HI-FI CHOICE

CASSETTE DECKS

A UNIQUE CONSUMER GUIDE TO £100+ STEREO DECKS

BY ANGUS McKENZIE

£1

YOU'VE NEVER HEARD ANYTHING LIKE THIS BEFORE.

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

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

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

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

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

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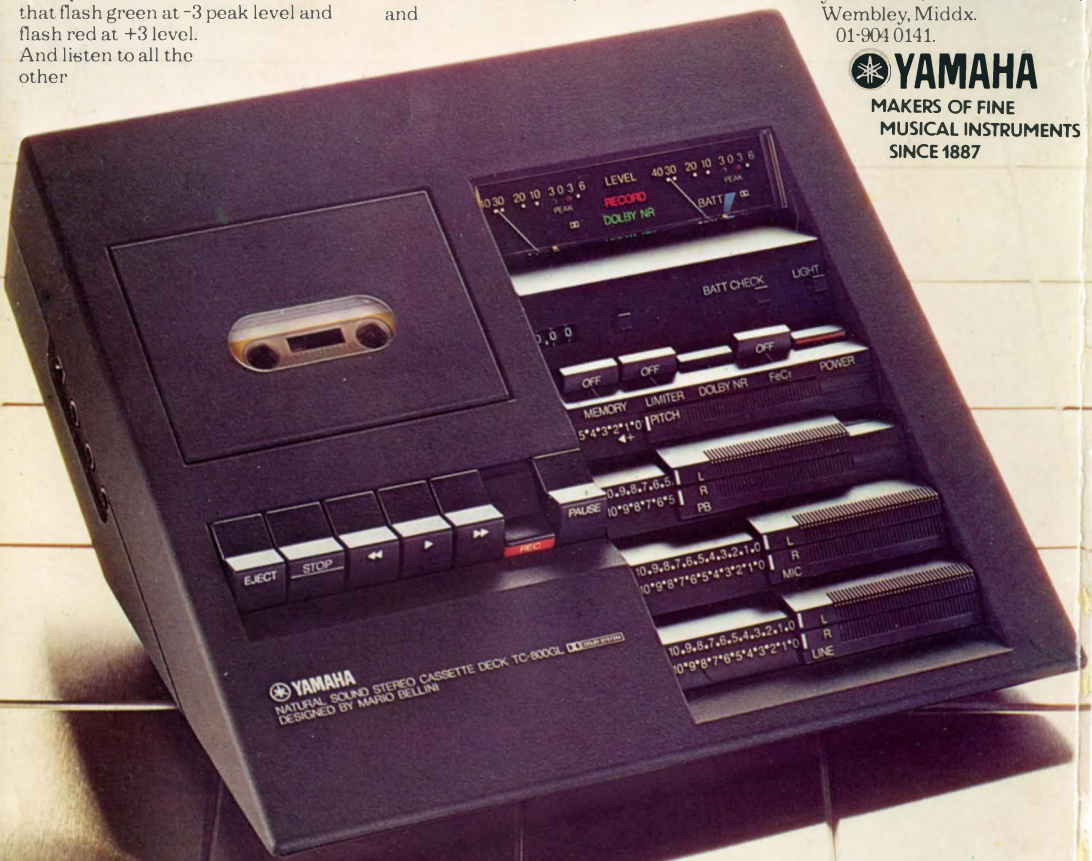

YOU'VE NEVER SEEN ANYTHING LIKE THIS BEFORE.

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TC800GL Stereo Cassette Deck, £179 plus VAT.

Contents

Hi-Fi Choice: Cassette Decks
Written by Angus McKenzie
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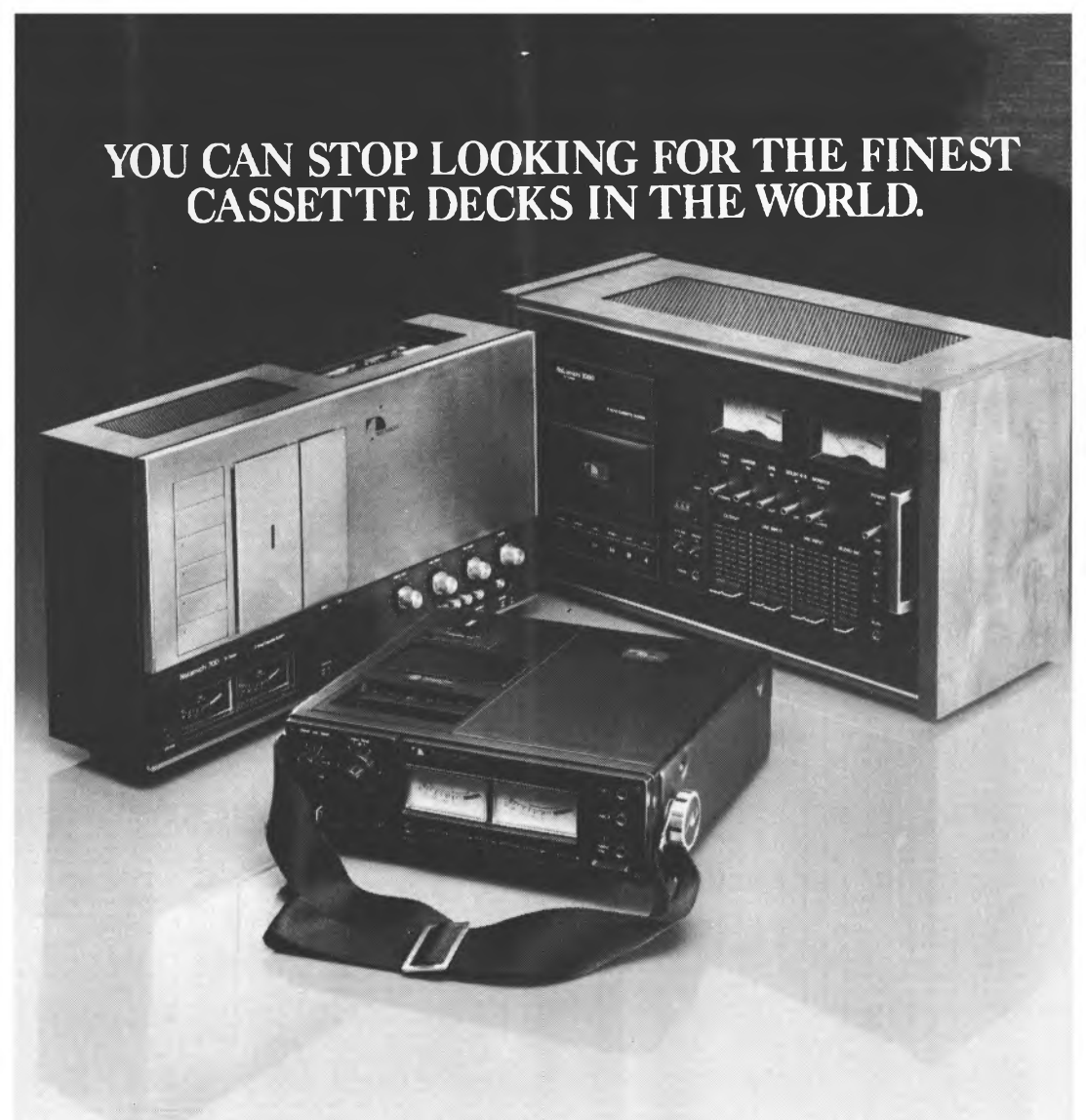

Nakamichi are the finest. They designed the world's first 3-head cassette system and put it into the first cassette deck ever to offer performance up to 20,000 Hz. And no one's ever been able to touch them.

For more details write to Natural Sound Systems Limited, Strathcona Road, Wembley, Middlesex. HA9 8QL. 01-904 0141.

NAKAMIC

Top left: Nakamichi Tri-Tracer 700. The ultimate domestic cassette deck. £399·60 excluding VAT.

Right: Nakamichi Tri-Tracer 1000. The professional standard cassette deck. £631·82 excluding VAT.

Lower left: Nakamichi Dual-Tracer 550. The portable cassette deck with Nakami performance. £236 excluding VAT.

INTRODUCTION

AS WITH many ideas, 'Hi-Fi Choice: Cassette Decks' proved easier in conception than execution. Initially, all three parties involved in the project—the Publishers, Angus McKenzie Facilities Limited and myself —felt there was a need for an objective consumer guide to the ever proliferating amount of hi-fi hardware equipment available to the public. As such, 'Hi-Fi Choice: Cassette Decks' is intended as the first in a series. Future volumes will review such items of unit audio as receivers, loudspeakers, etc. Nowhere before has such comprehensive and comparative information been made available to the prospective purchaser. We believe the publication will make the reader able to both choose equipment more wisely and understand the function of that equipment more fully.

The publishers and myself initially approached Angus McKenzie Facilities Limited to undertake the research and execution of this project as we believed that of all the independent audio laboratories available they were, quite simply, the most experienced and best equipped. The proof of the pudding, as the cliche admits, can be found in the reviews and conclusions that follow.

Additionally, both the publishers and myself would like to thank all the manufacturers, distributors and advertisers, without whose support and co-operation this project would never have materialised. We even forgive those who have been less helpful than we felt, in the circumstances, we had the right to expect.

But I believe the greatest thanks must go to Nicky Paul Barron and Dave Hudson, two of Angus McKenzie's assistants, who, despite all the frustrations and difficulties that occurred, worked above and beyond the point that either I or the Publishers had a right to expect.

Finally, our thanks to you, the reader, for having purchased the publication. It makes it all worthwhile. And should you wish to receive details of future editions of 'Hi-Fi Choice' please send a stamped addressed envelope. We will forward information as soon as it becomes available.

The Editor

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5¼" LP	1200'	£2 46
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NAKAMICHI 700	399.00	POA
GOODMANS SD100		112.95
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HITACHI 2030D	80.91	56.95

	Rec. pr.	Our pr.
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BASF 8200	180.00	139.95
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HARMON KARDMON 1000	189.00	POA
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ITT 88	153.64	109.95
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NATIONAL 269	81.94	POA
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TOSHIBA PT490 AUTO REVERSE	140.86	119.95
YAMAHA TB700	157.88	POA

	Rec. pr.	Our pr.
ALPHA CD1000	42.50	33.50
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from the range of PIONEER Tape Decks

CT-F2121 CASSETTE TAPE DECK

All the controls are at your fingertips on the front access panel of the CT-F2121. Built on the same chassis as the 5300, 6300 and 7300 amplifiers and ideal for stacking, it incorporates Dolby noise reduction and long-lasting 'Permalloy Solid' and 'Ferrite Solid' recording and erase heads. Other features include a tape selector switch, instant mode change switching, and a full auto-stop mechanism.

SPECIFICATIONS
Modes: Compact Cassette, 2 Channel Stereo/Mono
Recording System: AC Bias System (bias freq 85 kHz)
Heads: Permalloy Solid Rec/PB Head x 1
Ferrite Erasing Head x 1
Motors: Electronically Controlled DC Motor
Wow & Flutter: Less than 0.12% (WRMS)
Frequency Response: Regular Tape 30–13,000 Hz (40–11,000 Hz±3db)
CRO_2 Tape 30–16,000 Hz (40–12,000 Hz±3db)
Signal to Noise Ratio: Dolby off 48 db (Regular Tape)
Dolby on 58 db (over 5kHz Regular Tape)
By the use of CRO_2 Tape, S/N Ratio is further improved by 4.5 db over 5 kHz
Features Include: Tape Selector STD/CRO_2 with independently switchable Bias/EQ
Built-in Dolby System (On-Off switch)
Full Auto stop mechanism
Instant Mode Change Switching

CT-F9191 CASSETTE TAPE DECK

Pioneer have packed everything they know into the CT-F9191, which is designed for stacking with the 7500, 8500 or 9500 amplifiers. This unit has two motors, and a Dolby system which combines with tape selection facilities to give excellent frequency response and a signal-to-noise ratio which puts it at the top of its class. Features such as electronic instant-change mode switching, recording peak level indicator, switchable MPX filter, memory rewind and LINE/MIC mixing, make this the ultimate in front-loading cassette decks.

SPECIFICATIONS
Modes: Compact Cassette, 2 Channel Stereo/Mono
Recording System: AC Bias System (Bias Freq 85kHz)
Heads: Ferrite Solid Rec/PB Head x 1
Ferrite Erasing Head x 1
Motors: Electronically Controlled DC Motor x 2
Wow & Flutter: Less than 0.07% (WRMS)
Frequency Response: Regular Tape 25 – 16,000Hz (35 – 13,000Hz ± 3db)
CRO_2 Tape 20 –17,000Hz (30 – 14,000Hz ± 3db)
Signal to Noise Ratio: Dolby off 52 db (Regular Tape)
Dolby on 62 db (over 5kHz Regular Tape)
By the use of CRO_2 Tape, S/N Ratio is further improved by 4.5db over 5kHz
Features Include: Tape Selector STD/CRO_2 with independently switchable Bias/EQ
Built-in Dolby System (On-Off switch)
Electronic Instant Change Mode Switching
MPX Filter
Memory REW – Stop/Play (Rec)
REC Limiter
Logarithmic meters (–40db/+5db)
Peak indicator (+5db)
Line/MIC Mixing
Automatic tape selector

AVAILABLE
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throughout the U.K. – send for up to date price list.
For details of your nearest Comet Warehouse see Page 54.

This is virtually the entire Sonab range.

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

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

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

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

The music. Spacious, virtually infinite.

