifier gives a conservative output of 55 watts RMS.

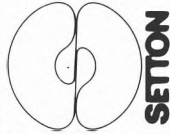
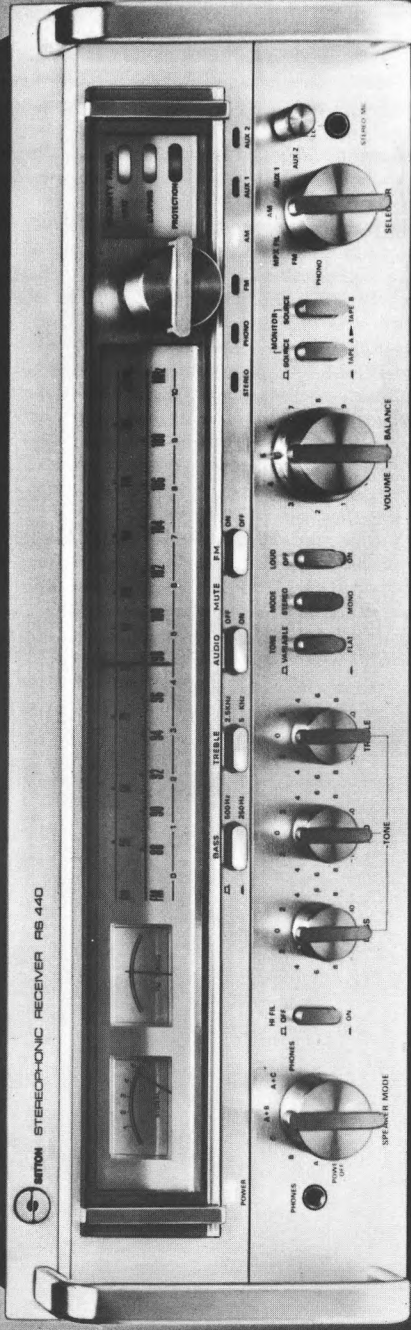
The interior is remarkable for a lack of connecting wires. But, where they exist, the connections are 'wrapped' rather than soldered. Avoiding the possibility of dry joints and breakage.

As you soon realise, Setton is built to a standard. Not to a price. And every amplifier and receiver is fully guaranteed for five years.

There is really no reason why you should have to change your Setton any more often than your house. But everything is subordinate to one purpose,

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| AIWA 5050 | POA | POA |
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| TOSHIBA SM 3600 | POA |
| WALTHAM STM 30 | POA |
| YAMAHA MS2B | POA |

Prices correct at time of going to press.

Test on our comparitors all the latest Hi-Fi from the following manufacturers:

Aiwa, Akai, Amstrad, Celestion, Castle, Ferguson, Garrard, Goodmans, Hitachi, JVC, Kef, Leak, Nakamichi, National, Philips, Pioneer, Rotel, Sanyo, Sony, Sharp, Sansui, Tannoy, Technics, Teac, Tandberg, Toshiba, Trio, Wharfedale & Yamaha.

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On the whole, music centres have been neglected by the specialist hi-fi press. The hi-fi enthusiast has ruled the roost with his expensive separates systems and technical terms. But, for the thousands of people who do not want to wade their way through mountains of hi-fi jargon in order to buy a simple sound system, and spend nights agonising over how to put all the bits and pieces together, let alone end up with the unruly conglomeration of wires that a separates system inevitably incurs — a music centre is the solution.

Each edition of 'Hi-Fi Choice' aims to be the most comprehensive guide to a particular hi-fi product. Previous issues have dealt with the separates market — cassette decks, loudspeakers, amplifiers, receivers and turntables. This edition aims to help you to purchase the system that suits your personal requirements. If you wish to know which units we can confidently recommend, then all you have to do is to turn to the 'best buy' section at the back of the book. To simplify matters further, we have also indicated which are the 'best buy' or 'recommended' models at the top of the relevant review pages. If you wish to see how each model has performed in comparison with its competition, then just turn to the 'overall comparison chart' and the 'summary and index of products reviewed' at the end of the book. But, we would like to stress the importance of reading all the reviews for yourself — there may be some systems which have narrowly missed a recommendation but which may appeal to you visually.

Although the reviews are written in a rather technical manner, a little time spent in reading the non-technical introduction that follows, will not only explain the meaning and significance of the language used, but also the importance of each parameter discussed. So, for those of you who are new to hi-fi technology, just turn the page and

read on. In addition, Mark Brutton, Editor of 'Design' magazine, has contributed an article on 'Aspects of music centre design' — a very important factor to take into consideration before making your final purchasing decision. For the more technically knowledgeable reader, the technical introduction explains the test methods and how they were carried out.

Please note that the prices quoted in this survey are typical retail prices including VAT, based on a dealer survey, carried out shortly before going to press. They should be regarded as an indication and are likely to change at any time, and will obviously vary from dealer to dealer depending on his discount and servicing policy. In addition, some music centres were supplied without loudspeakers, leaving the choice to the consumer. We have discussed this in the introduction, but for the purposes of assessing all the units on a value for money basis, we have added on a third to the basic cost of the system to allow for the price of loudspeakers. These prices in particular must be regarded as flexible, as they will obviously depend on how much you are prepared to spend on loudspeakers. Finally, the author would like to thank his wife for suffering the clutteration of 40 music systems; his industrious assistants — Bill Stevens and Charles Moir; and Decca, Enigma, EMI and Pye for the loan of records.

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These two Sanyo's – voted by Hi-Fi Choice Magazine as the two best buys in Hi-Fi.

The DCA 1001 Stereo Pre-main Amplifier provides 50 watts continuous power at 8 ohms with both channels driven. Frequency response from 15 to 25,000 Hz and harmonic distortion at rated power is 0.5%.

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What is a music centre?

Quite simply, a music centre is a modern version of the old radiogram, combining an amplifier, record deck, cassette deck and radio tuner in the same unit, but with the loudspeakers contained in separate cabinets. It must be stressed that a reasonable stereo sound quality cannot be obtained if the loudspeakers are contained in the same cabinet as the other components. In fact, as we shall discuss later, exactly where you place your loudspeakers will significantly affect the quality of the stereo sound reproduced.

What are the main advantages of buying a music centre as opposed to buying hi-fi separates?

There is no simple answer to this question as it depends entirely upon your own personal requirements. A music centre has the main advantage of being aesthetically neat and easy to set up, but has the disadvantage of being inflexible for the future. If your sole objective is to listen to records, cassettes and radio with the minimum of fuss, maximum of ease and a reasonable sound quality, then a music centre is just what you need. If, on the other hand, you are a hi-fi purist or tend to become dissatisfied with equipment soon after purchase, then stick to buying hi-fi separates.

To install a music centre, you don't have to be a technical genius. Everything is supplied in one unit so that you don't have to wrack your brains and everyone else's to decide what amplifier for example, is compatible with what record deck or radio tuner. The manufacturer takes care of all this and hopefully, creates the ideal match. But, here, hi-fi opinion is divided. Some claim that one manufacturer has the best chance of producing the right record deck for the right receiver (tuner and amplifier combined) for the right loudspeakers and so on; whereas others claim that each part of the hi-fi chain needs specialist attention and that one manufacturer cannot be jack of all the trades involved. So, if you know what you are talking about in terms of matching equipment, then investigate the separates market. Hi-Fi Choice has already produced guides to buying loudspeakers, cassette decks, turntables and cartridges, amplifiers and receivers. But, if

you are still confused about it all, then obviously a music centre is the easiest solution. And, with a music centre, all the wires are neatly out of sight inside the cabinet. This in itself is a bonus, as a bad wiring layout in a separates system will almost certainly introduce hum and noise problems.

But, (apart from the pick-up cartridge) individual components in the music centre cannot easily be replaced or updated. Thus, if you become dissatisfied with the performance of say, the record player, the only way to improve it is to buy a completely new system — a rather expensive way of changing your mind. And, bear in mind that if any section of the music centre goes wrong, the whole unit may have to be returned for servicing, which is not only a cumbersome task, but it may leave you without any sound system. Also, although the subjective sound quality has improved immeasurably since the days of the radiogram, many hi-fi purists would still claim that true high fidelity sound quality cannot be obtained from a music centre.

As an interesting exercise, we decided to test a separates hi-fi system to exactly the same measured standards as a music centre. The system consisted of a Pioneer PL-112D record deck with an Audio Tecnic AT-13EaP cartridge, an Aiwa AD 1250 cassette deck, a Technics SA-5070 receiver and a pair of Celestion Ditton 15 loudspeakers, the whole system costing about £400 including VAT — which is the average price of all the music centres tested. The results of the tests are published at the end of the music centre reviews and are discussed in the conclusions.

How easy is it to set up a music centre?

Even the most technically timid should be able to set up a music centre without too many headaches, especially as most of the centres tested were supplied with detailed instruction manuals. Apart from wiring up a 13 amp plug, unscrewing the transit clips on the turntable and in some cases mounting the counterbalance on the end of the arm and setting it to the correct tracking weight, the only other chore is to wire up the loudspeakers. Most systems clearly indicate which speaker lead should be connected to which socket. If by any chance, a mistake is

made, and the loudspeaker leads not connected properly, a hazy stereo image will be produced which means that the speakers are 'out of phase'. If this is the case, reverse the connections to one of the loudspeakers only.

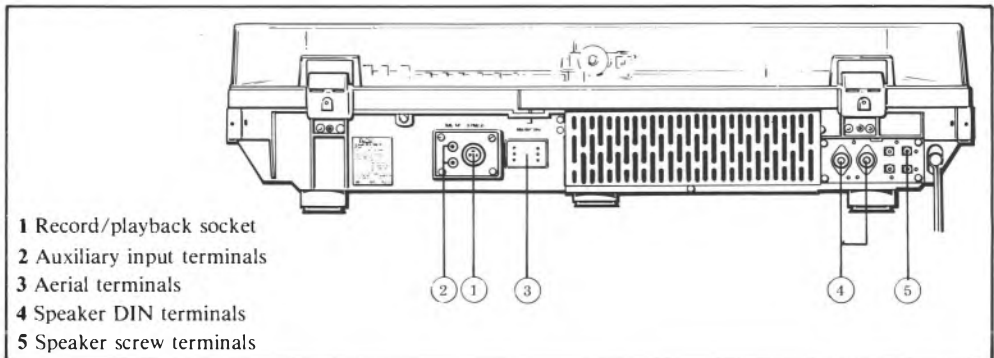
Unfortunately, many music centres were supplied with loudspeaker leads of inadequate length. For reasons which will become apparent later, it is desirable to place the loudspeakers at a reasonable distance from the main cabinet. Leads of approximately 8-10 metres should be acceptable for most rooms. If you have to extend the leads, ordinary electrical flex will do, but try to use the thickest wire available and be sure to maintain the correct phasing.

Some music centres have additional sockets for connecting an extra cassette deck, reel-to-reel recorder tuner. These inputs are located at the back of the music centre, as indicated in fig 1 — although the number of sockets provided will depend largely on the price of the system. The connecting sockets are usually of the 'phono' or 'five-pin DIN' type — see fig 2. Generally, American or Japanese equipment is supplied with single pin connectors, called 'phone plugs' which come in pairs for connecting stereo equipment. The five-pin DIN connector is found on European units and appears frequently on Japanese equipment for connection with tape recorders. Headphone and microphone sockets are usually found on the front panel and are used with jack plugs — either a two-pole mono version or a three-pole stereo one.

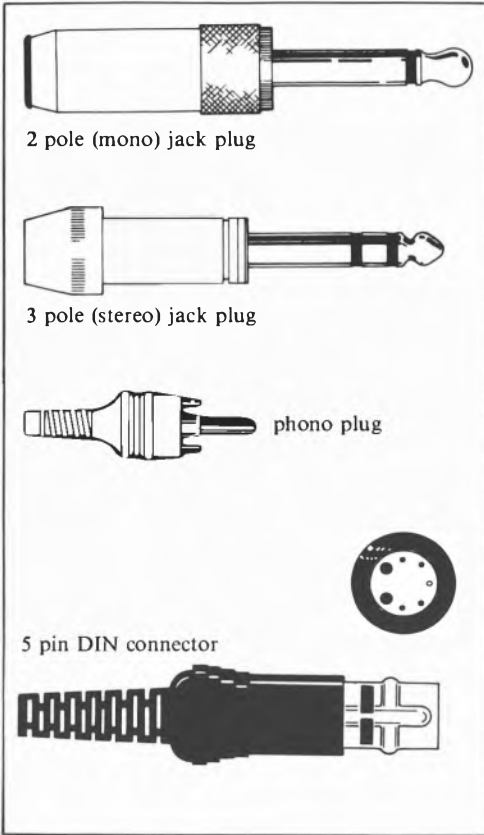
What kind of facilities are available on a music centre and which ones are particularly useful?

The variety of facilities available on a typical music centre are indicated in fig 3. Obviously the more you pay, the more comprehensive the facilities will be, although some of them may not be particularly useful to every owner. The chart on the following pages will enable you to compare the type of facilities offered by all the systems reviewed and decide which one suits your needs. Certain features are generally useful. Some systems provide additional external sockets for connecting an extra cassette deck or radio tuner. A *headphone socket* is very useful if there is only one hi-fi enthusiast in the house, as it allows him to use the system without interfering with others. And, if you wish to connect extension loudspeakers, some units have *additional speaker terminals*. Some centres supply either a mono or a stereo *microphone*, with a microphone input socket generally located on the front panel.

Bass and treble *tone controls* are provided in nearly all the systems tested, and allow you to increase or decrease the bass or treble frequencies as required. *Scratch filters* are useful, and are generally more effective in eliminating scratch than tone controls. *Rumble filters* are particularly important because many record players suffer from rumble. Unfortunately, this facility is rarely incorporated. A switchable *loudness control* helps to correct the apparent absence of bass at low listening levels, and this can be useful if



1 Rear view of typical music centre showing interconnecting sockets.



2 Types of connecting plugs.

you regularly require low level background music.

What facilities are useful on the radio tuner section?

Stereo *FM* (frequency modulation), long wave (*LW*), medium wave (*MW*) and short wave (*SW*) wavebands are offered on most of the music centres reviewed. Of prime importance is the *FM* waveband as this will produce the only good quality radio signal.

Pre-set tuning controls are very useful if you are only interested in receiving a few stations which have good strong signals. These stations are pre-tuned and are then available on pressing a button. It is inadvisable to pre-set

weak and distant stations as the quality of reception will vary from day to day and thus may need careful manual tuning.

The provision of a *tuning meter* or tuning lights helps you to achieve the best performance, especially from *FM* stations. It will indicate when the optimum tuning point has been reached.

A *signal strength meter* provides an indication of the strength of the radio signal.

By removing the signal to the loudspeakers when tuning between stations, the muting circuitry prevents the inevitable hiss or crackle, that is present between stations, from being audible — a noise which is particularly disturbing to some people. However, in doing this, the muting circuitry also eliminates all stations below a certain set signal strength. The *muting switch* puts the muting circuitry out of action to allow the reception of weak stations if required.

The *multiplex on/off* switch is useful if you wish to receive weak stereo stations which are troubled by hiss.

The following facilities are of lesser importance, but can still be valuable in some instances. The *stereo pilot light* indicates that you should be hearing the programme in stereo.

The best receivers include *AFC* (automatic frequency control) circuitry, that puts the final touch to the tuning of a station when it has been manually tuned to the approximate frequency. To be of maximum value, a switch should be provided to put the facility out of action until the station has been manually tuned to approximately the best point. This is known as the *AFC switch*.

A *quasi-stereo facility* can be useful if you wish to receive a low signal strength station and you are willing to sacrifice the stereo performance in order to improve the clarity of the received signal.

Some combinations of receiver and tape recorder performance result in the appearance of 'birdie whistles' when attempting to record a programme. A *whistle defeat switch* minimises this trouble.

What facilities are useful on the record player section?

Generally, a *magnetic pick-up* cartridge

Facilities

| | Head- phone socket | Micro- phone socket | Micro- phone supplied | Tape record/ replay external facility | Pairs of loud- speaker termi- nals | Bass and treble tone controls | Scratch filter | Rumble filter | Lo ne co |
|-------------------------------|--------------------------|---------------------------|-----------------------------|---|---|---|-------------------|------------------|----------------|
| Aiwa AF-5050 | Yes | Yes | — | Yes | 1 | Yes | — | — | Y |
| Aiwa AF-5090 | Yes | Yes | — | Yes | 2 | Yes | — | — | Y |
| Akai AC-3800L | Yes | Yes | — | Yes | 2 | Yes | — | — | — |
| Beocenter 4600 | Yes | Yes | — | Yes | 2 | Yes | — | — | — |
| Dynatron MC-1010CR | Yes | Yes | — | Yes | 1 | Yes | — | — | Y |
| Ferguson 20D 3971 | Yes | Yes | — | — | 1 | Yes | — | — | — |
| Fidelity System 4-40 | Yes | Yes | stereo | Yes | — | Yes | — | — | — |
| *Garrard GA-200 | Yes | Yes | — | Yes | 1 | Yes | — | — | — |
| Grundig RPG-300 | Yes | Yes | — | Yes | 2 | Yes | Yes | — | Y |
| Grundig RPL-500 | Yes | Yes | — | Yes | 2 | Yes | Yes | — | Y |
| Hitachi SDT-1675 | Yes | Yes | — | Yes | 1 | Yes | — | — | — |
| Hitachi SDT-7680 | Yes | Yes | stereo | Yes | 1 | Yes | — | — | Y |
| Hitachi SDT-7765 | Yes | Yes | stereo | Yes | 1 | Yes | — | — | Y |
| ITT MC-5042 | Yes | Yes | — | Yes | 1 | Yes | — | — | Y |
| ITT MC-5080 | Yes | Yes | — | Yes | 1 | Yes | Yes | Yes | Y |
| JVC MF-55LS | Yes | Yes | — | Yes | 2 | Yes | — | — | Y |
| JVC MF-1845 | Yes | Yes | — | Yes | 2 | Yes | Yes | — | Y |
| National Panasonic SG-2080L | Yes | Yes | stereo | Yes | 1 | Yes | — | — | — |
| National Panasonic SG-3060L | Yes | Yes | stereo | Yes | 1 | Yes | — | — | — |
| National Panasonic SG-3090L | Yes | Yes | — | Yes | 1 | Yes | Yes | — | Y |
| Nordmende 8025 SCP | Yes | Yes | — | Yes | 2 | Yes | — | — | — |
| Philips RH-953 | Yes | Yes | — | Yes | 1 | Yes | — | — | Y |
| Philips RH-970 | — | — | — | Yes | 1 | Yes | — | — | — |
| Pioneer M-6500 | Yes | Yes | — | — | 1 | Yes | — | — | Y |
| *Pye 1600 | Yes | Yes | — | — | 1 | Yes | — | — | — |
| Rotel EM-5010 | Yes | Yes | — | Yes | 2 | Yes | Yes | — | Y |
| Sanyo G-2711 KL Super 2 | Yes | Yes | stereo | Yes | 1 | Yes | — | — | — |
| Sanyo G-2811 KL | Yes | Yes | — | Yes | 1 | Yes | — | — | Y |
| Sharp SG-220E | Yes | Yes | — | — | 1 | Yes | — | — | — |
| Sharp SG-450E | Yes | Yes | — | Yes | 1 | Yes | — | — | Y |
| Skantic 2065 | Yes | Yes | mono | Yes | 2 | Yes | — | — | Y |
| Skantic 3063 | Yes | Yes | mono | Yes | 2 | Yes | — | — | Y |
| Sony EK-1K | Yes | Yes | — | Yes | 2 | bass only | — | — | Y |
| Sony HMK-70 | Yes | Yes | — | Yes | 1 | Yes | Yes | — | Y |
| Tandberg TR-220GC | Yes | Yes | — | Yes | 2 | Yes | Yes | Yes | Y |
| *Telefunken Studio Centre 50 | Yes | Yes | — | Yes | 2 | treble only | Yes | Yes | — |
| Toshiba SM-2700 | Yes | Yes | stereo | — | 1 | Yes | — | — | — |
| Toshiba SM-3150 | Yes | Yes | stereo | Yes | 1 | Yes | — | — | — |
| Ultra 6293 | Yes | Yes | — | Yes | 1 | Yes | — | — | Y |
| Hi-Fi Choice Separates System | Yes | Yes | — | Yes | 1 | Yes | — | — | Y |

Tuner Section

| id- s trol | Wavebands | | | Type of aerial socket ohms | Tuning meter | Signal strength meter | Muting switch | Local/ distant switch | Multi- plex switch | Stereo pilot light | AFC switch | Quasi- stereo switch | Whistle defeat switch |
|------------------|-----------|-----|--------|-------------------------------------|-----------------|-----------------------------|------------------|-----------------------------|--------------------------|--------------------------|---------------|----------------------------|-----------------------------|
| | AM | FM | SW | | | | | | | | | | |
| | AM/FM/SW | — | 75+300 | Yes | — | Yes | — | Yes | Yes | Yes | — | Yes | |
| | AM/FM/SW | — | 75+300 | Yes | — | Yes | — | Yes | Yes | Yes | — | Yes | |
| | AM/FM | Yes | 75+300 | — | Yes | Yes | — | Yes | Yes | — | — | Yes | |
| | AM/FM | Yes | 75+300 | Yes | — | Yes | — | Yes | Yes | Yes | — | — | |
| | AM/FM | — | 300 | — | — | Yes | — | Yes | Yes | Yes | — | Yes | |
| | AM/FM | — | 300 | — | — | — | — | Yes | Yes | Yes | — | Yes | |
| | AM/FM/SW | — | 300 | — | Yes | — | — | — | Yes | Yes | — | — | |
| | AM/FM | Yes | 75 | Yes | — | Yes | — | Yes | Yes | Yes | — | Yes | |
| | AM/FM/SW | Yes | 300 | — | Yes | Yes | — | Yes | Yes | Yes | — | — | |
| | AM/FM | Yes | 300 | — | Yes | Yes | — | Yes | Yes | Yes | — | — | |
| | AM/FM/SW | Yes | 75+300 | — | Yes | — | — | Yes | Yes | — | — | — | |
| | AM/FM/SW | Yes | 75+300 | — | Yes | Yes | — | — | Yes | — | — | Yes | |
| | AM/FM/SW | Yes | 75+300 | — | Yes | — | — | Yes | Yes | — | — | Yes | |
| | AM/FM | — | 75 | — | — | — | — | — | Yes | Yes | — | Yes | |
| | AM/FM | Yes | 75+300 | — | Yes | — | — | Yes | Yes | Yes | — | Yes | |
| | AM/FM/SW | — | 300 | — | Yes | — | Yes | — | Yes | Yes | — | — | |
| | AM/FM | — | 300 | — | Yes | Yes | — | Yes | Yes | — | — | — | |
| | AM/FM/SW | — | 300 | — | Yes | — | — | Yes | Yes | — | — | — | |
| | AM/FM | Yes | 300 | — | Yes | — | — | — | Yes | — | — | Yes | |
| | AM/FM/SW | Yes | 300 | Yes | — | — | — | — | Yes | — | — | Yes | |
| | AM/FM/SW | Yes | 75 | — | Yes | — | — | Yes | Yes | Yes | — | Yes | |
| | AM/FM/SW | — | 300 | — | — | — | — | — | Yes | Yes | — | Yes | |
| | AM/FM | — | 300 | — | — | — | — | Yes | Yes | — | Yes | Yes | |
| | AM/FM | — | 75+300 | Yes | — | Yes | — | — | Yes | — | — | — | |
| | AM/FM | — | 75 | — | — | — | — | Yes | Yes | — | — | Yes | |
| | AM/FM | — | 75+300 | Yes | — | Yes | — | Yes | Yes | — | — | — | |
| | AM/FM | — | 75 | — | Yes | — | — | — | Yes | — | — | Yes | |
| | AM/FM/SW | — | 75+300 | — | Yes | — | — | Yes | Yes | Yes | — | Yes | |
| | AM/FM | — | 300 | — | — | — | — | Yes | Yes | — | — | Yes | |
| | AM/FM/SW | Yes | 75+300 | — | Yes | Yes | — | Yes | Yes | Yes | — | Yes | |
| | AM/FM | Yes | 75 | — | Yes | — | — | — | Yes | Yes | — | — | |
| | FM | Yes | 300 | — | Yes | Yes | — | Yes | Yes | Yes | — | — | |
| | AM/FM | — | 300 | — | Yes | — | — | Yes | Yes | — | — | Yes | |
| | AM/FM | — | 75+300 | — | Yes | — | — | Yes | Yes | — | — | Yes | |
| | FM | Yes | 75+300 | Yes | Yes | Yes | — | Yes | Yes | Yes | — | — | |
| | AM/FM/SW | Yes | 300 | — | Yes | Yes | — | Yes | Yes | Yes | — | Yes | |
| | AM/FM | — | 75+300 | — | — | — | — | — | Yes | — | — | Yes | |
| | AM/FM | — | 75+300 | — | — | — | — | Yes | Yes | — | — | Yes | |
| | AM/FM/SW | — | 75+300 | — | — | — | — | Yes | Yes | Yes | — | Yes | |
| | AM/FM | — | 75+300 | — | Yes | Yes | — | Yes | Yes | — | — | — | |

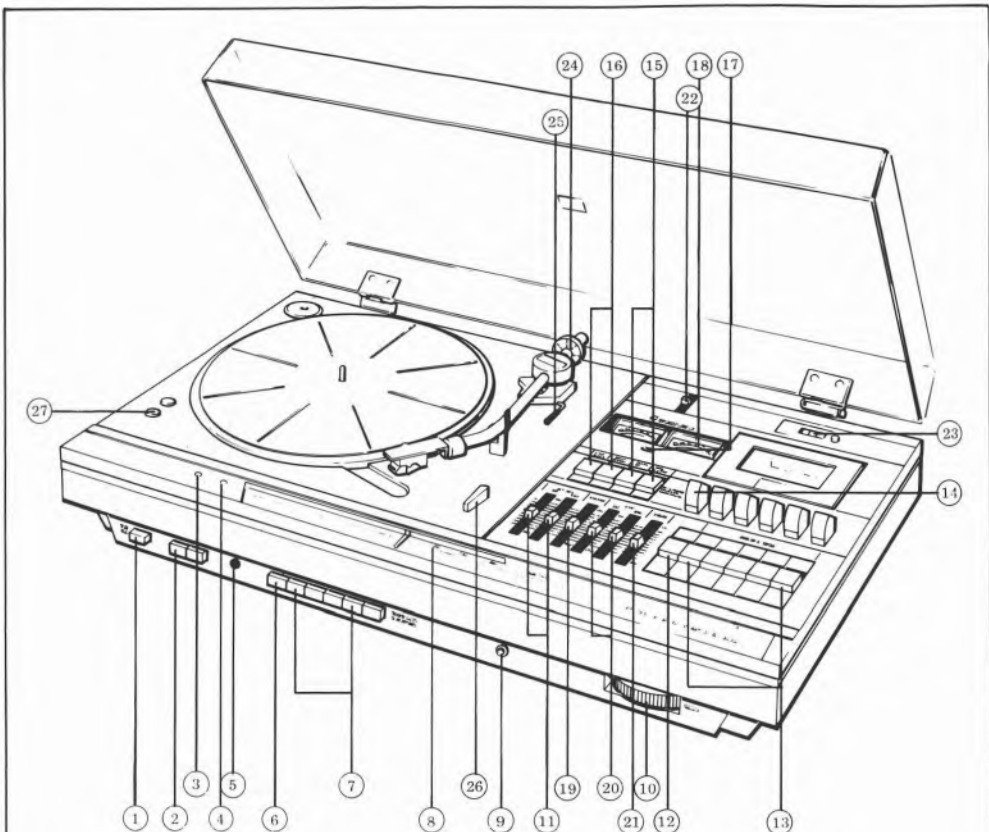
Facilities

Record Player

| | Type of pick-up cartridge | Auto record change | Inter-changeable head-shell | Cueing device | Tracking weight adjustment | Speed adjustment | Type of noise reduction system | Pause control |
|--------------------------------------|---------------------------|--------------------|-----------------------------|---------------|----------------------------|------------------|--------------------------------|---------------|
| Aiwa AF-5050 | Magnetic | — | Yes | Yes | Yes | — | Dolby | Yes |
| Aiwa AF-5090 | Magnetic | — | Yes | Yes | Yes | — | Dolby | Yes |
| Akai AC-3800L | Crystal | — | Yes | Yes | Yes | — | — | Yes |
| Beocenter 4600 | Magnetic | — | Yes | Yes | Yes | Yes | Dolby | Yes |
| Dynatron MC-1010CR | Magnetic | — | Yes | Yes | Yes | — | Dolby | Yes |
| Ferguson 20D 3971 | Crystal | — | — | Yes | — | — | Dolby | Yes |
| Fidelity System 4-40 | Magnetic | — | — | Yes | — | — | — | Yes |
| *Garrard GA-200 | Magnetic | — | — | Yes | Yes | — | Dolby | Yes |
| Grundig RPG-300 | Magnetic | Yes | Yes | Yes | Yes | Yes | — | Yes |
| Grundig RPL-500 | Magnetic | Yes | Yes | Yes | Yes | Yes | Dolby | Yes |
| Hitachi SDT-1675 | Magnetic | — | Yes | Yes | Yes | — | Dolby | Yes |
| Hitachi SDT-7680 | Magnetic | — | Yes | Yes | Yes | Yes | — | Yes |
| Hitachi SDT-7765 | Magnetic | — | Yes | Yes | Yes | — | Dolby | Yes |
| ITT MC-5042 | Magnetic | — | — | Yes | — | — | — | Yes |
| ITT MC-5080 | Magnetic | — | — | Yes | Yes | — | Dolby | Yes |
| JVC MF-55LS | Magnetic | — | Yes | Yes | Yes | — | ANRS | Yes |
| JVC MF-1845 | Magnetic | — | — | Yes | — | — | — | Yes |
| National Panasonic SG-2080L | Magnetic | — | Yes | Yes | Yes | — | Dolby | Yes |
| National Panasonic SG-3060L | Magnetic | — | Yes | Yes | Yes | — | Dolby | Yes |
| National Panasonic SG-3090L | Magnetic | — | Yes | Yes | Yes | Yes | Dolby | Yes |
| Nordmende 8025 SCP | Magnetic | Yes | Yes | Yes | Yes | Yes | — | Yes |
| Philips RH-953 | Magnetic | — | Yes | Yes | Yes | — | DNL | Yes |
| Philips RH-970 | Crystal | — | — | Yes | Yes | — | — | Yes |
| Pioneer M-6500 | Magnetic | — | Yes | Yes | Yes | — | — | Yes |
| *Pye 1600 | Crystal | — | — | Yes | — | — | — | Yes |
| Rotel EM-5010 | — | — | Yes | Yes | Yes | Yes | Dolby | Yes |
| Sanyo G-2711 KL Super 2 | Magnetic | — | — | Yes | — | — | Dolby | Yes |
| Sanyo G-2811KL | Magnetic | — | — | Yes | — | — | Dolby | Yes |
| Sharp SG-220E | Magnetic | — | — | Yes | — | — | — | Yes |
| Sharp SG-450E | Magnetic | — | Yes | Yes | Yes | — | Dolby | Yes |
| Skantic 2065 | Magnetic | — | Yes | Yes | Yes | — | DNL | Yes |
| Skantic 3063 | Magnetic | — | Yes | Yes | Yes | — | Dolby | Yes |
| Sony EK-1K | Magnetic | — | — | — | — | — | — | Yes |
| Sony HMK-70 | Magnetic | — | Yes | Yes | Yes | — | Dolby | Yes |
| Tandberg TR-220GC | Magnetic | — | Yes | Yes | Yes | Yes | Dolby | Yes |
| *Telefunken Studio Centre 50 | Magnetic | — | Yes | Yes | Yes | — | Dolby | Yes |
| Toshiba SM-2700 | Crystal | — | — | — | — | — | — | Yes |
| Toshiba SM-3150 | Magnetic | — | Yes | Yes | Yes | — | — | Yes |
| Ultra 6293 | Magnetic | — | Yes | Yes | Yes | — | Dolby | Yes |
| Hi-Fi Choice Separates System | Magnetic | — | Yes | Yes | Yes | — | Dolby | Yes |

| Cassette Deck | | | | | | | | |
|-------------------------|-------------------------|-----------|----------|-----------------------|-----------------------|--------------------------------|-------------------|--------------------------------------|
| Tape position indicator | Type of recording meter | Auto-stop | Lim-iter | Auto/manual recording | Fe/Cr replay facility | Auto CrO ² selector | Bias comp-ensator | |
| Yes | 2VU | Yes | — | — | Yes | Yes | Yes | Aiwa AF-5050 |
| Yes | 2VU | Yes | — | — | Yes | — | Yes | Aiwa AF-5090 |
| Yes | 2VU | Yes | — | — | Yes | — | Yes | Akai AC-3800L |
| Yes | 1VU | Yes | — | — | Yes | — | — | Beocenter 4600 |
| Yes | 2VU | Yes | — | — | Yes | — | Yes | Dynatron MC-1010CR |
| Yes | 2VU | Yes | — | — | — | — | — | Ferguson 20D 3971 |
| Yes | 1VU | Yes | — | Yes | — | — | — | Fidelity System 4-40 |
| Yes | 2VU | Yes | — | — | Yes | — | Yes | *Garrard GA-200 |
| Yes | — | Yes | — | — | Yes | — | Yes | Grundig RPG-300 |
| Yes | 2VU | — | — | Yes | Yes | — | Yes | Grundig RPL-500 |
| Yes | 2VU | Yes | — | — | Yes | — | Yes | Hitachi SDT-1675 |
| Yes | 2VU | Yes | — | — | — | Yes | Yes | Hitachi SDT-7680 |
| Yes | 2VU | Yes | — | — | Yes | — | Yes | Hitachi SDT-7765 |
| Yes | — | Yes | — | — | Yes | — | — | ITT MC-5042 |
| Yes | 2VU | Yes | — | — | Yes | — | Yes | ITT MC-5080 |
| Yes | 2VU | Yes | — | — | Yes | — | — | JVC MF-55LS |
| yes | 2VU | Yes | — | — | — | — | — | JVC MF-1845 |
| Yes | 2VU | Yes | — | — | Yes | — | — | National Panasonic SG-2080L |
| Yes | 1VU | Yes | — | — | Yes | — | — | National Panasonic SG-3060L |
| Yes | 2VU | Yes | — | — | Yes | — | — | National Panasonic SG-3090L |
| Yes | — | Yes | — | — | Yes | Yes | Yes | Nordmende 8025 SCP |
| Yes | — | Yes | — | — | — | Yes | Yes | Philips RH-953 |
| — | — | Yes | — | — | — | — | — | Philips RH-970 |
| Yes | 2VU | Yes | — | — | Yes | — | Yes | Pioneer M-6500 |
| Yes | — | Yes | — | Yes | — | Yes | — | *Pye 1600 |
| Yes | 2VU | Yes | — | — | Yes | — | Yes | Rotel EM-5010 |
| Yes | 2VU | Yes | — | — | Yes | — | Yes | Sanyo G-2711 KL Super 2 |
| Yes | 2VU | Yes | — | — | Yes | — | — | Sanyo G-2811KL |
| Yes | — | Yes | — | — | — | Yes | — | Sharp SG-220E |
| Yes | 2VU | Yes | — | Yes | — | Yes | Yes | Sharp SG-450E |
| Yes | 1VU | Yes | — | Yes | — | Yes | Yes | Skantic 2065 |
| Yes | 1VU | Yes | — | Yes | Yes | Yes | Yes | Skantic 3063 |
| Yes | — | Yes | — | — | Yes | — | — | Sony EK-1K |
| Yes | 2VU | Yes | Yes | - | Yes | — | Yes | Sony HMK-70 |
| Yes | 1VU | Yes | — | - | — | Yes | Yes | Tandberg TR-220GC |
| Yes | 1VU | — | — | - | Yes | Yes | Yes | *Telefunken Studio Centre 50 |
| Yes | — | Yes | — | - | — | Yes | — | Toshiba SM-2700 |
| Yes | 2VU | Yes | — | - | Yes | — | Yes | Toshiba SM-3150 |
| Yes | 2VU | Yes | — | Yes | — | Yes | Yes | Ultra 6293 |
| Yes | 2VU | Yes | — | — | Yes | Yes | Yes | Hi-Fi Choice Separates System |

A typical music centre layout



- | | | |
|-----------------------------|-------------------------------|--|
| 1 Power switch | 10 Tuning knob | 19 Balance control |
| 2 Speaker selector switches | 11 Recording level controls | 20 Tone controls |
| 3 Radio indicator | 12 Loudness control | 21 Volume control |
| 4 FM stereo indicator | 13 Source selection buttons | 22 Whistle defeat switch |
| 5 Headphone socket | 14 Cassette operation buttons | 23 Tape counter |
| 6 FM muting switch | 15 Tape select buttons | 24 Counterweight with stylus pressure dial scale |
| 7 Radio band selectors | 16 Noise reduction buttons | 25 Cue lever |
| 8 Tuning dial | 17 Recording indicator | 26 Reject lever |
| 9 Microphone socket | 18 Recording level meters | 27 Speed selector switches |

3 Layout of a typical music centre.

produces a better sound quality than a *crystal pick-up* cartridge and is thus to be preferred.

An *interchangeable headshell* is particularly useful, as it allows you to replace and improve the cartridge if you should wish. Most of the music centres reviewed incorporated this facility.

The option of a *tracking weight adjustment* allows the optimum use of an alternative pick-up cartridge. As with the bias compensator, it allows you to ensure that the arm and cartridge will be tracking at the right weight.

An *automatic record changer* is obviously very convenient for turning itself off and on at the beginning and end of a record side. Particularly useful for children.

Likewise a *cueing device* is also useful in case you should wish to hear a track in the middle of the record.

A record player *speed adjustment* is advisable if you are one of the very few people who have a sense of perfect pitch or if you wish to accompany a record on a fixed pitch instrument of your own.

What facilities are useful on a cassette deck?

Of prime importance is some sort of *noise reduction system*. The performance of all cassette systems is limited by the presence of noise from tapes. This noise becomes particularly noticeable if you live in a quiet area without traffic or other external disturbances. There are four different types of noise reduction systems: Dolby, ANRS, super ANRS and DNL — Dolby being the most widely used.

Both a *pause control button* and a *tape position indicator* (which indicates the amount of tape used) are now virtually universal on most cassette machines and are obviously useful.

There are two types of meters which are used to indicate the type of signal being recorded. The *VU meter*, common on European and American units, indicates the near RMS amplitude of the signal being recorded, whereas the British *PPM meter* indicates the peak value of the recorded material. The latter is undoubtedly more useful as it will enable you to make a less distorted recording of difficult programme material. *Twin meters* undoubtedly aid the

monitoring of both left and right channels when recording.

An *auto/manual recording level control switch* is sometimes incorporated which automatically limits and regulates the signal to be recorded. This is very useful for the unskilled user.

The provision of a *limiter* to control the maximum signal volume, is valuable to the unskilled user.

Current tapes have a variety of coatings — the three different types of tape available are chrome, ferric and ferrichrome, although some manufacturers have developed tapes which fall in between these definitions. Some units have a *Fe/Cr (ferric/chrome) replay facility* which allow you to switch the bias and equalisation to the appropriate values for the best performance on that particular type of tape.

Similarly, an *auto CrO₂ (chrome) switch* automatically selects the correct form of bias or equalisation for chrome tape. This only applies to certain makes of chrome tape which incorporate a special identification tag, in the edge of the cassette.

How much audio output power is needed from a music centre?

This will depend to an extent on the size and furnishings of your room and the kind of music you play. If you prefer heavy rock or jazz and have a large heavily furnished room, you will need a relatively high powered amplifier, whereas if the room is small and you play light orchestral music, the loudness desirable can be achieved by a lower powered amplifier.

In fact, the amplifier output that is necessary for acceptable performance is very small, 20-25 watts per channel generally being sufficient in an average sized room, unless very low 'efficiency' loudspeakers are used. (High 'efficiency' speakers require very little amplifier power to drive them.) But, if you are a hi-fi purist and you wish to obtain theoretical perfection, a high output power will minimise any form of 'peak clipping' — that is, the amplifier will be able to handle the most difficult programme material such as electronic music which contains a lot of

Loud speaker choice and positioning

sudden high frequency notes. In fact, clipping should be a rare occurrence, because both the record and tape recording studios and the BBC will have had to restrict the peak amplitude of the signals before either a record, tape or radio transmission can be made.

Unfortunately, high input powers are not without their disadvantages. The accidental dropping of the pick-up arm on the record or a defective plug connection may result in the damaging of the loudspeakers unable to withstand such sudden high power. Such practical aspects rather than the pursuit of pseudo-technical perfection makes it difficult to justify output powers much in excess of 50 watts per channel.

If loudspeakers are not supplied with the music centre, how do I make the right choice?

The choice of loudspeakers is always a difficult one, because what constitutes an acceptable sound quality is a very individual matter. Most of the music centres in this survey were supplied with loudspeakers but some manufacturers offer the consumer the opportunity of making his own choice. Unfortunately, the sound quality of all the systems tested was limited by the speakers supplied, suggesting that there are advantages in choosing your own, although it should be stressed that the speakers supplied were generally a great deal cheaper than units bought separately. As a rough guide, a pair of compatible speakers should cost about a third of the cost of the music centre.

If the music centre has a low powered amplifier (about 10-12W), then low efficiency speakers should be avoided because they would produce inadequate sound levels and may cause the amplifier electronic distress. However, small high efficiency speakers may have other disadvantages, such as unnaturally emphasising certain notes. The most important technical factor you need to consider is the impedance of the loudspeaker, which is expressed in ohms (Ω). This is an indication of the ability of the speakers to draw power from the amplifier. Approximately 99% of the amplifier power is lost in the voice coil of the loudspeaker, only about 1% being converted into acoustic power. Generally, a loudspeaker having an

impedance of 8 ohms will be happy with any amplifier, but if the impedance falls below about 4 ohms, you may have problems.

But, after you have ascertained that, theoretically at least, the loudspeakers should operate well with your system, the final arbiter must be your ears. A type of sound which appeals to your friend, may be quite unsuitable for you. So, if possible, before purchase, listen to the complete system, plus the new loudspeakers, in your own home, with music that you are accustomed to.

Why is loudspeaker placement so important?

Various factors affect the performance of loudspeakers. The degree of furnishing — whether heavy or sparse — will either improve or detract from the sound quality as will the exact positioning of the speakers. The importance of finding the best position for your speakers cannot be overstressed — even for a music centre.

Generally, manufacturers recommend where their loudspeakers should be placed. Some types of speaker are designed to be positioned specifically on the floor, some to be raised on a plinth, some to be wall mounted and some to be 'bookshelf' speakers. And, these instructions are not to be ignored if you want to get the best out of your system.

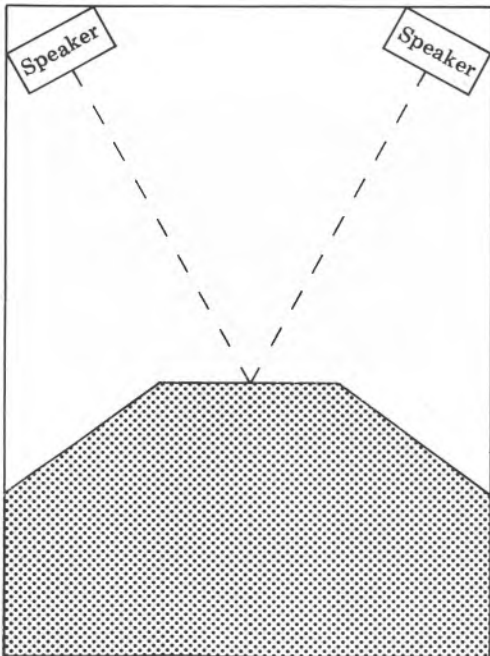
By placing a speaker on the floor in a corner or directly against a wall, bass frequencies will be boosted — sometimes too much, so that they sound 'boomy'. By moving the speaker away from the wall or corner or lifting it off the floor, a 'boomy' bass will be softened.

But, there is a simple way of discovering the right height and location for your speakers. If you put a mono signal into the loudspeakers — either from an old mono record or from a radio programme — and then place the two speakers in different domestically acceptable positions, you will be able to compare the sound quality obtained in the two different positions. You should continue to move the speakers around until you have found the best location as far as your ears are concerned. And in order to do this, it is obviously useful to have a flexible length of loudspeaker lead. But, whatever you do, don't allow the speakers to be screened by furniture or

curtains, as this will only result in a muffled sound quality.

So, having decided where the loudspeakers should be placed in relation to the floor and walls, it is now important to establish where they should be in relation to the rest of the furniture. It is desirable to place the music centre near to your 'stereo seat', so that you can easily adjust the controls while listening. In order to find the 'stereo seat' — that is, the best position for receiving the stereo image — turn the speakers slightly inwards to the centre of the room and draw two imaginary lines from the centre of each speaker (see fig 4). Where these two lines cross should be the area for receiving the best stereo reception. Hopefully, it coincides with where the sofa is placed!

You may feel after reading this that finding the best loudspeaker position sounds rather like hard work. But, you will be amazed by the difference it makes to the sound quality of the system and it's well worth the time and effort involved.



4 Optimum loudspeaker positioning.

How were the music centres tested and what do these tests show?

Each unit was evaluated both subjectively and objectively. Although objective technical tests indicate the major aspects of the quality of the music centre, some of the more subtle aspects of a good performance are troublesome or even impossible to assess by a purely objective approach. Carefully controlled listening tests fill this gap.

In the reviews, we have tried to restrict the amount of technical detail to a minimum, and rather than continually quote academic figures, we have graded the performance on many parameters on a five point scale: very good; good; average; fair; poor. Generally, each step corresponds to a two to one improvement in the parameter tested. However, as we go on to discuss the meaning and relevance of the tests applied, we have quoted figures which are acceptable or unacceptable on each parameter, so that if, at a later date, you are considering buying a music centre which has not been reviewed in this survey, you will be able to make some sort of objective judgement of the claimed specification.

So, what were the subjective tests?

The appearance, finish and ease of use were all assessed subjectively and comments are made in the reviews. But, of prime importance were the subjective listening tests. Where loudspeakers were not supplied, we used either the Celef Mini Professionals or the Wharfedale Lintons, as stated in the reviews where appropriate. As a general rule, the loudspeakers chosen were approximately one third of the price of the music centre.

Each music centre was auditioned on cassette tape, record and radio. A small panel of experienced listeners carried out the tests, both as a panel listening together at the same time, or individually, when the listener was able to sit and compare each unit with a reference unit for just as long as he thought necessary to confirm his judgement. At the end of the tests on all units, the top five music centres were compared with each other, as were the bottom five.

What objective tests were applied?

Each objective test is designed to reveal any

Frequency response; signal to noise ratio

problem in a specific section of the music centre which would detract from the overall performance of the unit. As the amplifier and loudspeakers are common to all functions of the music centre, they set an upper and sometimes a lower limit to the quality of performance that can be achieved by the other sections. So, the first series of tests are aimed at assessing the performance of the amplifier and loudspeakers.

However, there are certain parameters which are relevant to each section of the music centre. These are the frequency response, the signal to noise ratio, distortion and crosstalk, and it is advisable to discuss exactly what these mean before progressing to their relevance in each particular section of the music centre.

So, what is 'frequency response'?

The frequency response of any piece of equipment indicates its ability to produce various musical notes or frequencies at equal volume. This function is best shown in pen chart form, and we have included pen charts of the frequency response of the amplifier and loudspeaker; the record/replay response of the cassette deck and the frequency response of the record player in our reviews.

Frequency is measured in Hertz (Hz) or cycles per second, or kilohertz (kHz) for thousands of cycles per second. The human ear can sense low frequencies either by hearing or feeling vibrations. The physics of sound reproduction limit the ability of any loudspeaker to reproduce very low frequencies in the average sized room. This is because the wavelength of the reproduced sound approaches the largest dimensions of the listening room. In practice, this means that notes below around 40Hz cannot be reproduced in even fairly large listening environments. At the high frequency end, our hearing ability varies with age. Young children can hear up to 20,000Hz (or 20kHz), but by about 30 years of age the average limit is 16kHz, falling to about 14kHz at 40. However, although you may not be able to hear high frequencies they may still contribute to the subjective effects of music. So, basically, we are interested in the frequency response in any music system from about 40Hz up to 20kHz, and ideally, this response

should be constant over this range.

Because the ear does not function in a linear manner when sensing the intensity of sound, the change in volume is always measured in logarithmic units called decibels (dB), and the frequency response of a piece of audio equipment is specified as plus or minus (\pm) so many dB over the frequency range from a centre point, which is generally 1kHz. The audibility of the deviations in frequency response depend upon how rapid or sudden the change is and where it occurs in the frequency range.

The vertical scale of a pen chart indicates the intensity of sound in decibels (dB). All the pen charts included in this book are to a 50dB vertical scale, each small division representing 2dB. The horizontal scale shows the audio frequency range from 20Hz to 20kHz. Generally speaking, a 2dB variation from the 1kHz point, over the frequency range will not be audible, whereas a variation of 10dB will be very noticeable. In practice, the amplifier and tuner sections are capable of producing a flatter frequency response than the loudspeaker, turntable or cassette deck sections.

What about the signal to noise ratios?

In all cases, this is the ratio of the maximum loudness of which the equipment is capable to the residual noise in the system during the gaps in the programme. This noise is always present in the signal from tapes, records or radio and is also produced by various environmental sounds such as heavy traffic. The sound quality becomes quite unacceptable when the noise present is as loud as the quiet passages in the programme material.

Subject to a loudness limit of 90dBA, which is the maximum acceptable volume level in a typical domestic listening environment, the signal to noise ratio should not be less than about 50dBA, and preferably 60dBA if you live in a quiet residential area, having a low level of acoustic noise. (The 'A' specifies the type of noise weighting.). This applies to all the signal to noise ratio figures in the reviews, but as with the frequency response, some sections of the music centre are capable of achieving better results than others.

What exactly is distortion?

All types of distortion alter the original signal in some way or other and unfortunately it is impossible for any signal to pass through a piece of electronic equipment without some distortion being generated. Some types of distortion, such as wow and flutter and rumble, are confined to the turntable and cassette deck sections of the music centre, but harmonic and intermodulation distortions are prevalent in all sections.

All instruments naturally generate their own harmonics, and in fact these are a major factor in determining the musical quality of a note being played. However, when harmonics are present in the output signal of the amplifier, it is an indication that the amplifier is being overloaded, and the audible effect can be unpleasant. Intermodulation distortion is the inseparable consequence of harmonic distortion. It occurs when two or more tones are fed through the system — which is of course exactly what happens when music is played, and thus is audibly more objectionable.

In the reviews, distortion levels are expressed as a percentage of the signal level, a low figure indicating a good performance on this parameter.

What about the crosstalk measurements?

Ideally, there should be no leakage of the right channel signal into the left channel and vice versa. This leakage reduces the width of the stereo image and can at worst result in a mono programme. The amount of crosstalk (otherwise known as stereo separation) usually varies with frequency, the important frequency range being between 700Hz and 5kHz. Outside this band, lower crosstalk values are acceptable but high values are always advantageous and indicate a good design. In general, crosstalk figures in excess of 25dB are very good, around 20dB is average, whereas below 15dB is rather poor. The amplifier will usually achieve much better crosstalk figures than the other sections of the music centre.

Why is the power output measured into 4 and 8 ohms?

Transistor amplifiers (that is, the majority of

amplifiers on the market today) will generally deliver more power into a 4 ohm than an 8 ohm load. Thus, two power outputs are quoted to provide an indication of the power that the amplifier is capable of delivering into both 4 and 8 ohm speakers.

There are various methods of measuring the power output of an amplifier, and some of them result in higher output figures than others. Obviously, this is something that the manufacturer's advertising department encourages, but this can be misleading. We have quoted the RMS (Root Mean Square) power output which is now the most common method of expressing the power output. **Why is distortion at low power outputs so important?**

The basic function of the amplifier is to convert a small signal, sometimes only a few thousandths of a volt, into an output power of 20-30 watts. However, this process inevitably generates distortion, which has to be kept to a minimum. In fact, audible distortion usually sets the upper limit to the useable power of the amplifier. But, the distortions that occur well below the maximum power output, are in practice more significant in determining the acceptability of the sound quality.

In a well designed amplifier, the distortion will increase slowly and smoothly up to the power output limit, but in badly designed amplifiers, the high level of distortion which occurs at higher power levels will also be present at lower power levels. This results in the amplifier being hard or harsh to listen to. Thus, to sound acceptable, an amplifier must have low distortion at low power levels, the critical power region being at about one watt, which is the output power necessary to reproduce speech and the low end dynamics of ordinary music.

As far as the figures quoted in the review tables are concerned, the lower the number, the better the amplifier is in this respect.

What about the amplifier noise measurements?

There is always some residual noise from the output stages of the amplifier which cannot be controlled by the amplifier volume control. Thus the measurement in the reviews indicates the minimum noise level which will be

Amplifier measurements

produced by the speaker when no music is being played. In the tables, we have graded the performance on our good/average scale. However, the amount of noise which can be tolerated is dependent on the environment, but as far as specifications are concerned, a value of 2mV (millivolts) in a very quiet room will be just audible, whereas in a noisy room, a signal of 20mV would be quite acceptable. Obviously, the lower the figure the better, but bear in mind the noise levels which already exist in your listening room.

What is the relevance of the signal to noise ratio at the tape output?

Some music centres provide an additional socket to connect an external tape recorder. The signal to noise ratio quoted at this socket is the ratio of the signal output voltage available to the residual noise present when the signal is received. It indicates any signal to noise problems you may encounter should you wish to connect an extra tape recorder. again, the lower the figure, the better.

What do the 'input voltage for full modulation' figures show?

These figures show the maximum input voltage which can be fed into the tape, auxiliary or microphone sockets of the music centre without overloading it. If you are thinking of buying an additional cassette deck, radio tuner or microphone to connect to the music centre, these figures should be matched with the rated signal output figures of the required equipment. This will ensure technical compatibility with the equipment being purchased.

What about the tape output figures?

If you wish to record a programme from the music centre onto another tape recorder, this figure will tell you what voltage is available from the music centre to be fed into the recording unit. If the output voltage is insufficient, then the recording is likely to have a poor hiss level. Generally speaking, the output voltage available from the music centre should always be slightly higher than the input signal required by the tape recorder.

If you do have any problems in matching the input and output signals, then consult your local dealer.

What sort of amplifier crosstalk figures are acceptable?

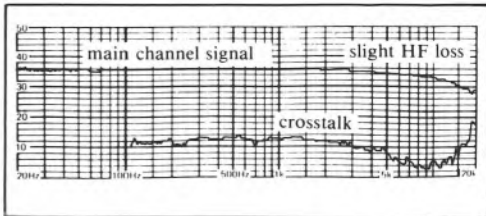
It is much easier to achieve good crosstalk figures in the amplifier section than in the rest of the music centre. Values of 50dB and over are very good and in fact are frequently attained. A 40dB rating is good, with a 30dB figure the acceptable minimum for an amplifier.

What about the channel balance measurements?

When equal input signals are supplied to both stereo channels, the output voltages to the loudspeakers should remain equal. If the two signal strengths become unbalanced, so that, for example, the right hand speaker receives more power than the left hand one, the stereo image will shift to the right hand side. Where quoted, very low figures indicate a good performance, a value of 2dB being just noticeable to the discerning listener.

How do you interpret the record player pen chart?

Any pen chart contains a great deal of information provided that you know how to extract it. The top line in the chart (see fig 5) shows the frequency response of the complete cartridge/arm/turntable/amplifier system. The lower line indicates the amount of crosstalk which has leaked from one stereo channel into the other and which will impair the stereo signal. The crosstalk figure at any given frequency can be obtained by measuring the difference between the frequency response line and the crosstalk line. Thus, in the example shown, the resulting crosstalk figure would be 22dB at 1kHz. Generally, values greater than 30dB at 1kHz are very good, 20dB is good, but below 15dB is rather poor.



5 Frequency response and crosstalk of a good record deck.

What is trackability and why is it important?

Basically, a record is composed of one continuous minute groove, the groove walls containing the musical information. The cartridge, or more accurately, the stylus tip, tracks the record groove walls and this contact generates electrical signals in the cartridge which are transmitted along the leads inside the arm and eventually into the amplifier. In order to keep the stylus tip in contact with the undulating groove walls, it is necessary to apply some sort of downforce; otherwise, as the record rotates, the stylus would be bounced out of the groove. The trackability figure is an indication of the ability of the stylus/cartridge/arm combination to track the record accurately.

Various factors combine to produce a good trackability. One of them is the tracking weight. This is the vertical load applied to the pick-up stylus in order to keep it in the record groove. But, if the downforce is too great, undue record wear may result. Most manufacturers specify the correct loading, but broadly speaking, it should not exceed 3 grams and can usefully be as low as 1.5 grams.

Another important factor is compliance, which is the degree of rigidity or resilience in the connection of the stylus to the cartridge through a 'cantilever'. If the compliance and stylus loading is too high (that is, the cantilever connection too 'springy'), the stylus may be displaced inside the cartridge housing. If the compliance is too low (the cantilever connection too stiff), the stylus will not be able to follow the more extreme modulations of the record groove. This results in mis-tracking, even at the recommended tracking weight, and will produce audible distortion.

What about the signal to noise measurement in this context?

This measurement evaluates the amount of noise present in the record player system when no record is being played. The average value for all the units tested was around 62dB, which is perfectly adequate, but obviously, values above this are advantageous.

What about the record player channel balance?

As explained earlier, when equal input signals

are supplied to both stereo channels, the output voltages to the loudspeaker should remain equal. If any unbalance occurs, the stereo image will shift. The record player's channel balance cannot approach the performance of the amplifier section, because it will be limited by any unbalance in the tracking of the twin volume controls.

What is wow and flutter and how is it caused?

The instantaneous speed of a turntable is not absolutely constant, although the average speed can be accurately maintained. Wow and flutter are types of distortion produced by any such instantaneous speed inaccuracies and the consequent pitch variations — a defect to which the human ear is particularly sensitive. Speed variations at low frequencies are called wow and at higher frequencies they are called flutter — both very onomatopoeic terms.

The 'just audible' amount of wow and flutter is a complex combination of these pitch inaccuracies, the susceptibility of the individual to these types of distortion and the kind of music being played. As a guideline, wow and flutter below 0.08% is very good, between 0.01 and 0.15% is good, but above 0.2% a harsh sound quality becomes rather obvious.

What about rumble?

This is caused by minute irregularities in the finish of the turntable bearing and by vibration from the drive motor. It occurs at low frequencies, generally below about 50Hz, and when the rumble is even moderately bad, these low frequency signals produce large excursions of the loudspeaker cone and distort the programme signal. Unfortunately, most turntables tend to suffer from this defect. Rumble levels below about -70dB are just about inaudible, at -60dB they are becoming a nuisance, particularly if you prefer to operate your system with the bass control at maximum. Below -50dB they are intolerable to all but the tonally deaf.

How does a tuner work?

The tuner section amplifies the radio signal from the aerial and extracts information, passing it to the pre-amplifier section, adding as little distortion as possible. This is a very complex procedure.

How a tuner works; Aerials

There are two ways of transmitting domestic radio programmes. Amplitude modulations (AM) transmissions are put out on the long, medium and some short wave bands. In an AM transmission, a signal of fixed frequency or wavelength is made to vary in amplitude by the signal obtained from the microphone. These variations are detected by the tuner circuitry and converted to small audio signals which are then amplified and reproduced through the loudspeakers. Unfortunately, many stations use the same wavelength, there being three times as many medium and long wave stations as there is frequency space. This results in a great deal of interference. And, in addition, AM transmissions are affected by electrical interference produced by many domestic appliances, and this causes a crackling sound in the programme. Thus, it is almost impossible to obtain a reasonable hi-fi sound quality from an AM transmission.

Generally, BBC Radios 2, 3 and 4, and local BBC and IBA (Independent Broadcasting Authority) stations are transmitted in FM. In frequency modulation (FM) transmissions, a signal of nominally fixed frequency is varied in frequency by the microphone signals. These frequency variations are detected by the tuner circuitry and follow the same transformation as the AM signals. But, the FM signal is of far higher quality than the AM signal and is not subject to interference from domestic appliances.

Stereo radio is transmitted in FM on VHF bands (see the map and information on stereo broadcasting on the following pages), but the signal carrying the stereo programme must also be capable of producing a mono signal, compatible for use with mono tuners. The system adopted by the BBC for this purpose is the so-called multiplex system. At the transmitter, the left and right channels of the stereo pair are added together to produce a sum signal and this is transmitted in the normal way. Thus, anyone with a mono tuner, is able to receive a mono programme. However, to transmit stereo, a 'difference signal', which is the difference between the left and right channels (the one minus the other) and which contains the second channel information, is transmitted on a supersonic

sub carrier. The stereo decoder in the tuner then extracts this 'difference signal' and the left and right stereo channels are recovered and reconstituted from the sum and difference signals.

In some models, the signal is passed through a filter which prevents any supersonic frequencies from being audible, and it is then fed into the pre-amplifier.

How important is a good aerial system?

As correct loudspeaker positioning improves the overall sound quality, so the use of a good aerial will improve radio reception quite dramatically. The expenditure of a little time, effort and money (about £20-£30) will be well rewarded. Obviously the type of aerial you need will depend on the distance between you and a BBC transmitter and the type of country that a signal has to pass over — see the map indicating the location of BBC transmitting stations. If there are obstructions such as tall buildings, gasometers or an odd mountain or two, the reception of the radio signal will be impaired.

An inadequate aerial rarely results in weak signals from the loudspeakers as might be thought. The signal from the loudspeaker remains strong but it is accompanied by noise of various kinds during the quiet passages in the programme and there may be time when the distortions are high. Ensuring that you receive the optimum signal from a particular station may necessitate careful orientation of the aerial to maximise the signal you want and to minimise the signals you do not want. While the more complex aerials greatly increase the signal from the wanted station, they also reduce the signal from other stations, a possible disadvantage if you wish to attempt any long distance receptions.

In general, there is no substitute for a good outside aerial, but circumstances may make that impossible. At locations within 10 miles from a main BBC transmitter, there is some danger that a good aerial will produce a signal strong enough to overload the early stages of the radio receiver with the result that some stations will appear rather mysteriously at several points on the tuning scale. If this happens you may have to use an attenuator in

BBC VHF Radio Transmitting Stations

Engineering Information Department, BBC, Broadcasting House, London W1A 1AA. Tel: 01-580 4468 Ext. 292.

Names of relay stations are inset under the main station of the group.

ENGLAND

| | Radio 1/2, Radio 3, Radio 4 | | | Local Radio | | | |
|------------------------------|-----------------------------|----------------------------|---------|---------------|----------------------|------------------|---------------|
| | R1/2 | Frequencies (MHz) R3 R4 | | Max erp kW | | Frequency MHz | Max 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 | | | | | | | |
| Powridge | 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 | | | | | | | |
| Wenloe | 89.95s | 96.8s | 92.125s | 120 | Radio Bristol | 95.5 | 5 |
| Bath | 88.8s | 91.0s | 93.2s | 0.035 | | | |

Stereo Broadcasting in the UK

South West

| | | | | | | | |
|-------------------|-------|-------|-------|-------|--|--|--|
| Les Platons | 91.1 | 94.75 | 97.1 | 1.5 | | | |
| North Hessary Tor | 88.1s | 90.3s | 92.5 | 60 | | | |
| Barnstaple | 88.5s | 90.7s | 92.9s | 0.15 | | | |
| Okehampton | 88.7s | 90.9s | 93.1 | 0.015 | | | |
| Redruth | 89.7s | 91.9s | 94.1 | 9 | | | |
| Isles of Scilly | 88.8s | 91.0s | 93.2 | 0.02 | | | |

North

| | | | | | | | |
|-------------|-------|-------|-------|-------|------------------------|-------|------|
| Belmont | 88.8s | 90.9s | 93.1s | 8 | Radio Humberside | 96.9 | 4.5 |
| Holme Moss | 89.3s | 91.5s | 93.7s | 120 | Radio Leeds | 92.4* | 5.2 |
| Scarborough | 89.9s | 92.1s | 94.3s | 0.025 | Radio Sheffield (main) | 97.4* | 5.2 |
| Sheffield | 89.9s | 92.1s | 94.3s | 0.06 | (relay) | 88.6 | 0.05 |
| Wensleydale | 88.3s | 90.5s | 92.7s | 0.025 | | | |

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

Radio stations in the UK

North East

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

SCOTLAND

| | Frequencies (MHz) | | | | Radio 1/2, Radio 3, Radio Scotland | | | | Frequencies (MHz) | | | |
|---------------|-------------------|-------|----------------|------------|------------------------------------|------|------|------|-------------------|----|----------------|------------|
| | R1/2 | R3 | Radio Scotland | Max erp kW | | | | | R1/2 | R3 | Radio Scotland | Max erp kW |
| Kirk o'Shotts | 89.9s | 92.1s | 94.3s | 120 | Grantown | 89.8 | 92.0 | 94.2 | 0.35 | | | |
| Ashkirk | 89.1s | 91.3s | 93.5s | 18 | Kingussie | 89.1 | 91.3 | 93.5 | 0.035 | | | |
| Ayr | 88.7s | 90.9s | 93.1s | 0.055 | Orkney | 89.3 | 91.5 | 93.7 | 20 | | | |
| Campbeltown | 88.6 | 90.8 | 93.0 | 0.035 | Thrumster | 90.1 | 92.3 | 94.5 | 10 | | | |
| Forfar | 88.3s | 90.5s | 92.7s | 10 | Rosemarkie | 89.6 | 91.8 | 94.0 | 12 | | | |
| Lochgilphead | 88.3s | 90.5s | 92.7s | 0.01 | Ballachulish | 88.1 | 90.3 | 92.5 | 0.015 | | | |
| Millburn Muir | 88.8s | 91.0s | 93.2s | 0.025 | Fort William | 89.3 | 91.5 | 93.7 | 1.5 | | | |
| Perth | 89.0 | 91.2 | 93.4 | 0.015 | Kinlochleven | 89.7 | 91.9 | 94.1 | 0.002 | | | |
| Pitlochry | 89.2 | 91.4 | 93.6 | 0.2 | Melvaig | 89.1 | 91.3 | 93.5 | 22 | | | |
| Rosneath | 89.2s | 91.4s | 93.6s | 0.025 | Oban | 88.9 | 91.1 | 93.3 | 1.5 | | | |
| Toward | 88.5s | 90.7s | 92.9s | 0.25 | Penifiler | 89.5 | 91.7 | 93.9 | 0.006 | | | |
| Meldrum | 88.7 | 90.9 | 93.1 | 60 | Skriaig | 88.5 | 90.7 | 92.9 | 10 | | | |
| Bressay | 88.3 | 90.5 | 92.7 | 10 | Sandale | 88.1 | 90.3 | 92.5 | 120 | | | |

WALES

| | Frequencies (MHz) | | | | Radio 1/2, Radio 3, Radio 4 | | | | Frequencies (MHz) | | | |
|---------------|-------------------|------|------|------------|-----------------------------|--------|-------|-------|-------------------|----|----|------------|
| | R1/2 | R3 | R4 | Max erp kW | | | | | R1/2 | R3 | R4 | Max erp kW |
| Blaenplwyf | 88.7 | 90.9 | 93.1 | 60 | Llangollen | 88.85 | 91.05 | 93.25 | 10 | | | |
| Dolgellau | 90.1 | 92.3 | 94.5 | 0.015 | Wenvoe | 89.95s | 96.8s | 94.3s | 120 | | | |
| Ffestiniog | 88.1 | 90.3 | 92.5 | 0.05 | Brecon | 88.9 | 91.1 | 93.3 | 0.01 | | | |
| Machynlleth | 89.4 | 91.6 | 93.8 | 0.06 | Carmarthen | 88.5 | 90.7 | 92.9 | 0.01 | | | |
| Haverfordwest | 89.3 | 91.5 | 93.7 | 10 | Llandrindod Wells | 89.1s | 91.3s | 93.5s | 1.5 | | | |
| Llanddona | 89.6 | 91.8 | 94.0 | 12 | Llandiloes | 88.1 | 90.3s | 92.5 | 0.005 | | | |
| Betws-y-Coed | 88.2 | 90.4 | 92.6 | 0.01 | | | | | | | | |

NORTHERN IRELAND

| | Frequencies (MHz) | | | | Radio 1/2, Radio 3, Radio 4 | | | | Frequencies (MHz) | | | |
|-------------------|-------------------|-------|-------|------------|-----------------------------|-------|-------|-------|-------------------|----|----|------------|
| | R1/2 | R3 | R4 | Max erp kW | | | | | R1/2 | R3 | R4 | Max erp kW |
| Divis | 90.1s | 92.3s | 94.5s | 60 | Larne | 89.1s | 91.3s | 93.5s | 0.015 | | | |
| Ballycastle | 89.0s | 91.2s | 93.4s | 0.04 | Londonderry | 88.3 | 90.55 | 92.7 | 13 | | | |
| Brougher Mountain | 88.9s | 91.1s | 93.3s | 2.5 | Maddybenny More | 88.7s | 90.9s | 93.1s | 0.03 | | | |
| Kilkeel | 88.8s | 91.0s | 93.2s | 0.025 | Newry | 88.6s | 90.8s | 93.0s | 0.03 | | | |

Information courtesy BBC Engineering Information Department and Independent Broadcasting Authority

Independent Local Radio Network

Belfast

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

Birmingham

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

Radio stations in the UK

Bradford

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

Edinburgh

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

Glasgow

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

Ipswich

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

Liverpool

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

London

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

London

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

Manchester

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

Nottingham

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

Plymouth

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

Portsmouth

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

Reading

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

Sheffield & Rotherham

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

Swansea

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

Teeside

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

Tyne/Wear

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

Wolverhampton/Black Country

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

the aerial circuit, or if only local stations are required, a less efficient aerial will generally eliminate this kind of trouble. However, broadly speaking, the type of aerial system required is as follows:

Close to a station, within 10 miles from the transmitter, a simple dipole such as in fig 6, or the even simpler flexible dipole supplied with the music centre should be sufficient.

At 25 miles from the transmitter, a two or three element aerial should be used as in fig 7.

At 50 miles from the transmitter, the four or six element aerial of fig 8 should be used.

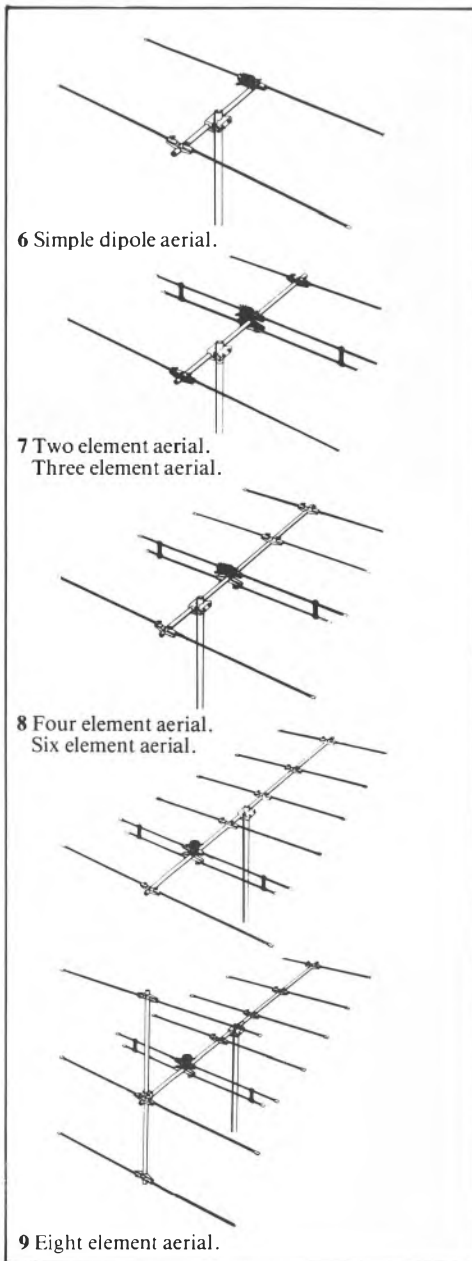
Over 50 miles from the transmitter, the eight element aerial shown in fig 9 should be mounted as high as possible on the side of the house facing the transmitter.

These suggestions are applicable if you use a receiver having a 'least usable sensitivity' figure (see reviews) below about 10 microvolts (μV). If your receiver has a 'least usable sensitivity' figure in excess of $10\mu\text{V}$, then it is suggested that you employ an aerial one step better than is listed on your location. These guide lines apply only if you are interested in receiving a programme from a main BBC station. If for geographical reasons you have to depend on any of the low power relay stations, it may be advisable to divide the distance between you and the transmitter by a factor of five, the eight element aerial being used at a distance of only 10 miles. If in doubt, the best policy is to consult your local radio dealer, who should be able to tell you about your local reception problems.

What is meant by the 'least usable sensitivity' measurement?

Tuner sensitivity is generally thought to be one of the most important specifications of a tuner. It shows how efficient the tuner will be at decoding a good stereo signal from what it picks up at its aerial socket. But, sensitivity alone can be a misleading indication of the tuner's capacity to receive distant stations with good quality. The signal to noise ratio achieved by the tuner is in fact much more important.

The figure quoted is in microvolts — μV . It indicates the signal from the aerial which will ensure that the inevitable noise and signal distortion is at least 30dB below the signals —



Tuner measurements

an acceptable sound quality for a less critical listener. Basically, the lower the figure quoted, the better — a good tuner having a 'least usable sensitivity' of around $2\mu\text{V}$, an average tuner around $5\mu\text{V}$, and a budget limited tuner about $15\mu\text{V}$.

Why have two signal to noise ratios been measured?

Both the signal to noise ratios indicate how well a tuner is able to receive a radio signal with the minimum amount of hiss and distortion.

The effective sensitivity of a tuner to a stereo signal is always lower than to a mono signal — a greater aerial signal being necessary to give an acceptable signal to noise ratio in stereo. On mono, the BBC consider that a signal of at least $250\mu\text{V}$ is required for adequate performance, but on stereo the minimum satisfactory signal is at least 1mV , 10-16dB higher.

The first signal to noise ratio gives the input voltage required to achieve an acceptable signal to noise ratio of 50dB when receiving a stereo signal. Low values are indicative of good performance, a tuner requiring an input of $60\mu\text{V}$ being very good, 60-100 μV average, while a low sensitivity receiver may require a signal in excess of $140\mu\text{V}$ to obtain a reasonable signal to noise ratio.

The second measurement expresses the signal to noise ratio for a relatively strong 1mV input signal (ie in stereo). A figure above 50dBA is acceptable, but some criticism may be expected from a listener living in a quiet area. With a figure above 60dBA, virtually all listeners would be satisfied, a value of between 65dBA and 70dBA being the maximum that can be achieved from the existing transmitting system.

What is AM rejection and why is it important?

This figure quoted, indicates how successful the tuner is at rejecting AM (amplitude modulation) signals whether produced by AM stations or domestic appliances. Values above 55dB are good, below 40dB inadequate.

What about the crosstalk measurement in this section?

As explained earlier this shows the amount of

leakage between left and right stereo channels and is indicative of the overall tuner/amplifier performance. It is the stereo decoding circuits in the tuner section that are generally responsible for poor crosstalk figures which degrade the stereo performance.

What is image rejection and why is it important?

Virtually all tuners are super-heterodyne types. This means that all the incoming signals from the aerial (which are always variable) are changed in frequency to the 'intermediate frequency' (IF — which is fixed) and then amplified in the IF amplifier section. This is because it is much easier to amplify a fixed frequency than a variable one. This intermediate frequency is obtained by combining the incoming signal frequency with a second frequency from a local oscillator and by using various filters. Generally speaking, this IF is between 455kHz and 475kHz for long and medium wave stations and much higher at around 10.8MHz for FM stations.

However, sometimes there is a station working on twice the IF frequency away from the wanted station, which can interfere with the reception of the wanted station. This is called it's image. The 'image rejection' figure indicates how effectively the receiver attenuates or rejects this image signal.

An image rejection of about 40dB is acceptable, but values of 55dB are desirable. A very well designed receiver will achieve an image rejection in excess of 70dB.

So, what is IF rejection?

As explained earlier, practically all FM tuners use an intermediate frequency (IF) around 10.8MHz. If you live close to a radio transmitter working near this frequency, you may be troubled by interference picked up directly on the IF sections of the tuner. A good tuner provides protection against this. The 'IF rejection' figure indicates it's effectiveness.

Values below 30dB are rather poor, but even so interference is only likely to be experienced if you live within a 100 mile radius of a transmitter working between 9 to 14MHz. If this is the case, values above 50dB are average and over 70dB excellent. Strangely enough, complaints about this form of

interference generally come from the North East coastal area.

How important is 'adjacent channel selectivity' and what does it mean?

Initially, all the FM stations in this country were spread out at frequency intervals of 200kHz. However, as public demand grew, later stations appeared at closer intervals. All tuners are designed to separate stations working on frequencies 200kHz away from each other in the 'adjacent channels'. The 'adjacent channel selectivity' measurement shows how sensitive a tuner is to interference from adjacent stations. A value of +5dB is good, +10dB or higher is very good. Negative values are only acceptable when the listener is within 30-40 miles of a main BBC station or when highly directional aerials are used to minimise the signal from any unwanted station.

Why is capture ratio important?

Unfortunately, broadcasting frequency space is limited. This has resulted in many stations having to transmit on the same or closely adjacent frequencies. Although the BBC and IBA have attempted to keep stations working on closely adjacent frequencies well spaced geographically, so that the minimum amount of interference is caused, many localities can still receive two stations on the same or similar frequencies. By rotating your aerial, one station can be favoured, but not always to the complete exclusion of the other. The capture ratio indicates the ability of the tuner to receive a strong station with the minimum amount of interference from a weaker station which is on the same frequency. A capture ratio of 2dB is very good, 6dB is average and 10dB is poor.

What is the '19kHz suppression' and why is it important?

As explained earlier, the 19kHz sub-carrier tone transmits information essential to the production of a stereo performance. It is generally inaudible except to very young ears, but unless it is adequately attenuated it may result in the appearance of 'birdie whistles' when the tuner is used with a tape recorder. In good tuners, a special filter is used to

eliminate this tone, but, in the cheaper models, it is more usual to rely on attenuating the audio frequency response.

Suppression of the 19kHz tone by more than 50dB is excellent, above 30dB adequate and below 10dB poor, although the actual incidence of trouble is also dependent on the tape recorder used. When the attenuation of the 19kHz pilot tone falls below about 25dB, a tuner that proves acceptable with one cassette recorder may be unacceptable with another. Some cassette recorders include a switch to change the bias frequency by a few kHz if 'birdie whistles' become obvious when recording from radio.

What is muting and how important is the muting level?

When tuning from station to station, a loud hissing noise is audible. Circuits can be included in the tuner to cut out the loudspeaker when tuning between stations, and so eliminate these bursts of noise. However, in doing this, the tuner also cuts out all stations below a certain set signal level. With tuners having 'least usable sensitivity' figures in the region of $3\mu\text{V}$, the muting circuit is usually set to cut off all stations with signal strengths below about $6\mu\text{V}$. This is the muting level.

How does a cassette recorder work?

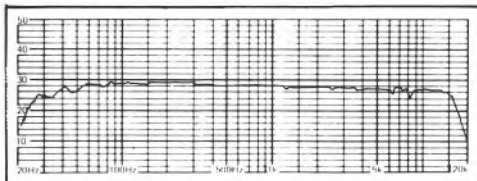
When recording, the cassette tape first passes over an erase head, to ensure that the tape is free from any previously recorded material. The tape, which is coated with millions of oxide particles, then passes a record head which is fed with an audio current. The programme is then recorded onto the tape in the form of variations in the magnetisation of the tape's oxide particles. On playback, the variations in the magnetisation of the tape's oxide coating are detected by the extremely narrow gap on the playback head. The variable magnetic field produced in the gap of the replay head induces an audio current which is then amplified and equalised in the replay amplifier. The equalisation process is simply a distortion of the signal as it is recorded and a mirror image correction on playback. This compensates for the deficiencies which are inherent in all types of

Cassette deck measurements

magnetic recording tape.

The type of tape used will affect the reproduction of the recording, and it is always advisable to buy good quality tapes and avoid the 'budget' variety.

Each cassette recorder will produce its best recordings on one particular type of tape, which is sometimes recommended by the manufacturer. This is because the ideal recording bias (which is a high frequency signal that moves the tape particles around to form the necessary pattern when recording) varies from one type of tape to another. Different types of cassette recorder have different bias settings, which will be suitable for one particular type of tape. However, chrome tapes have very special bias and equalisation characteristics and should only be used if you have a chrome (CrO₂) setting on your recorder. So, read the instruction manual, discover what type of tape the cassette recorder manufacturer recommends, try out a few brands, and when you have discovered which tape suits your recorder best, stick to it!



10 Record/replay response of a good cassette deck.

How important is the record/replay frequency response of the cassette deck?

Since most people record their own material from the radio or records, the record/replay response is very important as it shows the variation of output voltage over the frequency range from 20Hz to 20kHz. This will affect the quality of the recording made. Ideally, the frequency response should be flat to ensure that all the frequencies present in the original programme material are accurately reproduced at the same signal strength. If it is not flat and falls away at high and low frequencies, the bass and treble signals will be audibly reduced. The pen chart shown below in fig 10 reveals a slight loss of high frequencies, about 2dB down at 10kHz. Normally, a 5dB drop at 10kHz would be audible.

How important is azimuth alignment?

The correct alignment of the record/replay head is important if you regularly play commercial pre-recorded cassettes or tapes recorded on a friend's machine. Ideally, the gap in the record/replay head should be exactly at right angles to the guided edge of the tape. If the head is mis-aligned, high frequencies will be impaired, and in the worst cases, a series of peaks and dips will be introduced into the overall frequency response. However, if tapes are recorded and replayed on the same machine, no detrimental effects will be heard whether the heads are correctly aligned or not. This mis-alignment effect is frequently the cause of commercially recorded cassettes sounding 'dull'.

Azimuth mis-alignment is a fault that is almost impossible for the average owner to correct, so the ratings given in the reviews were measured with head alignment as received, but any serious mis-alignment is commented on in the reviews. It should also be noted that the amount of mis-alignment varies with the type of tape used, and provokes a different frequency response from different tapes used on the same machine.

What are the problems encountered with the signal to noise ratio in this section?

Unfortunately, the signal to noise ratio in cassette recordings is only marginally adequate even in the best machines. The noise is audible as background hiss in quiet music passages and necessitates a reduction in the loudness of orchestral music. The problem has been alleviated in the last few years by the introduction of noise reduction systems and improvements in tape quality, but the performance is often only marginally adequate for the reproduction of classical music which requires a wide dynamic range. A 60dB signal to noise ratio is necessary for an acceptable sound quality, and this is achieved by most of the recorders which include a noise reduction system.

Can you tell me more about the noise reduction systems?

Several systems are available for electronically reducing the amount of audible hiss in the quiet passages of a tape recording and thus

improving the signal to noise ratio. The best known is the Dolby system, which is used in almost all professional recording studios. It produces an improvement in the signal to noise ratio of about 10dB, which is very noticeable when judged subjectively. Basically, when recording, the Dolby system amplifies the quiet passages in the music. On replay, the system automatically reduces the volume of these passages to the normal level of the rest of the music. In doing this, the tape hiss has been suitably reduced.

Several other music centres used alternative noise reduction systems. The JVC units included two switch selected circuits — ANRS (audio noise reduction system) and Super ANRS. Broadly speaking, both aim to produce the same noise reduction as Dolby but neither have found wide use in professional circles. For best results, the recordings have to be made using ANRS or Super ANRS and in consequence are less effective if used on replay only.

The Philips music centres also employ their own noise reduction system — DNL (dynamic noise limiting), that continuously monitors the high frequency content of the recorded music and adjusts the high frequency response of the amplifier to be no wider than the spectrum of the music being reproduced. Thus, in quiet passages, where there is little high frequency content, the level of the background hiss is reduced by restricting the frequency range of the system. Though not nearly as effective as the Dolby circuitry, it can be useful on DNL recordings.

Why is output distortion important?

The maximum output signal that can be obtained from a magnetic tape is limited by the saturation of the magnetic coating. In a cassette recorder, this limit is usually indicated by the '0' or '100%' point on the recording level meter. Beyond this limit, distortion will generally be audible on replay. However, it is impossible to avoid over-stepping the '0' limit on the scale as otherwise the level of background hiss would be unacceptable. On some units, the '0' point on the scale may not indicate the maximum permissible signal level for all kinds of tape. The best way to discover the correct recording levels and the accuracy

of your meter is to experiment with various recordings until you have found the best compromise between excessive distortion and unacceptable tape hiss.

What about wow and flutter in the cassette deck section?

As explained in the record player section, wow and flutter are types of distortion produced by instantaneous speed inaccuracies and the consequent pitch variations. Values of 0.08% are very good, between 0.01% and 0.15% are good, but above 0.2% the distortion becomes very audible.

What about erase efficiency?

The erase head magnetically removes any previously recorded programme from the tape before a new recording is made. Unfortunately, this is never entirely successful and some signal inevitably remains on the tape and forms a background noise. Values in excess of 60dB are very good, around 55dB are good, but below 50dB are rather poor.

How important is the frequency response of the amplifier and loudspeaker?

Operating on the theory that the wider the frequency response, the better the amplifier, many consumers can be wooed into making the wrong choice. In practical terms, a flat frequency response from 20Hz to 20kHz is perfectly adequate, and in fact the majority of modern amplifiers are quite capable of achieving this.

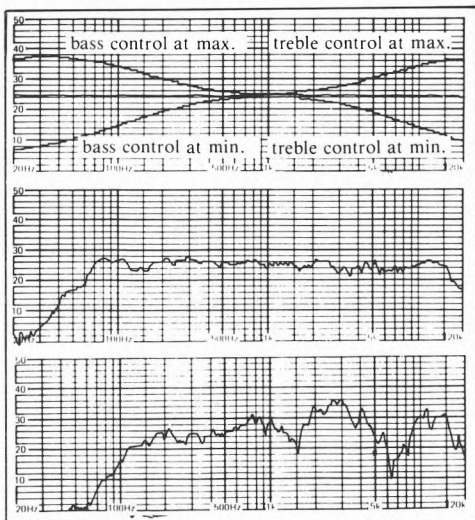
If the frequency range extends much below 20Hz, the loudspeaker cone may be driven to its limit and damaged by inaudible low frequency signals from, for example, a warp on a record or slow variations in the radio signal, it will certainly increase distortion. Extensions of the frequency range above about 20kHz has no significant effect on the sound quality, but results in the appearance of mains borne clicks and bangs generated by domestic electrical equipment and the signals from local radio transmitters which are carried along the mains power supply wiring. In fact, professional equipment rarely has a frequency response that extends as far as 20kHz.

Where loudspeakers are included with the

Loudspeaker measurements

music centres, the combined response of the amplifier and loudspeaker has been measured and the response chart included in the reviews. If no loudspeakers have been supplied, the pen chart shows the frequency response of the amplifier and the effect of its tone controls. In practice, the amplifier section of a music centre has a response that is much smoother than that of any loudspeaker, the amplifier response falling away slowly at both high and low frequencies, so the curve illustrating the combined performance is substantially that of the loudspeaker alone. All the 'wiggles' are due to the loudspeaker. These 'peaks' and 'dips' should be minimal, but 'peaks' produce more acoustic colouration than 'dips'.

A very good loudspeaker may have a response like the top curve, in fig 11 but a budget design may have the more restricted and peaky response indicated by the bottom curve.



11 Frequency response of a good amplifier plus a typical tone control response.
An excellent loudspeaker frequency response.
A poor loudspeaker frequency response.

And finally, how should I choose the right music centre?

Well, by now, you must have gleaned some of the basic facts of hi-fi technology and you are armed to tackle the reviews themselves. After

our exhaustive testing, we have been able to draw firm conclusions as to what are overall best buys or recommended units. But, we would like to stress that there may be units which have not been accorded the best buy status, but which may appeal to *you*, either aesthetically or because of some technical considerations. So, please read *all* the reviews to discover which is the music centre for you.

And on the subject of aesthetics and design — which after all is one of the most important factors in buying a music centre — Mark Brutton, Editor of 'Design' magazine has written an article on 'Aspects of Music Centre Design', explaining the practical considerations to take into account before making your final purchasing decision. So, read on.

Aspects of music centre design by Mark Brutton

Hi-fi manufacturers will tell you that music centres are *the* most important thing which is happening in the audio market — the non-technical music lovers' convenience pack. But, a music centre only makes sense if it is more simple to install, more simple to operate and more harmonious in your living room. In short, you should be looking for a very special kind of design.

Your needs start in the living room and not in the hi-fi shop. To create a convenient and agreeable home environment — to turn a 'house' into a 'home' — is the most difficult design assignment in the universe. Do not select a music centre as a gloriously isolated object; look first for a place to put it.

Although, loudspeaker positioning is a very important issue, you will find that they will sound pleasant in many positions; and every room offers its own alternatives. Loudspeakers are lightweight and relatively indestructible; and since they are each connected to the system by only one thin low-voltage wire, they can be happily dotted among the living room seats, doing useful service as plinths for ornaments, yesterday's newspapers, and so on. But, don't forget, the front grille must not be covered or obstructed in any way, or a muffled sound quality will result.

Much more difficult is the location of the 'Big Box' itself. For practical reasons, it must be: a) within reach of power; b) well lit, because dropping a stylus onto a record is nearly as difficult as threading a needle; c) at the right height to see and work the controls on the top surface, the controls on the vertical front edge and sometimes even the controls *underneath* the front edge (more of that later); and d) for the sake of the turntable, it must be isolated ('decoupled') from potentially shaky wood floors. In fact, no matter what the floor may be made of, a music centre is best fixed to the wall and not stood jog-prone on the carpet. If you put it on a wobbly coffee table, you are bound to have problems.

Such are the practical problems of location. Indeed, they may in your case be so great that you are driven, ironically, to buy not a music centre but something which separates the record deck from the rest (combined tuner/amplifier/tape decks are available). Then you can fix just the record deck to the wall (lowish, because all controls are on the top side) and put the rest, which suffers from no jog-proofing problems, on any surface you

choose (though it is neither technically nor practically desirable to separate the two by more than a few feet). If you go further and buy the equipment in three lumps (record deck, tape deck and tuner/amplifier) then your choice of location becomes even wider (high position for tuner/amplifier with controls all on the front; lowish position for tape deck with all controls on the top).

We begin to see that the clean simplicity of the 'one lump' idea is, in design terms, fairly tricky in real life. Because a music centre combines so many functions, it demands that an unusual number of conditions be simultaneously satisfied. I do not believe that the designers have in many cases solved their problems — and that goes for both the practical and aesthetic aspects.

As regards the look of the unit, buy whatever pleases you personally. But most emphatically, 'think living room' and try to ignore the entirely unnatural qualities of the showroom environment where you will first see your future possession. If you measure it, you will realise that it is going to look big when you get it home — as noticeable as the television. And since, unlike the television, it does not need to be seen, my best advice would be: put it out of sight altogether, in a stout, wall-fixed cupboard.

Am I spoiling your fun? There is one music centre in this review which, though I dislike it in all respects, I must praise for its 'discrete' qualities. That is the Dynatron MC-1010CR in its reproduction Jacobean cabinet. Though I disapprove of anything which tries to look like something else, I do believe that concealment is, in the case of music centres, a 'Good Thing'. The Dynatron is certain to be popular especially as it is available in other styles of 'reproduction' cabinets.

If, as is most likely, you plan to leave your music centre exposed, then remember one point: in the showroom, your music centre will be in fierce visual competition with the other products; at home, you will want it to harmonise. If it is 'good' in the first role, the

Aspects of music centre design

chances are that it will be 'bad' in the second.

For myself, I would pick a music centre with a plain, sharp-edged rectangular case, with a clear dust cover and a light-coloured finish. The knobs and dials will provide quite enough excitement. This is a personal choice which you are welcome to ignore; but it is best to try and think beyond the hi-fi showroom and beyond the first rapturous weekend of ownership. You only have to endure the close-up view of the unit when you use it; the middle-distance view is compulsory.

Now to the close-up view and a restatement of the music centre's basic promise: it is meant to be more simple than the 'four-lump', separates alternative. That certainly does *not* mean that it should reproduce music to a lower standard. Nor does it necessarily mean that it should have fewer controllable 'features', fewer knobs, switches and dials. But it does mean that it should be easier to install (see earlier comments) and, above all, easier to operate.

In fact the present generation of music centres follows the golden rule of all hi-fi marketing; the piece of equipment with the most elaborate facia *must* be fundamentally the best. Sometimes that may be true; but you don't need me to point out that it could as easily be false.