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

Sonab

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

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

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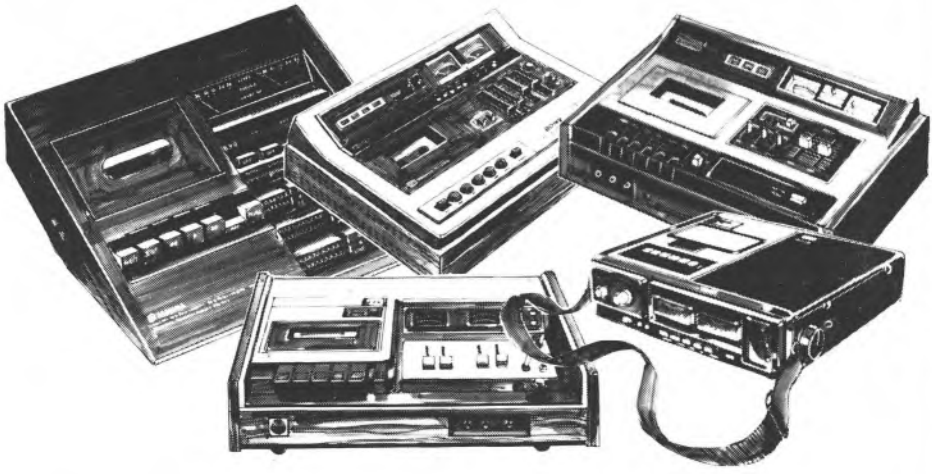
CASSETTE TECHNOLOGY HAS MADE TREMENDOUS PROGRESS..... ...KJ HAVEN'T STOOD STILL EITHER



Until the past year or so the Hi-Fi enthusiast has tended to regard the cassette as the poor relation in his search for high fidelity reproduction. However, with the introduction of more sophisticated machines together with the rapid improvement in both ferric and chrome tapes, he has quickly realised the huge potential of reproduction from the cassette.

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As a reel-to-reel tape, LH Super is in our opinion quite unsurpassed.

The figures quoted above are Angus McKenzie's own readings. The claims made for BASF LH Super cassettes, it's only fair to point out, are our own.

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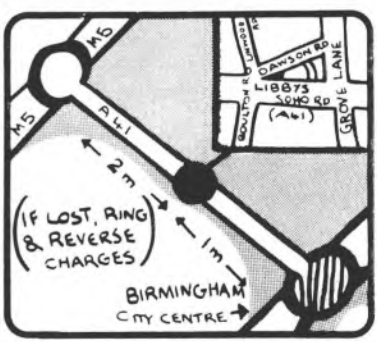

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HI-FI RECORDS

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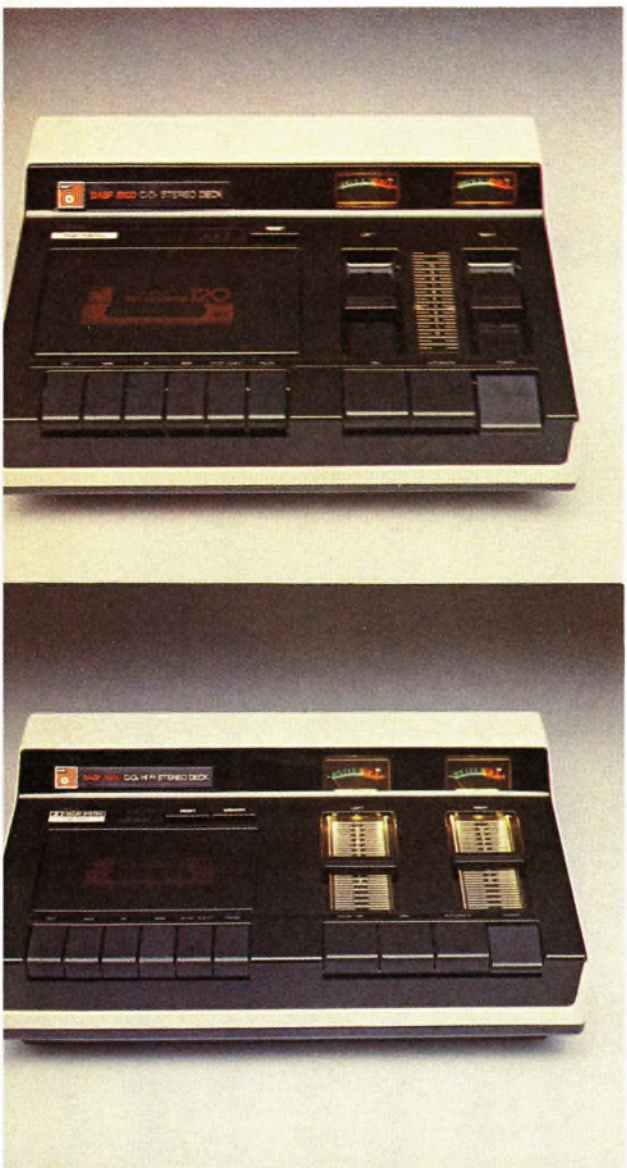

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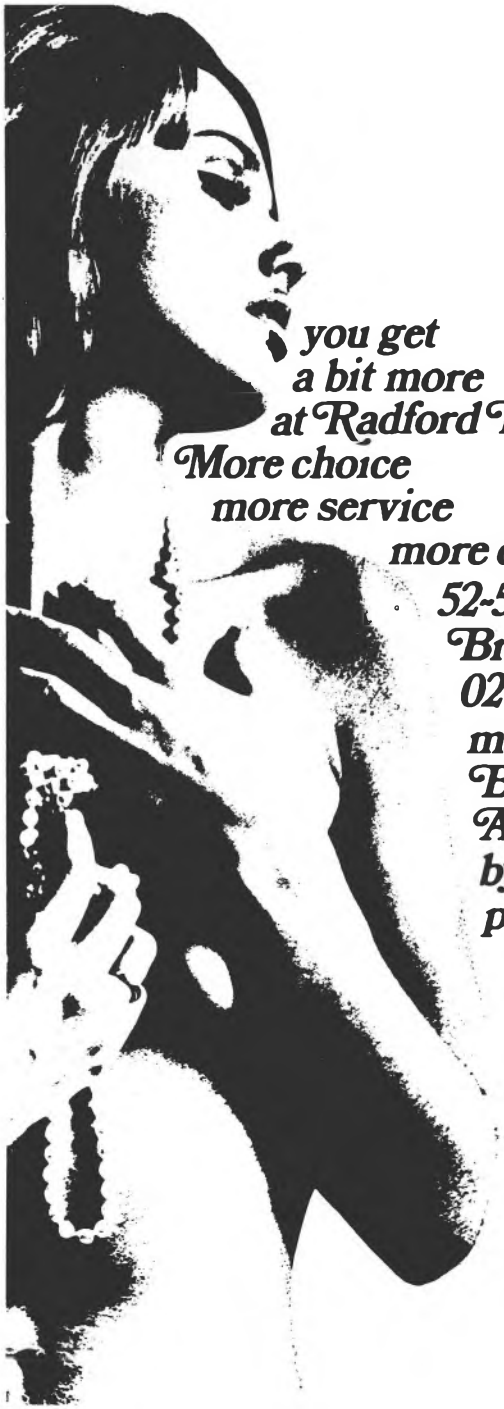

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Herb Alpert
"Greatest Hits"
CAM/YAM 980
includes: "Lonely Bull," "Spanish Flea," "Sc What's New?," "Up Cherry Street," "Tijuana Taxi."

Carpenters
"The Singles" 1969-1973"
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"Horizon"
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includes: "Please Mr. Postman," "Solitaire," "Only Yesterday," "Desperado."

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"Diamonds Rust"
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includes: "Never Dreamed You'd Leave In Summer," "Simple Twist Of Fate," "Dida," "Danny Boy."

Andy Fairweather Low
"La Borga Rooga"
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includes: "Jump Up And Turn Around," "8 Ton Crazy," "Champagne Melody," "My Bucket's Got A Hole In It."

A&M RECORDS

UNTIL recently the average person has regarded tape recording as a black art. Fifteen years ago, most machines were so complicated to thread up and operate that they were only owned by professional engineers, musicians and real enthusiasts. Not surprisingly, the use of such equipment in the home was confined to the male of the family. The distaff side, quite justifiably, had neither the time nor the patience to learn. However, by the end of 1974, according to the British Radio Equipment Manufacturers Association, more than 35% of all households in the United Kingdom owned some form of tape replay and/or recording equipment—a figure which is expected to more than double within the next five years. And, of the equipment in use, almost 90% employs the compact cassette configuration.

When Philips introduced their cassette system some ten years ago, they hardly could have realised that it was eventually to become the most popular audio recording medium. Initially it was designed as a 'LoFo' means of recording and reproducing background music, rather than the serious recording of high quality music programmes.

Early cassette recorders had an extremely limited frequency response and a very poor signal to noise ratio—even worse than the first domestic reel to reel machines, which were produced as early as 1950. The response on the first Philips cassette recorders only extended to around the 6kHz mark and some, as I well remember, were 20dB down at 10kHz! In addition, speed variations made such machines totally unacceptable for recording serious classical music.

It was not until 1970 that any remarkable improvement in the signal to noise ratio (ie: hiss) was made. In that year Ray Dolby, a brilliant American electronics engineer, designed in conjunction with his team a domestic version of his Dolby noise reduction system. This was and is

still known as the Dolby B system. A small experimental production run of these units which, when coupled to any domestic tape recorder, gave up to a 10dB improvement in tape hiss level without any significant reduction of quality, were produced. This prototype system was evaluated by many potential licencees who were already in the field of cassette recorder manufacture. It soon became obvious that the system improved the cassette medium to the extent that, with considerably superior mechanics, cassette recording could become a much higher fidelity process.

Throughout the world, work began in earnest to improve the relatively poor performance of cassette recorders. Amongst the first to produce a higher quality deck were Advent in the United States and Nakamichi in Japan. However, the first deck to show a significant improvement was made by Wollensack—a branch of the Minnesota Mining and Manufacturing Company, who are also responsible for the manufacture of Scotch recording tape. Incorporating Dolby, the Wollensack deck was the first to achieve relatively good stability in the transport, and was, in fact, used by Advent. Later versions of the same deck are now used in the Wollensack machines marketed in the United Kingdom by 3M, as well as NEAL 102B and 103, which are thus American decks but all-British electronics.

The early Nakamichi decks incorporating the Dolby B system were marketed by many companies in the United Kingdom, including Wharfedale, Bell & Howell and Kellar. Unfortunately, despite their showing considerable improvement over previous non-Dolby models, the mechanical performance of these decks left much to be desired. The main problem was poor head to tape contact caused, in part, by the tape weaving up and down the capstan.

Looking back rationally at the early days, cassette tape itself was generally rather poor, having a limited response and dynamic range. It also tended to hiss much more than its modern equivalent. I think it true to say that the very latest tapes give an improvement over their early predecessors almost as great as the improvement created by Dolby processing.

Thus, the best stereo cassette recorders using the best cassette tape are capable today of giving a performance that is more than acceptable to the vast majority of users. Certainly, the best modern machines have a wide frequency response and a good signal to noise ratio. Most have acceptable wow and flutter and, in general, the result is in many ways superior to the good domestic reel to reel machine of twelve years ago.

However, the publishers feel that the majority of the public are still in a quandry when it comes to deciding which stereo cassette recorder would be best suited to their requirements for the minimum cost. Almost all retailers have a vested interest in tending, naturally, to recommend models which they stock, which may not necessarily be the best answer to a particular user's requirements. Additionally, the reviews of cassette recorders appearing in the hi-fi magazines, although useful in many respects, usually fail to give comparisons of performance, thereby making it difficult to relate the review to optimum value for money. The Consumer Association partly fills an urgent need, but simply cannot allocate enough space to go into sufficient detail to enable those who are really interested to discover how all the technical parameters vary.

This book has therefore been written to explain all the different parameters met with in cassette tape recording, compare the performances of the majority of available machines, and thereby enable the reader more easily to make a choice. It must be emphasised, however, that the results published are those made specifically on the machines submitted for review, and neither the publisher nor the laboratories can accept any responsibility should the performance of any machine fail to come up to expectation. Very great care has been taken to ensure that all testing has been done fairly, and in such a way as not to favour certain machines whilst unfairly condemning others. To illustrate to the reader exactly how the project commenced we include the text of the original letter sent to each supplier, detailing the entire project:

"HI-FI CHOICE: CASSETTE DECKS
"Until now, the prospective purchaser of hi-fi equipment has had to base his buying decision on fundamentally inadequate information. Apart from manufacturer's literature, diverse reviews written according to different criteria in various magazines, and not always reliable advice

from shop salesmen, the potential customer has little from which to make a choice.

"Hence Hi-Fi Choice.

"Each volume in the series will comprehensively review all available equipment within a specific product category, occasionally excluding brands which, in the opinion of the publishers, are insufficiently available.

"The first volume in the seies, 'Hi-Fi Choice: Cassette Decks,' is to be published towards the end of September with a planned print order of 70,000 copies.

"Aquarius Publications have appointed Angus McKenzie Facilities Limited to carry out all the measurement and research work for the cassette recorder project. The compilation of written material will be under the personal supervision of Angus McKenzie with Richard Howell acting as editor.

"The reputation of Angus McKenzie Facilities Limited is such that the publishers have every confidence that the contribution of Angus McKenzie Facilities Limited will be totally impartial. Consequently, the publishers believe that all manufacturers/importers will be able to support this project fully.