Relax: if you read the technical reviews, you are not about to be cheated. But good or bad, cheap or expensive, you will very often be lumbered with a control layout which has been designed to look as complex as possible — and is therefore confusing to use.

Most music centres actually aggravate this problem. When a record deck, tape deck, tuner and amplifier are designed as separate units, however complex the mixture of controls, you do at least know roughly where to find the one you want. When everything comes in one piece, the controls could be anywhere — and of course, designers will often seize this super opportunity and put them in the places where you would least expect to find them. Welcome to the flight deck — but do you sincerely want to learn to fly?

If you think this is a fuss about nothing, consider the operations involved in tape-recording a record — one of the most

important jobs which your music centre will perform but, quite likely, something which you have not done before. Better still, try it on a music centre in the showroom.

The record is turning, the needle is poised, the tape is loaded. You 'zero' the tape counter, press 'play' and 'record' buttons together, run off the 'dead' bit at the beginning of the tape and press the 'pause' button. You release the pick-up arm lift, wait for the 'bump' sound, release the tape 'pause' and grasp your recording level controls. Away goes the music, the recording level (VU) meters bounce into the red sector and within a minute or so, you are fairly sure that you have loused it up. Better find out. Lift pick-up arm, stop tape, reverse tape, press 'play' and listen. Nothing? Yes, you have forgotten to press 'tape monitor' which is cunningly concealed among filters, 'loudness', speaker on/off's and a dozen other controls which you will use perhaps once a year. Try again. Tape ready, record ready, down with the pick-up arm, wait for the 'bump' and — nothing. Yes, you have forgotten once again to press 'tape monitor.' Return to 'Go.'

Do not therefore feel that you must buy a machine with an absolute minimum of controls. But do look for the machine which a) clearly separates record deck, tape deck, tuner and amplifier controls and b) organises its controls in order of importance.

The most important controls are: the on/off switch, the volume control, the switches which determine whether you are hearing record, tape or radio; the tuner knob, the wave-change switches and, if you have them, the pre-set station switches; the mechanical tape controls, the recording level controls; the turntable start switch and the pick-up arm lever.

The things you need to see are: the on/off indicator light, the recording (VU) meters, the tuning scale and the record turntable (which is one reason why I favour a clear acrylic cover).

Basically, the rest is only occasionally useful (and, contrary to what you might imagine, that includes the balance and tone controls). All may be safely packed into the more inconvenient positions, for the sake of the important stuff.

Take care on two further points: you will

find it at least slightly irritating if the controls which you need to use while a record is playing are enclosed under the dust cover — the recording level controls, for instance. When you raise and lower the lid, the chances of jogging the turntable are particularly high.

More important, beware of vertical front-edge mounted 'displays' (such as the tuning scale) and any front-edge mounted controls which have to be seen to be used. For the sake of the turntable at least, you will have to mount your music centre low enough to see and operate the top-surface controls. But can you then also see the front-edge controls without crouching?

The problem does not apply to all front-edge controls: no one needs to read the word 'volume' to find a large, distinct volume knob. But some music centres have an armoury of identical-looking controls along their front edges — and the labels may even be written underneath. In extreme cases, as mentioned earlier, a row of controls may even be located *under* the front edge — identical to look at, identical to touch. In many more cases, you will discover vertical, recessed tuning scales which can only be read at eye level. These are problems which can seem insignificant in the audio showroom, so 'think living room'. Ask to see your potential music centre placed at the height at which it will be used, and judge the matter for yourself.

After so much negative comment, positive recommendations are in order. First, the Toshiba SM-3150. The shape is agreeably simple (a plain, sharp-edged rectangle) with as few different finishes as possible: just one-piece 'wood' for top and sides with satin metal for the easily distinguishable tape deck, record deck and vertical tuner/amplifier panel. Though the wood is of course imitation, there are no obviously fake finishes; I particularly dislike chromed plastics which never look right and will, moreover, wear off in time.

Four good-looking knobs on the vertical surface control tone, balance and volume. I believe that knobs are more easy to control accurately than sliders; are only needed when it is desirable to 'read' the setting (typically, the recording level controls). In fact, the Toshiba's level control is a knob on the front-edge fascia — good to have it out from under

the acrylic cover, but a pity that the knobs are identical in size, shape and colour.

Another good one is the Pioneer M-6500: two big, heavy knobs for tuning and volume, the way it should be. In general, beware of knobs which stand proud of the fascia, 'out on stalks'. It looks weak and may actually be weak: the spindles were bent slightly on a number of test models. Turn your knobs to see whether they hump up and down as they go round.

Ultimately, of course, your choice of music centre will be governed by one overwhelming consideration: does it give you the best possible music sound for the money you are prepared to spend? That is a technical matter. But remember that, all other things being equal, 'design' is the thing which 'makes the difference'. Among the music centres which might suit you, you will find, I think that all other things are indeed more or less equal. The difference is well worth your careful consideration.

WHY GUILDFORD HI-FI HAS A NUMBER OF PROBLEMS

SALESMEN Sales personnel at this establishment have a disconcerting habit of treating the customer as though they were human-beings and capable of rational actions. On occasion they have recommended equipment when it was not in sock and have even recommended that customers listen to the equipment in their own homes prior to purchase.

LOCATION This shop is unwisely located more than twenty miles from Tottenham Court Road out in the wilds of Surrey. Customers are even allowed to park within walking distance which is unfortunate since the customer is not completely exhausted upon entering the shop and might not purchase the first item that is thrust at him.

PRICES Prices at this shop tend to be higher than those of well-known discounters. They try to justify this well-known practice by offering generous trade-in allowances, hire-purchase facilities, delivery, installation, home-demonstrations and an extravagant guarantee.

BRAND-NAMES There is a genuine dearth of reassuring, well-known, household brand names at this establishment. Instead they make the iconoclastic and highly improbable claim that many other smaller, less touted manufacturers make equipment that actually sounds better, costs less, lasts longer and represents better value for money than the well known brands.

TECHNOLOGY This is going to be hard to believe but this shop actually stocks valve equipment. Everyone knows that valves have been dead for the past ten years, and no wonder! They are bulky, noisy, hot and they wear out. Their specifications are inferior to solid-state designs and to top it all they cost more than transistors. But these guys say that although this is true, Valve equipment still sounds superior and they intend to cater to people who care about listening to accurate music reproduction rather than those who are interested in mere technological innovations. To show that they mean business they now stock such outlandish brands as dB Systems, Paragon, Futtermans and Lux valve equipment and they threaten to bring in even more esoteric gear in the future.

GUILDFORD HI-FI

270 HIGH ST, GUILDFORD, SURREY Tel. 71534

This introduction explains the purpose of the various technical tests and discusses the test techniques used. It will obviously be advantageous to read the consumer introduction before attempting to cope with this section. Several of the test techniques are common to the record player, cassette and radio section of a system, and these are described in the next few pages.

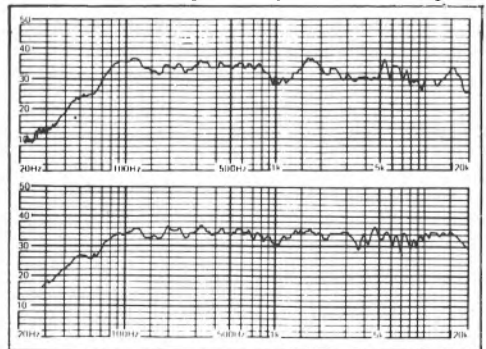
It is impossible to express the performance of technical equipment without making measurements and this requires a considerable collection of expensive test equipment. The absence of any measured data is often excused on the shallow argument that we do not listen with instruments but with ears, a point that is true but irrelevant. Both objective (instrumental) and subjective (listening) tests must be used to obtain any accurate and balanced evaluation of the performance of any sound reproducer equipment.

Because there are many methods of measuring any aspect of the performance of a music centre, it is essential that all measurement techniques and the methods of expressing the result should comply with one or other of the various international Standards. After considering all the various Standards that cover the test techniques used in the audio and radio field, it was decided that the tests should generally comply with those issued by the American Institute of High Fidelity Equipment Manufacturers as being the most recent and about the most comprehensive Standards currently available. In general there are no significant differences in the measurement techniques specified by the various national Standards, but they do not all use the same reference values for such parameters as the signal to noise ratio, modulation depth etc. One Standard may adopt a modulation depth of 100% as a reference while another adopts a modulation depth of 30%. The resultant signal to noise ratios measured on the same receiver by the two methods then differs by around 10dB. The use of differing instruments for measuring the noise level may result in a further difference of up to 12dB in the signal to noise ratio even though both instruments comply with some current Standard. Thus, it is important that the same references and same test techniques be used throughout the series of tests. Care must be exercised in comparing the quoted data with that measured by other Standards, or by non-standard or non-specified techniques, usually adopted because

they make the performance appear a great deal better than is justified. On all aspects of electrical safety, British Standard 415 and all its subsequent amendments have been followed.

As the amplifier and loudspeakers are common to all functions they set limits to the quality of the performance that can be achieved from any of the available programme sources, so the first series of tests were aimed at assessing the performance of these common features. Where loudspeakers are supplied with the music centre the amplifier and loudspeakers have been tested together as one unit. If the loudspeakers limit the performance of the system this is noted.

Several systems did not include loudspeakers in the quoted price, leaving the purchaser to choose speakers that please him and suit his budget. We had then to select speakers ourselves to allow us to carry out the listening tests, but this poses a problem in deciding just how much of the total budget can be devoted to buying loudspeakers. Broadly speaking, we have chosen loudspeakers that cost about one third of the system price, using a pair of Wharfedale Lintons for the lower price systems and a pair of Celef Mini Professionals for systems in the top price class. The frequency response charts of these two loudspeaker systems are in fig. 1.



1 Frequency response of Wharfedale Lintons
Frequency response of Celef Mini Professionals

Technical introduction

Frequency response

The measurement of the frequency response of an amplifier, or amplifier and speaker system is one of the simpler problems in measurement technology. In our laboratory it is automated, the frequency control dial of the signal generator being mechanically coupled to a B & K Type 2305 Chart Recorder. This sweeps the test frequency signal through the range from about 20Hz to 20kHz, the output of the amplifier under investigation, or from the measuring microphone being employed to deflect the stylus of the chart recorder to produce the charts shown in the reviews.

Most of the current generation of amplifiers will have a frequency response that is flat within $\pm 2\text{dB}$ over the audio frequency range between 20Hz and 20kHz, with any tone controls set into the zero position. This order of performance is much better than is really justifiable, but it is a performance that is relatively easy for the amplifier designer to achieve. It is virtually impossible for the loudspeaker designer to match the performance of a good amplifier, the frequency response and amplitude distortions being at least ten times worse than the equivalent performance of an amplifier.

The effect of the tone controls on frequency response is charted by the same equipment, both bass and treble tone controls being set first into their 'maximum' position to produce two limit curves on the assumption that any frequency response within these limits can be achieved by appropriate setting of the two controls. A range of adjustment of $\pm 10\text{dB}$ at frequencies of 100Hz and 10kHz is generally more than adequate to compensate for any deficiencies in other parts of the replay system. Thus the top curve in each chart displays the combined frequency response of the loudspeaker and amplifier and below this on the same chart a second pair of curves show the effect of the tone controls.

Signal to noise ratio

The upper limit to the loudness that is audibly acceptable in the listener's lounge is usually set by the harmonic and intermodulation distortions in the reproducer system, while the lower limit is set by the 'noise' that is always present in the signal from tapes, records or radio, or even road traffic. The reproduction

becomes subjectively unacceptable when these incidental noises have about the same loudness as the quiet sections of the programme signal, indeed the sound quality is generally unacceptable when the programme signal in the quieter passages is about 10dB higher than the noise. Though the noise so far discussed is that occurring in the recording and reproducing systems, acoustic noise in the domestic listening room is equally significant and may set a lower limit to the usable sound level. A user will generally adjust the volume control to make the quiet sections of the programme a little louder than the total acoustic noise present in the room, unless this brings the passages that have the maximum loudness to an unendurable level.

Subject to a maximum loudness limit of about 90dBA it is desirable that the ratio of the maximum signal to the residual noise be not less than about 50dBA, and preferably 60dBA, particularly if you live in a quiet residential area where the level of the acoustic noise in the lounge may not exceed 30dBA.

Now there are several ways of specifying the signal to noise ratio. It is usual to take the maximum output power of the amplifier as determining the upper limit of the signal power available and to compare this with the 'A' weighted level of the residual noise in the system measured in the absence of the signal. The 'A' weighting curve is the internationally standardised weighting relation used to bring objective measurements of noise level into agreement with the subjective opinion of a panel of listeners on the degree of annoyance aroused by the noise.

This process of specifying the signal to noise ratio would appear acceptable, but it is subject to some reasonable criticism. A 20 watt amplifier will produce loudness levels in a typical lounge of around 90-95dBA, about the maximum that anyone is likely to tolerate in a domestic environment. Changing to a 100 watt amplifier will increase the maximum possible level by 7dB, but it will not greatly change the maximum power actually used, merely because the 20 watt amplifier will provide all the power required. If the signal to noise is calculated from the maximum amplifier output and the 'A' weighted background noise, an increase in the power output of the amplifier system will increase the **quotable**

signal to noise ratio though it may well decrease the **achieved** signal to noise ratio. Any increase in the amplifier power output may result in some small increase in the electrical noise power output of the power amplifier and as this noise is constant irrespective of the volume control setting, the signal to noise ratio decreases as the volume is reduced.

Some further complications arise from the different techniques used for measuring audio noise. The British Standard specifies the use of the 'A' weighting frequency response in the measuring network, but in this respect it is out of step with current broadcast engineering practice which is in the process of changing to the use of a different weighting characteristic specified in CCIR Document 468. This weighting curve emphasises the contribution of the high frequency component of the noise to a greater extent than does the 'A' weighting relation. In consequence, the signal to noise ratios measured in accordance with the new requirements are generally about 5-12dB lower (worse) than when the 'A' weighting network is used. This emphasises the need for caution when comparing the performance claims made by different manufacturers.

Amplifier power output

There are almost as many methods of measuring the power output of an amplifier as there are methods of expressing the result and all the usual methods of measurement have some technical justification. In the present instance, the power output values quoted are those calculated from the readings of a true RMS reading voltmeter connected across a load resistance equal in value to the quoted impedance of the loudspeakers specified, the measurement being made at a single frequency of 1kHz. The readings are taken when waveform clipping is just visible on an oscilloscope. This 'just clipping' point generally corresponds to a harmonic distortion content of about 2%-3% but the distortion increases so rapidly at the onset of clipping that any quotation of the percentage distortion at this clipping point is almost meaningless. This is particularly true in the case of transistor amplifiers employing considerable amounts of feedback.

Where distortion values are quoted, they

have been measured using a Marconi wave analyser, Type 2330, or a B & K Type 2112 analyser, or a Hewlett Packard spectrum analyser, the input signal to the system under test being provided by a B & K Type 1014 signal generator having the output filtered to reduce the harmonic content. With appropriate precautions, the system is capable of measuring distortions down to about .001% or -100dB, a performance that was not approached by any of the systems tested.

Distortion at low power

The data table for each music centre includes information on the distortion at an amplifier power output of one watt. This is a surprisingly small amount of power but it is typical of the power levels employed in reproducing speech and music at an average rather than a hi-fi level.

Transistor amplifiers will generally deliver more power into a 4 ohm load than into an 8 ohm load. Thus two power outputs are quoted to provide an indication of the power that the amplifier is capable of delivering to the loudspeakers you select.

Amplifier noise

There is always some residual noise from the output stages of the amplifier that is not controlled by the amplifier volume control. The amplifier noise measurement in the review tables quotes this noise level as an unweighted RMS noise voltage. This is the signal which fixes the minimum noise level from the loudspeakers. A value of 2mV will produce a 'just audible' noise in a very quiet room. In a house near to a main traffic route a noise voltage of 20mV may be audible. The residual noise was measured by a B&K Type 2606 true RMS Voltmeter connected directly across the terminals of a loudspeaker.

Signal to Noise Ratio at Tape Output

Some of the systems provided an output voltage to drive an external tape recorder. The quoted signal to noise ratio at this socket is the ratio of the signal voltage available at this output to the residual noise present when the signal was removed.

Input Voltage for Full Modulation

Most of the systems included facilities for

Technical introduction

recording a signal from an external source, some of the systems having three separate sets of input sockets generally labelled Tape, Aux and Mike. We note the input voltage required to produce a 100%, 0dB or 0VU deflection on the recording level meters included in the system.

Tape output

Many systems provide an output signal for use in a separate tape recorder. The tape output figure indicates the output voltage available from the record player when this is playing a recording having a lateral velocity of 5cms/sec at a frequency of 1kHz. A typical music recording will provide a signal of about five times this value. This is a simple measurement of the voltage across the tape output terminals when a 1kHz recording of known lateral velocity is replayed.

Crosstalk

Ideally there should be no leakage of signal from either channel into the other channel, for this reduces the width of the stereo stage and at worst results in a monophonic performance. It is relatively easy to minimise the leakage in an amplifier but much more difficult to achieve the desired performance in a pick-up or tape machine. Crosstalk figures of 40dB are easily achieved in an amplifier. The crosstalk is usually a function of frequency but brevity restricts the quotation to the value at a frequency of 1kHz. The quoted figure is the ratio of the signal applied to either channel, to the leakage signal in the opposite channel.

Channel balance

With equal input signals to both channels the output voltage to the speaker terminals should remain in balance. This measurement indicates the degree of un-balance in dB at a frequency of 1kHz and with the volume control in its mid-position.

Signal to noise ratio

The signal taken as a reference in this instance is that provided by a record modulated at 3.45 cm/second at 1kHz while the noise is that due to induction into the pick-up and from all other sources when the pick-up is supported

just clear of the record surface.

The average value for all units tested was 60dB but signal to noise values above this are advantageous.

Channel balance

This has the meaning discussed in the amplifier section, but the record replay unit cannot approach the performance of the amplifier in this respect for any un-balance between the signals from two channel output from the pick-up are added to any un-balance that may exist in the tracking of the twin volume control.

Wow and flutter

This is the description of the pitch variation effect introduced by every mechanical link in the reproducer chain. The extent of these frequency modulation effects were measured using a Woelke ME 105 wow and flutter meter and a standard 3kHz recording of known low flutter content (Type B & K 2010) or a special direct cut record if the deck had a particularly good performance. This technique and the measuring equipment complies with the requirements of DIN 45,507.

Rumble

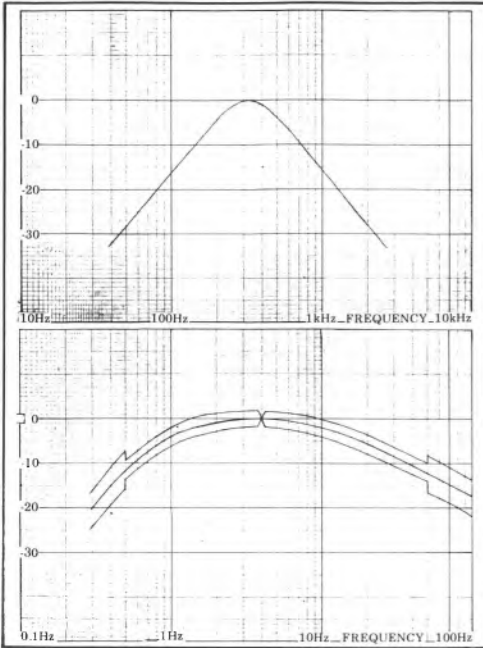
The relevant DIN standard specifies two weighting curves listed as Type A and Type B weightings. The Type 'A' weighting includes all disturbance frequencies below 300Hz and the Type 'B' weighting all disturbances having frequencies centred on 300Hz with a carrier frequency of 3kHz. The weighting curves are illustrated in fig. 2, the Type 'B' weighting being used for all the measurements quoted.

RECORD PLAYER SECTION

The problems discussed in the amplifier section have superimposed on them the problems of the record player section when this is being used. The distortions that beset the user of records have been dealt with in detail in a previous Hi-Fi Choice 'Turntables and Cartridges', so this limits the need to discuss the problems in great depth.

Frequency response

As the acoustically significant signal is that fed to the loudspeakers from the main amplifier output, the frequency response of



2 Weighting curve for wow and flutter measurements
Weighting curve for rumble measurements

the pick-up chain has been measured at the loudspeaker terminals. The resultant curve includes any irregularities that are present in the pre-amplifier and power amplifier, though these are rarely significant. This was one of the automated measurements included in the test programme, a standard B & K constant frequency record QR 2010 being played and the main amplifier output fed to a B & K Type 2307 level recorder to produce a chart showing the frequency response over the range from 20Hz to 20kHz. Frequency response, channel balance and crosstalk separation were all obtained from two rows in which the output voltage in both channels was measured first with the left channel only modulated and then with the right channel only modulated. The charts printed in the reviews can be directly compared with the similar charts published in 'Turntables and Cartridges'. In many instances the rumble level is sufficiently high to make measurement of crosstalk impossible below 100Hz.

Trackability distortion

The stylus load setting has been checked using a precision Correx gauge. Broadly speaking, the stylus loading should not exceed about 3 grams, and can be as low as 1.5g with advantage. It is doubtful whether there are any advantages in the use of ultra-low stylus loadings below about 1g.

If the compliance of the stylus suspension and the stylus load are not appropriately co-ordinated, the stylus will not stay in the record groove during heavy modulations, but the signal waveform will be greatly distorted at velocities below that at which the stylus actually jumps out of the groove. The increase in distortion with increase in recording velocity has been assessed using the pulsed 10.8kHz bands on the Shure tracking record TTR 103. The average value of the distortions measured at recording velocities of 15, 19 and 24cms/second are indicated in the review table. There is some disagreement among the pundits about the velocity up to which perfect tracking should be secured, largely due to the wide variation in the depth to which commercial records are modulated during recording. The nominal upper limit is 25 cm/second but there appears to be many recordings in circulation in which this limit is greatly exceeded. It should be emphasised that our trackability distortion values are not the usual harmonic distortion figures. They can only be compared with each other and with any other test data taken using the Shure test record TTR 103.

RADIO SECTION

Least usable sensitivity

Receivers can be built with any desired degree of sensitivity, but sensitivity alone is a misleading indication of the receiver's capacity to pick-up distant stations with good quality. The 'least usable sensitivity' is the signal from the aerial that will, broadly speaking, ensure that the inevitable noise plus signal distortion is at least 30dB below the signal. This is inadequate to ensure that the signal to noise ratio will satisfy the hi-fi enthusiast but it establishes an agreed level of signal to noise that is probably just acceptable to the least critical listener playing pop music.

The least usable sensitivity was measured

Technical introduction

with a 100% (1kHz) frequency modulated carrier signal provided by a Marconi 2008 or Marconi 2016 signal generator fed directly into the aerial terminals of the receiver section and reduced in level until the distortion and/or noise as measured at the loudspeaker terminals through a 1kHz null filter was just 30dB below the 100% modulated signal level. In accordance with the requirements of the IHF Standard, no weighting was applied when measuring the noise level.

Input to achieve a 50dBA signal to noise ratio
Much more important than achieving a low value for the least usable sensitivity is this parameter, which is the aerial signal required to achieve a signal to noise ratio of 50dB when receiving a stereo signal.

Signal to noise for 1mV input

An alternative method of indicating the performance is to quote the signal to noise achieved for a relatively strong signal of 1mV.

Distortion

Like every other part of the system, receivers introduce harmonic and amplitude distortion, and these add to the overall distortion. The distortion introduced by the receiver circuits is mainly due to bandwidth limitations in the IF section and to non-linearities in the detector, the distortion increasing with extension of modulation depth. The distortion was measured by applying a 97mHz FM signal to the receiver aerial terminals, the signal being modulated to a depth of 100% by a 1kHz tone. The overall distortion at the speaker terminals was then measured using the Marconi TF 2330 or B & K Type 2112 analysers, as appropriate. A value of about 1% was average, .5% very good and anything above 2% might be criticised.

AM rejection

AM rejection was measured by applying a 100 μ V 100% frequency modulated signal to the aerial terminals and noting the output level with the amplifier section to produce 1W RMS into an 8 ohm dummy load. Without altering any of the controls the carrier was then amplitude modulated to a depth of 30% and the change in receiver output noted. The AM

rejection ratio is expressed as the ratio in decibels of the output when the carrier is FM modulated to the output with amplitude modulation.

Stereo crosstalk

This has the meaning discussed in the amplifier section. The decoding circuits in a receiver can reduce the separation by introducing crosstalk between the right and left hand channel and so degrade the stereo performance. The figure quoted for separation in this section is an indication of the overall performance of the receiver/amplifier system. The amount of crosstalk was assessed by separately modulating the left and right channels of the stereo signal generator and measuring the leakage signal present in the opposite channel.

Image rejection

The circuit design and layout of the first few stages of a receiver are always intended to eliminate any station that happens to be working on a frequency twice the IF frequency away from the wanted station of the pair, and the 'Image Rejection' indicates how effectively the receiver attenuates this image signal.

Image rejection was measured by applying a 100% frequency modulated carrier signal to the aerial socket and tuning the generator to the image frequency. The signal level at the image frequency was increased in level until a 30dB signal to noise ratio was obtained at the frequency to which the receiver was tuned, the quoted image rejection being the ratio in decibels of the signal at the frequency to which the receiver was tuned to the signal at the image frequency.

IF rejection

IF rejection was measured by applying a 100% (1kHz) frequency modulated 95mHz signal to the aerial and tuning the generator to the receivers intermediate frequency (usually 10.7mHz). The signal at the intermediate frequency was increased in level until a 30dB signal to noise ratio was obtained on the programme to which the receiver was tuned, the quoted IF rejection being the ratio in decibels of the signal at the tuned frequency, to the signal at the IF frequency.

Adjacent channel selectivity

All radio receivers are designed to receive a wanted station without interference from stations working on frequencies 200kHz away from each other in the 'adjacent channels'. The figure in dB quoted for the adjacent channel selectivity is the amount by which the strength of the unwanted adjacent channel signal can exceed the strength of the wanted station and still produce a signal to noise ratio in the wanted station of 30dB.

Adjacent channel selectivity was measured by applying a wanted signal at a level of 100 μ V (unmodulated) to the aerial terminals and tuning the receiver accurately to this signal. A second generator was then connected (via suitable isolating circuitry) to the receiver and varied in frequency by \pm 200kHz, one standard channel separation (200kHz) with respect to the wanted signal frequency. The unwanted signal modulated to a depth of 100% by a 1kHz signal was gradually increased in level until the level of the 1kHz breakthrough into the wanted channel was only 30dB below the output obtained with 100% modulation in the wanted channel. Adjacent channel selectivity is quoted as the ratio (in decibels) of the unwanted RF signal to the wanted RF signal.

Capture ratio

It is a considerable advantage of an FM receiver system that the presence of a wanted station can prevent, or at least greatly reduce the signal from an unwanted station on the same, or a closely adjacent frequency. In a good receiver a wanted station will eliminate an unwanted station when it is only a few dB above it in radio signal strength. The input signal level difference at which an unwanted station is reduced in strength by 30dB is quoted as the 'Capture Ratio'.

Capture ratio was measured by connecting two signal generators simultaneously to the receiver under test. With both generators set to the same carrier frequency, one generator was set to give a 100 μ V 100% frequency modulated signal whilst the signal from the second generator was gradually increased in level until the audio output had fallen by 1dB. The level of the unwanted interfering signal was then increased until the audio output had fallen by 30dB. The capture ratio quoted in

the reviews is then the difference between the two values measured in decibels, divided by two.

Pilot carrier suppression

In good receivers special filters are used to eliminate the 38kHz and 19kHz stereo pilot tones and ensure an absence of 'birdie whistles' when the receiver output signal is being tape recorded, but in a budget priced receiver it is more usual to rely on increasingly attenuating the audio frequency response above a frequency of about 10kHz.

The data tables in the reviews notes the attenuation of the 19kHz tone that is achieved, all the receivers included in the present series of tests providing reasonably adequate attenuation of the 38kHz pilot.

When the attenuation of the 19kHz pilot tone falls below about 25dB a receiver that proves acceptable with one cassette recorder may be unacceptable with another make of recorder. Some cassette recorders include a switch to change the bias frequency by a few kHz if 'birdie whistles' become obvious when recording from radio.

Muting level

With receivers having least usable sensitivities in the region of 3 μ V the muting circuit is usually set to cut off all stations having strengths below about 6 μ V. This is the muting level. There are advantages in having a user-adjustable muting level for this allows the muting to be set to a level that is appropriate to the users location. In a town centre or near industrial areas the noise level is likely to be much higher than in country districts well away from electrical equipment etc., and making it possible to use a muting level approaching the least usable sensitivity value figure for the receiver.

Electrical frequency range

The requirements are the same as those discussed in the amplifier section and the test technique is basically the same. Instead of applying the variable frequency audio signal direct to the input terminals of the audio section, it is used to modulate (in stereo) a Marconi Type 2008. 2016 or Radiometer SMG1 signal generator tuned to a frequency in the region of 100mHz. This RF signal is

Technical introduction

applied to the aerial terminals of the radio unit and the audio modulating frequency swept through the usual frequency range of 20Hz-20kHz. The output voltage at the loudspeaker terminals is used to obtain a chart recording of the frequency response using the B & K Type 2305 chart recorder exactly as discussed previously.

Channel balance

The effects of channel un-balance in the receivers are exactly the same as discussed previously in connection with the amplifier section.

CASSETTE TAPE SECTION

Frequency response

As most users employ their machines for replaying tapes that they have recorded themselves it is the combined record/replay characteristic that is of major significance and it is this overall curve that is illustrated in the consumer introduction and each review. To assess the overall performance, a sine wave signal from a B & K Type 1014 oscillator was swept through the frequency range from 20Hz to 20kHz, at constant level and recorded on that tape. On replay, the tape and chart were synchronised to produce a pen chart showing the overall record/replay frequency response.

Azimuth alignment

The degree of mis-alignment of each head was checked by replaying a specially recorded 3kHz two track cassette known to meet the azimuth standards and comparing the phase of the signals from the two tracks. Mis-alignment is a fault that it is almost impossible for the average owner to correct, so all the performance data quoted was taken with the head alignment as received, but any serious mis-alignment is noted in the discussion of each machine.

It should be noted that the amount of mis-alignment varies with the type of tape used, one cause of the differences in frequency response that appears when different tapes are used on the same machine.

Signal to noise ratio

This has the same meaning and significance as before. The signal value is that recorded at the

zero on the cassette recording level meter while the noise is that measured with a new un-recorded tape run through the machine. When Dolby noise reduction circuitry is included the figure quoted in the reviews is the signal to noise ratio with Dolby in action. This improves the signal to noise ratio by 8-10dBa.

Wow and flutter

This is exactly the same as the problem encountered in the record player section.

Erase efficiency

The efficiency of the erase process is assessed by recording a 1kHz signal at full amplitude and then running the tape through the machine on its record settings, but without any applied signal. The ratio of recorded signal to the erased signal is then quoted as the erase efficiency.

LOUDSPEAKERS

Loudspeaker frequency response

Where loudspeakers are included with the music centre, the combined response of the amplifier and loudspeaker has been measured and the response chart included in the discussion of each centre. In practice, the amplifier section of a music centre has a response that is much smoother than that of any loudspeaker, the amplifier response falling away only slowly at both low and high frequencies so the curve illustrating the combined performance is substantially that of the loudspeaker alone. All the 'wiggles' are due to the loudspeaker.

The response is measured with the loudspeaker mounted at a height of approximately 2-5 metres above ground with the B & K half inch microphone at a distance of 1 metre from the speaker. The measurements are carried out in the open air under free field conditions, investigation having shown that the measured frequency is substantially independent of the location of the test equipment in the 2 acre open area.

A sine wave signal from a B & K Type 1014 signal generator is swept through the frequency range from 20Hz to 20kHz by a mechanical coupling to the chart recorder. The use of an unmodulated sine wave signal is a critical test of loudspeaker performance for

it illuminates all the minor variations in output due to phase cancellation between units in a multi-unit speaker system, and all the variations due to cabinet edge and depth effects. These undoubtedly exist, but their importance is not yet confirmed. It will be seen that in using sine wave signals the test technique agrees with that used for the earlier Hi Fi Choice publication on 'Loudspeakers'. This allows the response curves in the two publications to be directly compared.

Distortion

All loudspeakers introduce some distortion into the audio signal, adding harmonics and intermodulation tones that do not exist in the signal from the amplifier. The amount of distortion was evaluated during the frequency response measurements, the B & K 12mm microphone being mounted at a point one metre from the speaker and on the axis. The input signal to the loudspeaker was adjusted to give a sound level of 90dB at frequencies of 1kHz and 4kHz., and the distortion in the output signal from the microphone analysed using the Marconi Type 2330 wave analyser. The figure quoted is the average of the distortion values at the two frequencies.

Listening tests

A pair of keen ears will reveal any deficiencies in sound quality more rapidly than an objective approach and it takes every factor into account, so the objective tests were supported by carefully controlled listening tests using several experienced observers. First generation 15ins/sec tapes and direct cut discs were available, all covering the same selection of spoken and musical material. The signal on the tape was transferred from the tapes to cassettes on a Technics 9900 professional cassette deck allowing a direct comparison of the sound quality from two music centres, both reproducing the same programme. Generally the cassette being assessed was run a few seconds behind the reference cassette so any section of programme heard on one machine was repeated on the other to allow an immediate comparison of the sound quality of the two units.

When assessing the performance of the radio sections the same basic technique was

used, the 15in/sec tape being used to stereo modulate a Radiometer SMSG1 signal generator to provide equal radio signals to both receivers. When BBC programmes of good quality were available, the two receivers were tuned to the same station and heard alternately.

The record sections presented some special problems insofar as it was not possible to compare the performance of the record/replay facilities against that of the radio and cassette sections, all using the same programme except when testing a few of the top quality units. The same programme was available in all three formats but the records were of the direct cut type, usable without significant deterioration in sound quality for only ten to twenty playings. In consequence, these special discs were used only for the final comparison on the top ten units. All the preliminary comparisons were made using two copies of the same commercial record, carefully selected from current lists for their outstanding sound quality. In selecting all the material we had excellent co-operation from Decca, EMI, Enigma and Pye, all of them providing advice and selected recordings.

A small panel of experienced listeners carried out the comparisons both as a panel, listening together at the same time, or individually when the listener was able to sit and compare each unit, with a reference unit (JVC 55LS) for just as long as he thought necessary to confirm his judgement. This reference unit was one in the average price class, objectively tested and found to have a reasonable performance. It was allocated ten points and the performance of each of the other centres was ranked against the reference unit for each of the panel. The most effective comparison technique allowed each individual observer to assess the performance while manipulating the equipment himself and allocating separate ranking marks for record player, cassette and radio performance. The third observer also ranked the performance but then took note of any differences of opinion and made a special check of these aspects or arranged for some of the objective tests to be repeated. Where more than one model was submitted by a manufacturer the models were also compared with each other in

Technical introduction

the same way.

At the conclusion of the tests on the units the top five centres were compared with each other in a paired comparison test. The five receivers towards the bottom of the ranking were also given a paired comparison check.

It is worth emphasising that the differences in sound quality between the 'best buy' units is not large and is generally less than the difference between successive items in a broadcast programme. Thus the final choice between 'best buy' recommendations can generally be made on such aspects as appearance, size, facilities provided.

The sound quality of practically all the music centres was limited by the loudspeakers supplied with the centre, rather suggesting that there are advantages in choosing your own loudspeaker, though it should be emphasised that the speakers supplied were generally a great deal less costly than units bought separately on the open market.

Electrical Safety

British Standard 415 specifies such safety requirements as the minimum clearance between live parts, the use of earthing connections to metal parts, the precautions necessary to prevent accidental contact with live parts, colours of the leads in the mains cable etc. Each unit has been examined for compliance with ten of the most important aspects of the Standard and any infringement noted. However it should be appreciated that not all failures are equally important. A single pole mains switch wired into the neutral lead is much more dangerous than the absence of an anchorage for a lead to prevent it touching some live part if the soldered connection fails, so we have commented on the dangers of each failure to comply with B.S. 415.

The ten selected safety infringements are listed with a brief note interpreting the requirements. These are numbered and the number quoted in each data table.

At the moment, the safety requirements are rather ambiguous. Many of the items of equipment are of European origin and are designed to meet the electrical safety requirements specified by IEC 65. As in other areas, the B.S. 415 safety standards are in the process of being adapted to match the European IEC standards. However this may

take two to three years, and even then there may still be anomalies.

Legally all equipment sold in England must comply with B.S. 415 at the time it is sold, but, equally reasonably, equipment complying with IEC 65, but not complying in detail with the existing requirements of B.S. 415, is unlikely to present a serious safety hazard to the user.

B.I.S. 415 — Safety aspects

1. 5.3.1 Rated supply voltage and frequency label on equipment.
2. 5.3.2 User instructions fitted to the mains cable.
3. 9.1.1 Insulated or captive covers over live terminals outlets (i.e. mains outlets).
4. 9.1.4 Ventilation openings not dangerously positioned near any mains terminals (test pin 4mm Ø 100mm long test chain 2mm Ø 100mm long) suspended.
5. 9.3.2 All accessible metal parts should be either:
 - (a) Earthed and have creepage and clearance distance 3mm.
 - (b) Separated from live terminals by 8mm air even when wires are disconnected (i.e. cable should be adequately anchored to restrict any movement).
 - (c) Adequately insulated using barriers.
6. 14.5.2 Ratings on or near fuse holders.
7. 14.6.1 Mains switch (if power taken exceeds 5VA) of the double pole type. If less than 5VA single pole type is permissible if a label is attached specifying that equipment should be disconnected from mains when not in use.
8. 15.2 Safety earth socket should be positioned near mains leads and should not be capable of being loosened by hand — adequately marked i.e. (no mains inlets etc. within 25mm of terminals (see 9.15(1)) of any type.
9. 15.3.1 Adequate termination of mains cables (i.e. 8mm long strand must not touch metal parts).

10. 16.1 Adequate fixing of mains cables (knots or string not permitted).

Three to four minute extracts from the following titles were used for the comparative listening tests:— Chabrier 'Espania' with the National Philharmonic Orchestra; 'Concerto de Aranjuez' with the Norrie Paramor Orchestra; Mozart Piano Concerto No 21, 2nd Movement; 'Instant Concert' with the Royal Doulton Brass Band; 'Blue Champagne' with Acker Bilk, His Clarinet & Strings; Strauss — Tales from the Vienna Woods; 'Top Hat, White Tie & Tails' with Ken Moule & his Orchestra; Overture 1812 with the London Philharmonic Orchestra. The records used were:— Saint Saens Symphony No 3 with Zubin Mehta and the Los Angeles Philharmonic (Decca SXL 6482); Beethoven Piano Sonatas with John Lill (Enigma VAR 1003); Richard Strauss 'Also Sprach Zarathustia' with Zubin Mehta and the Los Angeles Philharmonic (Decca SXL 6379); Burt Bacharach 'Portrait in Music' Vol 2 (A & M AMLS 68159); Beatles 'Abbey Road' (Apple Records PCS 7088). Additional material consisted of direct voice recordings, a selection from 'Live and Let Die' and some percussion sections from a Technics tape. All the material was carefully selected from a much larger collection of recordings replayed on the laboratory reproducer system.

BEST BUY

Aiwa AF-5050

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



A compact 19 watt system of above average performance in a wood grain finish enclosure with a brushed aluminium front panel that carries all the controls and the radio tuning scale. This allows the owner to operate the equipment with the perspex cover closed. All the controls worked particularly smoothly. Facilities are average in number but are probably more than adequate for 95% of users. An unusual facility shared with the more expensive 5090 is the co-ordination of the record playing and cassette control facilities. When the system is set up to transfer the contents of a record to a cassette, the cassette mechanism does not start recording until there is a programme available from the record. Another unusual facility is the permanent connection of the twin modulation depth meters across an early stage in the amplifier leaving them in operation, whichever facility is in use.

The two speed record player is a semi-automatic mechanism of robust construction and average performance. The arm includes a calibrated stylus pressure adjustment and an uncalibrated anti-skating adjustment. The whole mechanism is spring mounted and the controls mounted on the plinth are sufficiently light in action to eliminate groove jumping when the controls are operated. Crosstalk is low over the whole frequency range. The frequency response is good and both tracking distortion and rumble are low.

A particularly robust cassette mechanism is fitted. It includes twin modulation depth meters, a three position bias and equalization

adjustment for ferric, ferro-chrome and chromium tapes, a digital footage counter and Dolby noise reduction. All the tape motion controls on the front edge are very smooth in action. The cassette rejection mechanism is nicely damped in operation. The measured frequency response is within $\pm 2\text{dB}$ over the range 40Hz to 12kHz, signal to noise ratio is fair but the erase facilities would benefit from some attention.

The radio receiver has a good average performance adequate in almost every situation. Signal to noise ratio, and harmonic distortion at 100% modulation are particularly good. The tuning scale is large and clearly printed and well illuminated and the scale includes a small but not too effective tuning meter and a stereo indicator light.

All the assessors were impressed with the quality of sound, particularly on radio and tape, it was relatively clean and clear with a bass and treble response that extended beyond the average range of units in this price class.

The loudspeaker frequency response was reasonably good being within $\pm 5\text{dB}$ between about 70Hz and 14kHz. The radio response of the record player were also good.

Overall, good value for money.

Amplifier Section

| | |
|--|--------------|
| Power output into 8 ohms | 17W |
| Power output into 4 ohms | 19W |
| Distortion at low power output 1W | 0.08% good |
| Amplifier noise | good |
| Signal to noise ratio for tape output | 74dB average |
| Input voltage for full modulation Tape | 190mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 600 μ V |
| Tape output | 68mV |
| Stereo crosstalk | 43dB average |
| Channel balance | v. good |

Record Player Section

| | |
|---|--------------|
| Frequency response | good |
| Trackability | v. good |
| Signal to noise ratio | 66dB v. good |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.12% good |
| Rumble | 61dB good |

Tuner Section

| | |
|------------------------------|-----------------|
| Least usable sensitivity | 14 μ V good |
| Input for 50dB signal/noise | 40 μ V good |
| Signal/noise for 1mV input | 66dB average |
| Distortion | 0.5% good |
| AM rejection | 59dB good |
| Stereo crosstalk | good |
| Image rejection | 40dB average |
| IF rejection | 72dB average |
| Adjacent channel selectivity | +3dB good |
| Capture ratio | v. good |
| 19kHz suppression | 50dB average |
| Muting level | 2.4 μ V |
| Frequency response | good |

Tape Section

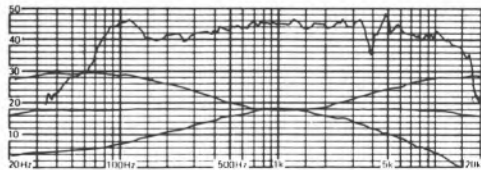
| | |
|----------------------------------|--------------|
| Record/replay frequency response | good |
| Azimuth alignment | poor |
| Signal to noise ratio | 56dB average |
| Distortion output | good |
| Wow and flutter | 0.2% fair |
| Erase efficiency | 48dB average |

Loudspeakers (where provided)

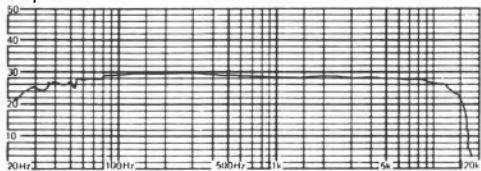
| | |
|---|-----------|
| Frequency response of amplifier and speaker | average |
| Distortion | good |
| Sensitivity | average |
| Length of loudspeaker lead | 4.7m good |

General Data

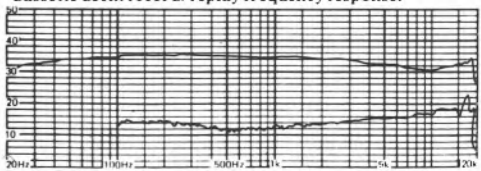
| | |
|---|------------------------|
| Compliance with British safety standards | — |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | very good |
| Typical selling price inc. speakers and VAT | £340.00 |
| Typical selling price ex. speakers and inc. VAT | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

BEST BUY

Aiwa AF-5090

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



This is the premium model in the Aiwa range with an amplifier system having a measured output of 31 watts. The enclosure is finished in teak, all the operating controls being mounted on a larger than usual brushed aluminium vertical front panel. Thus the unit can be used with the perspex cover closed. Very comprehensive facilities are provided, including separate VU meters for the left and right channels, a tuning meter, loudness contour and muting switches. The two VU meters are in circuit for all three signal sources, their readings being independent of the volume control setting. The radio tuning scale is large and clearly marked, a short waveband (6 to 16MHz) being included in addition to the long, medium and FM wave bands. When the system is set up to transfer music from a record to the cassette, the cassette mechanism does not start until activated by the pick-up arm mechanism.

A good two speed automatic turntable is mounted on a spring isolated plinth, the tone arm being provided with a calibrated stylus pressure adjustment. Anti-skating adjustment is included but it is uncalibrated. Tracking distortion and rumble were low, the signal to noise ratio and frequency response being particularly good, and wow and flutter about the best we found in the series of tests.

The cassette mechanism and all the tape motion controls are particularly smooth in operation and a delight to use. The cassette is inserted through a vertical hinged flap on the left side of the front panel, an unusual arrangement but one that is very convenient.

A three position switch selects the bias and equalization appropriate to chrome, ferric-chrome and ferric tapes. The general performance was good, wow and flutter being low but the efficiency of the erase facility could be improved with advantage. Unusually, a cassette storage rack is included on the left hand side of the deck adjacent to the record player.

It holds seven cassettes, but surprisingly it is just above the well screened mains transformer. However some careful tests indicated that this location had no adverse effects on the tape noise or treble response of any cassettes stored in the rack.

The radio section has a good performance, the data table showing that most aspects of the performance exceeded that of the budget version centre, the Aiwa AF-5050. The signal to noise ratio for a 1mV signal reached a record 72dB and an input of only 25 μ V was required to give a signal to noise ratio of 50dB indicating not only that the receiver was sensitive but that this sensitivity provided a good noise-free signal from weak stations. The tuning cursor is illuminated only when the receiver is correctly tuned to a station, a useful device. The tuning meter is a much more effective indicator of the correct tuning point than the similar instrument fitted to the Model AF-5050. The frequency response measured from aerial terminals to loudspeaker terminals was well maintained up to 15kHz, particularly commendable in view of the excellent suppression of the 19kHz sub-carrier.

For the listening tests, two Celef

loudspeakers were used. These are good loudspeakers costing about one one half the price of the music centre.