"Angus McKenzie Facilities Limited will be testing all machines to the same measured standards, so that readers will immediately see how models with widely differing performance claims will, in fact, compare in operation.

"In the interest of readers, the detailed notes which follow will be disclosed in full in a foreword to the publication, and thus the publishers again have confidence that the reader will accept the entire methods and means by which the project has been accomplished.

"All manufacturers and distributors of stereo cassette decks with a recommended retail price in excess of £125 are requested to submit a sample of any machine they wish reviewed to Angus McKenzie Facilities Limited as soon as possible.

"Although brief reference will be made to any model unavailable for review, the publisher will stress that a critical inference is not necessarily intended. However, the publishers feel that it is in interest of both the trade and the reader for all machines to be represented.

Each recorder submitted to Angus McKenzie Facilities Limited will be given a brief subjective check shortly after arrival, and the supplier will be told at this stage if there is any basic fault condition detected. The supplier will then be asked, in his own interest, to exchange the machine within a period of a few days, without any charge for the Laboratory's time. If, however, after all tests have been completed on a machine that did not appear to have basic faults at the time formal tests commenced, Angus McKenzie Facilities Limited feel that the tested sample is not typical in performance, the supplier will be invited to resubmit an extra sample for testing. Because of the high cost of the general testing programme, the supplier will be asked to bear the cost of a retest, which will be charged at the normal rates of Angus McKenzie Facilites for such work. Naturally, if a supplier is satisfied with the figures for the originally fully tested sample, these can be allowed to stand without further tests and no mention will be made that the supplier was asked to submit a further sample. However, if a retest does occur, even at the manufacturer's expense, a brief mention will be made in the text, together with the reasons for which the retest was deemed to be necessary.

"TEST PROGRAMME

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

All manufacturers are asked to submit user and service manuals (including circuits) with the equipment, and also two cassettes of each cassette type (ie: C60, C90, Fe, Cr, etc.) for use with each machine. The laboratory reserves the right to choose an alternative cassette brand if, in its opinion, the recommended brand is too difficult to obtain. The suppliers, however, will at all stages be informed if such problems arise, so that suppliers can themselves suggest alternatives, if necessary.

"The publishers additionally ask suppliers to send two suitable microphones for each recorder or group of recorders, which they deem suitable for use with their equipment. Although the microphones will not themselves be tested, the mic/recorder combination will be checked subjectively. The Laboratory will itself choose a suitable microphone if the supplier does not want to be seen to prefer any specific brand.

"The publishers request the suppliers to be responsible for the insurance of all equipment loaned for review during the time that the equipment is away from the suppliers' premises.

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

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

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

"New models not available anywhere at the commencement of tests can be submitted up to 30 June 1975 for inclusion. Therefore, the publishers would appreciate knowledge, which will be held completely confidentially, as soon as possible, to facilitate internal production arrangements.

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

How a cassette recorder works

The cassette itself contains tape which is only $\frac{1}{8}$" wide—approximately half the width of a normal open reel tape. Across this width four tracks are recorded, two in each direction. This allows a cassette recorder to record stereo in one direction and, by turning the cassette over, to record an additional stereo track in the opposite direction. The layout of the tracks is shown in fig. 1.

The cassette tape first passes over an erase head before recording takes place. An extremely high frequency alternating current, obtained from an erase oscillator, is passed through the erase head to wipe out any recording that had previously been made on the relevant stereo track.

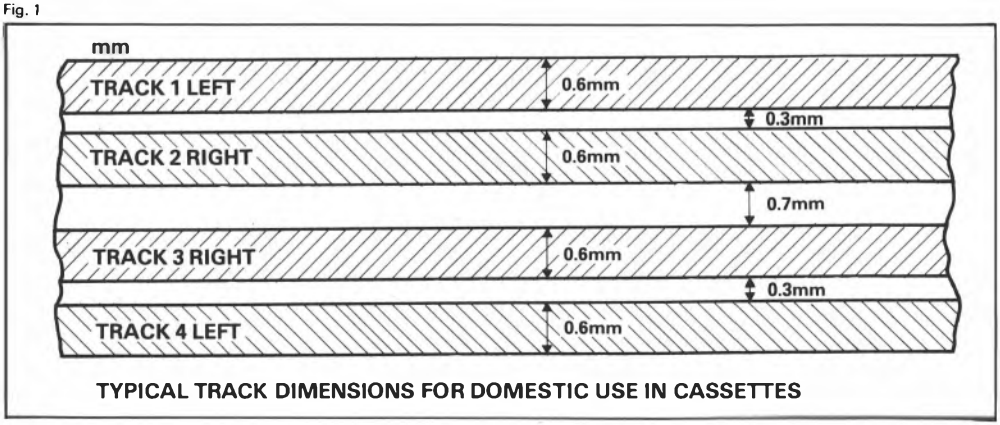
The tape then passes a record head, which is fed with an audio current and a high frequency bias current, the combination of which allows audio to be recorded onto the tape in the form of variations in the magnetisation of the tape's oxide particles. The high frequency bias current is, in fact, obtained from the erase oscillator but at a much lower level, since it purely has to magnetise the oxide particles in such a way that audio currents will then vary this magnetisation, in order that on playback the distortion will be acceptable. The process is similar to the biasing of transistors in electronic circuits, since without bias both a recording and an amplifier would have exceptionally bad distortion and, at low levels, would not work at all.

On playback, the variations in the magnetisation of the tape's oxide coating are picked up by the extremely narrow gap on the playback head. On almost all cassette recorders this is the same head as that used for record, but with different switched connections. The variable magnetic field produced in the gap of the replay head induces an audio current in the winding, and, to give a flat play back response, the output of the head has then to be amplified and equalised in the play back amplifier. The amount of equalisation applied to play back has been internationally standardised. Consequently, the record amplifier has to be designed so that the input programme which is to be recorded is equalised in such a way for the recording produced to replay correctly.

Very considerable high frequency boost is necessary on record to offset the losses inherent in the cassette recording process. Such losses are caused by the fact that normal oxides are incapable of a naturally flat response. This is mainly the result of a high frequency bias current having to be applied in the first place, since the high frequency bias partially erases high audio frequencies whilst they are being recorded. Therefore the high audio frequencies have to be boosted up on record and playback to achieve linearity.

The record amplifier of a cassette recorder is itself driven from a pre-amplifier which, in conjunction with the record gain controls, sets the required level on the tape for any given input level

Fig. 1



TYPICAL TRACK DIMENSIONS FOR DOMESTIC USE IN CASSETTES

to the cassette recorder. Clearly, more gain is required to amplify the output from a microphone than that from an FM tuner, which is already at a fairly high level. Most cassette recorders have two or three inputs with differing sensitivities, and these will be explained later.

All recorders are supplied with meters, which allow the user to tell if the correct volume level is being recorded. If too much level is passed through the record head bad distortion will result, since the oxide particles simply will not accept more than a given amount of magnetisation. However, if insufficient volume is recorded, the replay gain required to achieve full listening level will be correspondingly greater. Thus any hiss or hum in the system will be exaggerated, as it will become louder relative to the programme.

Some types of record level meter are more accurate than others. In particular, peak programme meter types allow the loudest levels being recorded to be judged very accurately. Ordinary VU type meters, on the other hand, frequently do not show the real peak level encountered in music, as the loudest moments of speech or music occur for only a few thousandths of a second, which is not long enough for a cheap meter movement to respond properly and give an accurate reading. Certain machines have peak reading indicators, which flash when a given loud volume level is reached.

Because, on most cassette recorders, the margin between tape noise becoming audible and distortion becoming objectionable is rather narrow, it is extremely important for the user to learn how to interpret meter level readings. It is therefore advisable to read the instruction manual carefully and experiment with, for example, recording from a stereo tuner, before attempting to make serious recordings that are intended to be preserved.

Input circuits

Most cassette decks are supplied with microphone DIN socket and phono socket inputs, although a few models have only phono or DIN sockets. The variation in socket types found on the cassette recorders has been a pest throughout all the tests, especially since the machines had to be tested in accordance with several different specifications. We measured how sensitive each input was in relation to a recorded level, equivalent to a standard reference level of magnetisation (referred to as Dolby level).
We also measured the maximum level that could be applied to each input before distortion resulted. Such distortion clearly results if too much level is introduced into a highly sensitive input. These measurements are highly relevant when cassette recorders are interconnected with hi-fi equipment and in particular we found that many recorders were overdriven on their DIN inputs when these were connected to many makes of tuner amplifier designed to other than DIN specifications. All DIN inputs incidentally were tested with a level of 470mV through a resistor of 470k ohms followed by a capacitor of 250pf shunting down to earth. This network represents a DIN standard source, the capacitor being approximately equal to the capacitance of a 1 metre cable used for normal interconnections. We also tested the input impedances to see if any further interconnection problems would arise.

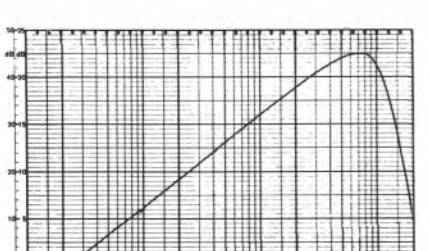
Play back circuits

The play back amplifiers of all the cassette recorders were checked to determine the frequency response resulting from playing international standard test tapes. We determined response for both ferric and chromium switched positions and also the various output levels from each machine for a given magnetisation on a test cassette. Each deck was checked with a very high level recording to see if the replay amplifier could handle very high recording levels without developing additional distortion. We also measured the accuracy of the meters to see if the machines were correctly calibrated for replay gain, particularly when the machines incorporated Dolby circuitry. In general the replay calibrations were fairly accurate on steady tone, but on pre-recorded cassettes very considerable variations were noted.

We listened to several different pre-recorded cassettes on each recorder and noted the subjective sound quality and comments on this are made in each review. We found that the accuracy which with the play back head had been set up by the manufacturers was frequently

not good enough with the result that some recorders might well not give a good high frequency response from the average pre-recorded cassette. All the recorders were adjusted to standard azimuth and inaccurate manufacturers' settings are referred to in each review under "azimuth". Since the output level from the replay head is so very low, the amount of amplification necessary to increase the level is considerable. Some machines had much noisier replay amplifiers than others, the best being five times better than the worst, ie the background noise introduced by the replay amplifier measured 1/5th (−14dB) of that of the noisiest. The noise level was measured in two ways, flat from 20Hz to 20kHz in which the main noise on most machines was caused by hum and low frequency rumble, and CCIR weighted, which applies equalisation to the measuring equipment to exaggerate noises which are subjectively more annoying to the human ear and which reduce noises which are far less annoying. The response curve of the CCIR weighting filter used is shown in fig. 2. We measured the CCIR weighted noise for both channels and in ferric, ferrichrome (where applicable) and chromium equalisation positions and we checked the amount of noise reduction achieved in each case. The optimum reduction should be 9.5dB but some machines did not achieve this. When ferrichrome or chromium cassettes are in use, most machines change equalisation on replay by approximately 4.5dB to reduce the audible hiss. Naturally we

Fig. 2
CCIR Filter



expected to see an improvement in replay noise of this figure but alas several machines hardly showed any improvement at all. It appears that insufficient care has been taken in some cases to design the replay amplifier circuits optimally and I was surprised to find that in many cases chromium dioxide equalisation was achieved by passively cutting high frequencies after the pre-amplifier in a network which reduced the level so much that an additional pre-amplifier was necessary to bring the level up again to that required to drive fully the Dolby circuitry. On some models this extra pre-amplifier introduced substantial noise. It would have been very much better to have incorporated switching in the head pre-amplifier itself to adjust the response appropriately without affecting gain at middle and low frequencies.

When the Philips system was first inaugurated the replay amplifier was designed to have a bass cut incorporated of some 3dB at 100Hz and 7dB at 50Hz. This required an appropriate boost on record to give an overall flat response. This, of course, meant that at low frequencies distortion became apparent on loud passages of music containing a considerable proportion of low frequencies. It has now been agreed internationally that the bass cut designed into the replay circuit should be 3dB loss at 50Hz and thus some 4dB less bass cut and therefore requiring less boost on record and hence lower bass distortion.

Most Japanese recorders have been made to the new standard, but unfortunately Uher CG 320 & 360, Beocord, Nakamichi 700, JVC CD 1950 and 1664, Pioneer CTF 7171 and 6161 and others still employ the old 1590 Us bass cut, and thus have more low frequency distortion when recording. Since the new standard has been fully accepted by DIN, these manufacturers really should put into effect immediate modifications.

Most machines allow the meters to switch between record and play back and whereas on record the meters read the relative level being introduced to the record head driver circuit, some of them on replay read the actual output from the recorder after the replay gain control and thus the reading could be varied at will by adjusting replay gain. With these models it was not possible to read the absolute level on the tape and so in the laboratory we used external equipment for check-

ing Dolby level.

Some of the noisier replay amplifiers clearly had not been designed in such a way that the replay had matched into the input of the amplifier for optimum noise performance. In some cases a machine showed a weighted noise figure better than it would have measured if the play back response had been equalised to be flat up to 14kHz or so rather than dropping by 10kHz. After much research, we decided to use Teac test cassettes rather than BASF ones, since we found that the latter seemed to have too much high frequency output on machines that had been very carefully set up from first principles in the laboratory. Out of six Teac test tapes five were within an exceptionally close tolerance and these were continually checked against our laboratory standard. It was necessary to azimuth every machine after checking its original state on delivery, so that all the machines were standardised for play back response tests, which included, naturally, frequency response and play back of a series of pre-recorded cassettes. We were pleased to see that the majority of machines had a very good play back response at the treble end, but unfortunately we noted considerable variations at the low frequency end. This made many pre-recorded cassettes sound boomy on some machines and light in bass on others and it was clear that not all pre-recorded tape duplicators had been standardised on the same play back equalisation.