In three separate listening sessions all the assessors were in agreement about the good standard of the performance. The distortion was low and bass and treble response were significantly better than the reference unit, providing greater clarity and a more precise stereo image.

Overall, good value for money.

Amplifier Section

| | |
|--|---------------|
| Power output into 8 ohms | 24W |
| Power output into 4 ohms | 31W |
| Distortion at low power output 1W | 0.1% average |
| Amplifier noise | good |
| Signal to noise ratio for tape output | 93dBa v. good |
| Input voltage for full modulation Tape | 195mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 400µV |
| Tape output | 95mV |
| Stereo crosstalk | 41dB fair |
| Channel balance | v. good |

Record Player Section

| | |
|----------------------------|---------------|
| Frequency response | good |
| Trackability | v. good |
| Signal to noise ratio | 69dBa v. good |
| Channel balance | v. good |
| Wow and flutter at 33½ rpm | 0.09% good |
| Rumble | 61dB good |

Tuner Section

| | |
|------------------------------|---------------|
| Least usable sensitivity | 1µV good |
| Input for 50dB signal/noise | 25µV v. good |
| Signal/noise for 1mV input | 72dBa v. good |
| Distortion | 0.5% good |
| AM rejection | 59dB good |
| Stereo crosstalk | good |
| Image rejection | 50dB good |
| IF rejection | 99dB v. good |
| Adjacent channel selectivity | +3dB good |
| Capture ratio | good |
| 19kHz suppression | 52dB good |
| Muting level | 4µV |
| Frequency response | v. good |

Tape Section

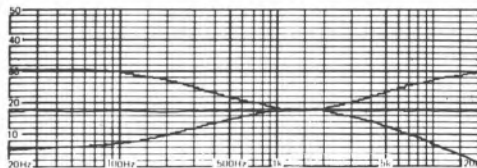
| | |
|----------------------------------|------------|
| Record/replay frequency response | good |
| Azimuth alignment | poor |
| Signal to noise ratio | 62dBa good |
| Distortion output | v. good |
| Wow and flutter | 0.13% good |
| Erase efficiency | 49dBa fair |

Loudspeakers (where provided)

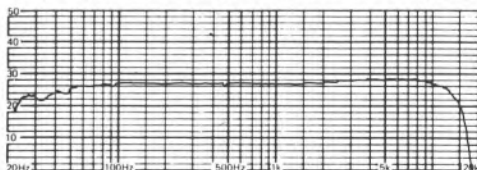
| | |
|---|---|
| Frequency response of amplifier and speaker | — |
| Distortion | — |
| Sensitivity | — |
| Length of loudspeaker lead | — |

General Data

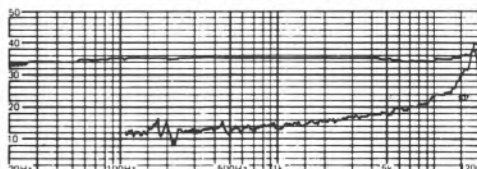
| | |
|---|------------------------|
| Compliance with British safety standards | — |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | good |
| Overall sound quality | v. good |
| Typical selling price inc. speakers and VAT | — |
| Typical selling price ex. speakers and inc. VAT | £400.00 |



Frequency response of amplifier and tone control response.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

BEST BUY

Akai AC-3800L

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



A high power system (40 watts per channel) that has a smaller than average deck area as a result of building the cassette unit into the front panel. However this makes the system somewhat deeper than average, but it has special appeal to those having a shelf of restricted area in which to stand the system. The system is metallic finished with a brushed aluminium front panel carrying the tuning scale and has an attractive engineering look about it.

A belt drive semi-automatic two speed turntable is incorporated, mounted on a separate resiliently supported plinth, the well finished tone arm having a calibrated stylus load adjustment but no calibrated anti-skating adjustment. There is a well damped lever operated control for lowering the pick-up.

The measured frequency response was flat down to 20Hz but tailed away slowly above 2kHz, being about 3/4dB down at 10kHz, but returning to the mid-frequency level right up to about 19kHz. Crosstalk was not as good as expected, there being considerable difference between left and right channels. Rumble, wow and flutter, signal to noise and tracking distortion were all in the average to above average class. Stereo image was left biased, probably due to the difference between left and right channel crosstalk characteristics.

A front loading cassette is built in to the left hand side of the front panel with the usual six smooth-acting piano-type tape motion controls. Dolby noise reductions, a digital footage counter, two separate VU meters and alternative bias levels for ferric and chrome

tape are provided. The measured record/replay frequency response was very good being within $\pm 1\text{dB}$ between 50Hz and 12kHz, distortion was low, wow and flutter about average, the signal to noise using Dolby, though good, was a little below some other Dolby equipped systems and the same comment applies to the erase efficiency.

Using the Wharfedale Linton speakers, the sound quality was well liked, distortion being low, the sound open and clean with a good stereo image.

The radio receiver covered the FM, LW and MW bands, the tuning scale being reasonably large but located behind the panel making it troublesome to read unless the eyes are on the same level. In addition to the manual tuning there are five touch sensors allowing five stations in the FM band to be pre-set. A small calibrated meter is included to give an approximate indication of the frequency of the station being pre-set and two further meters are included, one doubling as a tuning meter and recording signal level meter for the left channel, the third meter indicating the right channel signal only.

The receiver had a performance that matched that of the cassette system. Least usable sensitivity at $2.4\mu\text{V}$ and the signal required for a 50dB signal to noise ratio, $80\mu\text{V}$ were good, separation very good, as were the IF rejection, adjacent channel selectivity, image rejection and capture ratio. The overall frequency response from aerial to loudspeaker terminals was almost beyond criticism, being ruler-straight from 20Hz to about 14kHz.

Listening tests confirmed the objective measurements, the sound from the Lintons being clean and open with a good firm stereo image. Bass and treble response were good.

There was no criticism of the safety aspect of the equipment. Obviously a system in the 'top ten' class.

Amplifier Section

| | |
|---|-------------|
| Power output into 8 ohms | 34.8W |
| Power output into 4 ohms | 40W |
| Distortion at low power output 1W | 0.05% good |
| Amplifier noise | poor |
| Signal to noise ratio for tape output | 87dBA good |
| Input voltage for full modulation Tape | 160mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike. | 400 μ V |
| Tape output. | 35mV |
| Stereo crosstalk | 50dB good |
| Channel balance | v. good |

Record Player Section

| | |
|---|------------|
| Frequency response | good |
| Trackability | good |
| Signal to noise ratio | 64dBA good |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.11% good |
| Rumble | 61dB good |

Tuner Section

| | |
|------------------------------|--------------------|
| Least usable sensitivity | 2.4 μ V good |
| Input for 50dB signal/noise | 80 μ V average |
| Signal/noise for 1mV input | 62dBA poor |
| Distortion | 0.25% v. good |
| AM rejection | 40dB fair |
| Stereo crosstalk | v. good |
| Image rejection | 52dB good |
| IF rejection | 92dB v. good |
| Adjacent channel selectivity | +3dB good |
| Capture ratio | v. good |
| 19kHz suppression | 54dB good |
| Muting level | 46 μ V |
| Frequency response | v. good |

Tape Section

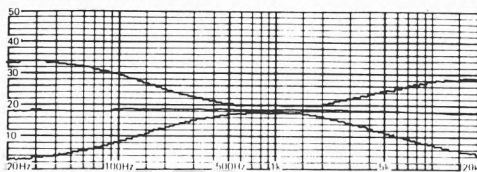
| | |
|----------------------------------|------------|
| Record/replay frequency response | good |
| Azimuth alignment | good |
| Signal to noise ratio | 61dBA good |
| Distortion output | v. good |
| Wow and flutter | 0.13% good |
| Erase efficiency | 50dBA good |

Loudspeakers (where provided)

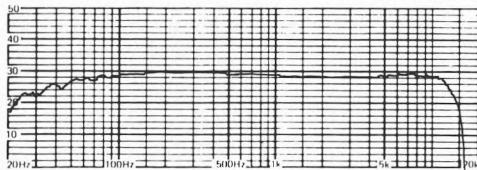
| | |
|---|---|
| Frequency response of amplifier and speaker | — |
| Distortion | — |
| Sensitivity | — |
| Length of loudspeaker lead | — |

General Data

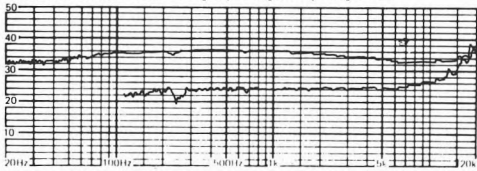
| | |
|--|------------------------|
| Compliance with British safety standards | No failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | v. good |
| Typical selling price inc. speakers and VAT. | — |
| Typical selling price ex. speakers and inc. VAT. | £290.00 |



Frequency response of amplifier and tone control response.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Beocenter 4600

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



This is a system in the style that characterises the current range of B & O equipment, long and of low profile with slide rule cursor type controls. The general finish was in brushed aluminium though the brightness of the top was tempered by a smokey coloured hinged Perspex cover over the record facilities, only the cassette unit being outside the cover. It was liked by all the assessors. The long clearly marked turning scale is set along the sloping top edge of the unit where it is easy to read either standing or sitting in front of the system. All the push button controls are set along the vertical section of the front edge immediately underneath the tuning scale and in consequence the legends are less easily read.

The record player is a 2 speed belt driven automatic mounted in a very flexible supported plinth without any user adjustments for stylus load or anti-skating and using a remarkable slim and lightweight arm and cartridge. The single multi-purpose control switch is mounted as it should be on the fixed section of the deck and not on the flexible plinth. The measured frequency response is remarkably flat down to 20Hz but trails off smoothly above 1kHz being about 4dB down at 10kHz. Separation is very good all the way up to 10kHz and is still around 15dB at 15kHz. Rumble, signal to noise, balance, wow and flutter are all very good and the tracking distortion is in the 'good' class. Sound quality was well liked by all the assessors, though the fall away in the 10kHz region was noticeable.

Performance of the cassette section was comparable with that of the record player, the

wow and flutter being very low, the distortion low, the signal to noise high and the erase efficiency very good. Using the recommended chrome tape the frequency response was within ± 2 dB between 40Hz and 14kHz. Sound quality was well above average, the reproduction being smooth and with obviously low distortion, the stereo image was well defined and tape hiss with Dolby in use was remarkably low.

This was a system in which the performance of all the individual units were well balanced, the radio receiver performance being well up to the high standard set by the cassette and record player. The frequency response was almost ruler straight from 30Hz to 15kHz with a remarkably high level of attenuation at 19kHz, distortion was low, separation good, and image rejection, AM rejection, IF rejection and Adjacent Channel rejection very good. Sound quality when used with the Celef speakers was praised by all the assessors. The bass being clean and extended and all the stereo image well formed.

There was a minor point of criticism of the safety aspect, the leads to the mains switch were not anchored against failure of the soldering.

In summary, a system that was well liked by all the assessors and one that can be recommended. Used with a pair of speakers such as the Celefs it was capable of a very satisfying performance.

Amplifier Section

Power output into 8 ohms 20W
 Power output into 4 ohms 27.4W
 Distortion at low power output 1W 0.028% v. good
 Amplifier noise v. good
 Signal to noise ratio for tape output 81dBA good
 Input voltage for full modulation Tape 570mV
 Input voltage for full modulation Aux —
 Input voltage for full modulation Mike 90μV
 Tape output 49mV
 Stereo crosstalk 43dB average
 Channel balance good

Record Player Section

Frequency response good
 Trackability average
 Signal to noise ratio 65dBA good
 Channel balance good
 Wow and flutter at 33 1/3 rpm 0.1% good
 Rumble 63dB v. good

Tuner Section

Least usable sensitivity 1.2μV good
 Input for 50dB signal/noise 31μV v. good
 Signal/noise for 1mV input 71dBA v. good
 Distortion 0.7% good
 AM rejection 64dB good
 Stereo crosstalk v. good
 Image rejection 72dB v. good
 IF rejection 81dB good
 Adjacent channel selectivity +4dB good
 Capture ratio good
 19kHz suppression 71dB v. good
 Muting level 3μV
 Frequency response v. good

Tape Section

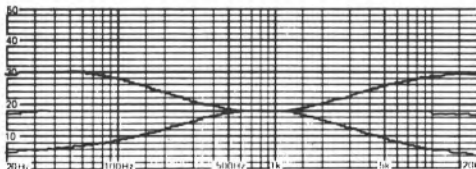
Record/replay frequency response v. good
 Azimuth alignment good
 Signal to noise ratio 59dBA average
 Distortion output good
 Wow and flutter 0.12% good
 Erase efficiency 50dBA fair

Loudspeakers (where provided)

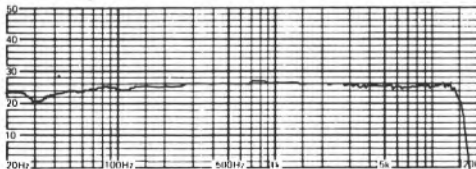
Frequency response of amplifier and speaker —
 Distortion —
 Sensitivity —
 Length of loudspeaker lead —

General Data

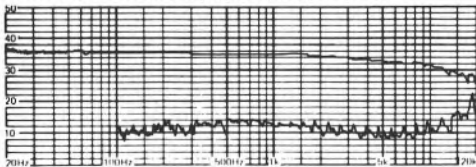
Compliance with British safety standards 5b
 Available facilities see Introductory Chart
 Overall finish and engineering excellent
 Overall sound quality v. good
 Typical selling price inc. speakers and VAT —
 Typical selling price ex. speakers and inc. VAT £400.00



Frequency response of amplifier and tone control response.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

RECOMMENDED

Dynatron MC-1010CR

Dynatron Radio Ltd., Ditton Walk, Cambridge. CB5 8QD. 022 05 2781.



Outstanding from the appearance point of view, the veneered cabinet being liked by all the assessors and certain to have the approval of most wives. This system is also available in a variety of cabinets, designed to match for example, 'Queen Anne' or 'Chippendale' furniture. Closed down, none of the electronic equipment can be seen, but this carries a penalty in that the lid has to be opened to operate any part of the system. Loudspeakers are styled to match the systems enclosure, the cabinets not being unduly large. The three electronic units are in black mounted in the veneered top deck, the radio unit being in the centre section together with all the general controls.

The record player is a two speed semi-automatic Garrard 35SB belt driven deck, the arm being complete with calibrated stylus load and anti-skating adjustment. Wow and flutter at .12%, rumble at -57dB and signal to noise at 66dB are all in the good class, while tracking distortion at 6% is acceptable. The measured frequency response is good, being within ± 2 dB over the frequency range between 50Hz and 12kHz and falling away only slowly and smoothly outside this range. Crosstalk is good at an average of around 21dB, a figure that was well maintained over the whole range.

The sound quality was better than the reference system, the stereo image being wider and more clearly defined, while treble response was much better, though there was a tendency to 'edginess' at high volumes.

The cassette unit was unusually large,

suggesting a long life. Facilities included Dolby noise reduction, CrO₂ bias provision, digital footage counter and a bias frequency change button to deal with the possible situation where 'birdie whistles' appear when recording from radio. Two good meters are provided to monitor the signal being recorded and there are illuminated indications that Dolby is in use and that the switching is in the 'record' mode. Measured record/replay frequency response was particularly smooth between 70Hz and 10kHz, with the response falling away smoothly outside this band. Wow and flutter had good average values, signal to noise with Dolby was a trifle low at 60dB, harmonic distortion was low at .7%, but the erase efficiency was a little on the low side at 51dB. All the assessors were pleased with the sound quality the stereo image being wider with solo voices well defined, bass response was surprisingly good and clean in view of the relatively small size of the speaker enclosures.

The radio unit was a little disappointing, the absence of a tuning meter making it necessary to use care in tuning if 'hiss' noise was not to be obvious in our particularly quiet listening room. Distortion was a little on the high side at high sound levels. The tuning scale was rather small though very clearly marked and the AFC system worked very well. Stereo images were well reproduced over a wide stage.

Criticism from the safety aspect might be made on a minor count, anchoring of the leads to the mains switch needed a little attention. The first unit failed during test, mains hum

becoming unduly prominent.

In summary, the system is outstanding in appearance, the performance of the record replay and cassette facilities is good, but the performance of the radio unit is not quite up to the standard of the others. Overall, though, good value for money.

Amplifier Section

| | |
|--|--------------|
| Power output into 8 ohms | 10.8W |
| Power output into 4 ohms | 11.4W |
| Distortion at low power output 1W | 0.21% poor |
| Amplifier noise | average |
| Signal to noise ratio for tape output | 88dB v. good |
| Input voltage for full modulation Tape | 91mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 160μV |
| Tape output | 92mV |
| Stereo crosstalk | 43dB average |
| Channel balance | v. good |

Record Player Section

| | |
|-------------------------------|--------------|
| Frequency response | good |
| Trackability | average |
| Signal to noise ratio | 66dB v. good |
| Channel balance | v. good |
| Wow and flutter at 33 1/3 rpm | 0.12% good |
| Rumble | 57dB fair |

Tuner Section

| | |
|------------------------------|--------------|
| Least usable sensitivity | 1.8μV good |
| Input for 50dB signal/noise | 60μV good |
| Signal/noise for 1mV input | 65dB average |
| Distortion | 1.4% poor |
| AM rejection | 58dB good |
| Stereo crosstalk | good |
| Image rejection | 47dB good |
| IF rejection | 77dB good |
| Adjacent channel selectivity | 0dB fair |
| Capture ratio | good |
| 19kHz suppression | 45dB average |
| Muting level | 5μV |
| Frequency response | good |

Tape Section

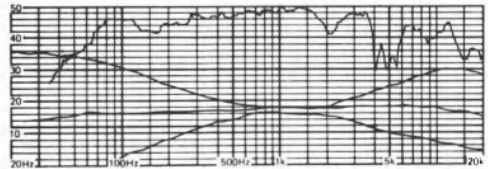
| | |
|----------------------------------|--------------|
| Record/replay frequency response | average |
| Azimuth alignment | fair |
| Signal to noise ratio | 60dB v. good |
| Distortion output | v. good |
| Wow and flutter | 0.12% good |
| Erase efficiency | 51dB average |

Loudspeakers (where provided)

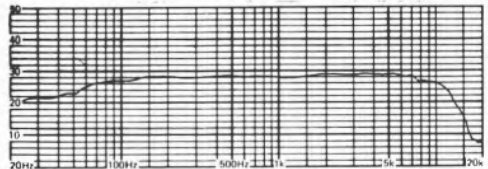
| | |
|---|---------------|
| Frequency response of amplifier and speaker | fair |
| Distortion | average |
| Sensitivity | poor |
| Length of loudspeaker lead | 6.34m v. good |

General Data

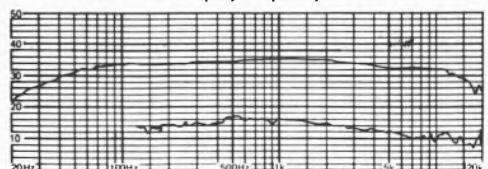
| | |
|---|------------------------|
| Compliance with British safety standards | 5b |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | good |
| Typical selling price inc. speakers and VAT | £420.00 |
| Typical selling price ex. speakers and inc. VAT | £360.00 |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Ferguson 20D3971

Thorn Consumer Electronics Ltd., Thorn House, Upper St Martins Lane, London WC2 01-836 2444.



This is a small unit in the budget price and output power class, the measured power output being about 6.2 watts, absolutely adequate for most domestic sized rooms but unlikely to raise enthusiasm in the hi-fi addict. It is finished in the popular black with brushed aluminium trimmings and having all the main controls and the tuning scale along the vertical front edge outside the hinged Perspex cover. It has a rather unusual tuning scale consisting of a small lamp moving behind a series of small holes with the legends on the front. Though different from most other arrangements it was not particularly liked for the light reduced the visibility of the un-illuminated legends. Seven push-buttons under the tuning scale provided a choice of facilities.

The record deck is an idler driver BSR model 1182, providing manual or semi-automatic playing of 7", 10" or 12" records at any of three speeds. Stylus balance adjustment is included, but it is uncalibrated and so requires a stylus pressure gauge for setting up. The performance was in the 'good' class except in respect of wow and flutter which was on the high side at .26% and at least to one critic was audibly unacceptable. The rumble was also a little on the high side and the drive would benefit from some attention to the mechanical design. The frequency response of the pick-up had a broad peak between 200 and 500Hz falling away gradually above this point and being down by 10dB at 10kHz. Separation was also open to criticism, the curves showing that it was below 20dB over most of the frequency range. The sound quality was

criticised by all the assessors on account of the lack of treble and the obvious wow and flutter.

The cassette unit was a large good looking instrument including Dolby noise reduction, a digital footage counter and separate recording level meters for both channels. The mechanical operation was very smooth but the wow and flutter was on the high side at .21% and obvious. Record/replay response was reasonably smooth up to about 3kHz but then fell away slowly and was about 10dB down at 10kHz. the sound quality suffered from the lack of treble and the wow and flutter.

Regrettably, the radio receiver was found to have a budget priced performance. IF rejection being in the 'good' class, but all the other measured parameters reflected the limited price of the unit.

Loudspeakers were on the small side and this restricted the low frequency performance, a shortcoming that set a limit to the performance of the whole system, but the stereo stage was wide, the position of individual instruments nicely defined, this aspect of the overall performance being above average. There was no criticism from the safety point of view.

In summary, a budget priced unit more suitable for the non-enthusiast who is not too critical and is pop-orientated.

Amplifier Section

| | |
|--|-------------|
| Power output into 8 ohms | 5.3W |
| Power output into 4 ohms | 6.2W |
| Distortion at low power output 1W | — |
| Amplifier noise | — |
| Signal to noise ratio for tape output | — |
| Input voltage for full modulation Tape | — |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 190 μ V |
| Tape output | — |
| Stereo crosstalk | — |
| Channel balance | — |

Record Player Section

| | |
|---|---------------|
| Frequency response | poor |
| Trackability | average |
| Signal to noise ratio | 61dBA average |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.26% poor |
| Rumble | 56dB fair |

Tuner Section

| | |
|------------------------------|------------------|
| Least usable sensitivity | 7.5 μ V fair |
| Input for 50dB signal/noise | 220 μ V poor |
| Signal/noise for 1mV input | 61dBA poor |
| Distortion | 2.2% poor |
| AM rejection | 46dB average |
| Stereo crosstalk | poor |
| Image rejection | 18dB poor |
| IF rejection | 72dB average |
| Adjacent channel selectivity | —3dB poor |
| Capture ratio | poor |
| 19kHz suppression | 43dB average |
| Muting level | — |
| Frequency response | fair |

Tape Section

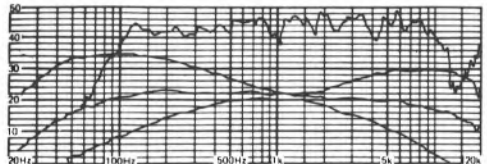
| | |
|----------------------------------|---------------|
| Record/replay frequency response | fair |
| Azimuth alignment | poor |
| Signal to noise ratio | 65dBA v. good |
| Distortion output | good |
| Wow and flutter | 0.21% fair |
| Erase efficiency | 56dBA v. good |

Loudspeakers (where provided)

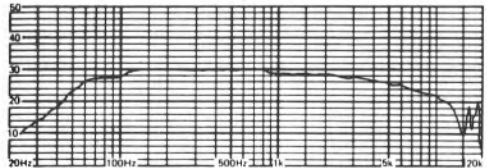
| | |
|---|--------------|
| Frequency response of amplifier and speaker | fair |
| Distortion | poor |
| Sensitivity | v. good |
| Length of loudspeaker lead | 3.6m average |

General Data

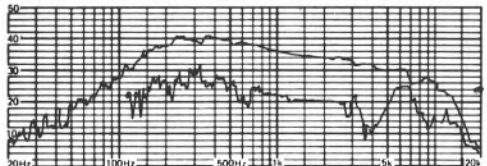
| | |
|---|------------------------|
| Compliance with British safety standards | No failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | good |
| Overall sound quality | poor |
| Typical selling price inc. speakers and VAT | £180.00 |
| Typical selling price ex. speakers and inc. VAT | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Fidelity System 4-40

Fidelity Radio Ltd., Victoria Road, London NW10. 01-965 9235.



This is a music centre complete with two loudspeakers at rather below the average price for all those tested. It is finished in black but differing from most of the others in having all the controls under the hinged Perspex cover that has to be raised for operation. This has some advantage in that all the controls are plainly visible whether the operator is sitting or standing.

The BSR semi-automatic record player unit is resiliently mounted and the controls on this plinth do not significantly disturb the pick-up when they are operated. Performance was a little below average, the wow and flutter and rumble both being rather worse than average. The pick-up supplied with the unit was faulty on arrival resulting in a poor frequency response on one channel and poor trackability. This was replaced by a new example on which all the test data was taken.

The cassette player is mounted in the centre between the radio and record player section. It is larger than average, has large recording level meters and incorporates a digital footage counter and automatic detection of a chromium tape cartridge. The technical performance was about average without being outstanding.

All the radio and microphone controls are grouped on the right hand side with a large illuminated tuning scale and tuning meter and all the facilities have selector buttons. Slider type controls are provided along the front of the unit for volume, balance, bass and treble adjustment and they all work very smoothly. The technical tests revealed some

shortcomings in the performance, distortion being on the high side, while image suppression and 19kHz suppression were below average. Crossover type distortion was rather evident at all levels but the circuit diagram revealed no obvious cause. After contacting Fidelity the amplifier section of the music centre was replaced with a modified amplifier resulting in the elimination of the crossover distortion.

BS 415 has evidently been taken to heart by the designers for the unit passed all the prescribed tests.

Listening tests placed the unit some way just below average, but so is the price, a factor that must be taken into account by most would-be purchasers.

In summary a good looking unit for the budget conscious.

Amplifier Section

| | |
|---|-------------|
| Power output into 8 ohms | 21W |
| Power output into 4 ohms | 25W |
| Distortion at low power output 1W | 0.38% poor |
| Amplifier noise | poor |
| Signal to noise ratio for tape output | 76dBA fair |
| Input voltage for full modulation Tape | — |
| Input voltage for full modulation Aux. | 134mV |
| Input voltage for full modulation Mike. | 350 μ V |
| Tape output | 165mV |
| Stereo crosstalk | 41dB fair |
| Channel balance | average |

Record Player Section

| | |
|---|------------|
| Frequency response | fair |
| Trackability | good |
| Signal to noise ratio | 48dBA poor |
| Channel balance | average |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.26% poor |
| Rumble | 53dB poor |

Tuner Section

| | |
|------------------------------|------------------|
| Least usable sensitivity | 8 μ V poor |
| Input for 50dB signal/noise | 50 μ V good* |
| Signal/noise for 1mV input | 66dBA average |
| Distortion | 1.4% poor |
| AM rejection | 48.5dB average |
| Stereo crosstalk | average |
| Image rejection | 20dB poor |
| IF rejection | 82dB good |
| Adjacent channel selectivity | +3dB good |
| Capture ratio | fair |
| 19kHz suppression | 42dB fair |
| Muting level | — |
| Frequency response | average |

Tape Section

| | |
|----------------------------------|---------------|
| Record/replay frequency response | average |
| Azimuth alignment | average |
| Signal to noise ratio | 58dBA average |
| Distortion output | poor |
| Wow and flutter | 0.16% average |
| Erase efficiency | 56dBA v. good |

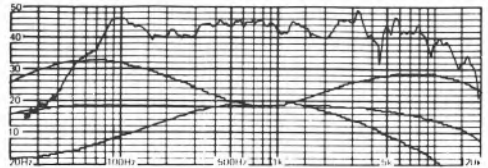
Loudspeakers (where provided)

| | |
|---|--------------|
| Frequency response of amplifier and speaker | average |
| Distortion | good |
| Sensitivity | poor |
| Length of loudspeaker lead | 3.4m average |

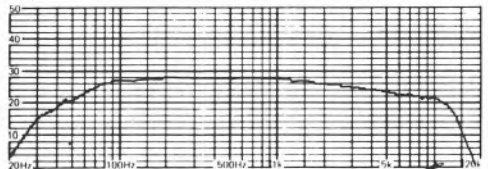
General Data

| | |
|---|------------------------|
| Compliance with British safety standards | No failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | good |
| Overall sound quality | fair |
| Typical selling price inc. speakers and VAT | £215.00 |
| Typical selling price ex. speakers and inc. VAT | £160.00 |

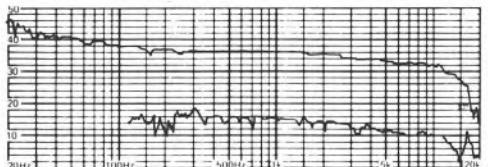
*See text



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.

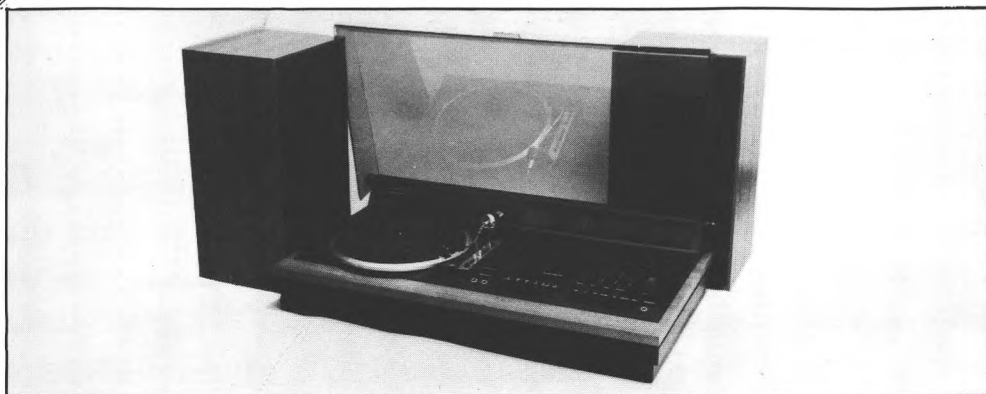


Record deck: frequency response and crosstalk, (1 channel).

RECOMMEND

Garrard GA-200

Garrard Engineering Ltd., Newcastle Street, Swindon, Wilts. 0793 35381.



This is a relatively high power (30 watt per channel) higher priced unit which performed relatively well. All the controls are mounted on the top deck under the Perspex cover with the tuning scale set at an angle along the back of the deck, nicely illuminated and having very clear markings. At the sides of the tuning scale are three meters, two indicating the recording level and the third an effective tuning meter. Four legends for Dolby, chrome, stereo and record light up when the particular facility is in use.

The record deck is naturally a Garrard, their type GT-15P, a belt drive 2 speed with calibrated stylus load and anti-skating adjustments and fitted with a Shure cartridge. Measured frequency response was within $\pm 1\text{dB}$ between 20Hz and 5kHz with a slow fall-off to about -4dB up to 20kHz. Crosstalk was very good over the whole frequency range. Wow and flutter were good, as were the tracking distortion, rumble level and the signal to noise ratio. Sound quality was above average, the treble and bass being well balanced and the distortion low, while the stereo image was well defined.

The cassette player was large and solid, suggesting a long life. The tape motion controls worked easily and sweetly. Twin recording level meters with separate recording level controls for left and right channels are fitted, and there are push-buttons to select the chrome tape bias, to shift the oscillator frequency to eliminate 'birdie whistles' during recording and to bring the Dolby noise reduction into circuit. The facility in use is

indicated by an illuminated legend immediately below the radio tuning scale.

Least usable sensitivity of the radio receiver section is high at $1.1\mu\text{V}$ and the signal required for a signal to noise ratio of 50dB is low. The signal to noise ratio achieved by a signal of 1mV is higher at 67dBA. AM rejection, Crosstalk, image rejection, IF rejection, the 19kHz rejection and the adjacent channel selectivity are all in the good to very good class. Sound quality was good, bass and treble being well balanced, the distortion is low with a well defined stereo image.

This was one of the systems having speaker leads that are too short to allow optimum placement of the loudspeakers well away from the system. The sample tested was a pre-production unit and the label specifying the working voltage and the instruction for fitting the mains plug has not been included.

In summary, a unit having an above average performance and worthy of detailed consideration.

Amplifier Section

| | |
|--|----------------|
| Power output into 8 ohms | 26.2W |
| Power output into 4 ohms | 30.4W |
| Distortion at low power output 1W | 0.018% v. good |
| Amplifier noise | average |
| Signal to noise ratio for tape output | 92dB v. good |
| Input voltage for full modulation Tape | 115mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 470 μ V |
| Tape output | 220mV |
| Stereo crosstalk | 45dB good |
| Channel balance | good |

Record Player Section

| | |
|---|------------|
| Frequency response | good |
| Trackability | average |
| Signal to noise ratio | 56dB poor |
| Channel balance | average |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.16% fair |
| Rumble | 60dB good |

Tuner Section

| | |
|------------------------------|--------------------|
| Least usable sensitivity | 1.1 μ V good |
| Input for 50dB signal/noise | 28 μ V v. good |
| Signal/noise for 1mV input | 67dB v. good |
| Distortion | 0.65% good |
| AM rejection | 57dB good |
| Stereo crosstalk | good |
| Image rejection | 53dB good |
| IF rejection | 98dB v. good |
| Adjacent channel selectivity | +3dB good |
| Capture ratio | v. good |
| 19kHz suppression | 67dB v. good |
| Muting level | 1 μ V |
| Frequency response | v. good |

Tape Section

| | |
|----------------------------------|---------------|
| Record/replay frequency response | v. good |
| Azimuth alignment | poor |
| Signal to noise ratio | 62dB v. good |
| Distortion output | poor |
| Wow and flutter | 0.09% v. good |
| Erase efficiency | 55dB v. good |

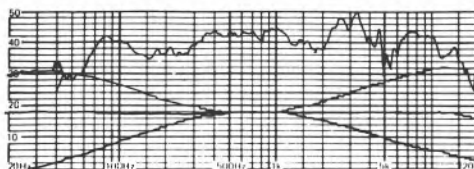
Loudspeakers (where provided)

| | |
|---|---------------|
| Frequency response of amplifier and speaker | fair |
| Distortion | good |
| Sensitivity | fair |
| Length of loudspeaker lead | 3.55m average |

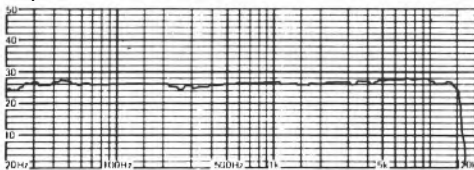
General Data

| | |
|---|------------------------|
| Compliance with British safety standards | 1, 2 |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | * |
| Overall sound quality | good |
| Typical selling price inc. speakers and VAT | £325.00 |
| Typical selling price ex. speakers and inc. VAT | £275.00 |

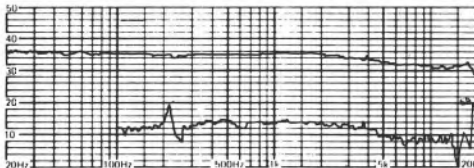
*See text.



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Grundig RPC-300

Grundig (GB) Ltd., 42 Newlands Park, London SE26 5NQ. 01-659 2468.



A high power (33 watts per channel) unit finished in black with silver trim having a much larger cassette deck than usual. All the controls are on a slightly inclined front panel that also carries the large tuning scale for manual tuning, and two meters, one indicating the tuning frequency when receiving an FM station and the second a tuning meter to facilitate accurate tuning. There is a long line of push buttons under the tuning meter with a group of somewhat inconvenient tuning knobs on the left hand side and eight tuning sensor buttons on the left hand side. The tuning controls are rather too close together for comfortable operation and on the model tested they carried legends in German. A large cassette unit is mounted on the right hand side of the deck.

The turntable is a Dual Type 1226 belt driven two speed turntable with a fine pitch control and employing a straight tubular arm carrying an offset head fitted with a Shure cartridge. A calibrated tracking weight adjustment and calibrated anti-skating adjustment are included, the whole mechanism being carried on a spring isolated plinth. The frequency response of the pick-up is very good, being within $\pm 2\text{dB}$ from 20Hz to 10kHz and then falling away smoothly, down only 4dB at 16kHz. Separation is good over the whole frequency range. Tracking distortion is unusually high at 10% but this measured value is greatly affected by the presence of a mechanical resonance around 300Hz, probably in the tone arm but it does not appear to have a very serious effect on the

performance when subjectively judged. Other tests taken at different test frequencies indicated that trackability was generally good. This section was thought to be above average with good treble response, low distortion and a good stereo stage.

The cassette system is unusually robust and includes switch selected bias for ferric, ferric-chrome and chrome tapes, a digital foot counter and a very useful feature, a small light underneath the cassette to indicate how much tape remains. The record/replay response was flat within $\pm 2\text{dB}$ between limits of 40Hz and 10kHz, however the distortion was high and the unit lacked Dolby noise reduction, about the only points that could be criticised.

The radio receiver included manual tuning and eight touch sensors to allow the pre-selection of seven stations, tuning of the selected station being carried out very conveniently by small knurled knobs under the front edge of the unit. The sensors carried small lights indicating which sensor was in use but it might be useful to provide some means of identifying the station selected, a comment that applies to all pre-tuning systems. Performance of the radio receiver was of a high standard, the receiver being highly sensitive and outstanding in almost every aspect of its measured performance. Sound was smooth and well balanced and the stereo image well formed.

There was criticism of three points on the BS 415 safety aspect, the failures being similar in many ways to the faults found on the more expensive Grundig 500

Though the loudspeakers provided were not unduly large, they had a good performance being within $\pm 4\text{dB}$ between 70Hz and 16kHz with only one dip of any significance. Stereo image formation was above average. A very good music centre, the absence of Dolby being about the only point on which criticism might be raised.

General Data

Compliance with British safety standards 2, 4, 5b
 Available facilities see Introductory Chart
 Overall finish and engineering excellent
 Overall sound quality good
 Typical selling price inc. speakers and VAT £500.00
 Typical selling price ex. speakers and inc. VAT £410.00

Amplifier Section

Power output into 8 ohms 24W
 Power output into 4 ohms 32.5W
 Distortion at low power output 1W 0.015% v. good
 Amplifier noise v. good
 Signal to noise ratio for tape output 94dB v. good
 Input voltage for full modulation Tape 195mV
 Input voltage for full modulation Aux —
 Input voltage for full modulation Mike —
 Tape output 530mV
 Stereo crosstalk 48dB good
 Channel balance good

Record Player Section

Frequency response good
 Trackability good
 Signal to noise ratio 62dB average
 Channel balance good
 Wow and flutter at 33 $\frac{1}{3}$ rpm 0.11% good
 Rumble 60dB good

Tuner Section

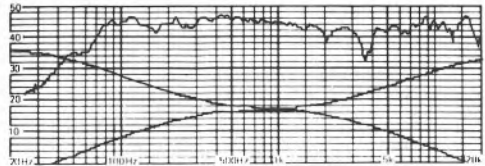
Least usable sensitivity 2.5 μV good
 Input for 50dB signal/noise 64 μV good
 Signal/noise for 1mV input 69dB v. good
 Distortion 0.25% v. good
 AM rejection 65dB good
 Stereo crosstalk good
 Image rejection 33dB fair
 IF rejection 91dB v. good
 Adjacent channel selectivity +7dB v. good
 Capture ratio average
 19kHz suppression 69dB v. good
 Muting level 8 μV
 Frequency response v. good

Tape Section

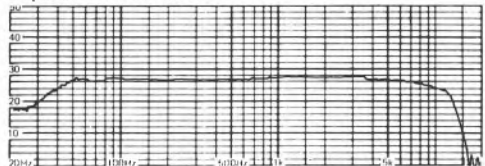
Record/replay frequency response good
 Azimuth alignment v. good
 Signal to noise ratio 62dB good
 Distortion output poor
 Wow and flutter 0.12% good
 Erase efficiency 57dB a good

Loudspeakers (where provided)

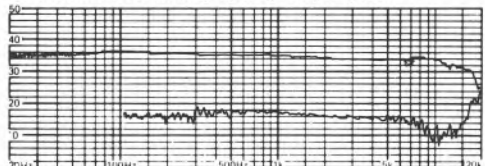
Frequency response of amplifier and speaker good
 Distortion good
 Sensitivity poor
 Length of loudspeaker lead 4.08m good



Frequency response of amplifier and loudspeaker and response of tone controls.



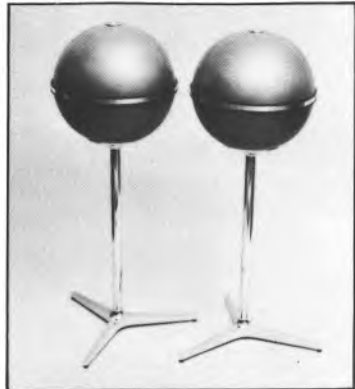
Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Grundig RPC-500

Grundig (GB) Ltd., 42 Newlands Park, London SE26 5NQ. 01-659 2468.



This is the Rolls Royce in the music centre field, the unit costing about £700 including the two rather stylish spherical loudspeakers. It is nicely finished in the currently fashionable black with a hinged Perspex cover. The system includes almost every facility imaginable as reference to the 'facilities' list will confirm.

This abbreviated description hardly does justice to the impressive appearance of the whole unit with its numerous coloured lights indicating each of the functions chosen. It is certainly a supreme status symbol and one that will impress any visitors with the owner's skill in being able to operate such an apparently complicated instrument, though in practice it is delightfully simple to operate after a few minutes study of the excellent instruction book. The technical performance of all three sections is excellent as will be seen from the performance data table.

The record player is a Dual two speed belt drive Type 1239G unit having the speed continuously adjustable over a range of $\pm 4.5\%$. The tone arm has calibrated adjustments for stylus pressure and anti-skating bias with a manual arm lift. The turntable is rather small, a 12 inch record overhanging sufficiently to hide the strobe markings. An excellent cassette unit is included and this can be lifted out and used separately to make recordings away from base. It is fitted with separate large modulation meters for left and right channels, Dolby facilities, separate switch selected bias and equalization for ferric and chrome tapes and automatic recording level control with

separate switch selected time constants for music and speech. These automatic level controls can be by-passed by a function selector switch when manual control is preferred.

The radio side is even more elaborate. Ten very smoothly operating push buttons allow the pre-set tuning of ten stations, each pre-set having the capability of tuning on either the FM, MW, or LW bands. Separate manual tuning however is not provided. Slider controls are provided for stereo balance, volume, and for tone control at four separate frequencies with a switch operated loudness contour control.

Special mention must be made of the loudspeakers. These are eye catchingly unusual. Each consists of two small woofers mounted back to back in a metal sphere mounted on a chromium plated tubular floor stand, or as an alternative, two attractive chromium plated chains are provided to allow the spheres to be suspended from the ceiling where floor space is at a premium. Two tweeters are used in each unit, one facing at an angle upwards with the other facing down at the same angle. Thus the spheres are substantially omni-directional. The measured frequency response is good, though the amplitude distortions are a little on the high side at the lower frequencies. The listening panels were divided in their opinion of the performance. Contrary to what might be expected, careful placement was required to attain a good stereo image and even so, the image was never thought to be as satisfactory

as that achieved by a pair of conventional speakers having reasonable directivity.

It would seem necessary for Grundig to reconsider the safety aspect more closely for the unit is thought to fail on four aspects; the ventilation openings over the mains voltage changer board are not sufficiently protected; the clearance between the switch contacts and earth is inadequate; a single pole switch is used and there is no colour code on the mains cable.

In summary, an expensive but eye catching system having an excellent technical performance and one in which everything works beautifully, but we have some reservations about the performance of the unusual loudspeakers that are included.

Amplifier Section

| | |
|--|----------------|
| Power output into 8 ohms | 25W |
| Power output into 4 ohms | 33W |
| Distortion at low power output 1W | 0.032% v. good |
| Amplifier noise | good |
| Signal to noise ratio for tape output | 85dB v. good |
| Input voltage for full modulation Tape | 130mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | — |
| Tape output | 170mV |
| Stereo crosstalk | 50dB good |
| Channel balance | good |

Record Player Section

| | |
|---|--------------|
| Frequency response | average |
| Trackability | good |
| Signal to noise ratio | 65dB v. good |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.14% good |
| Rumble | 61dB good |

Tuner Section

| | |
|------------------------------|------------------|
| Least usable sensitivity | 2.3 μ V good |
| Input for 50dB signal/noise | 44 μ V good |
| Signal/noise for 1mV input | 68dB v. good |
| Distortion | 0.28% v. good |
| AM rejection | 67 dB good |
| Stereo crosstalk | average |
| Image rejection | 54dB v. good |
| IF rejection | 72dB average |
| Adjacent channel selectivity | +5dB good |
| Capture ratio | good |
| 19kHz suppression | 68dB v. good |
| Muting level | 1.8 μ V |
| Frequency response | v. good |

Tape Section

| | |
|----------------------------------|--------------|
| Record/replay frequency response | average |
| Azimuth alignment | good |
| Signal to noise ratio | 65dB v. good |
| Distortion output | poor |
| Wow and flutter | 0.1% v. good |
| Erase efficiency | 58dB v. good |

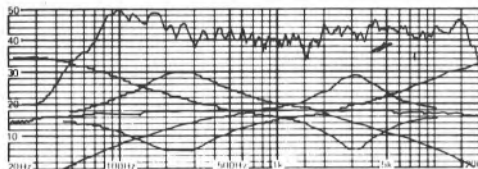
Loudspeakers (where provided)

| | |
|---|------|
| Frequency response of amplifier and speaker | good |
|---|------|

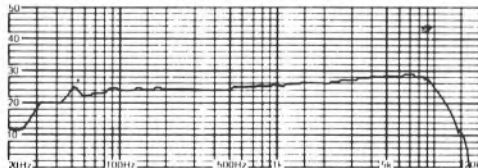
| | |
|----------------------------|--------------|
| Distortion | v. good |
| Sensitivity | poor |
| Length of loudspeaker lead | 5.8m v. good |

General Data

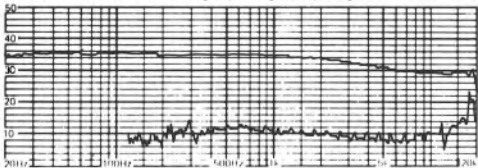
| | |
|---|------------------------|
| Compliance with British safety standards | 2, 4, 5b, 7 |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | good |
| Typical selling price inc. speakers and VAT | £700.00 |
| Typical selling price ex. speakers and inc. VAT | £550.00 |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Hitachi SDT-7675

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



This is a 22 watt per channel music centre mounted in a feak finish cabinet with all the controls on the deck top under the hinged Perspex cover, so it has to be operated with the cover up. It is unusual in dispensing with a tuning scale for the radio receiver and using a small meter calibrated in mHz for tuning. In total there are seven meters, all of the same size, four for tuning the long wave, medium wave and FM bands, and a fifth for tuning a short wave band that covers the frequency range of 6-10mHz. Two meters are added for checking the signal levels in the two stereo channels and a further meter to facilitate accurate tuning to the desired station. These meters are mounted along the rear of the deck in an angled panel that greatly improves the visibility. There is a considerable group of incidental facilities that should easily meet the needs of all but the most enthusiastic hi-fi user.