Wow and flutter

When the tape passes from the left hand spool through the transport and round the capstan to the right hand spool, its speed can be inaccurate in a continuous sense or more probably it may vary either rapidly or slowly. We measured the basic speed accuracy of each recorder to check that a pre-recorded cassette would play back at the correct pitch and we also measured the wow and flutter as a check on speed variations. Variations of up to a few cycles per second are termed wow and are caused by either irregularities in tensioning or by an imperfect pressure idler wheel. This wheel holds the tape in contact with the capstan and it must rotate extremely smoothly and have a perfectly parallel surface pushing against the capstan. If its wheel is slightly askew, the tape will tend to ride up and down the capstan slightly and thus cause azimuth variations and phase jitter.

Flutter is usually caused by eccentricities in the tiny capstan that is turned by its motor. The capstan has to revolve at a constant speed and thus, with the help of the pressure idler wheel, pulls the tape across the heads. If the capstan itself has an irregular surface or has poor bearings, flutter will develop in the form of speed variations above 10 times a second or so. These variations can cause a burbling effect on music and are particularly noticeable on woodwind instruments. We measured the wow and flutter with a DIN peak weighting meter three times each at the beginning, middle and end of a cassette and the figures quoted are the average of the nine readings taken. Machines having a wow figure higher than 0.15% would be audibly inferior to those significantly better. Machines better than 0.1% are very good and I doubt whether on normal programmes any user would notice speed variations.

The speed accuracy was measured using a calibrated cassette having a tone of 3kHz recorded on it at precisely 1⅞ips. We were surprised to find that almost all the recorders tested were remarkably accurate and even musicians would be hard put to it to notice any pitch errors on pre-recorded cassettes, unless the cassettes themselves were at fault.

Spooling and tape position indicators

We measured the time taken to wind on and rewind a full cassette tape on each machine. Machines that spool too quickly are more likely to damage cassette tape than those which spool relatively slowly. However a machine which rewinds extremely slowly can be very irritating, particularly if one wants to spool back an entire cassette before replaying a recording. Since it is a matter of opinion about spooling time, it will be up to the user to select a compromise. Many machines had a memory spooling system incorporated, which allows a pre-selected point to be chosen for stopping the cassette automatically during spooling.

The logic circuits of the various machines tested operate in many different ways, for in some cases it is possible to go direct from play into wind and return, whereas on others it is necessary to stop the transport before re-commencing play back. Some machines had the useful facility of going straight to rewind from record or play back and whilst the machine was rewinding the tape remained in semi-contact with the head, allowing monitoring of the spooling. When the rewind button is released the tape then reverts to play back rather than record. On the other hand if the rewind button is depressed from stop the head is muted and it is necessary to press the stop button again before playing a tape. Some machines were able to play back in either direction (eg Uher CG 360). On one machine (Dual C901) it was possible to record in either direction as well as play back and this is extremely useful. Note that some machines stop automatically when the tape has spooled to the end where as on others the motor is still engaged and harm could result if the machine was not switched to stop. The Wollensak decks used by NEAL could not be locked on to spool (though Wollensack's own machine did lock) and this could be a little tiresome if one wanted to spool back a complete C120 at the same time as serve drinks at a party.

Noise reduction systems

The first and by far the most successful noise reduction system to be developed for cassette was the Dolby B and its operation entails the boosting up of high frequencies at low levels on record and the reciprocal process of expanding them down again on replay together with tape hiss produced by the cassette recording. The frequency at which the boost comes in on record and cuts on replay varies with the actual level being recorded at any one moment, so that at very low levels frequencies above 2kHz are boosted by a full 10dB to be cut again on play back by a similar amount, thus restoring an overall flat response. The replay expansion should reduce tape hiss by approximately 9.5dB overall as compared with the results obtained when the noise reduction system was switched out. The Dolby B system at high levels marginally reduces high frequencies in an attempt to reduce tape saturation. There can be no doubt that this system transforms the cassette medium to a hi-fi one that is capable of giving results that are really superb. The very best machines that we tested gave results which were subjectively every bit as good as the average domestic reel to reel recorder (without Dolby) at 7½ips, but it is emphasised that the correct cassette tape must be used on each recorder. The Dolby system requires a signal to pass through the record Dolby at very close to the same level as it should replay through the system. To enable this to be set up and checked, Dolby Laboratories have defined a particular recording level at a frequency of 400Hz as being "Dolby level". Some machines have their meters set up such that a Dolby level calibration tape, available as a Metrosound accessory, and actually prepared by the writer, should play back at 0dB whereas on other recorders the reading may be intended to be +3dB. The calibration point on the meter should in any case be labelled and we noted any calibration errors present when both ferric and chromium tapes were in use. Most machines were very accurately calibrated on play back but on record some of the calibrations were many dB's out, despite the correct brand of cassette being used, as supplied by the manufacturer or importer. We did not re-calibrate the record section unless user operable controls were provided, since we felt that no normal user would be in a position to dig inside the electronics and correctly reset delicate potentiometers, let alone even find them correctly! Dolby calibration has to be accurate to within ±2dB for the overall sound quality not to suffer degradation.

Any errors in record equalisation of either high frequency boost or cut will have the error exaggerated when the Dolby circuitry is operating. We have chosen to publish only a sample of overall response pen chart recordings and these were taken at a level of 26dB below Dolby level, at which level no tape compression should be noticeable at high frequencies. Unfortunately the size of this book does not permit all the pen charts and measurements to be included, but nevertheless any anomalies found receive comments in the relevant text.

Since the Dolby system boosts low level high

frequency signals, but does not boost higher level signals to the same degree, any continuous spurious high frequency signals present such as multiplex breakthrough from an FM tuner must be removed in the recorder before the complete signal is passed through the Dolby record circuit. All Dolby machines contain a multiplex filter and whereas some recorders have the filter permanently in circuit, others have a switch provided to switch out the filter when the recorder is used for recording programmes from sources other than tuners in which no spurious high frequency signals are present. Each filter was checked by recording a 1kHz tone some 30dB below Dolby level and pulsing a 19kHz pilot tone at the same level on and off, whilst recording with the Dolby circuit operative. Almost all the recorders tested did not show any degradation of noise reduction action, although when the test was applied to the JVC recorders, employing the ANRS system, a considerable degradation was noticeable, which could reduce the available noise reduction of that system by 4dB or so if recordings were being made from a stereo tuner itself having inadequate multiplex filtering.

The ANRS system was compared with the Dolby system both on record and play back and whilst we consider that the two systems are fairly compatible, it certainly would not be true to say that they are fully compatible. It appears to us that the ANRS system does not have such a comprehensive control circuit as the Dolby and thus we found on subjective listening tests that Dolbied tapes reproduced through ANRS appeared to sound a little brittle and had too much high frequency energy. We also noticed an apparent expansion effect upwards of high energy high frequencies, which we can only describe as "fuffing". Unfortunately this effect also includes an apparent increase of cassette noise audible from time to time behind the programme and we were hard put to it to reproduce the same effect with Dolby, which was therefore subjectively much cleaner.

We also noticed similar effects when ANRS recordings were played back through the same system. We think it unfortunate that JVC, therefore, do not include Dolby on their machines and we are sorry to have to suggest that because of this, users may well favour machines incorporating Dolby rather than ANRS.

Philips introduced their own play back only noise reduction system some while ago before they ultimately were given a licence by Dolby, which now allows them to incorporate the full system in their recorders. The Philips system named DNL applies a fairly steep top cut below a pre-set dynamic level and whilst this will remove tape hiss on non-Dolbied cassettes, it also at the same time removes most of the higher harmonics of music present when instruments such as violins and guitars are playing quietly. It takes so much life out of a sound and in our opinion is in no way compatible with Dolby. It is useful, however, for removing hiss from very noisy cassettes if the reduction of extreme top in quiet passages is considered preferable to the hiss that would be audible without DNL. In all cases when DNL was switched in, the system worked as it was designed to but with the drawbacks already mentioned. We cannot see any real advantage purchasing a machine that has both DNL and Dolby over one having only the latter, although users who like to wear both a belt and braces may well find it an advantage very occasionally.

Distortion

We measured the third harmonic distortion produced on the tape of a frequency of 333Hz at both Dolby level and 4dB above Dolby level. Measurements were taken for both stereo tracks and on all cassette tape types recommended for each machine ie, ferric, ferrichrome and chromium. Chromium tape almost always produced considerably more distortion at low and middle frequencies than the other types and in some cases the distortion at high levels was really alarming as will be seen in the tables for each of the machines. Almost always, though, chromium tape produced a cleaner high frequency sound quality at climaxes, since it will accept more energy at these frequencies than ferric tape. About a year ago ferrichrome cassettes became available which have a basic ferric oxide layer coated with an aditional layer of chromium oxide on the surface. It can be said that ferrichrome cassettes can have the benefits of both ferric and chromium types, but the process of double coating is extremely critical.

Usually ferrichrome tape has sounded better than chromium on machines with appropriate switching, but in the meantime such major improvements have been introduced in ferric tapes that the difference between the latest high energy ferric tapes and ferrichrome types is becoming almost marginal. The latest samples of BASF Super LH, Agfa Super Ferrodynamic, Maxell UD and Ampex 20/20 have shown very considerable advances in distortion at middle frequencies and clarity at high frequencies that we can foresee that pure chromium dioxide cassettes are now virtually superseded. The best cassette recorders produced only 0.6% harmonic distortion at Dolby level on Superferic tape as opposed to an average of 1.25% on older types. We noted 2% distortion on average for chromium tape at the same level. Therefore, although chromium tape, appropriately equalised on play back, sounds about 3.5dB quieter, the new ferric cassettes can accept a recording level some 4dB greater than chromium for the same overall distortion, although it is admitted that chromium is still superior at very high frequencies. Recorders fitted with equalisation and bias switches for ferrichrome will sound even better if they are correctly set up.

Very few cassette recorders indeed have had their electronics and heads optimally designed for chromium tape, since it is exceptionally difficult to design a record head that will accept without distortion the very high record and bias currents necessary to obtain optimum performance. Most machines considerably underbias chrome tape and a comparison of performances of this tape on some of the machines will prove interesting. By far the lowest distortion on chrome tape was measured on the Nakamichi 700, whereas some recorders were literally five times worse! If you wish to use chrome tape in addition to ferric, then note the distortion at 4dB above Dolby level of the machine that appeals to you and consider whether the quoted distortion is good enough.

In general, as the bias level through the record head is increased the distortion at middle frequencies fairly dramatically decreases but unfortunately at about the same rate that a deterioration of high frequency performance is noted. Bias setting is therefore a compromise between mid frequency distortion and high frequency "squash". By squash I am referring to the inability of the cassette tape to reproduce levels above a maximum at the same level as is put into the recorder. At recording levels below the "squash point" level the frequency response of a cassette recorder should be substantially flat up to the frequency at which this squash is being measured, but at higher levels higher frequencies will be reduced at a very high level, when the programme itself contains considerable high frequency energy, its high frequencies will therefore be squashed and their impact subsequently reduced. Listen carefully to this effect when trying a cassette recorder at a high ievel. Heavy brass instruments, percussion instruments and vocalists can produce a rather nasty sound quality. In some cases, because of the amount of high frequency boost, applied in the recorder's recording amplifiers, the actual electronics themselves clip and this can produce an even more intolerable sound. It is better for the tape itself to limit high frequencies than for the electronics to do likewise by default, although some recorders do have pretty effective limiters built in which do not distort, good examples being those made by Sony.

To test the replay amplifiers we developed in our laboratory a special cassette recording containing a 333Hz frequency, which reproduced at a level of 6dB above Dolby level. The third harmonic distortion of this tone was approximately 3% but the second harmonic measured approximately .03%, since very great care had been taken to reduce the distortion to exceptionally low limits in our experimental recording amplifier. We noticed a considerable variation in the second harmonic distortion produced in the replay amplifiers of different machines and whilst we found none that created as much second harmonic distortion as would be present as 3rd harmonic on a tape, the measurement was an indicator to the competence of circuit design. We also checked machines that were able to monitor the input circuits on an output socket to see if any distortion was introduced before a programme entered the record amplifiers. Some preamplifiers had noticeable distortion, although in general the input pre-amp distortion was always pretty low.

Overall signal to noise performance

We measured the overall CCIR weighted signal to noise ratio with respect to Dolby level as this is clearly defined in terms of magnetisation flux. The total dynamic range available on most programmes will be several dB's greater than the overall figures quoted and the useable range is given in dB's in a separate column computed from the SN ratio ref. DL and the distortion characteristics of the relevant tape at low, middle and high frequencies. The signal to noise ratio was measured with the record gain control set to minimum and as in practice users will of course have the record gain control set somewhere above minimum, so that an appropriate input programme will be recorded at the correct level, we also measured any additional noise produced by the recorder input pre-amplifier both on the DIN and phono or auxiliary inputs. In some cases the DIN specified input level for testing degraded the overall noise produced, when chromium tape and Dolby circuitry was in use, by many dB's and thus the recorder's basic input sensitivities could not be used to the full without degradation of performance. We noticed on many models that the so called line input, sometimes referred to as phono or auxiliary input, was attenuated severely by a high value series resistor, which fed into the DIN input amplifer. Levels normally encountered in practice connected to these inputs, therefore, required a very high setting of the record gain controls to achieve optimum record level and considerable hiss resulted. The original sample of the Dual model C901, in fact, produced 20dB of additional noise in this test and after Dual's attention was drawn to this problem their engineers in Germany visited us with a completely re-designed pre-amplifier which virtually eliminated the problem and stated that all future models would incorporate the improved circuit. Many recorders had switches to select DIN or line inputs in each case working the pre-amplifier at optimum gain and thus reducing input noise to a minimum.