The record player is mounted on a spring supported plinth and employs a robust belt drive two speed turntable and a semi-automatic arm lifting mechanism. The arm is well finished and includes a calibrated stylus pressure adjustment and an uncalibrated anti-skating force adjustment. Tracking distortion is a little on the high side, while rumble, wow and flutter are in the fair to good group. The measured frequency response is very smooth from 40Hz to 5kHz but it then rises smoothly to a peak of 4dB at 15kHz.

A good cassette player is included, provided with two bias levels for ferric and chrome tapes, Dolby noise reduction, a digital counter

and seven light action push buttons to control the tape motion. Wow and flutter, erase efficiency and signal to noise ratio were found to have good average values. The measured frequency response using Maxell UD tape is very smooth between 40Hz and 2kHz but it then rises to a peak of 6dB at 15kHz. The tape record replay response and the phono response were both spoilt by a compulsory loudness contour facility operating within the main amplifier section.

The radio receiver was below average in performance, the signal to noise ratio being among the highest recorded from the receivers tested, though the signal to noise ratio achieved for a signal of 1mV was well up to the standard of the majority of receivers included in this series of tests. The frequency response measured between the aerial and loudspeaker terminals was excellent, being within ± 2 dB between 20Hz and 18kHz. The frequency indicating meters were not thought to be as good, accurate or convenient, but the pre-set tuning system for stations in the FM band was considered to be very satisfactory.

The rising frequency response noted on both the record and cassette facilities emphasised the hiss and noise and unless the tone controls were used, resulted in the treble response being a little too prominent. The loudness contouring though very useful when music was being used as a low level background, made the bass over prominent at more normal levels.

The construction complied with the safety requirements of BS 415.

The price difference between this unit and the SDT-7680 is relatively small and we feel that the SDT-7680 is well worth the extra cost.

Amplifier Section

| | |
|--|---------------|
| Power output into 8 ohms | 19W |
| Power output into 4 ohms | 22W |
| Distortion at low power output 1W | 0.07% good |
| Amplifier noise | v. good |
| Signal to noise ratio for tape output | 77dBa average |
| Input voltage for full modulation Tape | 550mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 700 μ V |
| Tape output | 135mV |
| Stereo crosstalk | 41dB fair |
| Channel balance | good |

Record Player Section

| | |
|---|---------------|
| Frequency response | good* |
| Trackability | fair |
| Signal to noise ratio | 62dBa average |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.15% fair |
| Rumble | 58dB average |

Tuner Section

| | |
|------------------------------|------------------|
| Least usable sensitivity | 20 μ V poor |
| Input for 50dB signal/noise | 250 μ V poor |
| Signal/noise for 1mV input | 63dBa fair |
| Distortion | 0.8% average |
| AM rejection | 36dB fair |
| Stereo crosstalk | good |
| Image rejection | 38dB fair |
| IF rejection | 61dB poor |
| Adjacent channel selectivity | +6dB v. good |
| Capture ratio | fair |
| 19kHz suppression | 32dB poor |
| Muting level | — |
| Frequency response | v. good |

Tape Section

| | |
|----------------------------------|---------------|
| Record/replay frequency response | good* |
| Azimuth alignment | good |
| Signal to noise ratio | 63dBa v. good |
| Distortion output | poor |
| Wow and flutter | 0.15% average |
| Erase efficiency | 50dBa fair |

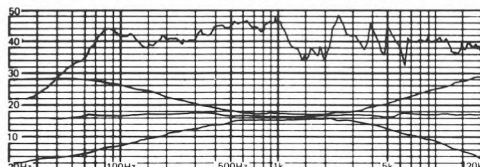
Loudspeakers (where provided)

| | |
|---|-----------|
| Frequency response of amplifier and speaker | fair |
| Distortion | v. good |
| Sensitivity | average |
| Length of loudspeaker lead | 2.9m fair |

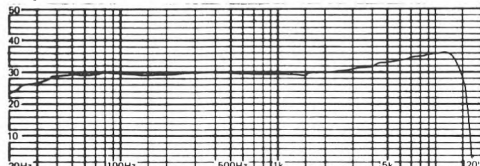
General Data

| | |
|---|------------------------|
| Compliance with British safety standards | No failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | good |
| Overall sound quality | average |
| Typical selling price inc. speakers and VAT | £335.00 |
| Typical selling price ex. speakers and inc. VAT | — |

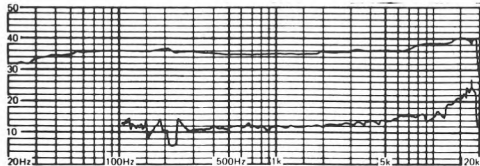
*See text.



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Hitachi SDT-7680

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



This is the top-of-the-line model in the Hitachi range of music centres, though the technical performance is not a great deal better than the SDT-7765. However the presentation is thought to be more attractive and a greater range of facilities are provided.

The centre is enclosed in a teak finished cabinet with all the operating controls mounted on a vertical front panel with an all-black finish. The cassette recording volume controls, main volume control, balance, bass and treble tone controls are all of the sliding type mounted in line above a narrow shelf that carries the legends for all the controls. Facility selection is by a series of push buttons immediately below the shelf.

A belt drive servo-controlled 2 speed motor is fitted to the record player, the speed being fully adjustable. A set of stroboscope markings is added to the turntable rim, with the neon light concealed in a small housing near the edge of the turntable. An 'S' shaped arm is used, fitted with a calibrated stylus pressure adjustment and though an anti-skating device is fitted, it is uncalibrated. Tracking distortion was a little higher on this model than on the others, and the wow and flutter was of the same order. The measured frequency response was very good, extending from around 50Hz to 20kHz and staying within ± 2 dB.

The cassette unit fitted to this model was a particularly robust type loaded through the top deck but with all the tape motion controls on the front edge outside the hinged Perspex cover. Dolby noise reduction, a digital footage

counter, separate meters for left and right channels and automatic selection of the appropriate bias for chrome tapes are included. The record/replay response is average, being within ± 1 dB between 40Hz and 2kHz, rising smoothly to a peak of about 4dB between 5kHz and 10kHz and extending to 15kHz.

Users have a choice of manually tuning the radio receiver or using the six pre-set selectorx. The tuning controls for these are contained in a small pull-out drawer in the centre of the front panel. These carry a surprisingly accurate frequency scale and as a good tuning meter is fitted, the tuning of all the pre-sets is very simple. The tuning scale for manual tuning is large and clearly marked. As with the other Hitachi models the frequency response of the radio receiver was very good, being within ± 1 dB between 40Hz and 10kHz but falling away smoothly by about 3dB at 15kHz. Adjacent channels selectivity was excellent, being among the best of all the music centres included in the review.

The loudspeaker is a special unit incorporating two Goodmans units and having a frequency response that is within ± 5 dB between 60Hz and 17kHz. The frequency irregularities are mainly in the band above 2kHz and are thought to be due to phase interference and so probably less important than is suggested by the curves.

The unit met all the safety requirements of BS 415.

This system had above average sound quality largely on account of the Goodmans

loudspeakers supplied. Attractive in appearance and well worth consideration if sound quality is very important to you

Amplifier Section

| | |
|--|---------------|
| Power output into 8 ohms | 26W |
| Power output into 4 ohms | 33W |
| Distortion at low power output 1W | 0.07% good |
| Amplifier noise | poor |
| Signal to noise ratio for tape output | 77dBA average |
| Input voltage for full modulation Tape | 330mV |
| Input voltage for full modulation Aux | 390mV |
| Input voltage for full modulation Mike | 600 μ V |
| Tape output | 430mV |
| Stereo crosstalk | 45dB good |
| Channel balance | good |

Record Player Section

| | |
|---|---------------|
| Frequency response | good |
| Trackability | poor |
| Signal to noise ratio | 56dBA poor |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.13% average |
| Rumble | 59dB average |

Tuner Section

| | |
|------------------------------|---------------------|
| Least usable sensitivity | 4.5 μ V average |
| Input for 50dB signal/noise | 125 μ V fair |
| Signal/noise for 1mV input | 63dBA fair |
| Distortion | 1% fair |
| AM rejection | 53dB average |
| Stereo crosstalk | fair |
| Image rejection | 48dB good |
| IF rejection | 44dB poor |
| Adjacent channel selectivity | +7dB v. good |
| Capture ratio | fair |
| 19kHz suppression | 39dB fair |
| Muting level | 3.5 μ V |
| Frequency response | v. good |

Tape Section

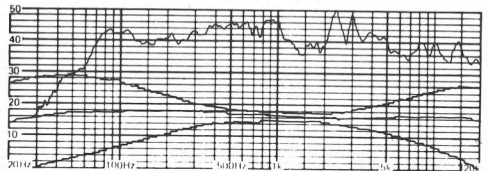
| | |
|----------------------------------|---------------|
| Record/replay frequency response | average |
| Azimuth alignment | good |
| Signal to noise ratio | 61dBA good |
| Distortion output | average |
| Wow and flutter | 0.17% average |
| Erase efficiency | 49dBA fair |

Loudspeakers (where provided)

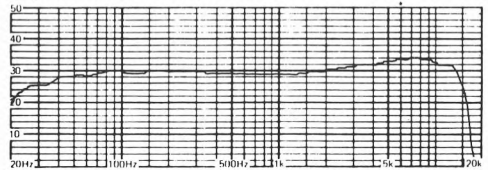
| | |
|---|-----------|
| Frequency response of amplifier and speaker | poor |
| Distortion | v. good |
| Sensitivity | good |
| Length of loudspeaker lead | 2.9m fair |

General Data

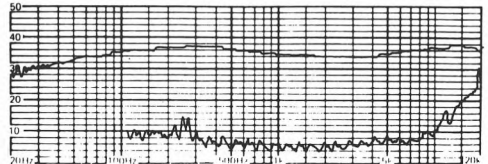
| | |
|---|------------------------|
| Compliance with British safety standards | No failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | good |
| Typical selling price inc. speakers and VAT | £365.00 |
| Typical selling price ex. speakers and inc. VAT | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Hitachi SDT-7765

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



This is a 25 watt per channel centre in a teak enclosure with all the controls on a vertical black front panel, unrelieved by any light coloured trim — so much so that a second look is required to differentiate the controls from the panel. The cassette player occupies the top left hand side of the deck but the cassettes are loaded through a slot in the front panel, a very convenient arrangement. The radio receiver controls on the right hand side include five pre-set push-buttons that allow the selection of five station in the FM band, but manual tuning facilities are also included. These cover the long, medium, short and FM bands, a large clearly marked tuning scale and a small tuning meter being provided. The pre-set tuning controls are conveniently mounted in a small drawer in the centre of the front panel. The tuning scales are small but the fine thread tuning core adjustment and the good tuning meter makes pre-tuning a relatively simple matter. The facilities provided are very comprehensive. (See the Introduction Chart).

A semi-automatic two speed turntable is included, the mechanism being mounted on very flexible spring supported plinth. There is a calibrated stylus pressure adjustment and the anti-skating force is also adjustable but a calibrated scale is not provided. The technical performance is in the 'good' class, wow and flutter being in the region of .12%, rumble is around 61dB and the signal to noise ratio is also 61dB. The record player frequency response is within ± 2 dB between 80Hz and 1kHz but above this frequency there is a gradual fall off, the output being 6dB down at

10kHz. Crosstalk is very good, being at least 25dB over the whole range from 100Hz to 10kHz. The stereo image is good but the loss indicated by the frequency response measurements is subjectively obvious making the reproduction rather dull and lifeless.

The cassette system is provided with three bias selection buttons for ferric, ferro-chrome tapes, Dolby noise reduction, separate recording level controls for the right and left channels and two VU meters. The cassette is inserted from the front, the mechanism being particularly smooth in action. Wow and flutter is about average, distortion output is very good, and the signal to noise ratio a few dB worse than that obtained on the 7675. The measured frequency response is substantially flat up to 6kHz but then rises smoothly to a peak at 14kHz. The sound quality was better than obtained from records but the frequencies in the 7-10kHz region were a little too obvious.

The radio receiver performance was generally better than that of the 7675, the sensitivity being about twice that of the cheaper model, but surprisingly some aspects of the performance were worse than that of the 7675. Separation, IF rejection and adjacent channel selectivity were all slightly inferior to the 7675 model. The aerial-to-loudspeaker terminal frequency response was very good, within ± 1 dB from 20Hz to 10kHz and down by about 7dB at 15kHz. The sound quality from radio was better than from records or cassettes, the treble being cleaner but the bass response could be improved with

advantage.

As with most music centres the loudspeakers supplied set the limit to the performance obtained. Between frequencies of 80Hz and 2kHz the response is reasonably smooth but the range above this frequency is much more irregular, though it is well maintained up to about 16kHz. Many of the irregularities evident above 5kHz are thought to be due to phasing difficulties and in consequence they are not so audibly evident as the response curves suggest.

The unit complied with BS 415 safety regulations and overall, is good value for money.

Amplifier Section

| | |
|--|----------------|
| Power output into 8 ohms | 22W |
| Power output into 4 ohms | 25W |
| Distortion at low power output 1W | 0.032% v. good |
| Amplifier noise | average |
| Signal to noise ratio for tape output | 78dB average |
| Input voltage for full modulation Tape | 275mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 220 μ V |
| Tape output | 300mV |
| Stereo crosstalk | 46dB average |
| Channel balance | v. good |

Record Player Section

| | |
|---|--------------|
| Frequency response | average |
| Trackability | good |
| Signal to noise ratio | 61dB average |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.12% good |
| Rumble | 61dB good |

Tuner Section

| | |
|------------------------------|------------------|
| Least usable sensitivity | 8 μ V poor |
| Input for 50dB signal/noise | 160 μ V poor |
| Signal/noise for 1mV input | 64dB fair |
| Distortion | 1.7% poor |
| AM rejection | 43dB average |
| Stereo crosstalk | fair |
| Image rejection | 46dB average |
| IF rejection | 50dB poor |
| Adjacent channel selectivity | +3dB good |
| Capture ratio | good |
| 19kHz suppression | 40dB fair |
| Muting level | — |
| Frequency response | good |

Tape Section

| | |
|----------------------------------|---------------|
| Record/replay frequency response | average |
| Azimuth alignment | average |
| Signal to noise ratio | 56dB fair |
| Distortion output | good |
| Wow and flutter | 0.16% average |
| Erase efficiency | 48dB poor |

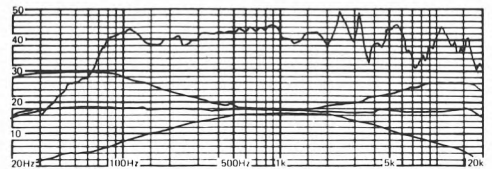
Loudspeakers (where provided)

| | |
|---|---------|
| Frequency response of amplifier and speaker | poor |
| Distortion | v. good |

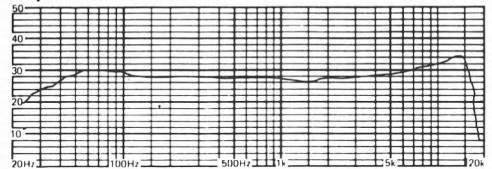
| | |
|----------------------------|------------|
| Sensitivity | good |
| Length of loudspeaker lead | 2.35m fair |

General Data

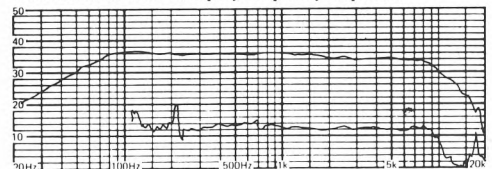
| | |
|---|------------------------|
| Compliance with British safety standards | No failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | very good |
| Typical selling price inc. speakers and VAT | £280.00 |
| Typical selling price ex. speakers and inc. VAT | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

ITT MC-5042

ITT Consumer Products Division, Maidstone Road, Sidcup, Kent, DA14 5HT. 01-300 7733.



This is an impressive looking unit having an output power of 12.5 watts per channel finished in black with a little light coloured trim as relief. All the controls are mounted along a near vertical front edge and outside the hinged Perspex cover. Even the cassette tape motion controls are accessible outside the cover. Slider type controls are used for volume control and for the two recording level controls, the knobs being grouped together on the right hand side. Push buttons are employed for selection of all the many facilities which include provision for the pre-selection of five stations in the FM band.

A three speed semi-automatic belt driven BSR turntable is mounted on a spring isolated plinth with a well finished 'S' shaped arm and with calibrated stylus loading and anti-skating adjustments. Trackability distortion was on the high side, signal to noise ratio, channel balance, wow, flutter and rumble on the poor side, rather disappointing in a good looking unit. The subjectively judged performance was agreeable though the objective test results were rather disappointing.

The cassette unit is of large size, suggesting a long operating life with large clearly marked push buttons arranged along the front edge. There are push button selection of bias for ferric and chrome tapes, Dolby noise reduction and for bias frequency shift. A digital footage counter is provided. The azimuth alignment was in error by about 75 degrees.

The signal to noise ratio was rather low, largely due to the absence of Dolby noise

reduction, distortion was on the high side, as were the wow, flutter and rumble. The measured frequency response was affected by the automatic recording level control system employed. The tape speed was well above standard, the consequent pitch change being very obvious.

Subjectively judged in our very quiet listening room, the sound quality was a bit disappointing, the hiss level being high while rumble, wow and flutter were obvious.

The radio receiver tuning scale is arranged along the near vertical front panel and is flanked by two recording level meters and a group of lights indicating the facility and the waveband being used. Least usable sensitivity was average, the input required for a signal to noise ratio of 50dBA was on the high side, distortion in the 'good' class, adjacent channel selectivity below average at -2dB, capture ratio poor, and the 19kHz suppression above average. The measured frequency response was good, being within about 2dB between 40Hz and 12kHz, with a smooth fall-off above this frequency.

Subjectively judged, the sound level quality was not thought to be particularly good, the hiss level being on the high side and the stereo image not well defined, though the treble response was thought to be good and particularly clean.

Overall, not a particularly impressive result but it is understood that the samples were from the first pre-production run and may not be representative of the main production.

Amplifier Section

| | |
|--|------------|
| Power output into 8 ohms..... | 11.8W |
| Power output into 4 ohms..... | 12.5W |
| Distortion at low power output 1W | 0.06% good |
| Amplifier noise | poor |
| Signal to noise ratio for tape output..... | 60dBA poor |
| Input voltage for full modulation Tape | 330mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | — |
| Tape output..... | 33mV |
| Stereo crosstalk | 47dB good |
| Channel balance | good |

Record Player Section

| | |
|---|------------|
| Frequency response..... | average |
| Trackability | poor |
| Signal to noise ratio | 57dBA poor |
| Channel balance | average |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.21% poor |
| Rumble | 56dB fair |

Tuner Section

| | |
|-----------------------------------|------------------|
| Least usable sensitivity..... | 7 μ V fair |
| Input for 50dB signal/noise | 110 μ V fair |
| Signal/noise for 1mV input | 66dBA average |
| Distortion | 1.1% fair |
| AM rejection | 48dB average |
| Stereo crosstalk | fair |
| Image rejection | 29dB poor |
| IF rejection | 71dB fair |
| Adjacent channel selectivity..... | -2.5dB poor |
| Capture ratio..... | poor |
| 19kHz suppression..... | 37dB fair |
| Muting level | — |
| Frequency response..... | good |

Tape Section

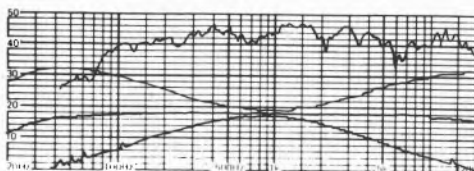
| | |
|--|------------|
| Record/replay frequency response | poor |
| Azimuth alignment | fair |
| Signal to noise ratio | 55dBA poor |
| Distortion output | poor |
| Wow and flutter | 0.19% fair |
| Erase efficiency | 50dB fair |

Loudspeakers (where provided)

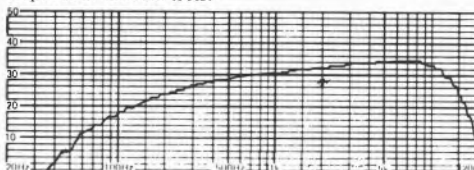
| | |
|---|-----------|
| Frequency response of amplifier and speaker | average |
| Distortion | poor |
| Sensitivity | average |
| Length of loudspeaker lead | 2.7m fair |

General Data

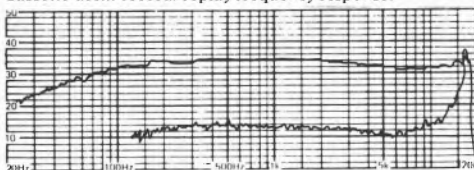
| | |
|--|------------------------|
| Compliance with British safety standards | 2, 5b |
| Available facilities..... | see Introductory Chart |
| Overall finish and engineering..... | good |
| Overall sound quality | fair |
| Typical selling price inc. speakers and VAT | £215.00 |
| Typical selling price ex. speakers and inc. VAT..... | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

ITT MC-5080

ITT Consumer Products Division, Maidstone Road, Sidcup, Kent, DA14 5HT. 01-300 7733.



This system is unusual in being manufactured in France. It is in the average power class, having an output of about 17 watts per channel into 4 ohms, perfectly adequate for almost any domestic situation. There is a very comprehensive collection of facilities, mostly selected by push buttons with those in use indicated by illuminated legends, the buttons and tuning scale being arranged along an angled front edge.

The turntable is one of ITT's own, the P163, a belt drive 2 speed semi-automatic unit mounted on a resiliently isolated plinth. The tone arm is nicely finished and is equipped with calibrated stylus load and anti-skating controls. Regrettably the first sample had a tone arm with high lateral friction, apparently due to being shipped with the counterweight in position. The replacement unit was completely satisfactory in this respect, the measured value being in the region of 15 milligrams. The measured frequency response was within about ± 1 dB between 20Hz to 2kHz, but fell away into a 3dB trough around 7kHz before a peak of about 2dB at 16kHz. Trackability was average, channel balance good, wow and flutter poor, and rumble fair. The overall performance was restricted by the limited bass response of the loudspeaker.

The cassette unit set into the right hand side of the deck was large, suggesting that it should have a long life. It was provided with two levels of bias for ferric and chrome tapes, an anti 'birdie whistle' push button, a digital footage counter, and Dolby noise reduction. Thanks to Dolby, the signal to noise ratio was

very good, the erase efficiency was very good but wow and flutter only fair. The sound quality was really limited by the loudspeaker performance but it was preferred to that of the reference unit.

The radio section had a large clearly marked tuning scale set into the front edge, but though the scale was clearly marked the single cursor lamp was so far from the FM scale that some concentration was required to decide the frequency to which the receiver was tuned. In addition to manual tuning facilities there are five push buttons that allow the pre-set tuning of selected FM stations. A tuning meter is provided, doubling as one of the channel signal level indicators when recording on cassette. Least usable sensitivity was good at 2.3 μ V, the signal required to achieve a signal to noise ratio of 50dB was about average, but the signal to noise ratio (61dB) achieved for a 1mV input signal was rather poor. The sound quality was again limited by the performance of the small loudspeakers, the restricted bass response making distortion rather more obvious than it would have otherwise been.

Performance preferred to that of the reference system, but it would obviously be advantageous to improve the speakers. The speakers appeared to be a design achieving relatively high sensitivity at the expense of distortion.

In short a system that should be bought without the loudspeakers. At a price of £285 it is a reasonable choice.

Amplifier Section

| | |
|--|---------------|
| Power output into 8 ohms. | 12.5W |
| Power output into 4 ohms. | 16.5W |
| Distortion at low power output 1W | 0.05% good |
| Amplifier noise | fair |
| Signal to noise ratio for tape output | 79dBA average |
| Input voltage for full modulation Tape | 230mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 160 μ V |
| Tape output | 185mV |
| Stereo crosstalk | 46dB good |
| Channel balance | good |

Record Player Section

| | |
|---|------------|
| Frequency response. | good |
| Trackability | good |
| Signal to noise ratio | 55dBA poor |
| Channel balance | v. good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.16% fair |
| Rumble | 60dB good |

Tuner Section

| | |
|--|--------------------|
| Least usable sensitivity | 2.3 μ V good |
| Input for 50dB signal/noise | 80 μ V average |
| Signal/noise for 1mV input | 61dBA poor |
| Distortion | 0.7% average |
| AM rejection | 49dB average |
| Stereo crosstalk | average |
| Image rejection | 54dB v. good |
| IF rejection | 92dB v. good |
| Adjacent channel selectivity | —2dB poor |
| Capture ratio | average |
| 19kHz suppression | 66dB v. good |
| Muting level | — |
| Frequency response. | good |

Tape Section

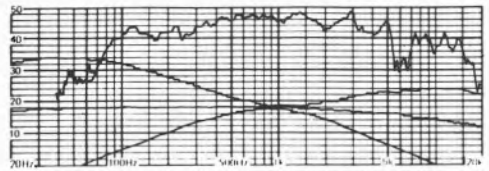
| | |
|--|---------------|
| Record/replay frequency response | average |
| Azimuth alignment | poor |
| Signal to noise ratio | 63dBA v. good |
| Distortion output | good |
| Wow and flutter | 0.22% fair |
| Erase efficiency | 55dBA v. good |

Loudspeakers (where provided)

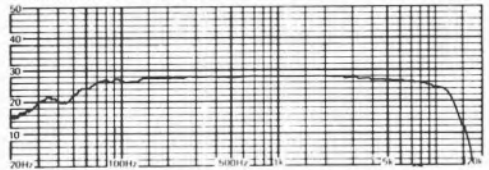
| | |
|---|------------|
| Frequency response of amplifier and speaker | fair |
| Distortion | fair |
| Sensitivity | good |
| Length of loudspeaker lead. | 4.42m good |

General Data

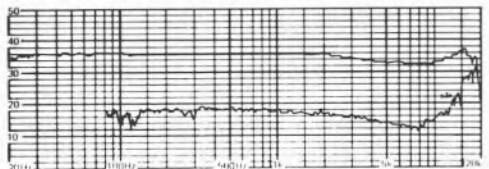
| | |
|--|------------------------|
| Compliance with British safety standards | 5b |
| Available facilities. | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | average |
| Typical selling price inc. speakers and VAT | £320.00 |
| Typical selling price ex. speakers and inc. VAT. | £285.00 |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

JVC MF-1845L

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



This is the low power model in the JVC range, the measured output being 15 watts per channel. It is also radically different in appearance having a vertical front panel in brushed aluminium, assembled in a teak finished enclosure with all the front panel controls having large and rather attractive looking knobs, also in aluminium. The auxiliary facilities are generous and should meet the requirements of all but the most dedicated of audiophiles owning a great deal of additional equipment.

The record changer is a semi-automatic 2 speed belt driven model on a very flexibly mounted plinth to reduce the effect of impacts on the equipment. A simple 'S' shaped arm is employed and though the stylus load can be adjusted, no calibration is provided on the counter balance weight, nor is there any anti-skating adjustment. Wow and flutter were worse than with the more expensive JVC MF-55LS and tracking distortion was also on the high side, but in other respects the objective performance of the record facilities was about the same as the 55LS, the signal to noise ratio being above average. The rumble performance was rather unusual in that the measured value on the inner to middle tracks was reasonable, but the rumble on the outer track was at very low frequency and was rather high. The frequency response of the pick-up etc., was generally very flat and smooth up to a frequency of 2kHz falling away smoothly to a valley of about -4dBA at 10Hz followed by a rise in output up to +4dB at 16kHz. This was audible when playing music having a

frequency range extending above 10-12kHz. Crosstalk was better than average over the whole frequency range but it tended to be modulated by the high rumble present in the outer grooves of the record.

The cassette mechanism was robust though wow and flutter were on the high side. The signal to noise ratio was above average for a machine without Dolby but the absence of a noise reduction system detracted greatly from the subjectively judged performance. A cassette storage rack was provided on the top deck.

Sensitivity of the radio receiver was below average, as was the signal to noise ratio for a 1mV input signal, an aspect of the performance that was subjectively obvious and really necessitated the use of a better than average aerial system. Apart from the IF rejection the performance was somewhat below average in most respects.

Many of the limitations that were subjectively obvious were due to the sub-standard performance of the loudspeakers, which, as the curve shows, had a rather wide trough in the response around 1.5kHz. The curve also indicated the performance of the 'noise cut' switch. This was an effective reducer of the noise but it also had a rather drastic effect on the treble components in the music.

The requirements of BS 415 were met except that the mains cable contained no instructions to the user on how to connect it to the mains plug.

Generally, a music centre for the budget

conscious owner living within about 25 miles of a main BBC station.

Amplifier Section

| | |
|--|--------------|
| Power output into 8 ohms | 12W |
| Power output into 4 ohms | 14.5W |
| Distortion at low power output 1W | 0.064% good |
| Amplifier noise | good |
| Signal to noise ratio for tape output | 73dB average |
| Input voltage for full modulation Tape | 280mV |
| Input voltage for full modulation Aux | 200mV |
| Input voltage for full modulation Mike | 240μV |
| Tape output | 120mV |
| Stereo crosstalk | 42dB fair |
| Channel balance | v. good |

Record Player Section

| | |
|-------------------------------|--------------|
| Frequency response | good |
| Trackability | poor |
| Signal to noise ratio | 61dB average |
| Channel balance | good |
| Wow and flutter at 33 1/3 rpm | 0.12% good |
| Rumble | 62dB v. good |

Tuner Section

| | |
|------------------------------|--------------|
| Least usable sensitivity | 9.6μV poor |
| Input for 50dB signal/noise | 180μV poor |
| Signal/noise for 1mV input | 61dB average |
| Distortion | 1.1% fair |
| AM rejection | 33dB fair |
| Stereo crosstalk | average |
| Image rejection | 57dB v. good |
| IF rejection | 80dB average |
| Adjacent channel selectivity | -2dB poor |
| Capture ratio | poor |
| 19kHz suppression | 58dB |
| Muting level | 46μV |
| Frequency response | good |

Tape Section

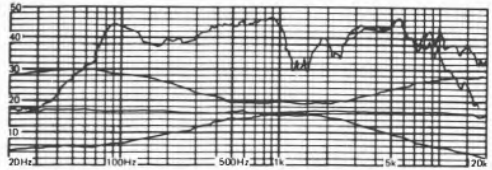
| | |
|----------------------------------|--------------|
| Record/replay frequency response | good |
| Azimuth alignment | poor |
| Signal to noise ratio | 55dB average |
| Distortion output | good |
| Wow and flutter | 0.27% poor |
| Erase efficiency | 51dB average |

Loudspeakers (where provided)

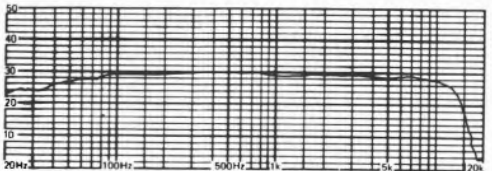
| | |
|---|-----------|
| Frequency response of amplifier and speaker | poor |
| Distortion | good |
| Sensitivity | fair |
| Length of loudspeaker lead | 2.5m fair |

General Data

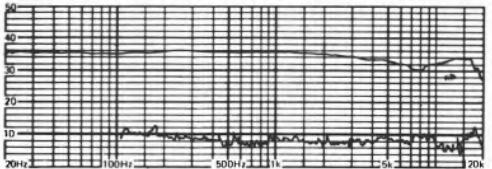
| | |
|--|------------------------|
| Compliance with British safety standards | 2 |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | good |
| Overall sound quality | fair |
| Typical selling price inc. speakers and VAT (SK 44s) | £335 |
| Typical selling price ex. speakers and inc. VAT | £265.00 |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

JVC MF-55LS

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



This was the reference system against which all the others were compared, chosen from the early arrivals as being around the average price. Thus it was heard every time any of the other systems were being checked and in consequence we might be expected to be more critical of the performance.

It is a unit having a low profile with a black finished deck having little light coloured trim. A large cassette unit is mounted on the right hand side with the record player on the left. Almost all the controls were under the Perspex cover but the very large and clearly marked tuning scale extended for about half the instrument length along the front edge angled upwards for easy reading. Nine push-buttons for selecting the facilities were mounted along the front edge under the tuning scale, but these were largely hidden by the overhanging scale.

The record player is a two speed belt drive unit having a relatively simple tone arm with a calibrated stylus load adjustment, but no calibrated anti-skating control. Tracking distortion was average, signal to noise ratio good, wow and flutter very good and with all the other aspects in the 'good' class. The measured frequency response was within $\pm 2\text{dB}$ from 20Hz to 10kHz with a peak of about 4dB at 15kHz. Crosstalk separation was very good at around 24dB over most of the frequency band. The sound quality was limited by the poor performance of the loudspeakers provided with the system. These sounded rather hollow and lacking treble response with distortion that was on the high side.

The cassette player was unusually large, hopefully this suggests a long life. Three levels of bias and equalization are provided, there are separate meters for the two channels and a digital footage counter. The unit incorporates two noise reduction systems, ANRS and Super ANRS, competitors for the Dolby system, though they have found little application except in JVC equipment. Tracking distortion was on the high side, signal to noise ratio average, distortion low (good) but wow and flutter was only fair as was the erase efficiency. The sound quality was dominated by the poor performance of the loudspeakers, as with the record player.

The least usable sensitivity of the radio receiver was good at $1.7\mu\text{V}$, the signal to noise ratio for 1mV about average at 63dBA, but the signal required for 50dBA signal to noise was low (good). All the other aspects of the performance were in the average-to-good class, and the adjacent channel selectivity was good. The frequency response was very good, being almost ruler-straight between 40Hz and 14kHz. Again the sound quality was dominated by the poor response of the loudspeaker.

Used with a pair of Wharfedale Lintons or the Celefs the performance was transformed. Purchased without loudspeakers this system is a reasonable proposition.

Amplifier Section

| | |
|--|--------------|
| Power output into 8 ohms | 22W |
| Power output into 4 ohms | 27W |
| Distortion at low power output 1W | 0.2% average |
| Amplifier noise | fair |
| Signal to noise ratio for tape output | 69dBA poor |
| Input voltage for full modulation Tape | 245mV |
| Input voltage for full modulation Aux | 185mV |
| Input voltage for full modulation Mike | 600 μ V |
| Tape output | 40mV |
| Stereo crosstalk | 42dB good |
| Channel balance | good |

Record Player Section

| | |
|---|---------------|
| Frequency response | good |
| Trackability | average |
| Signal to noise ratio | 62dBA average |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.07% good |
| Rumble | 63dB v. good |

Tuner Section

| | |
|------------------------------|------------------|
| Least usable sensitivity | 1.7 μ V good |
| Input for 50dB signal/noise | 64 μ V good |
| Signal/noise for 1mV input | 63dBA fair |
| Distortion | 0.4% good |
| AM rejection | 54dB average |
| Stereo crosstalk | average |
| Image rejection | 39dB fair |
| IF rejection | 54dB poor |
| Adjacent channel selectivity | +4dB good |
| Capture ratio | good |
| 19kHz suppression | 62dB v. good |
| Muting level | 2 μ V |
| Frequency response | v. good |

Tape Section

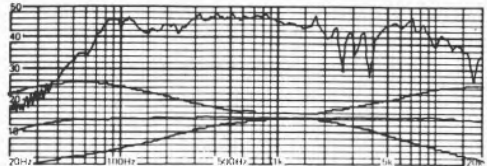
| | |
|----------------------------------|---------------|
| Record/replay frequency response | good |
| Azimuth alignment | v. good |
| Signal to noise ratio | 57dBA fair |
| Distortion output | v. good |
| Wow and flutter | 0.18% average |
| Erase efficiency | 49dBA fair |

Loudspeakers (where provided)

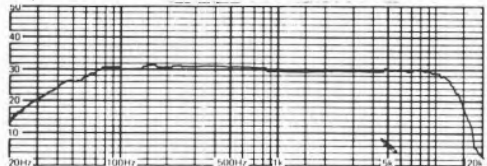
| | |
|---|---------|
| Frequency response of amplifier and speaker | fair |
| Distortion | v. good |
| Sensitivity | average |
| Length of loudspeaker lead | 2m poor |

General Data

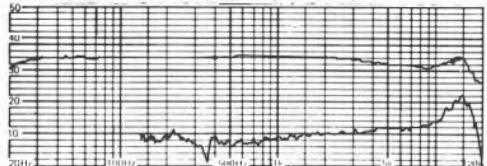
| | |
|---|------------------------|
| Compliance with British safety standards | 2 |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | good |
| Overall sound quality | average |
| Typical selling price inc. speakers and VAT (SB 208s) | £400 |
| Typical selling price ex. speakers and inc. VAT | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

National Panasonic SG-2080L

National Panasonic (UK) Ltd., 107-109 Whitby Road, Slough, Bucks. 01-753 4522



This is the cheapest of the National Panasonic group but in fact the price differences between all three are small and a little shopping around the discount houses may reverse the price order quoted here. The SG-2080L has a teak finished top deck in a teak enclosure with all the main controls mounted on a vertical front panel. The tuning scale is large, covering a short wave band in addition to the long, medium and FM bands. Facilities selection is controlled by a rotary switch with minor functions selected by push-button.

The record player section is a two speed belt drive automatic type mounted on a flexibly supported plinth. It has a rather massive arm with a calibrated counterbalance for stylus weight adjustment. The wow and flutter at .1% is very good, and the signal to noise ratio and trackability in the good class. The sound quality was limited by the loudspeakers, the average opinion of the assessors being that it was about equal to that of the reference system, distortion being lower and the bass response a little better, but the treble response not so well balanced against the bass.

Though the cassette mechanism is set into the top deck, the operating key type controls are all on the vertical front panel allowing the system to be operated with the Perspex cover down. Dolby noise reduction, a digital tape counter and unusually complete facilities for ensuring that the best possible performance from tape are included. Two three-position switches allow bias and equalisation to be separately chosen. Signal to noise ratio was good at 60dB, distortion only fair at 2% but

wow and flutter were rather poor at .22%. Subjectively judged, the sound quality was thought to be better than the reference system, the stereo image being much better. A real point of criticism is the level of the wow and flutter, though this may be a sample fault.

The radio section included four wavebands on a large clearly marked scale, the facilities and the waveband in use being selected by rotary switches. A tuning meter is included to facilitate tuning the FM band. The performance in respect of least usable sensitivity and the signal required to achieve a signal to noise ratio of 50dB were good, as were the AM rejection, stereo separation and image rejection, while the adjacent channel selectivity was poor at -9dB. IF rejection was very good. Again the sound quality was limited by the loudspeakers but it was preferred to the reference system. There was no point of criticism in respect of the safety aspects.

The system was generally liked but the high level of wow and flutter in the cassette mechanism and the poor adjacent channel selectivity are regrettable.

Amplifier Section

| | |
|--|---------------|
| Power output into 8 ohms | 16.5W |
| Power output into 4 ohms | 20W |
| Distortion at low power output 1W | 0.1% average |
| Amplifier noise | good |
| Signal to noise ratio for tape output | 78dBA average |
| Input voltage for full modulation Tape | 380mV |
| Input voltage for full modulation Aux | 330mV |
| Input voltage for full modulation Mike | 900 μ V |
| Tape output | 35mV |
| Stereo crosstalk | 45dB good |
| Channel balance | good |

Record Player Section

| | |
|---|---------------|
| Frequency response | average |
| Trackability | average |
| Signal to noise ratio | 62dBA average |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.1% good |
| Rumble | 61dB good |

Tuner Section

| | |
|------------------------------|------------------|
| Least usable sensitivity | 2.3 μ V good |
| Input for 50dB signal/noise | 57 μ V good |
| Signal/noise for 1mV input | 64dBA fair |
| Distortion | 0.7% average |
| AM rejection | 53dB average |
| Stereo crosstalk | fair |
| Image rejection | 43dB average |
| IF rejection | 88dB good |
| Adjacent channel selectivity | -9dB poor |
| Capture ratio | average |
| 19kHz suppression | 32dB poor |
| Muting level | - |
| Frequency response | average |

Tape Section

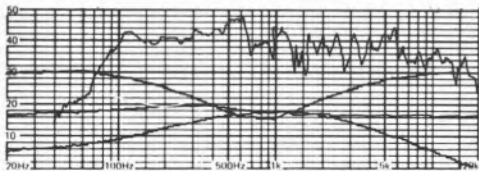
| | |
|----------------------------------|------------|
| Record/replay frequency response | good |
| Azimuth alignment | good |
| Signal to noise ratio | 60dBA good |
| Distortion output | fair |
| Wow and flutter | 0.22% fair |
| Erase efficiency | 53dBA good |

Loudspeakers (where provided)

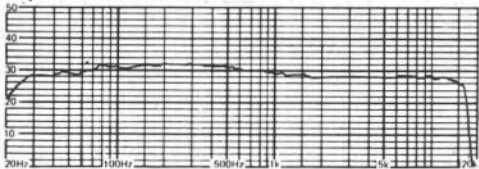
| | |
|---|------------|
| Frequency response of amplifier and speaker | fair |
| Distortion | fair |
| Sensitivity | v good |
| Length of loudspeaker lead | 2.04m poor |

General Data

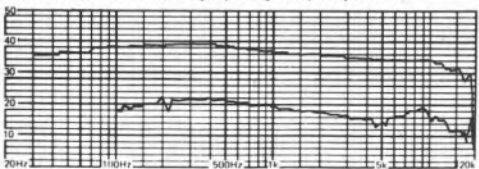
| | |
|---|------------------------|
| Compliance with British safety standards | no failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | average |
| Typical selling price inc. speakers and VAT (SB 208s) | £340 |
| Typical selling price ex. speakers and inc. VAT | - |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

National Panasonic SG-3060L

National Panasonic (UK) Ltd., 107-109 Whitby Road, Slough, Bucks. 01-753 4522



This is an elaborately equipped unit finished in black with only a small amount of light trim. The unit has a low profile, but the need to lift up the Perspex cover may minimise any advantage this has. All the controls, including those for tape motion control, are carried on the front panel, so this has an impressively technical appearance when all the indicator lights are in use.

The record player is a two speed, belt drive, automatic unit, having a massive but nicely finished cranked tone arm with calibrated stylus load adjustment, all mounted on a resiliently supported plinth. Trackability distortion was average, channel balance, signal to noise ratio and wow and flutter were all in the good group, but rumble was very good. The measured frequency response was a little disappointing there being a steady fall-away from around 500Hz reaching -10dB at 10kHz but the crosstalk separation was around 25dB up to 10kHz, though the two channels differed a little in this respect. Subjectively judged, the loss in treble response was rather obvious, but the sound was clean with a good stereo image.

The cassette unit was of the top loading type but having all the tape motion controls on the vertical front panel. It included Dolby noise reduction, switching for ferric and chrome tape bias and a single gain control for recording level. The measured frequency response was very good, being within $\pm 2\text{dB}$ from 100Hz to 14kHz but below 100Hz there was a rise of about 4dB extending down to 40Hz. Wow and flutter was poor at .22%, the

erase efficiency and signal to noise ratio were very good, but the distortion only average.

Subjectively judged, the performance was much better than that of the record facilities, but the high level of wow and flutter was noticeable. However, the reproduction was preferred to that of the reference unit.

The radio receiver performance was also disappointing, the least usable sensitivity being low (poor) as with the image rejection and IF rejection, capture ratio was only fair, but the adjacent channel selectivity and frequency response were good.

Subjectively judged, the sound quality was reasonable, the bass being clean with a good stereo image. There was no criticism on the question of electrical safety.

In summary, rather disappointing, particularly the performance of the radio section. Indeed this was out of alignment when received, the performance being greatly improved by alignment, the condition applying when the objective data was taken.

Amplifier Section

| | |
|--|------------|
| Power output into 8 ohms..... | 15.3W |
| Power output into 4 ohms..... | 16.8W |
| Distortion at low power output 1W | 0.16% fair |
| Amplifier noise | good |
| Signal to noise ratio for tape output | 81dBA good |
| Input voltage for full modulation Tape | 660mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 1.7mV |
| Tape output..... | 36mV |
| Stereo crosstalk | 42dB fair |
| Channel balance | good |

Record Player Section

| | |
|---|------------|
| Frequency response..... | fair |
| Trackability | average |
| Signal to noise ratio | 60dBA fair |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.11% good |
| Rumble | 61dB good |

Tuner Section

| | |
|------------------------------------|------------------|
| Least usable sensitivity | 7 μ V fair |
| Input for 50dB signal/noise | 200 μ V poor |
| Signal/noise for 1mV input | 60dBA poor |
| Distortion | 1% fair |
| AM rejection | 43dB average |
| Stereo crosstalk | v good |
| Image rejection | 33dB fair |
| IF rejection | 35dB poor |
| Adjacent channel selectivity | +1dB average |
| Capture ratio | fair |
| 19kHz suppression | 36 dB fair |
| Muting level | — |
| Frequency response..... | good |

Tape Section

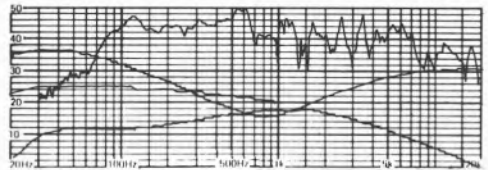
| | |
|--|--------------|
| Record/replay frequency response | good |
| Azimuth alignment | average |
| Signal to noise ratio | 63dBA v good |
| Distortion output | fair |
| Wow and flutter | 0.22% fair |
| Erase efficiency | 55dBA v good |

Loudspeakers (where provided)

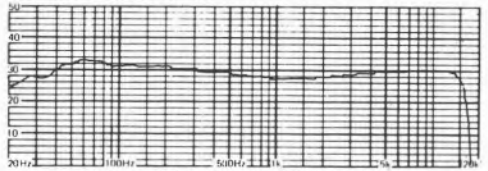
| | |
|---|------------|
| Frequency response of amplifier and speaker | fair |
| Distortion | fair |
| Sensitivity | v good |
| Length of loudspeaker lead..... | 2.04m poor |

General Data

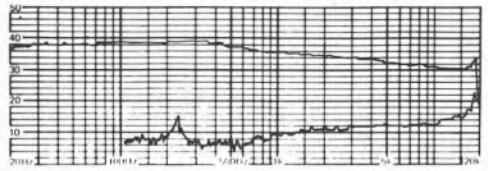
| | |
|---|------------------------|
| Compliance with British safety standards | no failures |
| Available facilities..... | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | average |
| Typical selling price inc. speakers and VAT | £300.00 |
| Typical selling price ex. speakers and inc. VAT | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

National Panasonic SG-3090L

National Panasonic (UK) Ltd., 107-109 Whitby Road, Slough, Bucks. 01-753 4522



This is the most expensive, the highest powered and the largest of the three National Panasonic units submitted. All the controls are on the vertical front edge of the unit allowing it to be operated with the Perspex dust cover down. The radio tuning scale is also on the front edge suggesting that for operating convenience the unit be mounted on a shelf a little below eye level.