The microphone input noise was checked subjectively using typical microphones usually selected by the manufacturer, but sometimes by us as being appropriate for the recorder. The best machines had extremely low noise microphone pre-amplifiers but I am afraid that the worst either produced a sound that we likened to Niagara Falls in the background or added an objectionable hum, which would most certainly disturb a user. It strikes me that some cassette recorder designers do not bother to listen adequately to their own products let alone compare their performances with those of equivalent-priced alternative brands. The publication of this book may well influence design in future to the ultimate benefit of users.

Whereas we found that the replay amplifier noise varied over a very considerable range from machine to machine, the overall noise in general varied over a considerable smaller range, with just a few exceptions. The margin between noise and distortion, though, is so critical that machines giving say 44dB S/N reference DL without noise reduction were subjectively much better than machines measuring only 4dB worse. Undoubtedly some of the difference was due to poor replay amplifier design (eg Teac 360) but in other cases the manufacturer had recommended either a noisy tape or one which gave rather poor distortion on their machine (B & O Model 2200).

It might be said that we should have tested all the recorders with the same good brand of tape, but since this would have involved our spending several hours aligning each recorder to the chosen tape, which no normal consumer could do, we considered it fairer to test the recorders on the brands stipulated by the manufactuers, since we felt that in all probability the average user would do likewise. Unfortunately many machines could not accommodate ferrichrome tape, but you may find that you obtain significantly better results on this tape (Sony and Scotch classic) in the ferric or ferric high switched positions on your recorder. If you notice too much top, though, it shows that the bias level setting on your recorder is almost certainly not suitable without adjustment.

Azimuth and phase jitter

If a cassette recorder is to play back pre-recorded cassettes with the optimum high frequency performance, the play back head must be aligned so that the magnetic gap, which picks up the variations in magnetisation of the tape, is at

exactly 90° to the direction of travel of the cassette tape. If it is tilted one way or the other so that it no longer remains vertical, (as seen directly from the front) a high frequency loss will become apparent when playing back cassettes recorded correctly on other machines. This error would not, however, affect recordings made on the same machine, since they too would be incorrect but would play back with the same error and thus would be linear overall. The problem would be akin to a motor car having the back wheels turned slightly in one direction, so that by compensating the steering in the front, the car would still move in a given direction but skew, as it were, the limit of course being the car moving bodily sideways! The effect is similar to that employed by the term "crabbing". The replay head must thus be set by the manufacturers, so that its azimuth is standard and any error in this setting will progressively degrade the reproduction of high frequencies of pre-recorded cassettes. The head must also be adjusted so that its height is correct for, if it is not, modulation appearing on the right channel of track 2 will become audible on the right channel of track 1 or vice versa.

We checked the crosstalk of all machines in this way and very few indeed were incorrect. We also measured crosstalk between left and right channels of a single track and frequently this deteriorated at high and low frequencies. High frequency crosstalk is usually produced in the input and output circuitry and in particular actually across the pins of the DIN sockets. To reduce both crosstalk and feed back from the monitoring circuits to the input, the DIN specification states that the replay pins of a 5 pin DIN socket should be muted on record. Most machines made in Japan were not wired up in accordance with this recommendation and thus did not conform to DIN specifications. (Refer to 'Interconnecting the recorder', which explains the problems in greater detail.) We measured crosstalk at three frequencies and usually found that although excellent measurements were produced by almost every machine at middle frequencies, considerable variations were found at low and high frequencies. Quite frankly, though, the L/R crosstalk on almost every machine was good enough for any normal programme source to be recorded without audible deterioration on play back in this respect.

Whilst some transports had an extremely even and accurate transfer of the tape from the left to the right side of the machine, others allowed the tape physically to move slightly either up and down the record/replay head or skew, so that the azimuth angle would be continually changing with respect to the edge of the tape. Moreover the tape/head contact was found rather imperfect occasionally. Any azimuth variations produced a change of relative phase between the two stereo tracks and this was measured with a gain/phase meter, with its output connected to a DC microvolt meter and a storage oscilloscope. Short term variations were observed on the millivoltmeter and long term variations across the screen of the oscilloscope, whose dot traversed slowly from left to right, tracing the long term variations of phase whilst drawing a line behnd it each time it traversed the screen. A stability and dropout test was made by recording a 10kHz tone on the left hand track and replaying it through equipment on to a pen chart recorder over a period of a minute or so. The pen chart recording showed us the short term variations in output and allowed us to check the dropout characteristics of each recorder. We picked the left hand track, since this was closest to the edge of the tape and is thus usually more critical. Again we carried out the test on the cassette tape recommended rather than a chosen type for all machines for the same reason as was explained earlier.

Overall frequency response

The overall response of each recorder was measured, using the recommended tape types for each machine, on both tracks and with and without Dolby or ANRS processing. The synchronised pen charts were fairly difficult to obtain, since it was necessary to record first a good frequency sweep from 20Hz to 20kHz on each track without dropouts and then play it back precisely in synchronisation with the frequency markings on the pen chart recorder paper. For this a B & K 2010 analyser, a 4409 synchroniser and a 2307 chart recorder were used and the most important charts recorded are shown with each individual review. The range on the

potentiometer used on the chart recorder was 25dB from top to bottom and thus boosts and cuts of up to 12dB from a central line are visible. Each major horizontal line represents 5dB change. Almost all recorders showed appreciable wiggles in the response below 200Hz and these are due to replay head characteristics. We found that some recorders has a response extending to well beyond 15kHz at the high frequency end, particularly on chrome tape, and we consider that recorders having such a response are not optimally designed, since very few signal sources have any significant output above 15kHz anyway and not many uses will be concerned with attempting to record frequencies not present on an input programme. Moreover if a cassette recorder has a replay head with an extremely fine gap, necessary to give an extended treble response, the output from such a head at lower frequencies is less and thus such a recorder will tend to have more noise on play back. If the same fine gap replay head also serves as a record head, matters are even worse, since unless the head is superbly well designed gap saturation can occur and thus distort at a lower level than it might otherwise.

With modern electronics and cassette technology, the optimum overall response is probably flat to 12kHz and a few dB down at 15kHz, since this subjectively will sound clean and less noisy particularly to a younger listener who will hear very high frequency hiss very readily. Almost all machines have pretty flat input circuits but some will show a severe high frequency loss when interconnected with DIN equipment (see later). In general the frequency response can be said to be good if the apparent boost or cut in the Dolbied state is within $\pm$3dB at 10kHz with respect to the response at 333Hz. At the low frequency end variations of up to $\pm$2dB would in practice be almost unnoticeable especially since the noise reduction sytems employed on cassette recorders do not exaggerate any errors at such low frequencies. Finally we checked the consistency of response between the two stereo tracks and, whilst a slight boost or fall off on any one track may not be serious, it would be more noticeable if on the alternate track the response measured in the opposite direction with respect to a flat one. If the left channel for example measured 3dB up to 10kHz and the right channel 3dB down in the Dolbied state, a shift to the left would become noticeable on sibilants of speech or singing or on high frequencies present at intermediate energies on a typical programme. Any relative inbalance of response receives comments in the text.

Interconnecting the cassette recorder with external equipment

The microphone input circuits, in addition to having different sensitivities from brand to brand, also have different input impedances. Many microphones are available in low, medium and high impedance versions. You should always be careful to select the right impedance microphone for the recorder in use. If a low impedance microphone is plugged into a high impedance input, there may be insufficient gain in the recorder to obtain full recording level from quiet speech. However, a high impedance microphone plugged into some low impedance inputs would also lose gain, and high frequencies as well. The optimum impedance input for a cassette recorder for most microphones available today (low impedance) is between 1000 ohms and 10,000 ohms. A microphone is referred to as low impedance if it presents a source of 600 ohms or less to the input circuits of the microphone pre-amplifier. Some circuits are more noisy than others, and thus if you wish to record speech you should select a recorder which performed well in the subjective tests. If on the other hand you wish to record loud music, and with the microphones fairly close to the musicians, you should choose a recorder capable of withstanding high microphone levels. The average low impedance microphone wll give an output of a few hundred microvolts on speech two feet away from the mic, but a pop group could produce an output from the same microphone some 40dB louder, ie of the order of several tens of mVs. Some of the recorders clipped at as low a level as 10mVs and would thus not be suitable for recording live music close to the microphone. This problem is a severe one and it would be better for some of the more expensive cassette recorders to include a low/high mic, input gain switch.

Remember too that capacitor microphones and most electrets give a higher output than

moving coil or ribbon types. If the recorder you select has a poor microphone input sensitivity, it will almost certainly be perfectly satisfactory with the more expensive electrets, for example, which in any case usually give better reproduction than the cheaper moving coil types, although it is stressed that an expensive moving coil microphone can be at least as good as even an expensive electret. The best microphone quality though will be found in genuine capacitor microphone types which need an appropriate power supply to power them.

The 5 pin DIN inputs should have an impedance as specified by the Deutsche Institute Norme (DIN) of between 1k ohm and 50k ohms. The optimum level for their operation is 1mV per k ohm of specified input impedance, thus a DIN input that we measured at 10k ohms impedance was tested at an input level of 10mVs. The DIN specification also states that an input level some 6dB higher than this should transfer through the system without distortion. Some machines only just had this overload margin and this is shown by the clipping level at which the input circuit distorts. Unfortunately this is not the entire problem, for too low a DIN input impedance can lead to noise problems developing whilst too high a one can lead to severe high frequency loss problems, especially if lengthy leads are used for interconnecting the equipment. To measure this effect we fed 470mVs through a 470k resistor right into the DIN input socket with an additional 250pF to earth to represent the capacity of a typical interconnecting cable. Recorders having an input impedance of higher than 20k ohms showed a progressively more serious high frequency loss in the input circuit and in particular the B & O model Beocord 2200 achieved the distinction of the highest HF loss in its input circuitry of any machine tested (approximately 7dB at 10kHz). We were alarmed to find that this recorder, in addition to its 50k ohm input impedance on the DIN socket, also had a measured input capacitance in excess of 250pF without our extra capacitor being added. Thus a typical cable connected to this model would present a capacitance of 500pF to equipment feeding it, so causing the loss measured. The auxiliary input on this machine, however, had a compensation capacitor added to offset the problem and gave a fall off of only 1.5dB at 10kHz — far more tolerable.

Some machines had inadequate screening around the input circuits and hum induction became a problem, which receives comment in the text. We feel that many models need a major re-design in the input circuitry, so that they can be used without aggravation with virtually any input source normally met with when interconnecting hi-fi equipment. If your amplifier or receiver is built to DIN specifications, it should be satisfactory simply to interconnect with a 1 metre 5 pole DIN plug on each end. If, however, it has a low source impedance tape recorder feed socket, it will be necessary to employ a lead having built-in resistors, so that the voltage fed from the amplifier is changed effectively into a current feed into the DIN socket on the recorder. Such leads are obtainable from well stocked hi-fi shops, although you may have some trouble in finding an assistant who can understand the interconnection problem! Always use the "Radio" DIN socket for interconnection with DIN equipment, but use the auxiliary sockets if you can for interconnection with non DIN external equipment. Conversely never connect a DIN receiver or amplifier to the high impedance inputs of a cassette recorder, for such a connection will give you serious high frequency loss, since both source and input impedances will be high and thus the capacity of the cable will reduce high frequencies severely. Do not forget also that connecting the phono outputs of an amplifier or receiver, not built to DIN spec., straight into the DIN sockets of many cassette recorders will produce overload distortion. In such cases always use an appropriate lead with built in resistors. Make sure that all interconnection leads have all the live wires separately screened. Two live wires inside a common screen, such as is used in balanced microphone cable, should never be used for feeding a stereo unbalanced signal, since crosstalk at high frequencies will result.

Earth looping can also be a problem. Always make sure that only one piece of equipment in the hi-fi set up is earthed to the mains, unless any particular piece of equipment's chassis is separated from the signal earth. It is best to earth the main amplifier or receiver and to connect the recorder to the mains with only two wires leaving free any earth wires provided. There is no harm,

however, in attempting different earthing combinations, provided that at least one piece of equipment is always earthed to the mains for safety. You may even find that reversing the live and neutral of the mains to a two wire mains connected machine can reduce hum. In some cases you will have to place the cassette recorder at least a foot or so away from the receiver or amplifier, since any mains transformer in the latter can induce hum into the play back head or electronics of the recorder. We found several machines were susceptible to this.

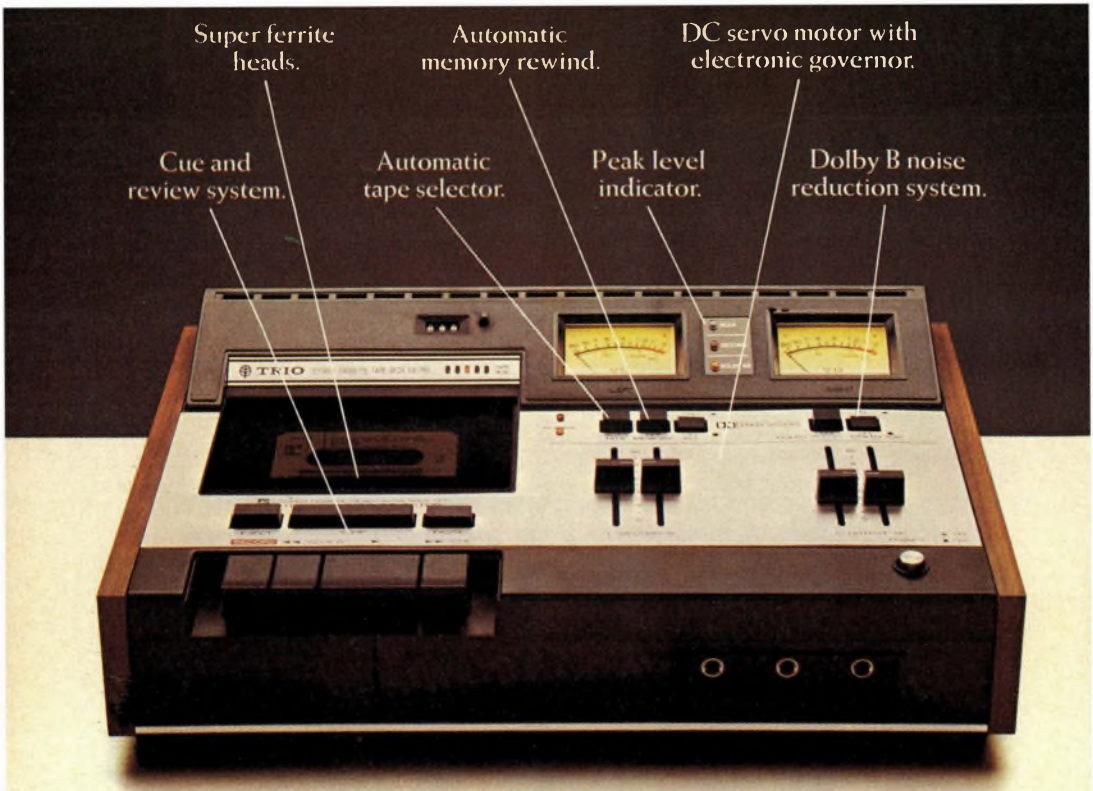
If your amplifier has a control to select the output level fed to the recorder, try varying this in conjunction with appropriately adjusting the recorder's record levels controls to obtain optimum signal to noise ratio without distortion. The Armstrong tuner amplifier range for example has a pre-set to adjust this whereas the Leak 2000 range has a switch which selects high or low source impedance and hence level into a DIN input. Having adjusted input levels do the same with your recorder on play back by adjusting the replay level control if fitted, so that a similar volume returns from the tape when you depress the tape monitor button. This will allow you to receive all input programmes at a similar level. Finally, unless your tuner has a superb multiplex filter incorporated in it, always use the multiplex filter in the cassette recorder if it can be switched in and out. If you do not switch in this filter, you might hear whistles and burbles on a cassette recording, produced by FM multiplex tones distorting and creating beats with the bias oscillator in the cassette recorder. These whistles should not, of course, be audible on the original broadcast, unless the tuner has a serious fault in its decoder.

Cassette tapes

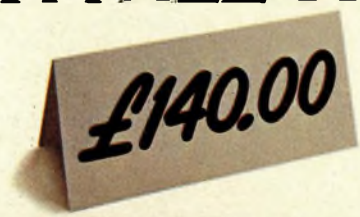
Very significant improvements have been made in ferric blank cassettes, for there has been a steady improvement in both signal to noise ratio and high frequency performance over the years. Many manufacturers naturally recommend either a brand of their own manufacture or a brand made by a company having fairly close associations with them. In general cassette recorders do work best with brands recommended for them, but unfortunately there are some exceptions to this rule. In some instances a recorder's performance could improve dramatically with an alternative tape type, if only minor adjustments to bias and/or equalisation are made, a typical example of this being the Teac range, in which TDK tape was stipulated for the medium bias/equalisation switched position but where Maxell UD tape gave a better performance. Another example was the B & O cassette recorder, in which the manufacturers recommended ordinary BASF cassette tape rather than the Super LH, with which we also tested the machine in a retest. Ferric cassette tapes can be placed into four basic performance categories with surprisingly little overlap.

In the top category are the new Super ferric types, such as Agfa, Super Ferrodynamic, BASF Super LH, Ampex 20/20 and Maxell UD. Amongst those in the next category would be TDK SD types, Agfa C60 plus and C90 plus, the latest EMI X1000 cassettes and the latest Scotch Superdynamic etc. In the third group are what we class as good "cooking" tapes, which include ordinary BASF, Agfa and Scotch. Finally in the last group we dare not mention any types, but there are quite a number of very poor quality cheap cassettes around that will give inferior signal to noise performance, poor distortion and very poor high frequency response.

I must emphasise that several tapes have not been sufficiently tested in my laboratory to categorise them or alternatively they are too difficult to obtain and are thus hardly worth mentioning. Sony and Nakamichi tapes appear to be very good as also are those made by Memorex, Fuji and ordinary Ampex types. Some very good tapes are available under retailers' own names and one particular example of very fine tape is the best quality distributed by Dixons Photographic marketed under the brand name 'Prinzsound'. This tape seemed to bear a remarkable resemblance in magnetic properties to that of Maxell UD, when we compared them in our laboratory. Some retailers' own brand tapes, however, are of a very low quality indeed and I suggest that you should always compare the performance of a cheap tape with that of a good one on your recorder and if you find the response and distortion characteristics of the retailer's own



THERE'S ONE FEATURE NO ONE ELSE HAS MANAGED TO INCLUDE WITH ALL THESE.



TRIO

B.H. Morris & Co. (Radio) Ltd., Trio House, The Hyde, London NW9 6JP. Tel: 01-205 6441.
Agents in Eire: Peat Wholesale Ltd., Dublin. Price Ex. VAT. and was correct at time of going to press.

brand good, you can continue to purchase it although you may find that the quality may change over a period either upwards or downwards depending upon the type of tape purchased in bulk by the retailer. To evaluate a tape quickly try recording a good live stereo broadcast from Radio 2 or 3, peaking a fairly high level on recording, and then play it back and compare it with the live sound of the broadcast. Check that the reproduction is not fluffy or noisy and that the high notes are reproduced clearly without being muffled or indeed too strident. Also check that the volume shown on the play back meters, where applicable, is the same as the volume recorded. A good quality cassette tape will accept a higher recording level than a poor quality one. Another good test for cassette tape is to record a high quality BBC news broadcast. Do not peak an unfairly high level and always use the Dolby where applicable. A bad tape or recorder will produce an unpleasant sound on speech sibilants. Thse sibilants will either be muffled or be emphasised or even produce a "thuthiness". The effect is akin to lispiness in reproduction, which is not audible on the original sound.

We trust that these notes will prove to be of some value as an introduction to the product tests which follow and also as a set of basic guidelines in getting the best use out of your cassette recorder.

Maintenance

A CASSETTE RECORDER will not continue to give optimum performance unless you maintain it regularly. The most important requirement is to keep the tape path clean, and you should buy a recommended type of cassette head cleaner which will remove odd oxide particles from the head surfaces. It is important to clean very carefully both the capstan and idler wheel occasionally, and this is best done by using cotton buds as supplied by chemists for cleaning ears. Sometimes it will be necessary to use a solvent, and this should be chosen very carefully. Ordinary methylated and surgical spirits must not under any circumstances be used because they contain dissolved additives, including vegetable matter, pyridine and oils. Industrial methelated spirit is satisfactory in some cases, although chemists will not be prepared to supply it without a special licence. Some retailers stock special head cleaning fluids, but be careful that these do not affect the material from which the idler wheel is made, and also that they will not dissolve the glues used in joining some parts together. To obtain good advice on head cleaning, go to a reputable retailer or ask the manufacturer/importer.

If any of the volume controls start crackling after a while the machine will have to be serviced by a dealer, but make sure that he does not touch any of the basic electronics when changing a simple control if the machine is working well in other ways.

Unfortunately the heads themselves will occasionally need replacement, for the tape will gradually wear the gap edges. A head change will become necessary either when a high frequency loss is noticeable on the same type of tape that has previously given good response or when high frequencies start varying in intensity showing poor head to tape contact. A head change should only be done by a very competent dealer or better still by the manufacturer/importer. An unskilled engineer will be more likely to produce results which are worse than the original head and will probably not azimuth the new head correctly. Metrosound test cassettes will be available shortly after this book is published, and enthusiasts will be able to check the replay performance of their recorders quite easily, provided that they have some form of external meter.

Your record/play back head should not normally require demagnetising and unless you have a very good reason for suspecting that the head has become magnetised do not attempt to use a demagnetiser. In any case this operation should only be carried out by an experienced person as more harm than good can be done by an inexperienced operator. Never under any circumstances touch the front of the heads with a screwdriver or other sharp object; in fact do not even try to touch them with your finger as they may become tacky and attract particles of dust and oxide. Keep to cotton buds and use a new one each time; even rags or handkerchiefs can cause damage.

Always keep your cassette tapes and the machine well away from direct sun or heat and store your cassettes in a relatively modest temperature in a place not subject to high humidity or rapid changes of temperature, to avoid print through and warp.

Finally if a dust cover is provided use it, and if one is not provided then cover the machine when not in use with a plastic sheet to keep dust out of the mechanism.

Maybe we shou cassette deck in

The problem with making something to the highest standards is that you usually have to give it a correspondingly high price.

Recommended retail price for the Sony TC 177SD, we're sorry to say, is £381.89 including VAT.

What do you get for all the money? The works.

A three head cassette recorder that an Audio Fair audience could not tell from a 15 ips open reel recorder.

Outstanding frequency response 30Hz to 17KHz ±3dB, using ferrichrome tape.

Three separate Ferrite and Ferrite heads for record, play-back and erase.

Two independent Dolby* systems for simultaneous re-cording and off tape monitoring

plus a calibration facility so that whatever cassette-tape you are using you can be certain that your recording will be played back accurately.

Special controls for optimum adjustment of bias and equalisation for all three kinds of tape.

An LED peak indicator to provide accurate control of

See your local Sony dealer for details. Or, for free do-it-yourself demonstrations and advice about all Sony equipmer

d sell our new
ı street like this.

cording levels and a limiter
cording system preventing
stortion on unexpected peak
els.

Dual capstan transport
stem cutting wow and flutter
0.07 wrms.

Line and microphone
xing capability.

The TC 177SD even has
uries like solenoid operation
and automatic shut off.

Perhaps this short list of its features helps to explain why the TC 177SD has been called (not by us) 'The ultimate in cassette recorder design'.

Until now only a big open reel recorder could give you the performance and features you get in this cassette deck.

In fact, it's what our engineers would like to buy for themselves.

SONY

Sony Showroom, 134 Regent Street, London W1R 6DJ. Price correct at time of going to press

'Registered Trade Mark of Dolby Laboratories Inc

Aiwa AD1300

Johnsons Of Hendon Ltd., Priestley Way, London, NW2 7TN. 01-450 8070

Although a very simple machine, incorporating Dolby B, the Aiwa 1300 acquitted itself very well indeed with only minor criticisms when one relates cost to performance. Two ¼" microphone jacks are provided with an input clipping sensitivity of 400uV for Dolby level, and was reached at 23mV, the input impedance being about 8k ohms. The sensitivity was found a little too low for moving coil microphones and so the Sony electret was used, which gave recordings of high quality on chrome tape with low noise. A very slight hum was audible on overall recordings, but this did not detract from the fine quality. There are bias and equalisation switches for ferric, ferrichrome and chrome cassettes. The 5 pole DIN input/output socket had an identical input sensitivity and clipping margin to the microphone one, but the impedance measured lower at 3.3k ohms, and this is slightly below DIN specification for the given sensitivity although more than adequate. At the DIN test level, no noise degradation occurred, but slight degradation did occur on the line input from 100mV source. The line in phono sockets had a sensitivity of 70mV and an impedance of approximately 100k ohms and did not clip with very high input levels. The deck functions were similar to those of the BASF range and if the wind button is depressed whilst the cassette is playing back cueing results since the tape is held in contact with the replay head. The wind and rewind buttons in those circumstances become spring loaded but if depressed from stop they will lock. The VU meters under-read 5dB on a 64m sec burst, and are thus better than average, although no peak reading light is provided. The wow and flutter in general was good in relation to the price, averaging .12%, although some cassettes might well give a degraded figure. Although the wow was only .11% at the beginning and end of a cassette, in the centre the figure rose to .15% and this is presumably due to insufficient tension on the capstan idler. In general, though, wow would only be heard on long sustained notes, very occasionally.

The replay performance was extremely good, the response being virtually flat on the left channel and showing a drop of only 1.5dB on the right, which would be practically inaudible. At the bass end, however, the replay response started falling so that it became approximately −2.5dB at 50Hz, and whilst this is acceptable it also showed up overall to produce a 3dB loss at 50Hz, on all tape types. The Chrome response was virtually flat to 10kHz on both channels, quite remarkable. Pre-recorded cassettes sound magnificent with very good head to tape contact and the replay noise level was just marginally worse than average, although adequate.