The facilities list shows that almost every possibility is covered. Six touch sensitive buttons allow the pre-setting of six stations in the FM band and a further sensor button changes over to manual tuning on a large clearly marked scale. When the pre-set stations are in use, the approximate frequency is indicated on a small illuminated meter. Tuning or pre-setting is simple, a very useful tuning meter being provided to indicate maximum signal when using the AM bands or centre frequency for an FM station.

The record player is an automatic turntable with the associated controls mounted on a flexibly supported plinth, the overall performance being of a reasonable standard. The turntable speed is variable and there are illuminated stroboscope markings round the turntable rim for the two speeds. The measured frequency response of the record section was flat up to a frequency of about 1kHz, but above this it sloped away smoothly until it was down by about 6dB at 7kHz, staying at this level up to around 18kHz. Crosstalk separation was good on one channel at around 27dB but it was down to about 14dB on the other channel. Trackability was good,

signal to noise ratio very good, and wow and flutter at .15% above average.

The cassette unit is to a higher standard. Two levels of bias and equalization are included for ferric and chrome tapes, with illuminated indicators showing the type in use. Dolby noise reduction system is included and separate meters show the degree of modulation depth on left and right channels. All the main operating controls are set in the front edge of the unit, the six levers controlling the tape motion being particularly smooth in operation. The record/replay frequency was much better than that of the gram section, being within about ± 2 dB between 40Hz and 14kHz., wow and flutter were very good, signal to noise ratio good and erase efficiency in the good category.

The performance of the radio section was the best of the three Panasonic units included in the survey, though not outstanding in comparison with other units in the same price category. The least usable sensitivity was high and in the good class, while the signal to noise ratio achieved for a 1mV signal and the signal required to achieve a signal to noise ratio of 50dBA were both in the good to very good class. Adjacent channel selectivity is average and the IF rejection poor in comparison to the other units, but all the other measurable aspects are in the good class. Used with the flexible dipole, reception of Wrotham 50 miles away was excellent.

Careful listening tests resulted in a slight preference for the SG-3090 when music was being reproduced, but an equally slight

preference for the reference unit on spoken material. Any differences were small and generally only detectable when an immediate comparison was made. It was found for example that the SG-3090 would have a slight preference when listening to one programme but the reference unit would be preferred when listening to a second programme on another station. A direct comparison of the same piece of music in disc and cassette resulted in a preference for the cassette. Good quality FM radio programmes sounded best of all. This is another example of a system which is dominated by the second rate performance of the loudspeakers supplied.

In summary, not a good buy if bought with the speaker system, but if used with a pair of good loudspeakers it should be an attractive proposition.

Amplifier Section

| | |
|--|---------------|
| Power output into 8 ohms | 25W |
| Power output into 4 ohms | 30W |
| Distortion at low power output 1W | 0.08% good |
| Amplifier noise | fair |
| Signal to noise ratio for tape output | 77dBA average |
| Input voltage for full modulation Tape | 370mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | .950μV |
| Tape output | 74mV |
| Stereo crosstalk | 42dB fair |
| Channel balance | v good |

Record Player Section

| | |
|---|---------------|
| Frequency response | fair |
| Trackability | average |
| Signal to noise ratio | 64dBA good |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.15% fair |
| Rumble | .58dB average |

Tuner Section

| | |
|------------------------------|---------------|
| Least usable sensitivity | 2μV good |
| Input for 50dB signal/noise | 64μV good |
| Signal/noise for 1mV input | 68dBA v. good |
| Distortion | 0.5% good |
| AM rejection | 53dB average |
| Stereo crosstalk | poor |
| Image rejection | 45dB average |
| IF rejection | 56dB poor |
| Adjacent channel selectivity | .0dB fair |
| Capture ratio | average |
| 19kHz suppression | 36dB fair |
| Muting level | — |
| Frequency response | average |

Tape Section

| | |
|----------------------------------|---------------|
| Record/replay frequency response | average |
| Azimuth alignment | good |
| Signal to noise ratio | 61dBA good |
| Distortion output | average |
| Wow and flutter | 0.075% v good |

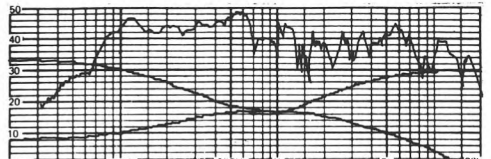
| | |
|------------------|------------|
| Erase efficiency | 53dBA good |
|------------------|------------|

Loudspeakers (where provided)

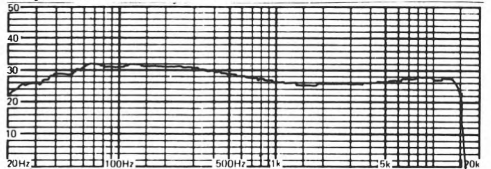
| | |
|---|------------|
| Frequency response of amplifier and speaker | fair |
| Distortion | fair |
| Sensitivity | v good |
| Length of loudspeaker lead | 2.04m poor |

General Data

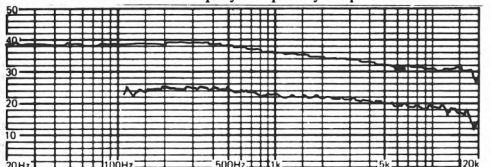
| | |
|---|------------------------|
| Compliance with British safety standards | no failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | fair |
| Typical selling price inc. speakers and VAT (SB 309s) | £470 |
| Typical selling price ex. speakers and inc. VAT. | £370.00 |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Nordmende 8025SCP

Vessco Vision & Radio Ltd., Vessco House, Unit 4, Blackwater Way, Ash Road, Aldershot, Hants. GU12 4DL. 0252 312661.



This is a smaller than average unit having a power output of 26 watts into a 4 ohm load. All the controls are under the hinged Perspex cover but a cut-out along the front allows most of them to be operated either with the cover down or with it only slightly raised. A friction retainer holds the cover in any desired position. A black top deck is enclosed in a silver metallic finished surround, the whole equipment having a rather heavy engineering look about it. Slide controls are used for volume, balance, treble and bass tone controls. Thus there are separate controls for left and right channels and for overall volume, very convenient and useful for a knowledgeable user but as the volume is changed by operation of any one of the three left, right or volume control sliders it may offer problems to the less experienced. Many of the legends are in German.

The record player is a Dual 1225 idler driven two speed unit having manual arm lift control, calibrated stylus load and anti-skating controls and a Shure pick-up, the whole record playing mechanism being assembled on a spring isolated plinth. As speakers are not included in the quoted price, two Wharfedale Super Lintons were used for the listening tests, a point to be taken into account when considering the cost of the system as tested. The frequency response of the record playing section was very good, being within about \pm dB between 20Hz and 20kHz but there were some differences in response between left and right channels. Separation was not particularly high at around 18dB but it was

well maintained over the whole frequency band.

The cassette system includes auto-selection of bias for chrome tape, a footage counter, bias frequency shift key and an unusual feature — a speech/music switch for use when recording. Automatic recording level control circuitry is incorporated but Dolby noise reduction circuitry is not included. The measured record/replay frequency was good, being within ± 2 dB between 60Hz and 9kHz with a very smooth roll-off beyond 10kHz. The treble response was lacking a little sparkle and subjectively judged, the wow and flutter appeared to be rather higher than the measured value, rumble was rather obvious but the distortion was low and the sound clean except for the comment about rumble. Used with the Linton speakers the stereo stage was markedly wider than that of the reference system with the orchestra spread more evenly over the space between the loudspeakers.

It is a limitation of all cassette tape systems that the signal to noise ratio is barely adequate when the equipment is used in a very quiet location. Dolby noise reduction circuitry is the current industry solution, so its absence is to be regretted. However it should be emphasised that our listening room is particularly quiet (between 18 and 20dBA at the time of the test) and this makes any residual noise unusually unpleasant. In a more normal environment the tape noise would not have been so obvious.

The radio receiver is of average sensitivity, but the adjacent channel selectivity was particularly good, the adjacent channel signal

having to be about 9dB higher than the wanted channel signal before the signal to noise ratio fell to 30dB. Separation was about average and the ultimate signal to noise ratio for a 1mV signal was very good at 68dB.

Subjectively judged, the performance was a little lacking in treble response but the stereo performance was very satisfactory and the distortion low. The loudness compensation could not be switched out of circuit and in consequence made speech a little bass heavy.

There was a minor point of criticism on the safety aspect, the leads on the mains switch could touch the metal deck if they broke away from the switch tags.

| | |
|----------------------------------|---|
| Sensitivity | — |
| Length of loudspeaker lead | — |

General Data

| | |
|--|------------------------|
| Compliance with British safety standards | 2, 5b |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | average |
| Typical selling price inc. speakers and VAT (LBS 400s) | £460 |
| Typical selling price ex. speakers and inc. VAT | £355.00 |

Amplifier Section

| | |
|--|---------------|
| Power output into 8 ohms | 22W |
| Power output into 4 ohms | 26W |
| Distortion at low power output 1W | 0.11% average |
| Amplifier noise | fair |
| Signal to noise ratio for tape output | 80dBA average |
| Input voltage for full modulation Tape | 385mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | — |
| Tape output | 120mV |
| Stereo crosstalk | 44dB average |
| Channel balance | good |

Record Player Section

| | |
|---|------------|
| Frequency response | good |
| Trackability | average |
| Signal to noise ratio | 64dBA good |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.21% poor |
| Rumble | 49dB poor |

Tuner Section

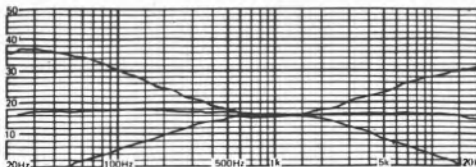
| | |
|------------------------------------|-----------------|
| Least usable sensitivity | 8 μ V poor |
| Input for 50dB signal/noise | 50 μ V good |
| Signal/noise for 1mV input | 68dBA v. good |
| Distortion | 0.56% good |
| AM rejection | 56dB good |
| Stereo crosstalk | average |
| Image rejection | 36dB fair |
| IF rejection | 82dB good |
| Adjacent channel selectivity | +10dB v. good |
| Capture ratio | average |
| 19kHz suppression | 33dB poor |
| Muting level | — |
| Frequency response | good |

Tape Section

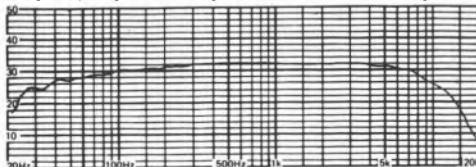
| | |
|--|------------|
| Record/replay frequency response | average |
| Azimuth alignment | average |
| Signal to noise ratio | 52dBA poor |
| Distortion output | fair |
| Wow and flutter | 0.14% good |
| Erase efficiency | 48dBA poor |

Loudspeakers (where provided)

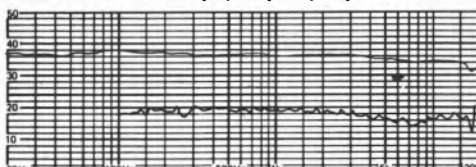
| | |
|---|---|
| Frequency response of amplifier and speaker | — |
| Distortion | — |



Frequency response of amplifier and tone control response.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Philips RH-953

Philips Electrical Ltd., Arundel Great Court, 8 Arundel Street, London WC2R 3DT. 01-836 4360.



A compact unit of rather low power output finished in black, but enlivened by some bright work trim and finish to the cassette unit. Two loudspeakers are included having leads of the commendable length of 10m. The majority of the controls and the large tuning scale are arranged along the front in the conventional way, but the panel is angled upwards greatly increasing the legibility of the scale and control markings. A novel feature is the addition of stylised graphs under the Perspex cursors to provide a general indication of the changes produced by moving the controls.

The record player is a two speed automatic unit employing a Philips Type 400 cartridge, calibrated stylus pressure and anti-skating bias adjustments being provided. The pick-up was inoperative on arrival due to a bent contact strip in the head shell, a fault that was easily rectified.

The cassette unit included a digital footage counter, automatic setting for chrome tapes, with a signal light to indicate that it was in operation and the Philips Dynamic Noise Limiter, a circuit that automatically limits the treble response to suit the spectral level of the programme being reproduced at that instant. This might be quoted as 'the poor mans Dolby' but in fact it was reasonably effective in reducing tape hiss. Signal to noise ratio at 58dBA was moderately good, distortion fair, wow and flutter on the high side and the erase efficiency at 55dB was good. The tape speed was about 2% high, the consequent pitch shift being obvious when the unit was being compared to the reference unit. The sound

quality was dominated by the poor performance of the loudspeakers provided.

The radio section had a performance above average in respect of least usable sensitivity, well above average in respect of signal to noise achieved for a signal input of 1mV, and the signal required for 50dBA, signal to noise very good for stereo separation, fair for adjacent channel selectivity and average for capture ratio. Trackability distortion was on the high side, signal to noise ratio average, wow, flutter and rumble somewhat better than average. The tuning controls were particularly smooth in action and the tuning scale large and easy to read. This is an above average performance in many respects, it is to be regretted that the overall sound quality was so limited by the loudspeakers supplied.

There was no criticism of any aspect of electrical safety.

Without the loudspeakers it is reasonably good value.

Amplifier Section

| | |
|--|------------|
| Power output into 8 ohms | 5.8W |
| Power output into 4 ohms | 8.4W |
| Distortion at low power output 1W | 0.16% fair |
| Amplifier noise | good |
| Signal to noise ratio for tape output | 66dB poor |
| Input voltage for full modulation Tape | 140mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | — |
| Tape output | 20mV |
| Stereo crosstalk | 38dB poor |
| Channel balance | v good |

Record Player Section

| | |
|---|------------|
| Frequency response | average |
| Trackability | poor |
| Signal to noise ratio | 59dB fair |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.11% good |
| Rumble | 60dB good |

Tuner Section

| | |
|------------------------------|-------------------|
| Least usable sensitivity | 1.6 μ V good |
| Input for 50dB signal/noise | 32 μ V v good |
| Signal/noise for 1mV input | 63dB fair |
| Distortion | 0.43% good |
| AM rejection | 53dB average |
| Stereo crosstalk | v good |
| Image rejection | 28dB poor |
| IF rejection | 72dB average |
| Adjacent channel selectivity | +2dB average |
| Capture ratio | average |
| 19kHz suppression | 44dB average |
| Muting level | — |
| Frequency response | good |

Tape Section

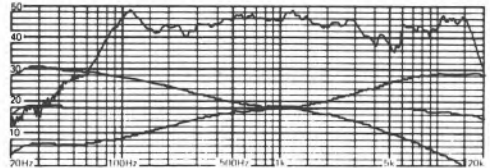
| | |
|----------------------------------|--------------|
| Record/replay frequency response | poor |
| Azimuth alignment | good |
| Signal to noise ratio | 58dB average |
| Distortion output | average |
| Wow and flutter | 0.26% poor |
| Erase efficiency | 55dB v good |

Loudspeakers (where provided)

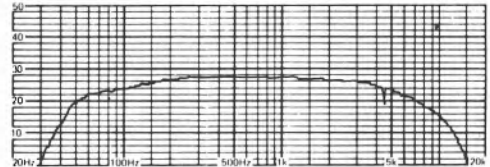
| | |
|---|------------|
| Frequency response of amplifier and speaker | average |
| Distortion | poor |
| Sensitivity | good |
| Length of loudspeaker lead | 10m v good |

General Data

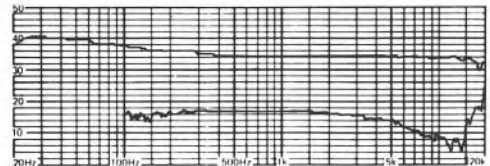
| | |
|---|------------------------|
| Compliance with British safety standards | no failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | poor |
| Typical selling price inc. speakers and VAT | £320.00 |
| Typical selling price ex. speakers and inc. VAT | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Philips RH-970

Philips Electrical Ltd., Arundel Great Court, 8 Arundel Street, London WC2R 3DT. 01-836 4360.



This is a small low power (5 watts per channel) unit at a price below £200 including loudspeakers so it is a point that must be borne in mind when judging the performance. In appearance it is well up to the standard of the much higher priced units included in this survey, the black finish being well relieved by fairly large areas of metallic trim, enclosed between teak finished end pieces. All the controls except those for tape motion are grouped on a vertical front panel, dominated by a large three band tuning scale very clearly marked. The various functions are selected by two rather small rotary switches in the panel centre with the usual four knobs for volume, balance and the bass and treble tone controls.

A two speed idler driven turntable is provided, two levers being used for cueing and speed selection. The tone arm is a simple cranked tube fitted with a stylus pressure adjustment. Trackability was surprisingly good, better in fact than in many of the more expensive units, but the other measured parameters are not up to this standard, the signal to noise ratio and the rumble being rather poor, though wow and flutter at .15% was fair. The measured frequency response was coloured by the loudness contouring applied to the amplifier so the curve should be interpreted with some care. On this basis it is not too bad, but the crosstalk separation, though reasonable around 1kHz, is rather poor in the important frequency range around 4kHz.

The sound quality was almost entirely controlled by the performance of the two

speakers supplied, the sound being disliked by all the judges. It was described as hollow, and very resonant, lacking in bass and having high levels of intermodulation distortion.

The cassette system was large suggesting a reasonable life, but the wow and flutter and the erase ratio were both poor, though the signal to noise ratio was up to the average value. The measured frequency response fell away rapidly above 7kHz but at low frequencies the curve was dominated by the loudness contouring and this makes comment a little difficult. As might be expected from the earlier comment the sound quality was entirely controlled by the poor loudspeakers supplied, the sound being hollow, resonant and disliked.

Some aspects of the radio receiver performance were surprisingly good, the least usable sensitivity, the signal to noise achieved for a 1mV input signal, and the signal required to achieve a signal to noise ratio of 50dB, all being above the standards expected for a unit in the budget price class, but image rejection, IF rejection, capture ratio and adjacent channel selectivity were all rather poor. The sound quality was entirely determined by the poor loudspeakers and all the earlier criticisms apply. There was no criticism of the safety aspects.

Obviously a system that cannot be recommended to anyone with hi-fi aspirations. If available without loudspeakers it would be worth considering, for its price.

Amplifier Section

| | |
|--|---------------|
| Power output into 8 ohms | 3.5W |
| Power output into 4 ohms | 5W |
| Distortion at low power output 1W | 0.11% average |
| Amplifier noise | — average |
| Signal to noise ratio for tape output | 62dB |
| Input voltage for full modulation Tape | 88mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | — |
| Tape output | 32mV |
| Stereo crosstalk | 46dB good |
| Channel balance | good |

Record Player Section

| | |
|---|------------|
| Frequency response | poor |
| Trackability | good |
| Signal to noise ratio | 54dB |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.15% fair |
| Rumble | 54dB poor |

Tuner Section

| | |
|------------------------------|------------------|
| Least usable sensitivity | 3.2 μ V good |
| Input for 50dB signal/noise | 58 μ V good |
| Signal/noise for 1mV input | 65dB average |
| Distortion | 0.7% average |
| AM rejection | 55dB good |
| Stereo crosstalk | good |
| Image rejection | 25dB poor |
| IF rejection | 61dB poor |
| Adjacent channel selectivity | —1dB fair |
| Capture ratio | poor |
| 19kHz suppression | 20dB poor |
| Muting level | — |
| Frequency response | poor |

Tape Section

| | |
|----------------------------------|------------|
| Record/replay frequency response | poor |
| Azimuth alignment | — v good |
| Signal to noise ratio | 51dB |
| Distortion output | — fair |
| Wow and flutter | 0.21% fair |
| Erase efficiency | 47dB |

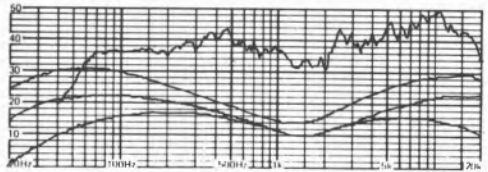
Loudspeakers (where provided)

| | |
|---|-------------|
| Frequency response of amplifier and speaker | poor* |
| Distortion | poor |
| Sensitivity | — v good |
| Length of loudspeaker lead | 5.7m v good |

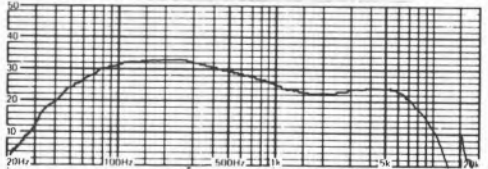
General Data

| | |
|---|------------------------|
| Compliance with British safety standards | no failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | good |
| Overall sound quality | poor |
| Typical selling price ex. speakers and VAT | £180.00 |
| Typical selling price ex. speakers and inc. VAT | — |

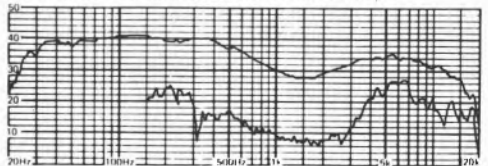
*See text.



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Pioneer M-6500

Shriro (UK) Ltd., Unit 5B, The Ridgeway, Iver, Bucks. 0753 65 2722



This unit is unusual in having a metallic finish, the vertical front panel being in brushed aluminium with the large tuning scale arranged horizontally along the edge where it is very easy to read. The front panel does not have the mass of push buttons that characterise many of the music centres, nor is there the usual multiplicity of sockets along the rear of the unit. However all reasonable facilities are provided, the relative simplicity of the controls making the centre particularly attractive to the owner whose prime interest is in the programme and not in 'driving' his equipment. Power output at 20 watts per channel is about average.

As loudspeakers are not included in the quoted price, all the tests were carried out with a pair of Wharfedale Lintons having the frequency response curve illustrated in the Technical Introduction.

The turntable is a belt driven 2 speed unit having a nicely finished tone arm and includes a calibrated stylus force adjustment, a calibrated anti-skating control and two arm controls, the whole unit being mounted on a spring isolated plinth. The measured frequency response was characterised by a smooth drop of about 5dB in output between 2kHz and 10kHz but the output was then well maintained up to 20kHz. Crosstalk was very good over the whole frequency range, and the reproduction was liked by all the assessors.

The cassette unit is more robust than usual and includes separate record-level controls and meters for left and right channels, push button selection of bias and equalization for

ferric and chrome tapes and a digital footage counter. All the tape motion controls are unusually smooth in operation. Frequency response of the cassette unit was particularly smooth between limits of 100Hz and 10kHz with a slow fall-off below 100Hz, but a rapid fall-off above 10kHz. Reproduction was much cleaner than from the reference unit, the treble response being a little over bright but easily dealt with by a minor adjustment of the treble tone control. Absence of Dolby noise reduction circuitry is regrettable as the hiss level was obvious when the music centre was used in a very quiet room.

The radio receiver controls are neatly set out and the vertical front panel is unusual in having large distinguished looking aluminium control knobs, even the function selector being of this type. Long, Medium and FM bands are covered, the band in use being indicated by small green indicator lights along the right hand top edge, balanced by a small but useful tuning meter on the left hand side. Measured data suggested an above average performance, the frequency response being ± 1 dB between 20Hz and 15kHz. Distortion and indeed almost all the other listed aspects of the objective performance were above average.

Sound quality was well liked, treble a little prominent but much smoother than the reference unit. The electrical performance probably justified the use of more expensive loudspeakers than the Lintons used for the sound quality assessment.

There was a minor failure to meet BS 415,

the openings in the rear ventilation cover being large enough to allow the standard pin to enter, but in view of the location of the cover such an accident appears extremely unlikely.

Overall, though, good value for money.

Amplifier Section

| | |
|--|-------------|
| Power output into 8 ohms | 13.6W |
| Power output into 4 ohms | 20W |
| Distortion at low power output 1W | — |
| Amplifier noise | — |
| Signal to noise ratio for tape output | — |
| Input voltage for full modulation Tape | — |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 350 μ V |
| Tape output | — |
| Stereo crosstalk | — |
| Channel balance | — |

Record Player Section

| | |
|---|-----------------|
| Frequency response | good |
| Trackability | v. good |
| Signal to noise ratio | 61.5dBA average |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.16% fair |
| Rumble | 61dB good |

Tuner Section

| | |
|------------------------------|------------------|
| Least usable sensitivity | 1.8 μ V good |
| Input for 50dB signal/noise | 63 μ V good |
| Signal/noise for 1mV input | 65dBA average |
| Distortion | 0.5% good |
| AM rejection | 64dB good |
| Stereo crosstalk | fair |
| Image rejection | 69dB v. good |
| IF rejection | 90dB good |
| Adjacent channel selectivity | +1dB average |
| Capture ratio | v. good |
| 19kHz suppression | 36dB fair |
| Muting level | 1.2 μ V |
| Frequency response | v. good |

Tape Section

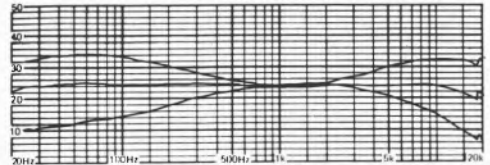
| | |
|----------------------------------|---------------|
| Record/replay frequency response | average |
| Azimuth alignment | average |
| Signal to noise ratio | 56dBA fair |
| Distortion output | v. good |
| Wow and flutter | 0.15% average |
| Erase efficiency | 52dBA average |

Loudspeakers (where provided)

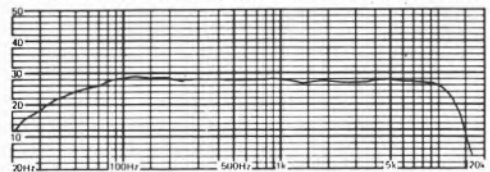
| | |
|---|---|
| Frequency response of amplifier and speaker | — |
| Distortion | — |
| Sensitivity | — |
| Length of loudspeaker lead | — |

General Data

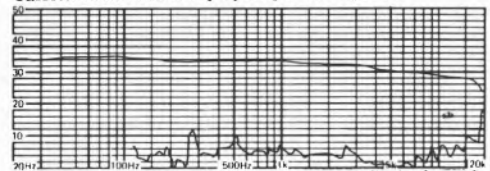
| | |
|---|------------------------|
| Compliance with British safety standards | 4 |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | good |
| Typical selling price inc. speakers and VAT | £300.00 |
| Typical selling price ex. speakers and inc. VAT | £240.00 |



Frequency response of amplifier and tone control response.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Pye 1600 Black Box

Pye Ltd., PO Box 49, St Andrews Road, Cambridge CB4 1DS. 022 05 2781



This is a budget priced, budget powered system with the minimum amount of trimmings aimed at the first user and those not interested enough in hi-fi to delve deeply into the mysteries of electronics.

It is a relatively small system, having a metallic finished deck in a teak sided enclosure, all the common controls being mounted on a vertical front panel. This also carries a large tuning scale that is particularly clearly marked.

The record player is a Garrard 620SP two speed automatic model mounted on a resiliently isolated plinth. Stylus load adjustment is provided but this is uncalibrated and thus requires a stylus pressure gauge for accurate setting. There is no anti-skating adjustment. The measured frequency response was not too bad but there was a gradual fall-away above about 1kHz. Crosstalk was around 25dB and very satisfactory over most of the important parts of the frequency but above about 5kHz and in the region of 250Hz the separation was greatly reduced. Other objective aspects of the player performance were generally in the slightly-below-average class. Trackability was rated as poor due to an arm resonance occurring at the tracking test frequency. Sound quality was aptly described as 'crystal pick-up' but the rather limited response of the loudspeaker reduced the rumble to a satisfactory level although the measured value is below average. Hum was a little on the high side in spite of the limited response of the speaker.

A large cassette unit is included, suggesting

a long life. It is a simple unit having a single recording level control but in addition an Automatic Level Control system is included. Two signal lights are included to indicate that the recording level is satisfactory. Experience shows that though an expert user will achieve a better result when he is provided with some complex control facilities, the average user will get a better result if the facilities are greatly simplified. Automatic adjustment for chromium tapes is included but there is no Dolby noise reduction system. In consequence the 'hiss' noise level is rather too audible if the system is used in a very quiet room. If you live within 2-300 yards of a main road the hiss will probably be of little account.

The record/replay frequency response was a little disappointing, there being a gradual fall-away above about 1kHz though the fall-off was fairly smooth. Sound quality was not thought to equal the reference system, the bass deficiencies in the speaker system limiting the quality that could be achieved while the high treble loss in the cassette unit rather limited the top response.

A large and very clearly marked tuning scale was fitted to the radio receiver but the sensitivity was below average, as were most of the other measurable parameters, this was also true of the price, a point that should be kept firmly in mind. The sound quality was below average but this was almost entirely due to the relatively poor performance of the speakers.

In summary, not a particularly enchanting performance, but it is probably adequate for the less technical user who is not in the hi-fi

addict class.

All the safety aspects of BS 415 were met.

Amplifier Section

| | |
|--|-------|
| Power output into 8 ohms | 9.55W |
| Power output into 4 ohms | 11W |
| Distortion at low power output 1W | — |
| Amplifier noise | — |
| Signal to noise ratio for tape output | — |
| Input voltage for full modulation Tape | — |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | — |
| Tape output | — |
| Stereo crosstalk | — |
| Channel balance | — |

Record Player Section

| | |
|---|------------|
| Frequency response | poor |
| Trackability | poor* |
| Signal to noise ratio | 55dB poor |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.26% poor |
| Rumble | 55dB fair |

Tuner Section

| | |
|--|------------------|
| Least usable sensitivity | 7 μ V fair |
| Input for 50dB signal/noise | 160 μ V poor |
| Signal/noise for 1mV input | 59dB poor |
| Distortion | 0.8% average |
| AM rejection | 47dB average |
| Stereo crosstalk | poor |
| Image rejection | 24dB poor |
| IF rejection | 55dB poor |
| Adjacent channel selectivity | +1dB average |
| Capture ratio | good |
| 19k Hz suppression | 35dB fair |
| Muting level | — |
| Frequency response | average |

Tape Section

| | |
|--|---------------|
| Record/replay frequency response | poor |
| Azimuth alignment | poor |
| Signal to noise ratio | 56dB fair |
| Distortion output | poor |
| Wow and flutter | 0.15% average |
| Erase efficiency | 53dB good |

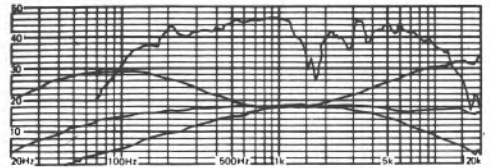
Loudspeakers (where provided)

| | |
|---|------------|
| Frequency response of amplifier and speaker | poor |
| Distortion | poor |
| Sensitivity | v. good |
| Length of loudspeaker lead | 3.12m fair |

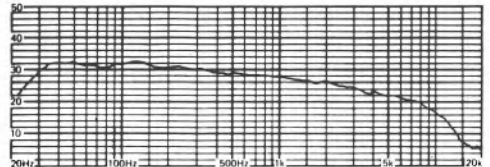
General Data

| | |
|---|------------------------|
| Compliance with British safety standards | No failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | poor |
| Typical selling price inc. speakers and VAT | £220.00 |
| Typical selling price ex. speakers and inc. VAT | — |

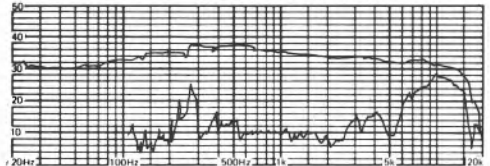
*See text.



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

BEST BUY

Rotel RM-5010

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



This is a good looking system in the high power category (35 watts per channel). The usual black top deck is relieved by a small amount of metallic trim and enclosed by teak finished ends. All the main controls and the radio tuning scale are mounted on a vertical front panel. Large black knobs are used for the sound controls and for the choice of the facilities, but push buttons are employed for the selection of the auxiliary provisions.

The cassette unit is impressively massive, employing a two speed DC servo controlled turntable having stroboscope markings round its perimeter. The 'S' shaped arm is a nicely engineered component having a calibrated stylus loading adjustment, and unusually, one of the thread-and-counterweight types of anti-skating compensators. Manual cueing and separate pitch controls for the two turntable speeds are provided. Trackability is good, as is wow and flutter, rumble and channel balance, while the signal to noise ratio at 86dBA is very good. The sound quality was well liked, being a considerable improvement on the reference unit.

The cassette section has two large VU meters, Dolby noise reduction, a digital footage counter and unusually, separate microphone and line volume controls to allow the mixing of speech and music during recording. Although the tape motion controls are on the top deck, the front panel carries illuminated legends indicating the tape control in use. The performance of the cassette section was on the same high level as the record player, signal to noise ratio, distortion and

frequency response being very good, only wow and flutter being average. Sound quality from cassette was on a par with that from the record player.

The least usable sensitivity of the receiver section was high at $1.1\mu\text{V}$, and the input for a 50dBA signal to noise ratio was low. The signal to noise ratio achieved for a 1mV input signal was average at 66dBA, though this is a very good figure in absolute terms. Distortion was very good at .16%, whilst the AM rejection, IF rejection, stereo crosstalk, image rejection and capture ratio were all in the good to very good class. Adjacent channel selectivity was average at +2.5dB. The aerial to loudspeaker terminal frequency response was within $\pm 2\text{dB}$ from about 30Hz-14kHz.

Sound quality was well liked, the distortion being low and the quality clean. Bass was slightly deficient and sibilants slightly emphasised on female speech, but the overall performance was rated as very good.

There was no criticism on safety aspects, so generally the system ranks as having good sound quality and being very good value for money.

Amplifier Section

| | |
|--|----------------|
| Power output into 8 ohms | 28.3W |
| Power output into 4 ohms | 35W |
| Distortion at low power output 1W | 0.028% v. good |
| Amplifier noise | good |
| Signal to noise ratio for tape output | 88dB v. good |
| Input voltage for full modulation Tape | 160mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 540μV |
| Tape output | 145mV |
| Stereo crosstalk | 45dB good |
| Channel balance | v. good |

Record Player Section

| | |
|---|--------------|
| Frequency response | good |
| Trackability | good |
| Signal to noise ratio | 68dB v. good |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.1% good |
| Rumble | 60.5dB good |

Tuner Section

| | |
|------------------------------|----------------|
| Least usable sensitivity | 1.1μV good |
| Input for 50dB signal/noise | 33μV good |
| Signal/noise for 1mV input | 66 dB average |
| Distortion | 0.16% v. good |
| AM rejection | 57.5dB good |
| Stereo crosstalk | v. good |
| Image rejection | 60dB v. good |
| IF rejection | 91dB v. good |
| Adjacent channel selectivity | +2.5dB average |
| Capture ratio | good |
| 19kHz suppression | 43dB average |
| Muting level | 1.6μV |
| Frequency response | v. good |

Tape Section

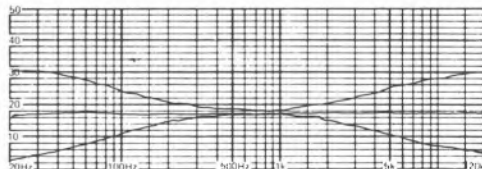
| | |
|----------------------------------|---------------|
| Record/replay frequency response | v. good |
| Azimuth alignment | good |
| Signal to noise ratio | 63dB v. good |
| Distortion output | v. good |
| Wow and flutter | 0.16% average |
| Erase efficiency | 52dB average |

Loudspeakers (where provided)

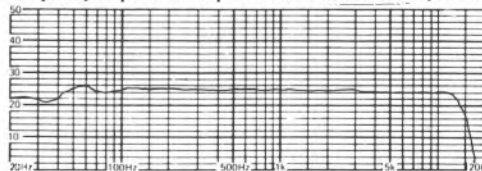
| | |
|---|---|
| Frequency response of amplifier and speaker | — |
| Distortion | — |
| Sensitivity | — |
| Length of loudspeaker lead | — |

General Data

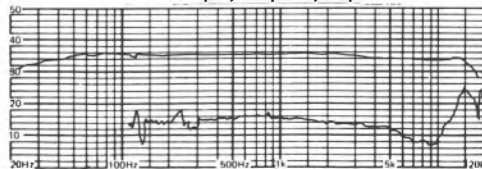
| | |
|---|------------------------|
| Compliance with British safety standards | No failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | v. good |
| Typical selling price inc. speakers and VAT | £310.00 |
| Typical selling price ex. speakers and inc. VAT | £131.00 |



Frequency response of amplifier and tone control response.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

BEST BUY

Sanyo G-271 1 Super 2

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



A deck made in the fashionable black finish but relieved by a fair amount of light coloured trim and the teak veneered sides to the enclosure. All the controls and the tuning scale are carried on a vertical brushed aluminium front panel, but the cassette tape motion controls are under the spring biased perspex cover.

The record player is a two speed semi-automatic belt driven type isolated from the main frame on a spring mounted plinth. The nicely finished arm is provided with a calibrated anti-skating adjustment, but an uncalibrated stylus load adjustment. The measured frequency response is within ± 2 dB between 100Hz and 10kHz, but falls away below 100Hz and rises to a peak of about 4dB around 16kHz. Crosstalk separation averages about 20dB at 1kHz. Trackability could be improved with advantage, the tracking distortion being on the high side even at lateral velocities as low as 15 cms/sec. The signal to noise ratio was good to very good, while the rumble level was average. The sound quality was considered to be unusually clean for such a low power system, probably due to the low distortion measured at the 1 watt level, but the limited bass response of the loudspeaker and the fall-off in the pick-up response in the same band tended to make the sound rather short of bass and gave some undue prominence to the middle and treble.

The cassette mechanism is a large and impressive looking unit provided with Dolby noise reduction, a digital footage counter and two levels of equalization for ferric and

chrome tapes. Two recording level meters and two separate faders are included. The record/replay response is within 1dB between 100Hz and 15kHz, an excellent performance slightly marred by the fall-off below 100Hz, the response being about 4dB down at 50Hz. Wow and flutter are average to fair at .17%, signal to noise ratio good to very good, and erase efficiency very good. The sound quality suffered from the restricted bass response of the loudspeaker, but it was surprisingly clean and the stereo image was well defined. In this respect it was much better than the reference unit.

Least usable sensitivity at $3\mu\text{V}$ was very good, and the input signal required to achieve a signal to noise ratio of 50dBA was low at $63\mu\text{V}$ a good to very good performance, though the signal to noise ratio achieved for an input signal of 1mV was fair at 64dBA. Distortion at .3% was very good, AM rejection about average, stereo separation very good, image rejection and IF rejection very good, capture ratio 'average' at 5dB, 19kHz rejection very good at 41dB. Adjacent channel selectivity at -2.5 dB was only fair. The frequency response will be seen to be very good indeed being within 1dB between 100Hz and 13kHz, though falling away below 100Hz. This fall-off is common to all three facilities, rather suggesting that it is the common amplifier that is setting the performance.

The safety requirements of BS 415 were met on all counts.

The performance is in the top ten class. There are some indications that some part of

the bass loss is due to the amplifier. The advantages of having low distortion at low power outputs appears to be demonstrated by the clean performance, even though the system is one of the lowest powered among those tested.

Amplifier Section

| | |
|--|--------------|
| Power output into 8 ohms | 6.4W |
| Power output into 4 ohms | 7.1W |
| Distortion at low power output 1W | 0.07% good |
| Amplifier noise | poor |
| Signal to noise ratio for tape output | 71dBA poor |
| Input voltage for full modulation Tape | 200mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 370 μ V |
| Tape output | 140mV |
| Stereo crosstalk | 48dB v. good |
| Channel balance | v. good |

Record Player Section

| | |
|---|----------------|
| Frequency response | good |
| Trackability | poor |
| Signal to noise ratio | 60dBA fair |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.12% good |
| Rumble | 57.5dB average |

Tuner Section

| | |
|------------------------------|-----------------|
| Least usable sensitivity | 3 μ V good |
| Input for 50dB signal/noise | 63 μ V good |
| Signal/noise for 1mV input | 64dBA fair |
| Distortion | 0.3% v. good |
| AM rejection | 56dB good |
| Stereo crosstalk | v. good |
| Image rejection | 46dB average |
| IF rejection | 83dB good |
| Adjacent channel selectivity | -2.5dB poor |
| Capture ratio | fair |
| 19kHz suppression | 41dB fair |
| Muting level | — |
| Frequency response | good |

Tape Section

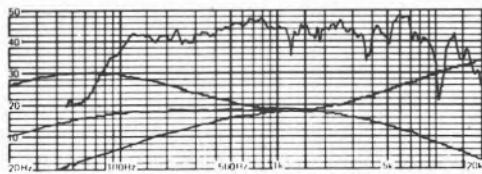
| | |
|----------------------------------|---------------|
| Record/replay frequency response | v. good |
| Azimuth alignment | good |
| Signal to noise ratio | 61dBA good |
| Distortion output | good |
| Wow and flutter | 0.17% average |
| Erase efficiency | 51dBA average |

Loudspeakers (where provided)

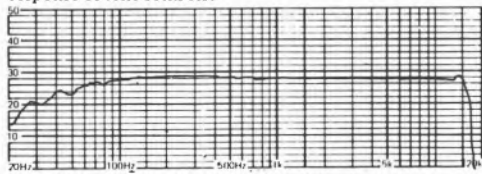
| | |
|---|-----------|
| Frequency response of amplifier and speaker | average |
| Distortion | poor |
| Sensitivity | good |
| Length of loudspeaker lead | 2.3m fair |

General Data

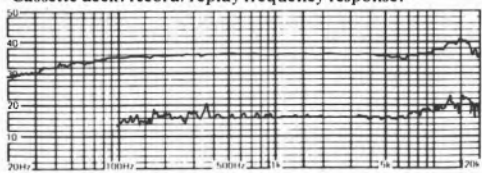
| | |
|---|------------------------|
| Compliance with British safety standards | No failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | average |
| Typical selling price inc. speakers and VAT | £237.00 |
| Typical selling price ex. speakers and inc. VAT | n. a. |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (I channel).

RECOMMENDED

Sanyo G-2811KL

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



This is a system in the high power class — 23 watts per channel — in the currently fashionable black finish with little relief in the way of plated trim. All the controls are on the top deck under a Perspex cover, so the system has to be operated with the cover up. The layout of the top deck is very convenient, the radio tuning scale being set along the rear edge of the top panel and angled upwards for easy viewing. In front are three good meters for right and left channel signals, and a third meter for tuning on both AM and FM. Lever type switches are used for selecting the facility required with push buttons for selecting the required radio waveband. Eight touch sensors for the pre-selection of seven radio programmes are arranged along the front edge of the deck.

The record player is a two speed belt drive semi-automatic unit mounted on a plinth that is resiliently isolated from the deck. There is no calibrated adjustment of stylus load or anti-skating force. The pick-up response was somewhat unusual in having a peak around 14kHz, though fairly uniform in output up to 10kHz. Separation was good at 20dB but it decreased rapidly above 10kHz to a value in the region of 10dB. Wow and flutter were exceptionally good at .08%, the signal to noise ratio and rumble were very good, but tracking distortion was in the poor class. The sound quality was a little disappointing, largely due to the peak in the treble response, though this could be tamed by the use of the treble tone control.

The cassette unit included Dolby noise

reduction, provision for ferric and chrome tapes, a digital footage counter, separate volume controls and level meters for left and right channels. Wow and flutter was good, as were the erase efficiency and distortion, the signal to noise ratio with Dolby being very good. Record/replay frequency response displayed the same characteristics as the record player, there being a broad peak of about 5dB in the 8-10kHz region. Sound quality was liked, but the treble peak required use of the tone control to make the sound acceptable.

A very neat radio unit is well laid out and convenient to use. Eight touch sensors along the front edge allow the pre-selection of seven FM stations, or of manual tuning using the large conveniently angled scale along the back edge of the deck. Though touch sensors are very convenient they change stations rather easily on accidental contact and probably rather confusingly for a non-technical user. Technical performance was in the 'above average' class for most parameters, adjacent channel selectivity also being above average. The frequency response was good being within ± 2 dB from 50Hz to 10kHz and only 3dB down at 15kHz, though nearly 40dB down at the 19kHz sub-carrier frequency.

The sound quality was very good and was liked, though the bass was rather prominent in a narrow frequency band, while the extreme bass was rather lacking.

There was minor criticism on the safety aspect. Although the switch leads were not anchored strictly to BS 415 standards on the

sample it appeared unlikely that any mishap would occur.

However, good value for money.

Amplifier Section

| | |
|--|---------------|
| Power output into 8 ohms | 18.2W |
| Power output into 4 ohms | 23W |
| Distortion at low power output 1W | 0.044% good |
| Amplifier noise | average |
| Signal to noise ratio for tape output | 86dBA v. good |
| Input voltage for full modulation Tape | 170mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 315µV |
| Tape output | 270mV |
| Stereo crosstalk | 48dB v. good |
| Channel balance | v. good |

Record Player Section

| | |
|-------------------------------|---------------|
| Frequency response | good |
| Trackability | poor |
| Signal to noise ratio | 67dBA v. good |
| Channel balance | v. good |
| Wow and flutter at 33 1/3 rpm | 0.08% v. good |
| Rumble | 65dB v. good |

Tuner Section

| | |
|------------------------------|---------------|
| Least usable sensitivity | 2.8µV good |
| Input for 50dB signal/noise | 80µV average |
| Signal/noise for 1mV input | 65dBA average |
| Distortion | 1% fair |
| AM rejection | 54.5dB good |
| Stereo crosstalk | average |
| Image rejection | 46dB average |
| IF rejection | 90dB good |
| Adjacent channel selectivity | +4dB good |
| Capture ratio | poor |
| 19kHz suppression | 38dB fair |
| Muting level | — |
| Frequency response | good |

Tape Section

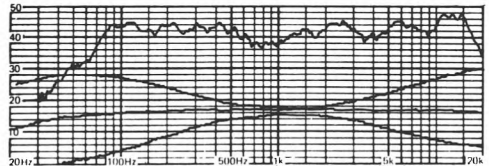
| | |
|----------------------------------|---------------|
| Record/replay frequency response | average |
| Azimuth alignment | good |
| Signal to noise ratio | 64dBA v. good |
| Distortion output | good |
| Wow and flutter | 0.14% good |
| Erase efficiency | 53dBA good |

Loudspeakers (where provided)

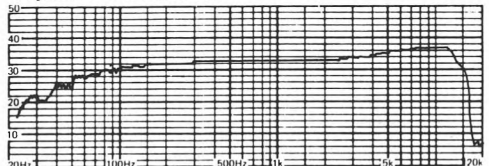
| | |
|---|------------|
| Frequency response of amplifier and speaker | good |
| Distortion | average |
| Sensitivity | poor |
| Length of loudspeaker lead | 1.93m poor |

General Data

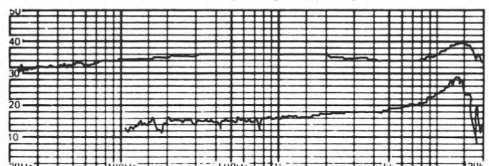
| | |
|--|------------------------|
| Compliance with British safety standards | 5b |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | v. good |
| Typical selling price inc. speakers and VAT | £380.00 |
| Typical selling price ex. speakers and inc. VAT. | £310.00 |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Sharp SG-220E

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



This is a unit at the lower end of the price class and with a relatively low power output. It employs a front loading cassette unit and this allows space for cassette storage on the deck top. It is a relatively large unit having a vertical front panel in brushed aluminium with large knobs also in aluminium, the enclosing case being teak finished.

The record player is a belt drive two-speed automatic type employing a 'S' shaped arm with playing weight adjustment but no anti-skating device. The measured frequency response of the pick-up shows a large valley in the mid range and a peak in the 15kHz region caused by a compulsory loudness contour feature, both aspects of performance that could be removed with advantage. Crosstalk is around 20dB over most of the frequency range, a good but not outstanding performance. Tracking distortion, rumble, and stylus weight were all on the high side, but the signal to noise ratio was well up to the standard of more expensive units. Sound quality was judged to be reasonable but the high frequency peak and rumble were a little too obvious to the assessors.

Front loading is very convenient for an operator whether the cassette unit is mounted on a high or low shelf. The cassette eject is very smooth as are all the tape motion controls. The frequency response exhibits the same valley in mid-range, presumably due to the loudness compensation being permanently in circuit. The same quality exhibited some of the characteristics of the record replay system,

though the treble peak was much less obvious. Wow and flutter were on the high side, and the absence of Dolby made the hiss unduly prominent in our very quiet listening room. A house within 300 or 400 yards of any sizeable road would have a much higher internal noise level and the tape hiss would be correspondingly less obvious.

The radio receiver is of medium sensitivity as are all the other objective aspects of the performance, except the frequency response which was definitely well above average, being within ± 2 dB from about 30Hz to 16kHz. The sound quality was a little below average, the good frequency response doing nothing to reduce the rather prominent treble peaks in the loudspeaker. The tuning scale is large, very clearly marked and the illuminated cursor very effective, but a tuning meter would be a great advantage.

There was no criticism of any points on the score of electrical safety.

In summary a good looking receiver, somewhat below average performance but much below average price. A good choice for the budget conscious user who is not a hi-fi enthusiast.

Amplifier Section

| | |
|--|---------------|
| Power output into 8 ohms | 5W |
| Power output into 4 ohms | 6.6W |
| Distortion at low power output 1W | 0.31% poor |
| Amplifier noise | good |
| Signal to noise ratio for tape output | 77dBA average |
| Input voltage for full modulation Tape | 205mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 450 μ V |
| Tape output | — |
| Stereo crosstalk | 26dB poor |
| Channel balance | v. good |

Record Player Section

| | |
|---|------------|
| Frequency response | fair* |
| Trackability | average |
| Signal to noise ratio | 63dBA good |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.1% good |
| Rumble | 53dB poor |

Tuner Section

| | |
|------------------------------|---------------------|
| Least usable sensitivity | 4.4 μ V average |
| Input for 50dB signal/noise | 80 μ V average |
| Signal/noise for 1mV input | 62dBA poor |
| Distortion | 1.6% poor |
| AM rejection | 45dB average |
| Stereo crosstalk | poor |
| Image rejection | 55dB v. good |
| IF rejection | 85dB good |
| Adjacent channel selectivity | —2dB poor |
| Capture ratio | average |
| 19kHz suppression | 39dB fair |
| Muting level | — |
| Frequency response | v. good |

Tape Section

| | |
|----------------------------------|---------------|
| Record/replay frequency response | average* |
| Azimuth alignment | good |
| Signal to noise ratio | 55dBA poor |
| Distortion output | average |
| Wow and flutter | 0.2% fair |
| Erase efficiency | 52dBA average |

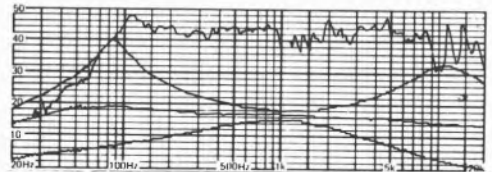
Loudspeakers (where provided)

| | |
|---|------------|
| Frequency response of amplifier and speaker | average |
| Distortion | poor |
| Sensitivity | v. good |
| Length of loudspeaker lead | 2.54m fair |

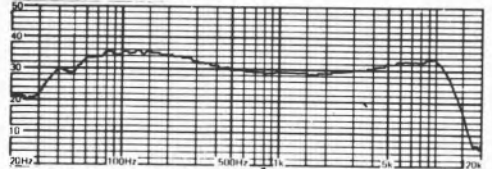
General Data

| | |
|---|------------------------|
| Compliance with British safety standards | no failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | good |
| Overall sound quality | fair |
| Typical selling price inc. speakers and VAT | £210.00 |
| Typical selling price ex. speakers and inc. VAT | £180.00 |

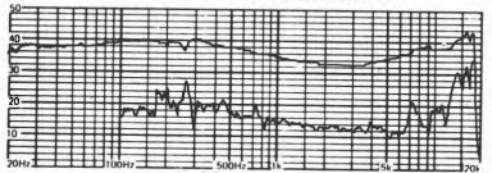
*See text.



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.

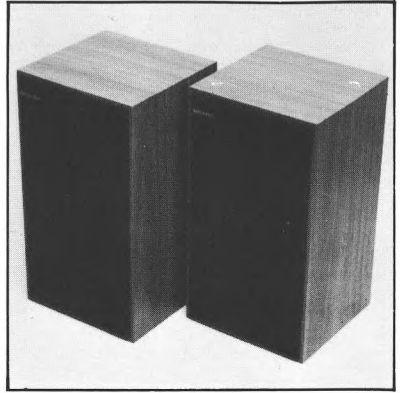


Record deck: frequency response and crosstalk, (1 channel).

RECOMMENDED

Sharp SG-450 E

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



A unit nicely finished in metallic black with a little light coloured trim and the usual hinged Perspex cover, but having all the controls under the cover. Power output is 22 watts per channel into a 4 ohm load, so it is in the higher power league with a multiplicity of facilities to match.

A resiliently isolated plinth carries a two speed belt automatic turntable, the pick-up arm including calibrated controls for stylus load and anti-skating bias. The pick-up response was particularly smooth being within $\pm 2\text{dB}$ between 30Hz and 14kHz. Crosstalk was good at an average of around 22dB over most of the frequency range, though decreasing a little at frequencies above 5kHz. Tracking distortion was in the 'good' class but rumble was a little on the high side. Liked by the listeners, though there was some criticism of the level of the rumble.

The cassette unit was above average in robustness and included a digital footage counter, auto-selection of bias for CrO₂ tapes, Dolby noise reduction and an indicator light to remind the operator that he has selected the 'record' position and is about to erase a valuable tape. Two other signal lights indicate that the tape is fast winding or rewinding. The record/replay response was very good indeed, being flat within $\pm 1\text{dB}$ between 40Hz and 16kHz. Wow and flutter were low at .1% and the signal/noise ratio with Dolby very good at 64dBA. The unit includes a simple circuitry to allow the tape to be forward driven at its fast forward speed until a gap in the recording appears at the end of a selection. It then

reverts to the normal replay speed.

The assessors were favourably impressed with the sound quality so it appears in the top ten list.

A particularly large tuning scale is employed, the scale being along the back of the deck and tilted upwards to improve the visibility. Tuning covers four wavebands, a short waveband being included. A row of fourteen push-buttons along the front edge of the tuning scale controls all the facilities and below this there is a row of three meters, one doubling as tuning meter and channel recording level meter, while the other provides an approximate indication of the frequency to which the receiver is tuned. Five touch sensors are used to allow the pre-tuning of five stations in the FM band, while the sixth sensor selects manual tuning. Unusually this manual tuning is done by a knob on the right hand side of the unit and outside the Perspex cover.

The sensitivity is high at 1.5 μV and the input voltage necessary to achieve a signal to noise ratio of 50dB is low at 50 μV . The signal to noise achieved for an input signal is high at 64dBA. All the other measured aspects of the performance are in the good to very good class.

Again the sound quality was well liked. There was no criticism of the system from the safety aspect of BS 415. So, in summary, a system having a good performance in almost every respect, with ample facilities to please any enthusiast.

Amplifier Section

| | |
|--|----------------|
| Power output into 8 ohms | 17W |
| Power output into 4 ohms | 21.4W |
| Distortion at low power output 1W | 0.025% v. good |
| Amplifier noise | fair |
| Signal to noise ratio for tape output | 83dBA good |
| Input voltage for full modulation Tape | 298mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 1.1mV |
| Tape output | 29mV |
| Stereo crosstalk | 47dB average |
| Channel balance | v. good |

Record Player Section

| | |
|---|---------------|
| Frequency response | good |
| Trackability | good |
| Signal to noise ratio | 61dBA average |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.12% good |
| Rumble | 51dB poor |

Tuner Section

| | |
|------------------------------|------------------|
| Least usable sensitivity | 1.5 μ V good |
| Input for 50dB signal/noise | 50 μ V good |
| Signal/noise for 1mV input | 65.5dBA average |
| Distortion | 0.5% good |
| AM rejection | 51dB average |
| Stereo crosstalk | fair |
| Image rejection | 53dB good |
| IF rejection | 95dB v. good |
| Adjacent channel selectivity | +4dB good |
| Capture ratio | good |
| 19kHz suppression | 56dB good |
| Muting level | 5.8 μ V |
| Frequency response | v. good |

Tape Section

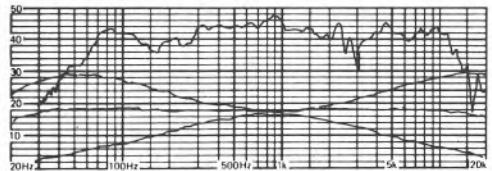
| | |
|----------------------------------|---------------|
| Record/replay frequency response | v. good |
| Azimuth alignment | poor |
| Signal to noise ratio | 64dBA v. good |
| Distortion output | fair |
| Wow and flutter | 0.09% v. good |
| Erase efficiency | 55dBA v. good |

Loudspeakers (where provided)

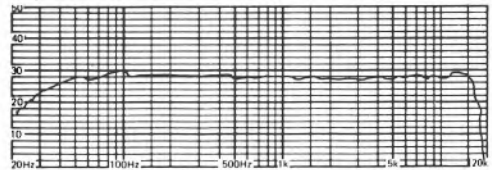
| | |
|---|------------|
| Frequency response of amplifier and speaker | average |
| Distortion | fair |
| Sensitivity | average |
| Length of loudspeaker lead | 2.81m fair |

General Data

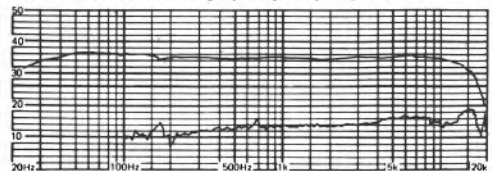
| | |
|---|------------------------|
| Compliance with British safety standards | no failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | v. good |
| Typical selling price inc. speakers and VAT | £360.00 |
| Typical selling price ex. speakers and inc. VAT | £320.00 |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Skantic 2065

Skantic (UK) Ltd., Station Road, Edenbridge, Kent TN8 6EY. 073 286 5231.



This is one of the lower priced units finished entirely in black and having the cassette and turntable on top with the radio tuning scale and the controls along the front edge. These controls were turned to face upwards, greatly improving the visibility.

The record player plinth is resiliently mounted to minimise any disturbances due to impact on the supporting shelf or table and the simple but well made tone arm has calibrated stylus pressure and anti-skating adjustments.

The cassette mechanism is a small but well made unit that includes a digital footage counter and automatic sensing of the insertion of a chromium tape cassette. The push-buttons were a little rough in operation and wow and flutter were on the high side at .22%.

The radio tuning scale is smaller than average but is mounted where it is clearly visible along the front edge with the volume control, balance, bass and treble controls, having large and clearly marked scales. Along the top centre of the front panel is a row of sixteen push-buttons that select the various facilities and allows the pre-set selection of seven stations. All the sliders and buttons were particularly smooth in operation. The technical performance of the units was a little above average in all respects except wow and flutter. This was slightly worse than average on both the cassette deck and record player. The sensitivity of the microphone facility was on the high side, only $100\mu\text{V}$ being required to reach the red sector on the rather small recording level meter, but this high sensitivity was accompanied by a rather low signal to

noise ratio.

The sound quality was considered to be slightly above average for records, somewhat below average from the cassette and average from FM radio. From this point of view the Skantic is average, or a little above average in value for money and the choice would depend on the appearance and on the selection of facilities offered.

Only one rather minor point came to light in the electrical safety inspection, one lead could touch the record player if it broke away from the terminal, though this is thought to be an unlikely occurrence.

Amplifier Section

| | |
|--|---------------|
| Power output into 8 ohms. | 19.6W |
| Power output into 4 ohms. | 17.6W |
| Distortion at low power output 1W | 0.18% fair |
| Amplifier noise | good |
| Signal to noise ratio for tape output | 77dBA average |
| Input voltage for full modulation Tape | 225mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike. | 100 μ V |
| Tape output. | 33mV |
| Stereo crosstalk | 41dB fair |
| Channel balance | good |

Record Player Section

| | |
|---|---------------|
| Frequency response. | good |
| Trackability | good |
| Signal to noise ratio | 69dBA v. good |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{2}$ rpm | 0.25% poor |
| Rumble | 61dB good |

Tuner Section

| | |
|--|------------------|
| Least usable sensitivity | 1.5 μ V good |
| Input for 50dB signal/noise | 40 μ V good |
| Signal/noise for 1mV input | 65dBA average |
| Distortion | 0.45% good |
| AM rejection | 67dB good |
| Stereo crosstalk | v. good |
| Image rejection | 54dB good |
| IF rejection | 96dB good |
| Adjacent channel selectivity | +2dB average |
| Capture ratio | good |
| 19kHz suppression | 62dB v. good |
| Muting level | 1 μ V |
| Frequency response. | good |

Tape Section

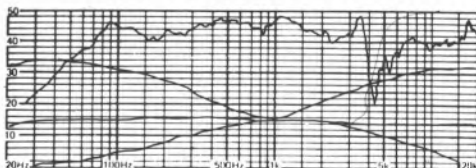
| | |
|--|------------|
| Record/replay frequency response | average |
| Azimuth alignment | average |
| Signal to noise ratio | 52dBA poor |
| Distortion output | good |
| Wow and flutter | 0.22% fair |
| Erase efficiency | 49dBA fair |

Loudspeakers (where provided)

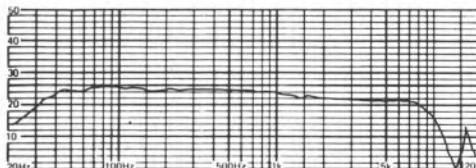
| | |
|---|-----------|
| Frequency response of amplifier and speaker | fair |
| Distortion | good |
| Sensitivity | poor |
| Length of loudspeaker lead | 4.9m good |

General Data

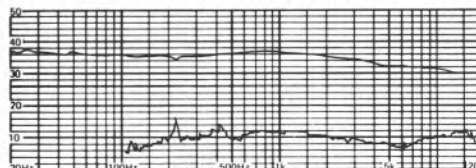
| | |
|---|------------------------|
| Compliance with British safety standards | 2, 5 |
| Available facilities. | see Introductory Chart |
| Overall finish and engineering. | good |
| Overall sound quality | fair |
| Typical selling price inc. speakers and VAT | £360.00 |
| Typical selling price ex. speakers and inc. VAT | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Skantic 3063

Skantic (UK) Ltd., Station Road, Edenbridge, Kent TN8 6EY. 073 286 5231.



This is a unit of above average power (32 watts per channel), and has a very comprehensive range of additional facilities. It is finished in a matt black and scores in having all the controls on the front edge and on an inclined front panel allowing everything to be operated with the hinged Perspex cover down. Rather regrettably the hinged cover did not fit, the fixing holes apparently being in the wrong position. Regrettable also was the noise which radiated from the mains equipment inside the unit.

The record replay facilities include a belt driven two speed semi-automatic turntable, the arm being unusual in having a stylus load adjustment consisting of a sleeve-shaped weight sliding along the actual arm while the anti-skating adjustment was operated by a separate small knob on the spring mounted plinth. The tracking distortion was a little worse than average but the wow and flutter and the rumble were all in the good class. The pick-up frequency response was within $\pm 2\text{dB}$ from 20Hz to 10kHz and it was well maintained out to 20kHz. Crosstalk was rather low from left channel into right, but much better from right into left. Subjectively judged, the peak in the loudspeaker response was objectionable, making the percussion instruments unduly intrusive.

The cassette mechanism is a better-than-average type, wow and flutter being particularly low, the erase efficiency fair, and the distortion output good. Dolby is included so the signal to noise ratio is satisfactory. Our only criticism was that the speed was about

3% slow, very obvious to the listening panel. The record/replay response was good, being within about $\pm 1\text{dB}$ from about 40Hz to 9kHz with a gradual tail-off above this. Subjectively judged, the performance was coloured by the relatively poor response of the loudspeakers.

The radio receiver was unusual in that it dispenses with a large tuning scale, three pre-tuning operated sensors allowing a choice of three stations, while the fourth sensor provided manual tuning. However the frequency indicating meter was on the small side making it difficult to identify the station being heard. The receiver was of average sensitivity, but the signal to noise ratio achieved for an input of 1mV was very good and the IF rejection was in the outstanding class.

Subjectively assessed, the performance was adversely affected by the performance of the loudspeakers. This is a good example of a system that would benefit from having better loudspeakers. There was criticism of the acoustic noise radiating from the unit directly and from the loudspeakers. In our quiet listening room (22dBA in the middle of the day) the direct radiation raised the noise level by about 9dBA, even with the volume control at zero. In a house nearer to main roads where the ambient noise level was around 40dBA this noise from the equipment would probably have been unnoticeable.

From the safety aspect there is criticism of the absence of instructions on how to add a plug to the mains lead and on a minor point, the anchorage of the leads to the mains

transformer.

The sound quality was about equal to, or a little below that of the reference unit and at its price not a particularly 'good buy'.

Amplifier Section

| | |
|--|-------------|
| Power output into 8 ohms | 28W |
| Power output into 4 ohms | 33W |
| Distortion at low power output 1W | 0.058% good |
| Amplifier noise | average |
| Signal to noise ratio for tape output | 76dBA fair |
| Input voltage for full modulation Tape | 380mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 200μV |
| Tape output | 73mV |
| Stereo crosstalk | 40dB fair |
| Channel balance | good |

Record Player Section

| | |
|---|------------|
| Frequency response | good |
| Trackability | fair |
| Signal to noise ratio | 63dBA good |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.12% good |
| Rumble | 61dB good |

Tuner Section

| | |
|------------------------------|---------------|
| Least usable sensitivity | 4.3μV average |
| Input for 50dB signal/noise | 128μV fair |
| Signal/noise for 1mV input | 65dBA average |
| Distortion | 0.6% good |
| AM rejection | 52dB average |
| Stereo crosstalk | good |
| Image rejection | 46dB average |
| IF rejection | 85dB good |
| Adjacent channel selectivity | +1dB average |
| Capture ratio | good |
| 19kHz suppression | 68dB v. good |
| Muting level | 8.8μV |
| Frequency response | good |

Tape Section

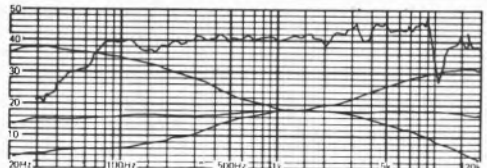
| | |
|----------------------------------|----------------|
| Record/replay frequency response | good |
| Azimuth alignment | good |
| Signal to noise ratio | 57dBA fair |
| Distortion output | good |
| Wow and flutter | 0.075% v. good |
| Erase efficiency | 49dBA fair |

Loudspeakers (where provided)

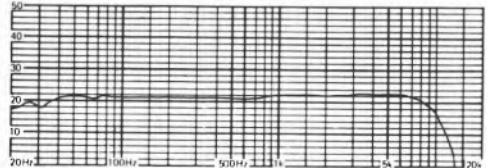
| | |
|---|-----------|
| Frequency response of amplifier and speaker | average |
| Distortion | poor |
| Sensitivity | good |
| Length of loudspeaker lead | 5.1m good |

General Data

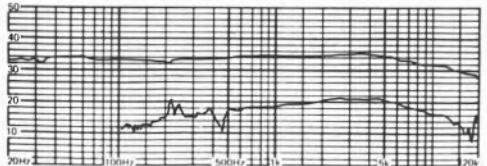
| | |
|---|------------------------|
| Compliance with British safety standards | 2, 5b |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | good |
| Overall sound quality | fair |
| Typical selling price inc. speakers and VAT | £470.00 |
| Typical selling price ex. speakers and inc. VAT | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Sony EX-1K

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



This is a very basic low power unit at the bottom end of the price range and therefore the performance has to be looked at with the price in mind. It is basic in the sense that it consists of radio, record player and cassette units without all the frills that grace the expensive systems. In addition, the loudspeakers provided are very simple two unit enclosures of restricted performance.

The record player is an automatic unit without any resiliently mounted plinth and without stylus pressure or anti-skating adjustment. In spite of its simplicity the wow and flutter, and rumble were both above average while the tracking distortion was well up to average. The measured frequency response of the magnetic pick-up showed a marked hollow in the middle of the band, but in part this is due to the inclusion of loudness compensation that could not be switched out of circuit, (see also record/replay response for tape section). Separation was much above average at about 30dB in mid frequency range. The sound quality was limited by the performance of the two cheap looking loudspeakers. These were short of bass and had a pronounced honky resonance in the lower middle frequency range.

The cassette player was of good-average construction with six piano key type push buttons to control tape motion and cassette ejection. The measured record/replay response was rather restricted, being 6dB down at 7kHz, wow and flutter at .18% was worse than average, but the erase ratio and harmonic distortion were both a little better

than average. Sound quality was limited by the loudspeakers, while the lack of Dolby noise reduction made tape hiss rather obvious in our particularly quiet listening room.

A four band radio receiver is included, the tuning dial being of medium size but clearly marked and located on a sloping front panel that made it easy to see. All the functions were selected by a row of push buttons along the vertical front panel. Sensitivity was above average, but AM rejection, image rejection and capture ratio were below average, adjacent channel rejection at -8dB being among the lowest found in this series of tests. IF rejection and the signal to noise ratio achieved for a signal of 1mV were reasonably good.

There was no criticism on the score of BS 415 safety. Loudspeaker lead length at 2.4m was too short to allow the speakers to be used in any other position than on each side of the unit, quite the wrong location.

In summary, a system that does not need an engineer or hi-fi enthusiast as an operator. Performance is rather limited by the loudspeakers provided, but with other loudspeakers it would be good value for money.

Amplifier Section

| | |
|--|-------------|
| Power output into 8 ohms | 6.4W |
| Power output into 4 ohms | 6.8W |
| Distortion at low power output 1W | 0.14% fair |
| Amplifier noise | fair |
| Signal to noise ratio for tape output | 74dB fair |
| Input voltage for full modulation Tape | 240mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 600 μ V |
| Tape output | 39mV |
| Stereo crosstalk | 40dB fair |
| Channel balance | v. good |

Record Player Section

| | |
|---|--------------|
| Frequency response | poor* |
| Trackability | v. good |
| Signal to noise ratio | 60dB fair |
| Channel balance | v. good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.09% good |
| Rumble | 64dB v. good |

Tuner Section

| | |
|------------------------------|---------------------|
| Least usable sensitivity | 3.7 μ V average |
| Input for 50dB signal/noise | 100 μ V average |
| Signal/noise for 1mV input | 66dB average |
| Distortion | 0.35% v. good |
| AM rejection | 32dB fair |
| Stereo crosstalk | good |
| Image rejection | 35dB fair |
| IF rejection | 85dB good |
| Adjacent channel selectivity | -8dB poor |
| Capture ratio | poor |
| 19kHz suppression | 29dB poor |
| Muting level | — |
| Frequency response | fair* |

Tape Section

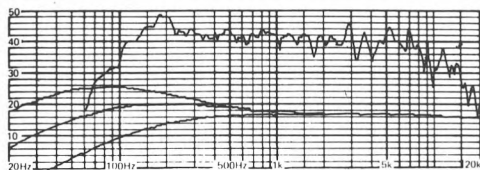
| | |
|----------------------------------|---------------|
| Record/replay frequency response | poor* |
| Azimuth alignment | fair |
| Signal to noise ratio | 54dB poor |
| Distortion output | v. good |
| Wow and flutter | 0.18% average |
| Erase efficiency | 50dB fair |

Loudspeakers (where provided)

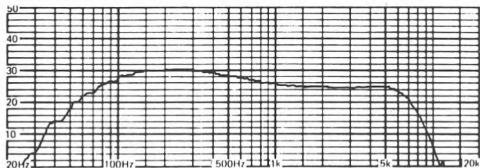
| | |
|---|-----------|
| Frequency response of amplifier and speaker | poor |
| Distortion | poor |
| Sensitivity | good |
| Length of loudspeaker lead | 2.6m fair |

General Data

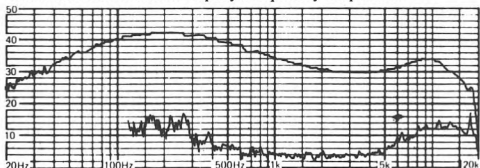
| | |
|---|------------------------|
| Compliance with British safety standards | no failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | good |
| Overall sound quality | poor |
| Typical selling price inc. speakers and VAT | £200.00 |
| Typical selling price ex. speakers and inc. VAT | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Sony HMK-70

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



A 25 watt music centre priced a little above the average for the series of units tested, teak finished with a brushed aluminium front panel and having the usual hinged perspex cover. All the main controls including the large tuning scale are arranged along the front edge so it would be advantageous to mount the unit on a shelf at a height that allows the front scale to be read easily. This is a comment that applies to all the units having vertical front panels. The facilities are about average in number but almost certainly adequate for most users.

The record player is of above average quality incorporating a spring isolated automatic turntable, without stroboscope markings on the turntable rim. A light hand is necessary when operating those controls mounted on the plinth or the pick-up stylus will jump the groove, a comment that also applies to operation of the cassette controls. The measured frequency response showed that the treble response was down by an average of 4dB at 10kHz while the separation was also low at an average of about 18dB at 1kHz, but this separation was well maintained up to high frequencies.

The cassette unit is also above average quality and includes a switch selected choice of bias and equalization for ferric and chromium tapes, Dolby noise reduction and a digital footage counter. The six push buttons controlling the tape motion are large but rather heavy in action. Separate meters are provided for indicating the modulation depth in both left and right channels. The measured frequency response was about 7dB down at

10kHz, very similar to the performance of the record player.

The radio receiver has a good performance and has a large clearly marked tuning scale, a five light signal strength indicator, and a stereo indicating light. The five light tuning indicator was considered to give a rather coarse indication of the correct tuning point and was rather too sensitive, all five lights being operated by a very modest radio signal. The bezel round the tuning scale has a serrated surround that restricts the angle at which the scale can be read. This could be modified with advantage to allow the scale to be read without having to have the eyes almost opposite the scale. No pre-set tuning system is included but sliding markers are provided to identify wanted station. The measured frequency response was good, being 2dB down at 50Hz and 3dB down at 10kHz., and thus much better in this respect than the record player or cassette.

The overall sound quality was liked by the assessors, probably because of the above average performance of the loudspeakers supplied. These had some mid frequency emphasis that was rather obvious but the response curve indicates that the treble response was well maintained up to a frequency in the region of 15kHz and this had a beneficial effect on the general clarity. Stereo image definition was not particularly good. The construction complied with the safety requirements of BS 415.

Amplifier Section

| | |
|--|--------------|
| Power output into 8 ohms | 24W |
| Power output into 4 ohms | 25W |
| Distortion at low power output 1W | 0.16% fair |
| Amplifier noise | good |
| Signal to noise ratio for tape output | 80dB average |
| Input voltage for full modulation Tape | 335mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 130μV |
| Tape output | 33mV |
| Stereo crosstalk | 44dB average |
| Channel balance | v good |

Record Player Section

| | |
|---|--------------|
| Frequency response | average |
| Trackability | v good |
| Signal to noise ratio | 63dB average |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.12% good |
| Rumble | 59dB average |

Tuner Section

| | |
|------------------------------|--------------|
| Least usable sensitivity | 2μV good |
| Input for 50dB signal/noise | 40μV good |
| Signal/noise for 1mV input | 68dB average |
| Distortion | 0.8% average |
| AM rejection | 41dB average |
| Stereo crosstalk | fair |
| Image rejection | 44dB average |
| IF rejection | 95dB v. good |
| Adjacent channel selectivity | —2dB poor |
| Capture ratio | average |
| 19kHz suppression | 52dB good |
| Muting level | — |
| Frequency response | good |

Tape Section

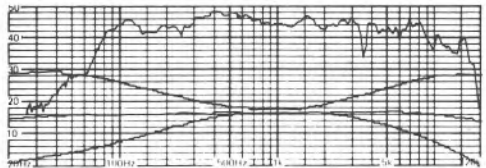
| | |
|----------------------------------|--------------|
| Record/replay frequency response | fair |
| Azimuth alignment | good |
| Signal to noise ratio | 60dB average |
| Distortion output | good |
| Wow and flutter | 0.24% poor |
| Erase efficiency | 53dB average |

Loudspeakers (where provided)

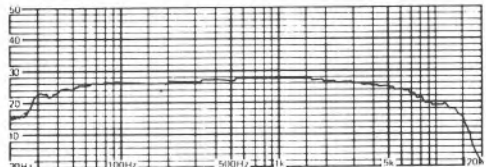
| | |
|---|--------------|
| Frequency response of amplifier and speaker | good |
| Distortion | fair |
| Sensitivity | average |
| Length of loudspeaker lead | 3.4m average |

General Data

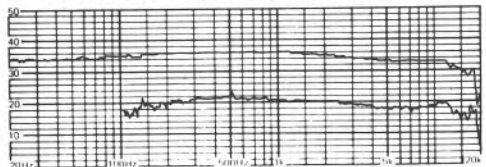
| | |
|---|------------------------|
| Compliance with British safety standards | no failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | good |
| Typical selling price inc. speakers and VAT (SS2030S) | £400 |
| Typical selling price ex. speakers and inc. VAT. | £320.00 |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (l channel).

Tandberg TR 220GC

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



Compact unit having a black finished top deck nicely relieved by light trim and the brushed aluminium front panel carrying all the operating controls. The whole mechanism is mounted in a teak finished enclosure.

A Dual two speed belt drive, semi-automatic deck is mounted on a resiliently isolated plinth, carrying a straight tone arm having calibrated stylus load and anti-skating controls. An uncalibrated pitch control is fitted, useful if you have a gift of perfect pitch or you wish to accompany a recording on your own fixed pitch instrument. The measured frequency response was very flat up to a frequency of about 2kHz but then dipped smoothly by about 5dB at 10kHz, flattening out up to around 18-20kHz., a good performance. Trackability, rumble and signal to noise ratio were good, but wow and flutter were fair at .15%. The sound quality was considered to be rather above the average.

The cassette unit included Dolby and a digital footage counter but no bias or equalization adjustments. The signal to noise ratio at 67dBA was very good, helped no doubt by the Dolby circuitry. Distortion was on the high side, rather suggesting in view of the very good signal to noise ratio, that the recording level meter was out of calibration and setting a recording level that was on the high side. The erase efficiency was very good, but wow and flutter only about average. Measured frequency response was good, being within ± 2 dB from 70Hz to 10kHz and then falling away fairly smoothly. Sound quality was considered to be somewhat above average

with a better stereo image than average.

The radio receiver was unusual in only having an FM band. Both manual tuning and four pre-set tuning push-buttons are provided, a small frequency meter nominally reading the tuned frequency but this was very inaccurate in the particular system tested. The pre-set stations and the other major facilities are selected by a row of very smooth acting push buttons immediately under the tuning scale, with an additional group of small buttons under the control knobs switching the loudness contour circuitry, high and low frequency filters and a stereo/mono facility. A central zero tuning meter and a good muting system simplify tuning.

The measured aerial-to-loudspeaker terminal frequency response was good, being within ± 2 dB between 70Hz and 15kHz with a very effective filter attenuating the 19kHz sub-carrier. The signal required for a signal to noise ratio of 50dBA was low at 70 μ V, a good performance and the signal to noise of 1mV (65dBA) was average. Distortion was very good at .34%, crosstalk very good, AM rejection, IF rejection, adjacent channel selectivity and capture ratio were all average-to-good. Sound quality was above average, being clean, forward and having a good stereo image. Female speech suffered from some accentuation of sibilants, an effect less obvious though present both when playing records or tape. There was no criticism on any of the aspects of BS 415 we checked.

Generally a very nice receiver having a good performance, but the absence of any AM



bands should be noted by a would-be purchaser.

Amplifier Section

Power output into 8 ohms 19.5W
 Power output into 4 ohms 27.5W
 Distortion at low power output 1W 0.045% good
 Amplifier noise average
 Signal to noise ratio for tape output 88.5dBa v. good
 Input voltage for full modulation Tape 135mV
 Input voltage for full modulation Aux —
 Input voltage for full modulation Mike 1.1mV
 Tape output 48mV
 Stereo crosstalk 46dB good
 Channel balance v. good

Record Player Section

Frequency response good
 Trackability good
 Signal to noise ratio 64dBa good
 Channel balance good
 Wow and flutter at 33 1/3 rpm 0.15% fair
 Rumble 61dB good

Tuner Section

Least usable sensitivity 3.5µV average
 Input for 50dB signal/noise 70µV good
 Signal/noise for 1mV input 65dBa average
 Distortion 0.34% v. good
 AM rejection 52dB average
 Stereo crosstalk v. good
 Image rejection 49dB good
 IF rejection 83dB good
 Adjacent channel selectivity +2.5dB average
 Capture ratio good
 19kHz suppression 76dB v. good
 Muting level 5.5µV
 Frequency response good

Tape Section

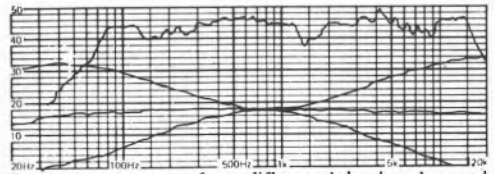
Record/replay frequency response good
 Azimuth alignment average
 Signal to noise ratio 67dBa v. good
 Distortion output poor
 Wow and flutter 0.15% average
 Erase efficiency 57dBa v. good

Loudspeakers (where provided)

Frequency response of amplifier and speaker good
 Distortion v. good
 Sensitivity average
 Length of loudspeaker lead 3.6m average

General Data

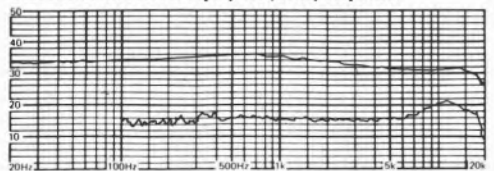
Compliance with British safety standards No failures
 Available facilities see Introductory Chart
 Overall finish and engineering excellent
 Overall sound quality v. good
 Typical selling price inc. speakers and VAT £390.00
 Typical selling price ex. speakers and inc. VAT £340.00



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Telefunken Studio Centre 5030

AEG Telefunken Ltd., 217 Bath Road, Slough, Berks. Slough 872110.



This is a comprehensively equipped music centre in the upper price class, finished in black with Perspex cover and supplied complete with two small loudspeakers in moulded cases. The radio controls function selector and LED indicators are arranged along the front edge in a convenient position for a seated user. All the FM pre-selectors are touch sensors rather than push-buttons, very convenient for the male owner but quite so convenient for a girl friend with long finger nails. The accessories include an excellent instruction book.

The two speed record player employs a belt drive turntable on a resiliently mounted plinth that also carries the tone arm and the player selectors. Though the resilient mounting gives good protection against disturbances from accidental knocks on the unit and from acoustic feedback, it is very difficult to avoid jarring the pick-up when operating the controls actually mounted on the turntable plinth. The pick-up arm is well made and equipped with calibrated stylus pressure and anti-skating adjustments, but the speed of operation is rather low. The tracking distortion is low, wow and flutter a good average value but rumble at -57dB was a little below average. The sound quality was also a little below average.

The cassette mechanism is of above average quality and includes a digital tape counter, Dolby facilities, a DIN socket on top of the unit for external microphones, push button selection of bias and equalisation for ferric and chrome tapes and automatic recording

level control. A useful and unusual facility is a 'fade out' push button for use when adding comment to a recording. On pressing this button the recorded level is reduced to 6dB returning to its set value when the fade-in is complete. Another unusual facility is the inclusion of a bias frequency push button control to eliminate 'birdie whistles' due to interaction of bias and other frequencies.

The radio section has a large tuning dial and controls mounted along the front edge of the unit with the dials sloped backwards to improve their visibility. The slide rule type tuning dial is large and particularly easy to read and is very smooth in operation. In addition to the manual selection of stations, seven touch operated pre-sets allow seven stations in the FM band to be pre-tuned. An additional touch sensor switches rather too easily from pre-set to manual tuning when the tuning knob is touched. The technical performance is excellent, the only adverse comment being that the image rejection is well below the average for all the units tested.

Volume control, balance control and separate bass and treble tone controls are operated by sliders, very conveniently placed along the front edge below the main tuning dial. The circuit incorporates a loudness contour correction but this cannot be switched out of use. A novel feature is the extensive use of LEDs to indicate not only the function in use, but as indicators of tuning station frequency, recording level, tape motion etc. They look very attractive but provide only

limited but probably adequate resolution.

The unit fails to comply with BS 415 in one minor respect only. The Standard requires a special anchorage for any mains wire that may become disconnected from its terminal. Leads inadequately anchored can touch the deck if they come adrift.

There are a few minor criticisms. The loudness contour compensation cannot be switched out of circuit and the cassette mechanism on the sample tested was rather noisy even with the tape stationary, though this may be a sample fault. The sound quality was considered to be above average on radio and from the cassette system, but a little below average from records.

Amplifier Section

| | |
|--|----------------|
| Power output into 8 ohms | 25.5W |
| Power output into 4 ohms | 34W |
| Distortion at low power output 1W | 0.016% v. good |
| Amplifier noise | v. good |
| Signal to noise ratio for tape output | 82dBA good |
| Input voltage for full modulation Tape | 250mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | — |
| Tape output | 260mV |
| Stereo crosstalk | 50dB v. good |
| Channel balance | good |

Record Player Section

| | |
|---|---------------|
| Frequency response | average* |
| Trackability | good |
| Signal to noise ratio | 66dBA v. good |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.1% good |
| Rumble | 57dB fair |

Tuner Section

| | |
|------------------------------|------------------|
| Least usable sensitivity | 1.3 μ V good |
| Input for 50dB signal/noise | 44 μ V good |
| Signal/noise for 1mV input | 67dBA good |
| Distortion | 0.53% good |
| AM rejection | 50dB average |
| Stereo crosstalk | fair |
| Image rejection | 31dB poor |
| IF rejection | 67dB fair |
| Adjacent channel selectivity | +3dB good |
| Capture ratio | v. good |
| 19kHz suppression | 53dB good |
| Muting level | variable |
| Frequency response | v. good |

Tape Section

| | |
|----------------------------------|---------------|
| Record/replay frequency response | average |
| Azimuth alignment | good |
| Signal to noise ratio | 58dBA average |
| Distortion output | fair |
| Wow and flutter | 0.08% v. good |
| Erase efficiency | 48dBA poor |

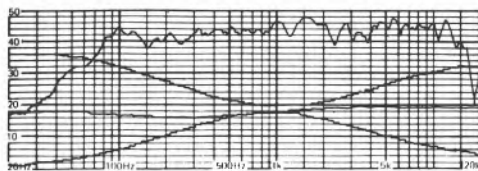
Loudspeakers (where provided)

| | |
|---|------|
| Frequency response of amplifier and speaker | good |
|---|------|

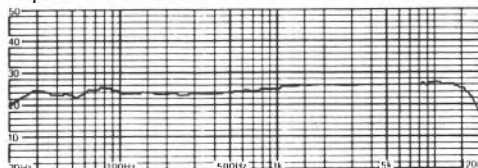
| | |
|----------------------------|-----------|
| Distortion | good |
| Sensitivity | fair |
| Length of loudspeaker lead | 4.6m good |

General Data

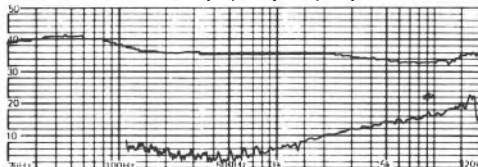
| | |
|---|------------------------|
| Compliance with British safety standards | 5b |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | average |
| Typical selling price inc. speakers and VAT (TL 510s) | £550 |
| Typical selling price ex. speakers and inc. VAT | £450.00 |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Toshiba SM-2700

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



This is a piece of equipment at the lower end of the price scale necessarily involving some compromise between price and technical performance. The measured power output is low, 7.6 watts per channel into 4 ohms but to some extent this is compensated by the use of loudspeakers of above average efficiency, probably achieved by the use of thin paper cones and the elimination of any sound absorbing treatment in the cabinet.

The unit has a silver metallic finish, all the operating controls being large aluminium knobs, the only push button being the main switch. Additional facilities are adequate but are obviously not intended to satisfy the hi-fi enthusiast. The socketry along the rear of the unit caters for left and right speakers, aerial terminals and the mains input only.

A simple two speed turntable is mounted on a resiliently isolated plinth and though the stylus load can be adjusted there is no calibrated scale. The frequency response of the pick-up is not particularly good, mainly due to the effect of loudness contouring, a compulsory feature of the unit. Tracking distortion and rumble are on the high side, but wow and flutter were average.

Cassette performance was disappointing, the wow and flutter being particularly high, around .38% in the middle of the tape length. A second sample reduced this figure to .23%, a useful improvement but still a poor performance. Signal to noise ratio was comparable with an average unit but as no Dolby noise reduction circuitry is included the hiss level was on the high side. However it is

worth noting that the hiss noise from cassette tapes has a very smooth characteristic quite unlike the 'crackles and pops' that characterises the noise from records.

The radio receiver was also of average performance, the signal to noise ratio, IF rejection, 19kHz suppression and adjacent channel selectivity were all in the average-poor class. There were two unusual points raising criticism, the acoustic noise directly radiated by the mains equipment and the presence of a very obvious middle frequency hump in the loudspeaker response, far more objectionable than would be estimated from the measured frequency response of the speaker system.

Only one minor point of criticism from the safety viewpoint was found.

This is a music centre at the low price end of the scale and one obviously not really suitable for a hi-fi enthusiast but it may meet the needs of those interested in having low level background music.

Amplifier Section

| | |
|--|------|
| Power output into 8 ohms | 6.2W |
| Power output into 4 ohms | 7.6W |
| Distortion at low power output 1W | — |
| Amplifier noise | — |
| Signal to noise ratio for tape output | — |
| Input voltage for full modulation Tape | — |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | — |
| Tape output | — |
| Stereo crosstalk | — |
| Channel balance | — |

Record Player Section

| | |
|---|------------|
| Frequency response | poor* |
| Trackability | poor |
| Signal to noise ratio | 57dBA poor |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.15% fair |
| Rumble | 51dB poor |

Tuner Section

| | |
|------------------------------|---------------------|
| Least usable sensitivity | 10 μ V poor |
| Input for 50dB signal/noise | 100 μ V average |
| Signal/noise for 1mV input | 62dBA poor |
| Distortion | 2.5% poor |
| AM rejection | 52dB average |
| Stereo crosstalk | fair |
| Image rejection | 38dB fair |
| IF rejection | 80dB average |
| Adjacent channel selectivity | +3dB good |
| Capture ratio | poor |
| 19kHz suppression | 38dB fair |
| Muting level | — |
| Frequency response | good |

Tape Section

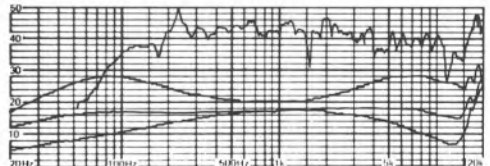
| | |
|----------------------------------|------------|
| Record/replay frequency response | poor |
| Azimuth alignment | good |
| Signal to noise ratio | 53dBA poor |
| Distortion output | v. good |
| Wow and flutter | 0.23% poor |
| Erase efficiency | 50dBA fair |

Loudspeakers (where provided)

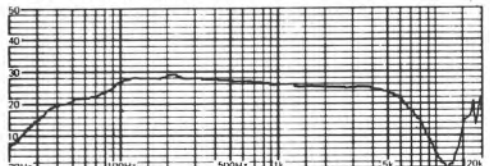
| | |
|---|-----------|
| Frequency response of amplifier and speaker | poor |
| Distortion | poor |
| Sensitivity | v. good |
| Length of loudspeaker lead | 2.6m fair |

General Data

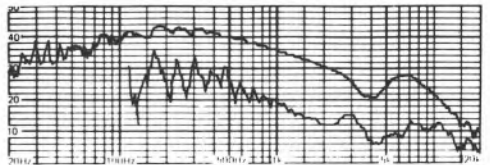
| | |
|---|------------------------|
| Compliance with British safety standards | 5b |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | good |
| Overall sound quality | poor |
| Typical selling price inc. speakers and VAT | £180.00 |
| Typical selling price ex. speakers and inc. VAT | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Toshiba SM-3150

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



This is a large attractive looking system, though of only medium power, (12 watts per channel). All the main controls are mounted on a vertical front panel finished in brushed aluminium. Facilities are selected by seven rather unusual push bar switches with four metallic knobs providing the usual volume and tone controls. A three band tuning scale is set back from the front panel and angled backwards at the top to facilitate viewing but some of the advantage is lost by having the scale some distance behind the slot in the panel.