The overall response on TDK SD ferric tape was quite unusually flat (see pen chart), and the distortion very low, particularly on the left channel. Although the overall weighted noise on ferric tape was below average, a reasonably wide dynamic range could be recorded since there was only a slight increase of distortion above Dolby level, the left channel rising to 2.1% whilst the right increased to 3.8%, still fairly low for a 4dB level. The record quality was very well liked although there was just a slight suspicion of azimuth wander. Better still was the performance on Sony ferrichrome with distortion at Dolby level being 0.5% on the left channel and 0.75% on the right, increasing to only 1.3% and 2.4% respectively. Whilst the response at 10kHz fell to −3dB on the left channel, it was flat on the right, and subjectively the sound was very good indeed, with a much lower noise level than ferric, measuring −46dB weighted, which improved a full 10dB with Dolby, thus giving one of the best overall figures. Since very high levels recorded cleanly with low high frequency distortion, the dynamic range which could be recorded was very wide indeed. Chromium tape gave about the same extremely low noise overall, but had a slightly rising top at 10kHz and marginally more distortion, although considerably better than average, averaging 1.5% at Dolby level and 4% at +4dB, a figure reached at Dolby level on many other machines. The replay azimuth on delivery was moderately well set at −25° at 3kHz, and no cross talk or erase problems were encountered.

Despite its very modest price, then, this machine performed very well and is thus clearly good value for money. Although very simple input gain control is provided, it will probably be much easier to operate than many other machines especially since no serious problems of any kind arose.

Replay Azimuth Deviation from Average	-17
Microphone Input Sensitivity	400V
Microphone Input Clipping	23mV
Microphone Input Impedance Average	8K
DIN Input Sensitivity	400μV
DIN Input Clipping	23mV
DIN Input Impedance Average	3.4K
Line Input Sensitivity	70mV
Line Input Clipping	>10V
Line Input Impedance Average	95K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+1½
Ferric 10kHz Average Left and Right	-1
Chrome 10kHz Average Left and Right	-4.75

REPLAY NOISE

Ferric 20/20 worst channel	46dB
Ferric CCIR weighted Dolby Out	49dB
Ferric Dolby Improvement	9.75dB
Chrome CCIR weighted Dolby Out	53dB

Wow and Flutter Average	0.12%
Speed Average	-0.1%
Meter Under-read at 64ms	-5dB

DISTORTION

At Dolby Level monitoring input	0.1%
Overall Ferric Av. L+R at Dolby Level	0.77%
Overall Ferric Av. L+R at +4dB	2.9%
Overall FeCRO2/LN Av. L+R at Dolby Level	0.6%
Overall FeCRO2/LN Av. L+R at +4dB	1.85%
Overall Chrome Av. L+R at Dolby Level	1.5%
Overall Chrome Av. L+R at +4dB	4%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	-0.25
10kHz FeCRO2/LN Dolby Out Av. L+R	-1
10kHz Chrome Dolby Out Av. L+R	+1

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0.5/ -0.75dB
Ref. 333Hz FeCRO2/LN	+0.25/ -1.5dB
Ref. 333Hz Chrome	+1.25/ -1.0dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	41dB
Dolby Improvement	9.5dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	46dB
FeCRO2/LN Dolby Improvement	10dB
Chrome CCIR weighted Av. L+R Dolby Out	47dB
Chrome Dolby Improvement	9dB

DIN Input Noise Degredation	2dB
Line Input Noise Degredation	0dB
Spooling Time	3m 11secs

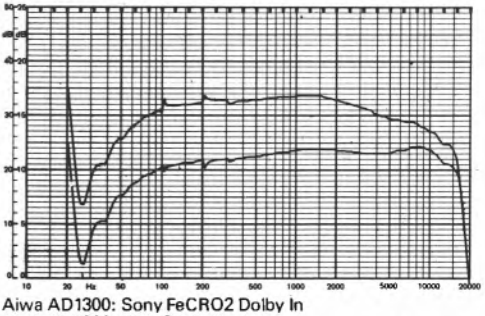
DYNAMIC RANGE

Ferric	60.5dB
FeCRO2/LN	67dB
Chrome	65dB

TAPE USED

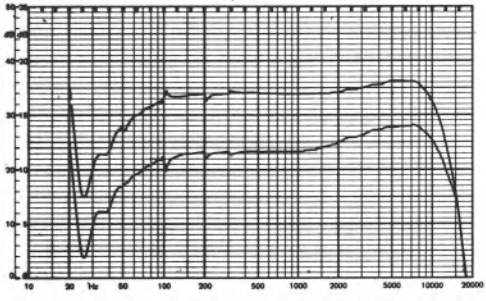
Ferric	TDK SD
FeCRO2/LN	SONY
Chrome	TDK KR

Recommended Retail Price: £127.75



Aiwa AD1300: Sony FeCRO2 Dolby In

Aiwa AD1300: TDK SD Dolby In



Aiwa AD1600

Johnsons Of Hendon Ltd., Priestley Way, London, NW2 7TN. 01-450 8070

This model is one of several in the survey which is basically very well designed with no particular problem areas, but with a performance slightly marred by insufficient trouble being taken in the factory adjustment of pre-set controls. The deck incorporates all the usual facilities, Dolby B processing, ¼" microphone jack inputs and DIN and line (phono) input and output sockets. A stereo headphone jack is also incorporated. Since there are no peak reading lights, users will have to rely on the rather average VU meters which under-read a 64m sec tone burst by 7dB. The deck operated extremely well, was very simple to operate and well liked. In particular the wow and flutter figure, averaging 0.07%, is regarded as very good indeed. The stability was good, but unfortunately the machine was delivered very badly out of azimuth, enough to make pre-recorded cassettes sound muffled. When this was corrected, though, they reproduced very well, with a response extending well above 10kHz, but the bass end proved to have the old time constant of 1590u secs which Aiwa should correct. The replay response on both ferric and chromium measured exceptionally flat at middle and high frequencies.

The microphone input had a sensitivity of 310uV and the excellent clipping point of 41mV, so that an electret microphone would work very well with the recorder on even very loud sounds. However, only just enough gain is incorporated for speech, and so 200ohm moving coil microphones with their inherently low output would not be satisfactory for speech, although the same would not be true of 600ohm types. The DIN input gave no problems having a sensitivity slightly lower than that of the microphone but an even better clipping margin (60mV) into an impedance of 3.4k ohms. This might be usefully increased to 6.8k ohms or so, although the DIN specification is just about met on sensitivity and easily met on clipping. The phono inputs were high impedance and presented no problems at all even at very high levels. They had a sensitivity of 90mV.

The overall distortion was extremely low for both ferric and ferrichrome but chrome tape was very average. At Dolby level ferric (TDK SD) measured very low at 0.6%, rising to only 2.3% at +4dB, and Sony ferrichrome was only very marginally higher at Dolby level (0.9%) again rising to 2.3% at +4dB. Both ferric and ferrichrome tapes had a noticeable high frequency boost, ferric being approximately 3dB up between 5 and 10kHz, whereas ferrichrome rose to a peak of +4.5dB at just above 10kHz on both channels. This treble rise produced on both tape types was of a rather hard quality but one that was nevertheless very clean and clear, and surprisingly the quality was not really disliked. Since the distortion was very low, the machine obviously had excessive record equalisation and might well have been aligned at the factory for an older type of tape. However, since the laboratory used the tape specified by the British Agents, Aiwa must accept the criticism. Most other modern tapes, incidentally, including Maxell UD, BASF Super LH, etc, would possibly have shown an even greater rise but older types such as ordinary BASF LH would have had a flatter response but much higher distortion.

TDK chrome was a bit of a disaster in that the response showed a peak of 7dB at 10kHz with Dolby processing switched in. The distortion was very average at Dolby level, measuring 2.2% rising to 5.8% at +4dB. The sound quality was very scratchy and distortion became quite apparent at high recording levels particularly at lower frequencies. A Sony stereo electret microphone gave very clean speech recordings which were just a little toppy on ferrichrome tape but considerable spitching was noticed when speech was reproduced on chrome tape. The ferric overall noise performance was slightly below average but the ferrichrome and chrome performances were pretty good. Ferrichrome measured −55dB CCIR weighted noise (Dolby in) reference Dolby level, and, since the overload performance was excellent, clearly gave the best overall performance. If this deck had been equalised correctly it would have been recommended and possibly other samples will be better aligned. The availability of three bias and equalisation positions is indeed useful and by varying these and using unconventional positions for ferrichrome the response might well have been better.

Replay Azimuth Deviation from Average	163deg
Microphone Input Sensitivity	315μV
Microphone Input Clipping	41mV
Microphone Input Impedance Average	8.2K
DIN Input Sensitivity	430μV
DIN Input Clipping	60mV
DIN Input Impedance Average	3.4K
Line Input Sensitivity	91mV
Line Input Clipping	
Line Input Impedance Average	>100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+1.5
Ferric 10kHz Average Left and Right	–0.75
Chrome 10kHz Average Left and Right	–4.8

REPLAY NOISE

Ferric 20/20 worst channel	50.5dB
Ferric CCIR weighted Dolby Out	49.75dB
Ferric Dolby Improvement	10.5dB
Chrome CCIR weighted Dolby Out	52,75dB

Wow and Flutter Average	0.076%
Speed Average	+0.1%
Meter Under-read at 64ms	–7dB

DISTORTION

At Dolby Level monitoring input	0.18%
Overall Ferric Av. L+R at Dolby Level	0.57%
Overall Ferric Av. L+R at +4dB	2.3%
Overall FeCRO2/LN Av. L+R at Dolby Level	0.9%
Overall FeCRO2/LN Av. L+R at +4dB	2.3%
Overall Chrome Av. L+R at Dolby Level	2.2%
Overall Chrome Av. L+R at +4dB	5.8%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+1
10kHz FeCRO2/LN Dolby Out Av. L+R	+3.5
10kHz Chrome Dolby Out Av. L+R	+4

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0.75/+1½dB
Ref. 333Hz FeCRO2/LN	+4/ –1½dB
Ref. 333Hz Chrome	+5/ –1½dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	41.5dB
Dolby Improvement	9.25dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	45.5dB
FeCRO2/LN Dolby Improvement	9.5dB
Chrome CCIR weighted Av. L+R Dolby Out	45.5dB
Chrome Dolby Improvement	8.25dB

DIN Input Noise Degredation	1dB
Line Input Noise Degredation	0dB
Spooling Time	2m 10s

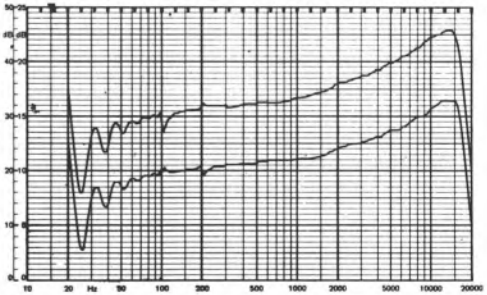
DYNAMIC RANGE

Ferric	62dB
FeCRO2/LN	67dB
Chrome	61.5dB

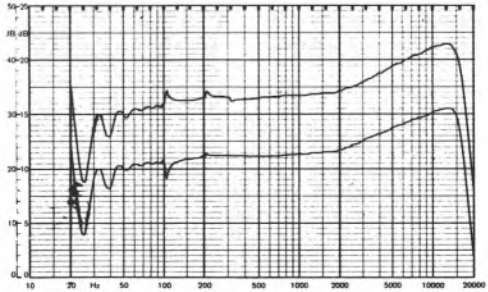
TAPE USED

Ferric	TDK SD
FeCRO2/LN	SONY
Chrome	TDK KR

Recommended Retail Price: £172.08



Aiwa AD1600: TDK KR Dolby In
Aiwa AD1600: Sony FeCRO2 Dolby In



Aiwa AD1800

Johnsons Of Hendon Ltd., Priestley Way, London, NW2 7TN. 01-450 8070

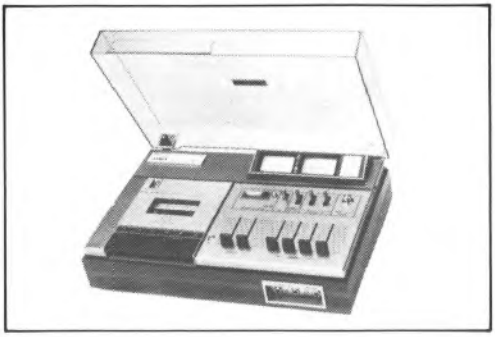
A very recent design, this model incorporates Dolby B processing and a very high standard of mechanical and electrical performance. It also has one particularly interesting feature, a series of peak reading lights operating at various peak levels. The VU meters themselves were very average but the lights operating at Dolby level and +4dB allow very accurate record level setting, indicating even with an 8m sec burst, so transients will be accurately shown. The deck functions were very easy to operate. It was possible to go direct from play to rewind and hear the tape in this position. Two separate pairs of input faders are provided for microphone and line/DIN inputs, thus allowing mixing of microphone with either of the other inputs. The machine has a replay line out level control and unfortunately the meters read the level after this control rather than before so that intrinsic levels cannot be determined at all easily. On record, though, no trouble was experienced.