The turntable is unusually large and robust, the unit being a two speed belt drive automatic type on a resiliently isolated plinth. A beautifully finished 'S' shaped arm is employed having a calibrated stylus load adjustment and an uncalibrated anti-skating adjustment. The measured frequency response was unusual with the maximum output around 20Hz, falling away steadily at about 2dB per octave right up to 15kHz. Crosstalk was only fair, averaging around 17dB over the whole frequency band. Trackability and rumble were fair and all the other parameters were average. Judged subjectively the sound was bass heavy with a good stereo image, but as with many other systems, the sound quality was controlled by the performance of the loudspeakers and this set a rather low limit to what could be achieved.

The cassette mechanism was particularly large and included separate meters for left and right channels, a digital footage counter, two levels of bias for ferric and chrome tapes and

Dolby noise reduction. The measured record/replay response was good but it exhibited the same bass heavy relation that characterised the pick-up section. The output was at its maximum around 50-100Hz, but then fell steadily away, right up to about 13kHz where it was about 4dB down. Wow and flutter were good, while signal to noise ratio and distortion were very good. The sound quality was better than was achieved by the record player but again the limit was set by the loudspeakers.

Least usable sensitivity of the radio section and the signal required to achieve a signal to noise ratio of 50dB were both good, as were the adjacent channel selectivity and AM rejection. IF rejection was very good but the image rejection was poor, a rather mixed bag of results. The frequency response measured from the aerial terminals to loudspeaker terminals was smooth all the way up to 15kHz, but it exhibited the same bass rise found in the cassette and record replay units. The sound quality obtainable from radio was superior to that from the record player or the cassette unit and equal to that provided by the reference system, though the stereo image provided by this Toshiba unit was superior to that from the reference system.

In summary, a good looking and particularly robust system, rather low in power and with the sound quality limited by the speakers supplied.

Amplifier Section

| | |
|--|-------------|
| Power output into 8 ohms | 11W |
| Power output into 4 ohms | 12W |
| Distortion at low power output 1W | 0.25% poor |
| Amplifier noise | poor |
| Signal to noise ratio for tape output | 83dBA good |
| Input voltage for full modulation Tape | 540mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 180 μ V |
| Tape output | 370mV |
| Stereo crosstalk | 48dB good |
| Channel balance | v. good |

Record Player Section

| | |
|---|------------|
| Frequency response | average |
| Trackability | fair |
| Signal to noise ratio | 63dBA good |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.12% good |
| Rumble | 57dB fair |

Tuner Section

| | |
|------------------------------|--------------------|
| Least usable sensitivity | 2.7 μ V good |
| Input for 50dB signal/noise | 75 μ V average |
| Signal/noise for 1mV input | 66dBA average |
| Distortion | 0.8% average |
| AM rejection | 53dB average |
| Stereo crosstalk | good |
| Image rejection | 32dB fair |
| IF rejection | 90dB good |
| Adjacent channel selectivity | +2dB average |
| Capture ratio | average |
| 19kHz suppression | 35dB fair |
| Muting level | — |
| Frequency response | average |

Tape Section

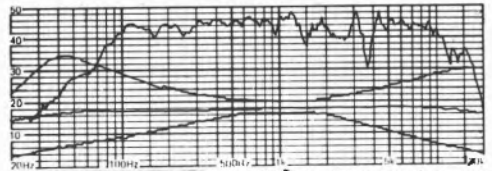
| | |
|----------------------------------|---------------|
| Record/replay frequency response | good |
| Azimuth alignment | good |
| Signal to noise ratio | 62dBA good |
| Distortion output | good |
| Wow and flutter | 0.12% good |
| Erase efficiency | 51dBA average |

Loudspeakers (where provided)

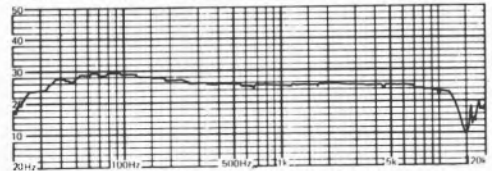
| | |
|---|-----------|
| Frequency response of amplifier and speaker | average |
| Distortion | poor |
| Sensitivity | good |
| Length of loudspeaker lead | 2.9m fair |

General Data

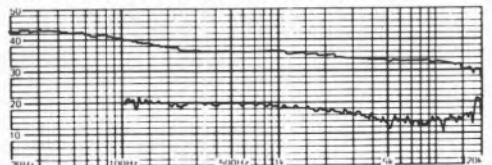
| | |
|---|------------------------|
| Compliance with British safety standards | 5b |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | good |
| Overall sound quality | fair |
| Typical selling price inc. speakers and VAT | £300.00 |
| Typical selling price ex. speakers and inc. VAT | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Ultra 6923

Thorn Consumer Electronics Ltd., Thorn House, Upper St Martins Lane, London WC2. 01-836 2444.



Unusual in being a British product, this is a 14 watts per channel unit finished in a rather shiny black in a teak surround. All the main operating controls are mounted on an inclined front panel greatly improving the visibility and allowing the unit to be operated with the hinged Perspex cover in the closed position. The cassette player is a better than average mechanism and the record player is a Garrard 125 SB turntable and includes a calibrated stylus weight adjustment and calibrated anti-skating adjustment. An unusual feature is the use of two volume controls in place of a balance control, probably preferable for the technical user but the need to keep left and right levels in balance when adjusting the volume may not be obvious to a non-technical user. The auxilliary facilities are extensive.

The Garrard semi-automatic deck is mounted on a spring isolated plinth and employs a synchronous motor belt driving the table. The record player was criticised by all three assessors, the arm was out of adjustment when first used, putting down the pick-up clear of the record edge. Rumble was -50dB and was audibly obvious. Tracking distortion rather high at 8.4%. The sound quality was below average lacking treble and being rather diminutive in scale. The measured frequency response was disappointing and the separation low, the left channel being much worse than the right channel in this respect.

The cassette mechanism includes Dolby noise reduction, separate VU meter level controls to minimise the risk of 'birdie whistles' appearing when recording from

radio. The sound quality was a little above average and was appreciably better than the quality from records. Distortion was a little on the high side and the erase efficiency could be improved with advantage.

The radio receiver had a better performance than either of the other facilities, the frequency response being smooth and extended, the balance of treble and bass being reasonable, distortion moderately low, the signal to noise ratio good and the sensitivity above average. The input voltage ($40\mu\text{V}$) required to achieve the reference signal to noise of 50dB was low. The receiver has a large clearly marked four waveband tuning scale with a light to indicate the presence of a stereo signal, AFC but no tuning meter. Sound quality was judged to be above average the overall performance being let down by the relatively poor performance of the record/replay facilities.

The loudspeaker response was smoother than average and though well maintained up to 10/15kHz was rather lacking in bass output below 80Hz. The construction satisfied all ten requirements of BS 415.

This is a system that should have your consideration, particularly if radio is of greater importance than records or tape and you already have a speaker system.

Amplifier Section

| | |
|--|---------------|
| Power output into 8 ohms | 11.8W |
| Power output into 4 ohms | 13.8W |
| Distortion at low power output 1W | 0.09% average |
| Amplifier noise | poor |
| Signal to noise ratio for tape output | 82dBA good |
| Input voltage for full modulation Tape | 390mV |
| Input voltage for full modulation Aux | — |
| Input voltage for full modulation Mike | 200 μ V |
| Tape output | 130mV |
| Stereo crosstalk | 49dB good |
| Channel balance | good |

Record Player Section

| | |
|---|------------|
| Frequency response | fair |
| Trackability | poor |
| Signal to noise ratio | 63dBA good |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.17% fair |
| Rumble | 50dB poor |

Tuner Section

| | |
|--|---------------------|
| Least usable sensitivity | 4.5 μ V average |
| Input for 50dB signal/noise | 160 μ V poor |
| Signal/noise for 1mV input | 65dBA average |
| Distortion | 0.57% good |
| AM rejection | 40dB fair |
| Stereo crosstalk | poor |
| Image rejection | 53dB good |
| IF rejection | 68dB fair |
| Adjacent channel selectivity | 0dB fair |
| Capture ratio | good |
| 19kHz suppression | 36dB fair |
| Muting level | — |
| Frequency response | good |

Tape Section

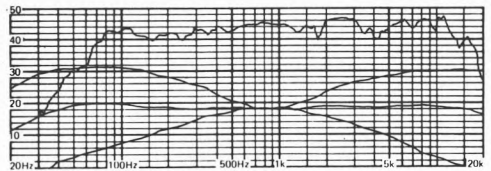
| | |
|--|---------------|
| Record/replay frequency response | good |
| Azimuth alignment | v. good |
| Signal to noise ratio | 63dBA v. good |
| Distortion output | fair |
| Wow and flutter | 0.13% good |
| Erase efficiency | 53dBA good |

Loudspeakers (where provided)

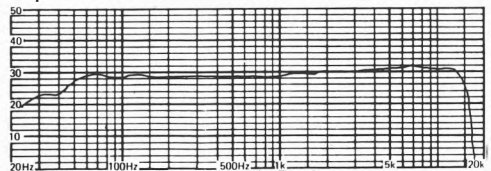
| | |
|---|--------------|
| Frequency response of amplifier and speaker | good |
| Distortion | good |
| Sensitivity | average |
| Length of loudspeaker lead | 3.5m average |

General Data

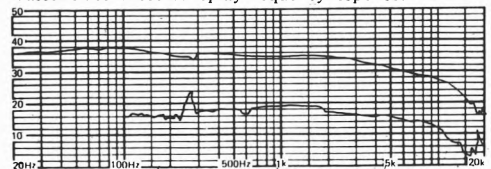
| | |
|---|------------------------|
| Compliance with British safety standards | No failures |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | average |
| Typical selling price inc. speakers and VAT | £300.00 |
| Typical selling price ex. speakers and inc. VAT | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

BEST BUY

Hi-Fi Choice Separates Systems



The separate units chosen matched the average price of the music centres at £400. They were as follows:— the Pioneer PL-112D record player, the Audio Technics 13EaP cartridge, the Technics SA-5080 receiver; the Aiwa AD-1250 cassette deck and the Celestion Ditton 15 loudspeakers.

No particular problems presented

themselves in interconnecting the units, some care being required to ensure that the loudspeakers were properly phased, a point that is taken care of in most of the music systems by the use of polarised plugs. The separate systems can never be so neatly arranged as a music system. Placed side by side, the separates required about 48 inches of shelf space as compared to about 28 inches for the reference system.

The record player, a Pioneer PL-112D is a small two speed belt drive, semi-automatic unit incorporating an 'S' shaped arm with calibrated stylus load and anti-skating adjustments, the unit being enclosed in a perspex hinged cover. Tracking distortion, signal to noise ratio, channel balance, wow, flutter and rumble, where all in the very good category, a result that was not obtained from any of the music centre record players. The measured frequency response was flat within about $\pm 1\text{dB}$ from around 40Hz to 4kHz, but above this frequency the output tailed away fairly smoothly being about 6dB down at 13kHz. Crosstalk was around 26dB into one channel but only 18dB into the other channel.

The Aiwa cassette unit has all the controls mounted on an angled front panel that makes it very convenient to use. On pressing the 'eject' button the cover slides up out of the way and the cassette carrier moves into a convenient position for unloading and loading. Facilities are extensive, twin VU meters to indicate the recording level plus a LED that flashes to indicate that the peak level is exceeding the limit even if the VU meter appears to show that all is well. There are twin slider type volume controls, two three-position switches providing different levels of bias and equalization, Dolby noise reduction and a multiplex filter are included.

The measured record/replay frequency response was very smooth from 50Hz to 15kHz with a few rather well marked 'wiggles' below 50Hz due to the head geometry and a fairly rapid fall-away above 15kHz. Every aspect of the performance was good to very good except the azimuth alignment which was only in the fair class with a mis-alignment of 70°. The erase efficiency was only average.

The Technics radio receiver has all the controls mounted on a vertical brushed

aluminium panel with the tuning scale extending almost the full width of the unit. Facility choice is made by a rotary switch with separate push-button for the loudness contour and the tape input signal.

Least usable sensitivity is high at $1.2\mu\text{V}$ and the signal required for a signal to noise ratio of 50dB is low (good) at $50\mu\text{V}$ while the signal to noise achieved for a 1mV signal is good at 66dB. Distortion is very good at .28%, image rejection, IF rejection and capture ratio are in the very good class. Adjacent channel selectivity is average at +2dB. Frequency response is very good being within $\pm 1\text{dB}$ from 20Hz to 10kHz and falling away smoothly up to 15kHz. The Celestion Ditton 15 speakers had a good response up to about 4kHz continuing reasonably uniformly up to 20kHz but there was a shelf in the response at 3-4kHz. The distortion put them into the very good category but the sensitivity was on the low side. We all gave it rather higher marks than any of the music centres, the sound being cleaner, producing a better stereo image and being easier on the ear.

In summary, the separates system should be the choice if good sound quality was your primary target but the discussion in the introduction of the merits of music systems should be studied before making a final decision, particularly if ease of use, and neat presentation are your main objectives.

Amplifier Section

| | |
|--|-------------------|
| Power output into 8 ohms | 21W |
| Power output into 4 ohms | 25W |
| Distortion at low power output 1W | 0.02% v. good |
| Amplifier noise | good |
| Signal to noise ratio for tape output | 92dB v. good |
| Input voltage for full modulation Tape | 170mV |
| Input voltage for full modulation Aux | 142mV |
| Input voltage for full modulation Mike | 380 μV |
| Tape output | 280mV |
| Stereo crosstalk | 45dB good |
| Channel balance | v. good |

Record Player Section

| | |
|---|---------------|
| Frequency response | good |
| Trackability | v. good |
| Signal to noise ratio | 66dB good |
| Channel balance | good |
| Wow and flutter at 33 $\frac{1}{3}$ rpm | 0.09% v. good |
| Rumble | 64dB v. good |

Tuner Section

| | |
|-----------------------------|------------------------|
| Least usable sensitivity | 1.2 μV good |
| Input for 50dB signal/noise | 50 μV good |

| | |
|------------------------------|-------------------|
| Signal/noise for 1mV input | 66dB average |
| Distortion | 0.28% v. good |
| AM rejection | 58dB good |
| Stereo crosstalk | good |
| Image rejection | 64dB v. good |
| IF rejection | 95dB v. good |
| Adjacent channel selectivity | +2dB average |
| Capture ratio | v. good |
| 19kHz suppression | 37dB fair |
| Muting level | 1.8 μV |
| Frequency response | v. good |

Tape Section

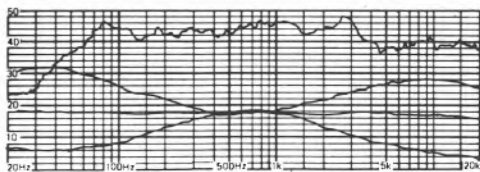
| | |
|----------------------------------|--------------|
| Record/replay frequency response | v. good |
| Azimuth alignment | fair |
| Signal to noise ratio | 60dB good |
| Distortion output | good |
| Wow and flutter | 0.1% v. good |
| Erase efficiency | 51dB average |

Loudspeakers (where provided)

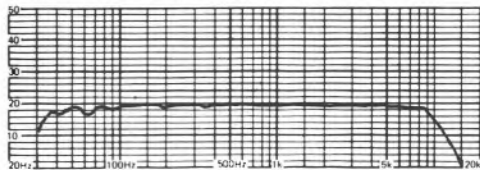
| | |
|---|-------------------|
| Frequency response of amplifier and speaker | good |
| Distortion | v. good |
| Sensitivity | poor |
| Length of loudspeaker lead | No leads supplied |

General Data

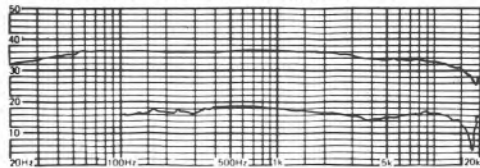
| | |
|---|------------------------|
| Compliance with British safety standards | — |
| Available facilities | see Introductory Chart |
| Overall finish and engineering | excellent |
| Overall sound quality | v. good |
| Typical selling price inc. speakers and VAT | £400.00 |
| Typical selling price ex. speakers and inc. VAT | — |



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



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Aiwa AF 5090



Aiwa AF 5050

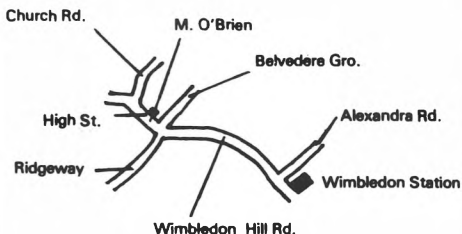
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Having examined forty systems some general conclusions emerged.

The music system approach to assembling a hi-fi system has considerable advantages to most users, though it may not have the same appeal to the hi-fi enthusiast. The integrated system is neater, more compact and has more 'wife appeal' than almost any possible assembly of separate units. It has the technical advantage that the impedance and signal level interfacing between units has been dealt with by the designer. Noise and hum pick-up on the inter-connecting leads has been eliminated at the factory and it would be difficult for any hi-fi separates enthusiast to duplicate the facilities provided by the better examples of music systems.

Up-dating of a system is difficult, but as there are unlikely to be any major developments in records, pick-ups, receivers or cassette units in the next five years, extensive up-dating may not be necessary for a considerable time. The overall performance is generally limited by the loudspeakers and pick-up cartridges included in a system and these are items easily changed, even by the ordinary user.

The sound quality obtainable from almost all the systems, irrespective of price, was found to be limited by the loudspeaker included with the systems. Thus there are some advantages in either buying a system without loudspeakers, or appreciating that a considerable improvement in performance can be obtained by buying a better pair of speakers when the budget allows. The next weakest link in the chain was the pick-up cartridge supplied. Replacement by a more expensive model is an easy change and one that will generally result in a considerable improvement in the performance of the record replay system.

The stylus loading specified for most of the pick-ups was on the low side, adequate for playing light music but too low to ensure the best performance when playing a concert orchestral work. An increase in stylus loading of about 20% generally led to an improvement in the tracking of most of the cartridges.

The best location for a music system is almost invariably near the users normal seating position, as it allows the user to

appreciate the effects he is producing by manipulation of the controls. This requires that the loudspeakers be well away from the control system, though the loudspeaker leads supplied were rarely long enough to allow the loudspeakers to be placed in the optimum position.

Unless you live in a noisy location, choose a music system that includes Dolby or one of the other noise reduction systems in the cassette player. Current tapes and equipment provide insufficient headroom to allow an adequate signal to noise ratio to be obtained if the system is operated in a quiet room, though it should be emphasised that tape hiss is much less annoying than the 'pop and crackle' that characterises the surface noise from a gramophone record.

Accurate tuning of an FM receiver is facilitated by a tuning meter, or a pair of tuning lights. Signal strength meters are not quite as useful in practice, though a good alternative. The best tuning point is almost invariably the point at which background hiss is at its minimum, but without instrumental assistance this may not be easy to determine.

We were not impressed by the inclusion of 'loudness compensation'. Unless the music system is used to provide background music for long periods, the loudness compensation sound becomes tiring.

With few exceptions the standard of workmanship was high.

Best buys and recommendations

Selecting the 'best buy' and 'recommended' systems is not a simple matter, as so much will depend on how much money you have to spend. There is little doubt that a Rolls Royce is a 'best buy' in cars, but the price makes it prohibitive for most people. So, in a similar way your own affluence and interests will affect your choice of sound system. For example, if you are a hi-fi enthusiast, and the sound quality is the most important criterion, you will be unimpressed by the multiplicity of facilities or the pretty lighting effects offered by some systems. So, a lot of factors have to be taken into account when making your final decision.

Many of the units are available without loudspeakers, and it is obviously necessary to take this into account when comparing prices. For the purposes of this section, where loudspeakers were not supplied, we have quoted a price which is the cost of the basic system plus one third of the system price, in order to allow for the purchase of loudspeakers. We have suggested that you should allow one third of the unit cost for the price of your loudspeakers, but whether this should be one half, one quarter or one fifth of the unit price is debatable — it depends on how much you wish to spend. In some cases, the amount of money added for the loudspeakers is critical in terms of what 'best buy' price category it is in, and many of them are borderline cases being able to fit into two price groups, depending on the cost of the loudspeakers. So, please regard the following price groups as somewhat fluid.

The best buy systems were selected as follows. During the listening tests the referees ranked each unit against a reference unit which was chosen at a very early stage from the middle of the expected price range. The sum of the points for each unit was then plotted against price and a 'least squares' best fit line added to indicate the average. Systems well above this average line are obviously the 'best buys' while those systems lower down but still above the line are the 'recommended' models in each price grouping. However, aspects other than sound quality have to be considered. Ranking the technical data obtained during the objective tests was done on an easier basis. The average value for each

parameter was calculated from the data from the forty samples. Two groups were then identified above and below this average standard and classified as 'very good', 'good', 'average', 'fair', and 'poor', but it should be emphasised that these ratings refer to an average value for the parameter in the forty samples. Thus, 'very good' may in fact be only 'average' by an absolute standard or by the standards of specialised hi-fi separates.

Systems costing below approximately £300 including VAT

Three systems had special attractions. The **Sanyo G-2711 Super 2** costs around £237.00 and though it is low powered (7 watts per channel) the sound was unusually clean, probably because the distortion at low power output was low. Trackability was not particularly good, but a change of cartridge should improve the performance. The system is not available without loudspeakers, but the electronics are good and justify a more expensive pair at a later date. Most of the objectively assessed parameters reached reasonable standards, but the adjacent channel selectivity was fair, suggesting that you check this particular aspect before purchase. A demonstration over one evening should be adequate to indicate whether you are likely to have problems in your area. If so, a directional aerial is the solution.

The **Hitachi SDT-7765** at around £280.00 is in the high power class (25 watts per channel) and thus may have a greater appeal if you are interested in pop music. Although different aspects of the performance were criticised, in particular the sensitivity of the tuner section, the overall performance was above average, especially for its price. In particular, the five pre-set tuning facility is useful.

The **Pioneer M-6500** just manages to get into this price group, used with the Linton speakers. The overall sound quality was well liked and the objectively assessed parameters were above average, but the reproduction from tape was not up to the standard of the record player or tuner section. Dolby noise reduction circuitry was not included so it is suggested that you consider the Sanyo or Hitachi models if you live in a particularly quiet area. Appearance is not an aspect we

would comment on with confidence, but in this case, it may tip the scale for a would-be purchaser.

Systems costing approximately £300 to £400 including VAT

This comprises the largest number of systems of widely differing characteristics and again there are a number of systems clustered around the price boundaries.

The **Aiwa AF-5050** costing around £340.00 is an attractive looking system with a good performance. The interconnection of the record/replay and the cassette recording system to ensure that the tape motion did not commence until the cartridge was down on the record will appeal to many users. Almost all the measured parameters were in the 'good' class and the loudspeakers had a reasonably smooth response over the audio range. A 'best buy'.

Another 'best buy' is the **Akai AC-3800L**, a high powered system (40 watts per channel) costing about £360.00 including the Wharfedale Lintons. It had a rather 'engineering' appearance which will appeal to some, with a generally good performance and the sound quality was liked by all the panel members. The quality of the radio section received particularly favourable comment, but the record player section was open to some slight criticism. However, the performance of the electronic circuitry would justify the purchase of more expensive loudspeakers than the Lintons.

The **Tandberg TR-220GC** was another attractive unit that is a little higher in price (at around £385.00) and a shade lower in sound quality than the two 'best buys'. However, it can be recommended and the performance reached a good standard in almost every respect, particularly on the FM tuner section, the pick-up response being about the only point that was criticised.

The **Sharp SH-450E** at around £360.00 can also be recommended for its generally good performance, with low distortion and a clean sound quality from the speakers.

The **Sanyo G-2811KL** at about £380.00 was supplied with a little above average loudspeakers to the great advantage of all three music centre sections. Trackability was

not up to the standard of the rest of the system, but this could be improved by replacing the cartridge. The measured parameters were all in the 'good' class, and the styling was well liked.

The **Garrard GA-220** at around £325.00 (plus an extra £22.50 for a special table) was a prototype sample and it is expected that any problems encountered will be ironed out in production. The performance of the loudspeakers was rather better than most of the speakers supplied with the other systems.

Systems costing approximately £400 to £500 including VAT

This group included the '**Hi-Fi Choice Separates System**' costing around £400.00. The sound quality from this system was well above that of any of the music centres tested, so from that point of view it is outstanding value for money. However we must emphasise that it does not have many of the advantages of an integrated system as discussed in the introduction.

The **Rotel RM-5010** at around £400.00 including the Wharfedale Lintons is around the same price of the separates system and did not quite match up to the sound quality performance of the separates but had all the advantages of an integrated system in good measure. All the measured parameters were in the 'good' to 'very good' class and the sound quality was well liked by all the panel. It is worth noting that a pick-up cartridge is not supplied so it is necessary to add the cost of this to the quoted system price.

The **Dynatron MC-1010CR** at about £420.00 including speakers and VAT, was liked by all the panel, especially in appearance, but we were rather disappointed by the performance from the tuner section. Apart from this, almost every other parameter was in the 'good' class, and the performance from the radio receiver may be suffering from the problems that appear inherent in any first production sample. So, in view of the good performance from the other sections and the loudspeakers, the unit can be recommended. It is assembled in reproduction cabinets that completely conceal the electronic unit and it is radically different in appearance to any of the other systems tested.

Best buys and recommendations

Systems costing over approximately £500 including VAT

Two systems stood out above all others in the price group. The **Aiwa AF-5090** and the **Beocenter 4600**. The sound quality of both the systems was not considered to be as good as the separates system but they both had advantages of an integrated system and in the case of the Beocenter, the styling was admired by all the panel. The performance of all three sections in each unit was in the 'very good' class on almost all aspects and both have the additional hard-to-specify feeling of a luxury performance, everything working smoothly and sweetly. It is difficult to choose between the two systems. The Beocenter was thought to be marginally better than the Aiwa in performance, but the Beocenter was marginally higher in price. The final choice

can safely be made on appearance with the confidence that the performance was more than adequate.

A word about the most expensive system included in the tests — the **Grundig RPC-500** at around £700 including speakers. It is an excellent system with almost all the remarks made about the performance of the Aiwa and Beocenter applying to the Grundig with equal force. As a status system it is in the very top class, for the facilities include almost everything one can think of and it looks very impressive. However, the performance of the spherical loudspeakers was not thought to do justice to the electronics although, like the system, they look very attractive. Perhaps a Rolls Royce performance with a Vauxhall radiator.

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Buying Boxes

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Overall comparison chart

* see text

| | Amplifier section | | Record deck section | | | | Tuner section | | |
|--------------------------------------|-------------------------|--------------------------------|---------------------|---------------|-----------------|---------|--------------------------|--------------------------------------|------------------------------|
| | Power output into 8ohms | Distortion at low power output | Frequency response | Track ability | Wow and flutter | Rumble | Least usable sensitivity | Input for 50dB signal to noise ratio | Adjacent channel selectivity |
| | | | | | | | | | |
| Aiwa AF-5050 | 17W | good | good | v. good | good | good | good | good | good |
| Aiwa AF-5090 | 24W | average | good | v. good | v. good | good | good | v. good | good |
| Akai AC-3800L | 34.8W | good | good | good | good | good | good | average | good |
| Beocenter 4600 | 20W | v. good | good | average | good | v. good | good | v. good | good |
| Dynatron MC 1010CR | 10.8W | poor | good | average | good | fair | good | good | fair |
| Ferguson Studio 20D-3971 | 5.3W | — | poor | average | poor | fair | fair | poor | poor |
| Fidelity System 4-40 | 21W | poor | fair | v. good | poor | poor | poor | good | good |
| Garrard GA-200 | 26.2W | v. good | good | average | fair | good | good | v. good | good |
| Grundig RPC-300 | 24W | v. good | good | good | good | good | good | good | v. good |
| Grundig RPC-500 | 25W | v. good | average | good | average | good | good | good | good |
| Hitachi SDT-7675 | 19W | good | good | fair | fair | average | poor | poor | v. good |
| Hitachi SDT-7765 | 22W | good | average | good | good | good | poor | poor | good |
| Hitachi SDT-7680 | 26W | good | good | poor | average | average | average | fair | v. good |
| ITT MC-5042 | 11.8W | good | average | poor | poor | fair | fair | fair | poor |
| ITT MC-5080 | 12.5W | good | good | good | fair | good | good | average | poor |
| JVC MF-55LS | 22W | poor | good | average | v. good | v. good | good | good | good |
| JVC MF-1845L | 12W | good | good | poor | good | v. good | poor | poor | poor |
| National Panasonic SG-2080L | 16.5W | average | average | average | good | good | good | good | poor |
| National Panasonic SG-3060L | 15.3W | fair | fair | average | good | good | fair | poor | average |
| National Panasonic SG-3090L | 25W | good | fair | average | fair | average | good | good | fair |
| Nordmende 8025 SCP | 22W | average | good | average | poor | poor | poor | good | v. good |
| Philips RH-953 | 5.8W | fair | average | poor | good | good | good | v. good | average |
| Philips RH-970 | 3.5W | average | poor* | good | fair | poor | good | good | fair |
| Pioneer M-6500 | 13.6W | — | good | v. good | fair | good | good | good | average |
| Pye 1600 | 9.55W | — | poor | poor* | poor | fair | fair | poor | average |
| Rotel RM-5010 | 28.3W | v. good | good | good | good | good | good | good | average |
| Sanyo G-2711 Super 2 | 6.4W | good | good | poor | good | average | good | good | poor |
| Sanyo G-2811KL | 18.2W | good | good | poor | v. good | v. good | good | average | good |
| Sharp SG-220E | 5W | poor | fair* | average | good | poor | average | average | poor |
| Sharp SG-450E | 17W | v. good | good | good | good | poor | good | good | good |
| Skantic 2065 | 19.6W | fair | good | good | poor | good | good | good | average |
| Skantic 3063 | 28W | good | good | fair | good | good | average | fair | average |
| Sony EX-1K | 6.4W | fair | poor* | v. good | v. good | v. good | average | average | poor |
| Sony HMK-70 | 24W | fair | average | v. good | good | average | good | good | poor |
| Tandberg TR 220GC | 19.5W | good | good | good | fair | good | average | good | average |
| Telefunken Studio Centre 5030 | 25.5W | v. good | average* | good | good | fair | good | good | good |
| Toshiba SM-2700 | 6.2W | — | poor | poor | fair | poor | poor | average | good |
| Toshiba SM-3150 | 11W | poor | average | fair | good | fair | good | average | average |
| Ultra 6923 | 11.8W | average | fair | poor | fair | poor | average | poor | fair |
| Hi-Fi Choice Separate System | 21W | v. good | good | v. good | v. good | v. good | good | good | average |

| | Frequency response | Cassette deck section | | | Frequency response of amplifier and speaker | Overall sound quality | Typical selling price inc. speakers | Typical selling price ex. speakers | Value for money |
|---------|--------------------|----------------------------------|-----------------------|-----------------|---|-----------------------|-------------------------------------|------------------------------------|-----------------|
| | | Record/replay frequency response | Signal to noise ratio | Wow and flutter | | | | | |
| v. good | good | fair | fair | average | v. good | £340 | — | good | |
| good | good | good | good | — | v. good | — | £400 | good | |
| v. good | good | good | good | — | v. good | — | £290 | good | |
| v. good | v. good | average | good | — | v. good | — | £400 | good | |
| good | average | good | good | fair | good | £420 | £360 | reasonable | |
| fair | fair | v. good | fair | fair | poor | £180 | — | reasonable | |
| average | average | average | average | average | fair | £215 | £160 | reasonable | |
| v. good | v. good | good | v. good | fair | good | £325 | £275 | good | |
| good | good | good | good | good | good | £500 | £410 | reasonable | |
| good | average | v. good | v. good | good | good | £700 | £550 | poor | |
| v. good | good* | v. good | average | fair | average | £335 | — | reasonable | |
| good | average | fair | average | poor | good | £280 | — | good | |
| v. good | average | good | average | poor | good | £365 | — | reasonable | |
| good | poor | poor | fair | average | fair | £215 | — | reasonable | |
| good | average | v. good | fair | fair | average | £320 | £285 | reasonable | |
| v. good | good | fair | average | fair | average | £400 | £360 | poor | |
| good | good | poor | poor | poor | fair | £335 | £265 | reasonable | |
| average | good | good | fair | fair | average | £340 | — | reasonable | |
| good | good | v. good | fair | fair | average | £300 | — | reasonable | |
| average | average | good | v. good | fair | fair | £470 | £370 | poor | |
| good | average | poor | good | — | average | £460 | £355 | reasonable | |
| good | poor | average | poor | average | poor | £320 | — | poor | |
| poor* | poor* | poor | fair | poor* | poor | £180 | — | poor | |
| v. good | average | fair | average | — | good | £300 | £240 | good | |
| average | poor | fair | average | poor | poor | £220 | — | reasonable | |
| v. good | v. good | v. good | average | — | v. good | — | £310 | good | |
| good | v. good | good | average | average | average | £237 | — | good | |
| good | average | v. good | good | good | v. good | £380 | £310 | good | |
| v. good | average* | poor | fair | average | fair | £210 | £180 | reasonable | |
| v. good | v. good | v. good | v. good | average | v. good | £360 | £325 | good | |
| good | average | poor | fair | fair | fair | £360 | — | reasonable | |
| good | good | fair | v. good | average | fair | £470 | — | poor | |
| fair* | poor* | poor | average | poor | poor | £200 | — | reasonable | |
| good | fair | good | poor | good | good | £400 | £320 | reasonable | |
| good | good | v. good | average | good | v. good | £390 | £320 | good | |
| v. good | average | average | v. good | good | average | £550 | £450 | poor | |
| good | poor | poor | fair | poor | poor | £180 | — | poor | |
| average | good | good | good | average | fair | £300 | — | reasonable | |
| good | good | v. good | good | good | average | £300 | — | reasonable | |
| v. good | v. good | good | v. good | good | v. good | £400 | — | good | |

Get it all out of your system.

Our MF-55 Music System combines a full-size turntable, 4 waveband stereo receiver and a stereo cassette deck incorporating 2 noise reduction systems into one beautiful unit. It's the only entertainment centre that uses our "Super ANRS" (Automatic Noise Reduction System). Hi-fidelity standard performance and sensational looks make the MF-55 ideal for the person who enjoys no-fuss good music. The MF-55, another development from JVC.

Turntable 2-speed, (33- $\frac{1}{3}$ and 45 RPM), belt-driven 12" platter, arm reject switch, counterweight for tracking, and a Moving Magnet Cartridge.

Cassette Deck ANRS and Super ANRS noise reduction systems, long-life cronios head, full Auto-Stop, large VU Meters (easy to read) and tape counter.

Stereo Receiver Four wavebands, (FM/MW/LW/SW), FM Stereo Indicator, speaker selectors, long distance reception switch, tone loudness switch and 4-band dial switch.

TYPICAL SPECIFICATIONS

Amplifier:
Continuous Power: 25 watts RMS per channel at 4 ohms.

Tuner:
Type: 4-band (FM/MW/LW/SW)
FM Stereo Tuner with PLL IC
Multiplex.
Stereo Separation: 35 dB

Cassette Deck
Type: Stereo Cassette Deck with Fully Automatic Stop, ANRS and Super ANRS.
Track System: 4-track, 2-channel stereo.

Frequency Response: (Normal)
50-13,000Hz (Chrome) 40-15,000Hz.
Wow and Flutter: 0.15% (WRMS).

Turntable:
Type: Belt-Drive Turntable with Auto Return Mechanism.
Motor: DC Servo.
Cartridge: Moving Magnet.



50
YEARS
OF SOUND
TECHNOLOGY
1927-1977

JVC
ANOTHER STEP CLOSER TO REALITY

Adjacent channel selectivity: the ability of the tuning section to reject stations close in frequency to the required one.

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

AM: Amplitude modulation. The way in which radio waves are used to carry sound signals on long, medium and short wave bands.

ANRS: Automatic Noise Reduction System, used by JVC to minimise tape hiss.

Capture ratio: This indicates the ability of the tuner to reject an unwanted station in favour of a slightly stronger wanted one on the same frequency.

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

Colouration: In a sound, the unnatural emphasis of some frequencies. Produces a boomy, screechy, hollow or honky effect depending on the frequency involved.

Crosstalk: Unwanted leakage of the right channel signal into the left channel and vice versa.

Decibel (dB): A logarithmic unit used in audio to indicate the relative intensity of a sound or the relative strength of a signal. One decibel is about the smallest signal level change perceptible to an expert ear. The decibel is also used as a unit of 'loudness' level, 0dB being the minimum audible sound intensity.

Decoder: In a tuner, the circuit which accepts the FM multiplex system and produces left and right discrete outputs.

Distortion: The total percentage of unwanted signal in a wanted signal.

DNL: Dynamic Noise Limiter, a noise reducing circuit used by Philips which is active on playback only.

Dolby System: The most widely used form of noise reduction system, which is designed to reduce tape hiss.

Equalisation: Any modification of a circuit frequency response to improve the signal to noise ratio. Usually some frequencies are boosted by a fixed amount during the recording process and correspondingly attenuated on playback to overcome deficiencies inherent in the recording medium.

FM: Frequency modulation. The way in which radio waves are used to carry mono and stereo signals in the VHF bands.

Frequency: A measure of Hertz (Hz) or cycles-per-second, high frequencies being high pitched, low frequencies being low pitched.

Frequency response: The accuracy with which an audio unit reproduces high and low frequencies at the same intensity as the middle ones. Ideally, the intensity reproduced should be identical to the intensity at the input. 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 around 1kHz.

Harmonic distortion: The unwanted harmonics that appear in the output of an audio system due to signal overloading.

Headshell: A light casing in which the cartridge is securely mounted. Generally detachable, to allow the cartridge to be easily changed.

Hertz (Hz): Indicates the frequency cycles-per-second. 1Hz = 1 cycle-per-second. 1kHz (kilohertz) = 1000 cycles-per-second.

Impedance: The resistance to an alternating current (AC) presented by an audio circuit, expressed in ohms (Ω), almost always much higher than the resistance to DC.

Intermodulation distortion: The percentage of unwanted signal produced from the interaction of two audio signals.

Glossary

Loudness control: A control which boosts the bass and sometimes the treble at low volume settings. This is intended to compensate for the characteristics of the human ear at low listening levels. **Microvolt (μV):** $1\mu\text{V}$ is one millionth of a volt, and corresponds to the weakest possible station that the average tuner can receive, although at poor quality.

Microvolt (μV): 1μ is one millionth of a volt, and approximates the weakest possible signal that a good tuner can detect, although the sound quality is likely to be very poor.

Multiplex filter: A circuit which introduces severe attenuation at supersonic frequencies to decrease interference encountered from the sub-carrier in a stereo transmission system.

Ohms (Ω): A unit of resistance or impedance.

Phase: Signals that are 'in phase' move together in-step and signals that are 'out of phase' move 'out of step' with each other.

Rumble: The low or medium frequency disturbances that arise in a turntable, mainly due to roughness in the motor and platter bearings.

Sensitivity: Measure of signal strength required to activate the tuner for a specified output. Weak signals necessitate the use of a highly sensitive tuner.

Tape hiss: Produced by the regular magnetization of the minute particles of iron or chrome oxide in the magnetic coating on a tape. It can be reduced by noise reduction systems.

Trackability: Indicates the general ability of an arm/cartridge/stylus combination to track the grooves in a record accurately.

VU meters: Some level meters are calibrated in VUs, representing volume units in 1dB steps. 0VU is a very approximate indication of the permissible peak recording level on average programme material.

Watt (W): Technically, a unit of power obtained by multiplying the amps of current flowing in a circuit by the voltage driving them. The most important hi-fi usage is in defining the power output of an amplifier and the power handling capability of a loudspeaker.

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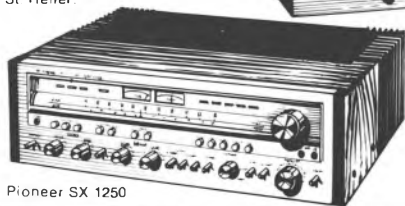
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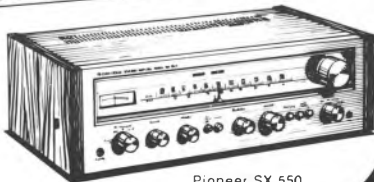
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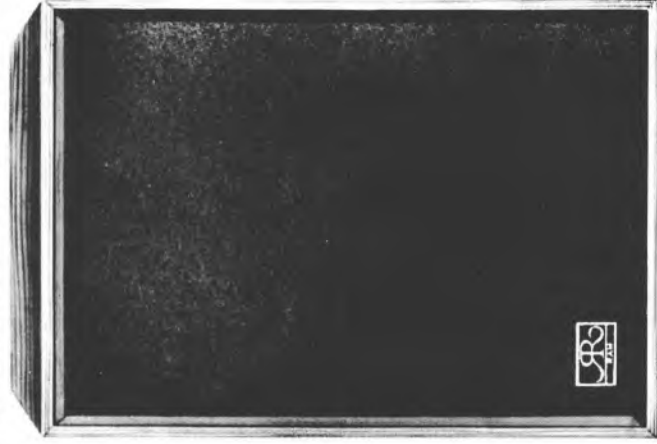
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Summary and index of products reviewed

Aiwa AF-5050

A compact 19 watt per channel system with an above average performance for its price, particularly on the radio and tape section. Good value for money and a best buy.

Aiwa AF-5090

A new model from Aiwa at the top of the range, smooth operating and attractive. The general performance was in the 'very good' class. A best buy.

Akai AC-3800L

A high power system (40 watts per channel) with a good performance, particularly from the radio section. However, the record player section was open to slight criticism. Overall though, good value and a best buy.

Beocenter 4600

An unusual and attractive appearance with a very good sound quality and overall performance. Good value for money and a best buy.

Dynatron MC-1010CR

Recommended for its attractive appearance and generally good performance, although some problems were encountered on the tuner section. Also available in various styles of 'reproduction' cabinets.

Ferguson 20D

A very cheap unit at around £180 including speakers, the performance may be adequate for the less critical and pop-orientated listener.

Fidelity System 440

Although the sound quality was below average, so is the price. A good looking unit for the budget-conscious.

Garrard GA-200

A new all British product from Garrard. It can be recommended for its generally above average performance and the quality of the speakers supplied is rather better than the norm.

Grundig RPC-300

A very good, if expensive, music centre, the absence of Dolby being about the only criticism. The appearance is unusual and attractive.

Grundig RPC-500

The Rolls Royce of the music centre market.

Costs around £700 including speakers. Recommended for its excellent technical performance and attractive appearance, but not particularly impressed by the loudspeaker performance. It is available without loudspeakers at about £550.

Hitachi SDT-7675

Generally a good performance, but the price difference between this and the SDT-7680 is rather small, the SDT-7680 being well worth the extra cost.

Hitachi SDT-7765

Relatively high powered at 25 watts per channel, the overall performance was above average, especially for its price, although the tuner sensitivity in particular was criticised. However, good value and a best buy.

Hitachi SDT-7680

The sound quality was above average, mainly due to the Goodmans speakers supplied. Attractive in appearance and well worth considering.

ITT MC-5042

The pre-production sample tested did not give a particularly impressive performance although some of the faults may be rectified in production.

ITT MC-5080

Overall, a slightly above average performance, which was let down by the quality of the speakers supplied. If purchased without speakers, at around £285 it is reasonable value for money.

JVC MF-1845L

Some problems were encountered on the tuner section and the loudspeakers were well below average performance. Basically, a system for the budget conscious if bought without speakers and for an area with no radio reception problems.

JVC MF-55LS

Overall, gave an 'average' to 'good' performance, but the sound quality suffered from the performance of the speakers supplied. Purchased without speakers, this system is reasonable value for money.

National Panasonic SG-2080L

The cheapest in the range tested, some

Summary and index of products reviewed

problems were encountered in the cassette deck and tuner sections.

National Panasonic SG-3060L

The performance of the tuner section was rather disappointing although the sound quality was reasonable.

National Panasonic SG-3090L

The general performance was liked, but the sound quality was severely let down by the speakers supplied. At about £370 it would be reasonable value for money without speakers.

Nordmende 802SSCP

A fairly neat system which would be worth considering if you already own a pair of speakers.

Philips RH-953

Another system which would benefit from being bought without the loudspeakers supplied.

Philips RH-970

Generally, a below average performance, but would be worth considering at its price if available without speakers.

Pioneer M-6500

Can be recommended for its good overall performance and sound quality, although it does not include Dolby. Also attractive and easy to use.

Pye 1600 (Black Box)

Below average in performance but may be adequate for the less technical user.

Rotel RM-5010

The overall performance was rated as very good and the sound quality was well liked. Good value for money — a best buy.

Sanyo G-2711KL

Generally a good performance for the price although very low powered and used with better loudspeakers could be in the top ten class. Basically though, good value for money and a best buy.

Sanyo G-2811KL

Recommended for the very good sound quality and the performance which was in the above average class.

Skantic 2065

Average, or a little above average value for

money, with a number of useful facilities and an unusual appearance.

Skantic 3063

The sound quality was not particularly inspiring due to the below average loudspeaker performance. Not very good value.

Sharp SG-2201

A good looking unit with a below average performance but also a below average price.

Sharp SG-4501

Performed well in almost every respect and had ample facilities. Overall good value for money — a best buy.

Sony EX-1K

Simple to operate, but a rather limited performance due to the speakers supplied. Without the speakers it would be good value for money.

Sony HMK-70

Can be recommended for a good overall sound quality due to the above average performance of the speakers supplied.

Tandberg TR-220GC

Overall, this unit can be recommended for its good performance, although AM bands were not included in the tuner section.

Telefunken Studio Centre 5030

A comprehensively equipped music centre but rather expensive for its performance.

Toshiba SM-2700

A low priced music centre with a budget performance.

Toshiba SM-3150

A good looking and robust system, but the sound quality was limited by the speakers supplied.

Ultra 6293

The tuner performance was above average for the price, but this was not matched by the quality of the other sections.

Hi-Fi Choice Separates System

An excellent performance but obviously without the advantages of an integrated system. Nevertheless a best buy.



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