The ¼" microphone input jacks presented a maximum sensitivity of 240uV which was adequate for electret or capacitor microphones but not quite enough for recording distant speech with moving coil mics. The clipping margin was excellent at 70mV and the impedance was 5.5k ohms. The DIN input unfortunately had a very poor range of input levels available, since the sensitivity, reasonable at 300uV, and the impedance of 2.6k ohms (just a little low) were matched by a very poor clipping level of 10mV. Although this is within DIN specification, there will undoubtedly be clipping problems if the DIN socket is used for connecting equipment having DIN sockets, but not designed precisely to DIN specification. The DIN input had an extremely low noise level, and strangely when a DIN plug was inserted into the socket the overall tape noise decreased very slightly which was rather puzzling but was confirmed by checking several times. The line input (phonos) had a sensitivity of 50mV with no noise degradation, and an excellent clipping margin.

The replay performance was very good indeed, all the responses being virtually flat to 10kHz, although the old bass time constant of 1590 u secs was chosen. The replay noise figures were good, the chrome figure ref. Dolby level, with Dolby in, measuring −64dB. Pre-recorded cassettes replayed with excellent head to tape contact and good stability. Very noticeable was the consistently good azimuth when cassettes were replayed, although unfortunately on delivery the azimuth was found to be set incorrectly, some 100° out at 3kHz.

The overall sound quality was certainly in the top class of machines tested, for not only were the general distortion levels low on ferric and ferrichrome cassettes but the responses also were good. On ferric, for example, 10kHz measured only 1.5dB down, on the left, and was virtually flat on the right, and subjectively tapes had a very wide overall response. The distortion, even at +4dB, measured only 2.7%, falling to 0.55% at Dolby level. Whilst the overall noise level on ferric tape was only average the low distortion allowed a very wide dynamic range to be recorded. Ferrichrome usually produced an even better result having a distortion of only 1.9% at +4dB and yet 4.5dB quieter background than ferric. The pen charts show the good response overall, and ferrichrome tape on this machine produced an almost exceptional sound quality showing the cassette medium at its best. Chrome tape, although having a good overall response, had noticeably more distortion at 2.2% at Dolby level, rising to 6% at +4dB, with virtually the same overall noise as ferrichrome. Although the chromium tape produced very clean recordings at high frequencies distortion became apparent at high recording levels and thus chrome could not be recommended, since the ferrichrome performance was so superb. The machine also incorporated a useful user adjustable pre-set for biasing ferric tape, and so many different makes could be used with satisfactory results after adjustment.

It is felt that the machine can be strongly recommended, although the DIN input circuit could cause a problem to some users. The machine clearly shows significant technical improvements over machines produced a year or so ago and should give results which will be more than good enough for all normal domestic purposes.



Replay Azimuth Deviation from Average	108°
Microphone Input Sensitivity	240μV
Microphone Input Clipping	70mV
Microphone Input Impedance Average	5.5K
DIN Input Sensitivity	300μV
DIN Input Clipping	7.75mV
DIN Input Impedance Average	2.7K
Line Input Sensitivity	49mV
Line Input Clipping	10V
Line Input Impedance Average	85K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+1.5
Ferric 10kHz Average Left and Right	+0.25
Chrome 10kHz Average Left and Right	−4.25

REPLAY NOISE

Ferric 20/20 worst channel	52dB
Ferric CCIR weighted Dolby Out	50.5dB
Ferric Dolby Improvement	10.5dB
Chrome CCIR weighted Dolby Out	54dB

Wow and Flutter Average	0.07%
Speed Average	+0.21%
Meter Under-read at 64ms	−7dB

DISTORTION

At Dolby Level monitoring input	0.03%
Overall Ferric Av. L+R at Dolby Level	0.54%
Overall Ferric Av. L+R at +4dB	2.7%
Overall FeCRO2/LN Av. L+R at Dolby Level	0.67%
Overall FeCRO2/LN Av. L+R at +4dB	1.9%
Overall Chrome Av. L+R at Dolby Level	2.2%
Overall Chrome Av. L+R at +4dB	6%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−1
10kHz FeCRO2/LN Dolby Out Av. L+R	+1
10kHz Chrome Dolby Out Av. L+R	−3

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0.5/ −1.25dB
Ref. 333Hz FeCRO2/LN	+1.0/ −0.5dB
Ref. 333Hz Chrome	+0.5/ −5.0dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	42.5dB
Dolby Improvement	9.75dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	48dB
FeCRO2/LN Dolby Improvement	9.5dB
Chrome CCIR weighted Av. L+R Dolby Out	47dB
Chrome Dolby Improvement	9dB

DIN Input Noise Degredation	0dB
Line Input Noise Degredation	0dB
Spooling Time	2m 10s

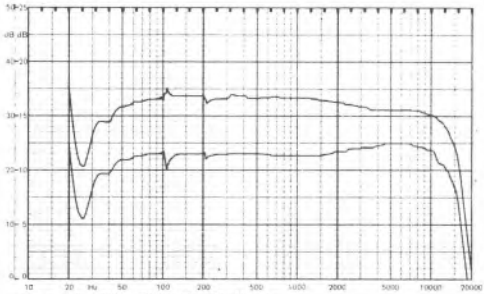
DYNAMIC RANGE

Ferric	63dB
FeCRO2/LN	69dB
Chrome	64dB

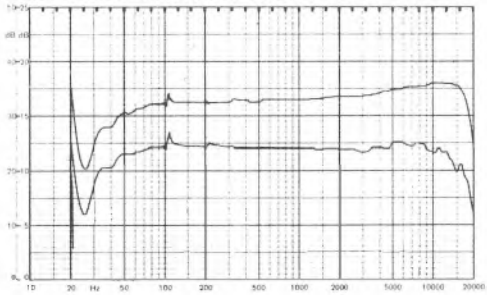
TAPE USED

Ferric	TDK SD
FeCRO2/LN	SONY
Chrome	TDK KR

Recommended Retail Price. £189.74



Aiwa AD1800: TDK SD Dolby In
Aiwa AD1800: Sony FeCRO2 Dolby In



Akai GXC 39D

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

Akai were in the course of changing models whilst this book was being written, but at the last minute this new model was submitted. It is a fairly low price machine incorporating Dolby B processing and has only basic facilities, which nevertheless include a record limiter and peak reading light. The machine was a production prototype and unfortunately had clearly been misaligned very badly on the chrome tape. The deck functions permit operation from one function to another without pressing the stop button. The wow and flutter measured 0.14% which was rather below average. Other mechanical aspects measured quite well, including phase jitter and stability. The VU meters were very small and difficult to read, and a 64m sec tone burst under read 5dB, which was better than average. The peak reading light came on at 4dB above Dolby level, and was thus set fairly optimally.

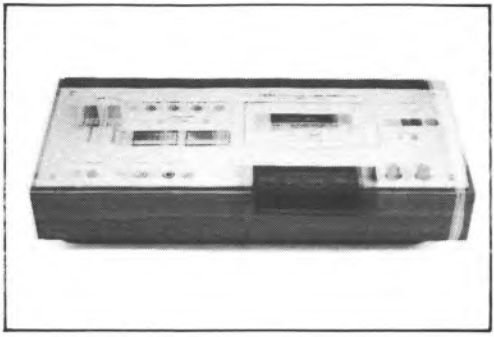
The ¼" microphone jack sockets gave a sensitivity of 440uV clipping at 92mV, an excellent overload margin, but too insensitive for moving coil mics. The DIN input did not quite conform to DIN specification, having a sensitivity of 4.8mV, but much too high an input impedance of 29k ohms, although the clipping margin was excellent. This impedance would be likely to induce high frequency cut from a DIN source and the sensitivity was not really adequate for the DIN specification although probably would be found satisfactory. No noise degradation was noted. The line input, sensitivity 68mV, therefore added some hiss from a 100mV source, and this degraded the overall noise by 5dB. An annoying hum was noticed both on recorded cassettes and pre-recorded ones, and this was subjectively louder on ferrichrome tape than on ferric, since the former was inherently less hissy and thus the hum stood out more.

On replay the response was very flat, 10kHz being approximately 1dB down on both channels. Chromium tape had insufficient reduction of hf as compared with ferric, and was thus approximately 1dB up at 10kHz. The replay noise level did not measure too well, particularly on the right channel which must have had a faulty component, although probably the hum component contibuted a fair amount to the overall reading. Pre-recorded cassettes had a wide frequency response, and sounded well, although the hum was audible in quiet passages.

BASF Super LH ferric tape gave an overall third harmonic distortion of 333Hz of 1% average, which rose rapidly to 3.8% at +4dB. The response was 2.5dB at 10kHz with Dolby in, and this must be considered fairly reasonable since any errors are exaggerated by Dolby processing. The subjective quality was quite good, although distortion seemed to come up rather suddenly at high levels, and the hiss level was about average on the left channel but the right channel was rather poor. Since the machine has the facilities for accepting ferric and ferrichrome and chrome tapes by depressing the ferric or chrome buttons, or both together, Sony ferrichrome was checked and found to be 1.1% at Dolby level rising to 3.8% at +4dB, again rather a steep rise. The overall noise on ferrichrome was far better than ferric and a slight roar that had been noticed on the right channel disappeared. The frequency response was disappointing with Dolby, 10kHz measuring −6dB (see pen chart). BASF chrome proved a disaster on this machine, having approximately 13.5% distortion at Dolby level and rising to an excruciating 19% at +4dB! The record calibration was clearly incorrect, and the sound quality showed the machine to be so badly mis-set that the recording was not even of mild entertainment value.

The microphone input sensitivity was a little low and an electret microphone will be necessary to obtain sufficient recording level for speech.

If this machine is a typical sample it cannot be recommended, but it seems hardly believable that it should have been sent out with such a poor overall performance on ferrichrome and chrome, since both the manufacturer and importer have a good reputation. Assuming then that the response and distortion problems can be overcome, Akai will have to improve the hum level, and if the problems are sorted out the GXC 39D might well become reasonable value for money.



Replay Azimuth Deviation from Average	18°
Microphone Input Sensitivity	440μV
Microphone Input Clipping	92mV
Microphone Input Impedance Average	4.6K
DIN Input Sensitivity	4.8mV
DIN Input Clipping	920mV
DIN Input Impedance Average	29K
Line Input Sensitivity	68mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+3
Ferric 10kHz Average Left and Right	−1.25
Chrome 10kHz Average Left and Right	−3.5

REPLAY NOISE

Ferric 20/20 worst channel	49dB
Ferric CCIR weighted Dolby Out	46dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	49dB

Wow and Flutter Average	0.14%
Speed Average	+1.5%
Meter Under-read at 64ms	−5dB

DISTORTION

At Dolby Level monitoring input	0.18%
Overall Ferric Av. L+R at Dolby Level	0.95%
Overall Ferric Av. L+R at +4dB	3.8%
Overall FeCRO2/LN Av. L+R at Dolby Level	1.1%
Overall FeCRO2/LN Av. L+R at +4dB	3.8%
Overall Chrome Av. L+R at Dolby Level	13.8%
Overall Chrome Av. L+R at +4dB	18.9%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−1.25
10kHz FeCRO2/LN Dolby Out Av. L+R	−2.75
10kHz Chrome Dolby Out Av. L+R	−2.5

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0.5/ −1.0dB
Ref. 333Hz FeCRO2/LN	+0.5/ −3.0dB
Ref. 333Hz Chrome	+0.5/ −2.75dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	40.75dB
Dolby Improvement	12dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	44.5dB
FeCRO2/LN Dolby Improvement	10dB
Chrome CCIR weighted Av. L+R Dolby Out	44dB
Chrome Dolby Improvement	10.5dB

DIN Input Noise Degredation	0dB
Line Input Noise Degredation	4.5dB
Spooling Time	1m 18s

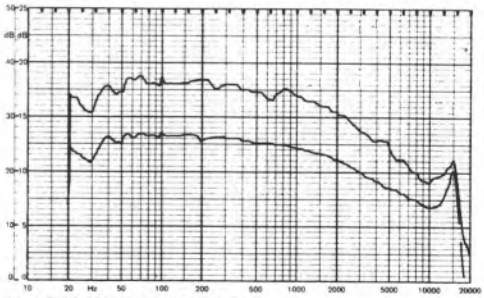
DYNAMIC RANGE

Ferric	62.5dB
FeCRO2/LN	63.5dB
Chrome	58dB

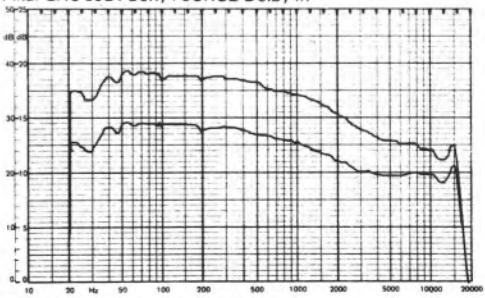
TAPE USED

Ferric	BASF SUPER LH
FeCRO2/LN	SONY
Chrome	BASF

Recommended Retail Price: £149.20



Akai GXC 39D: BASF CRO2 Dolby In
Akai GXC 39D: Sony FeCRO2 Dolby In



BASF United Kingdom Ltd., Knightsbridge House,
197 Knightsbridge, London SW7 1SA. 01-584 5080

It is surprising that the model 8100 has inherently a lower noise overall than almost all the other machines tested if their Dolby processing circuits are switched out. Indeed, it is actually better than a few with Dolby and the manufacturers must be congratulated on producing such excellent performance without an overall noise reduction system. The deck includes the Philips DNL system for play back only but whilst this removes hiss it also removes much of the life from pre-recorded cassettes, giving almost always a dull reproduced sound. Pre-recorded cassettes sounded well, and in particular non Dolbyed ones, although processed cassettes did play back reasonably if the treble control on an external amplifier was turned down. The general noise performance of the machine then was exemplary and the distortion levels throughout also measured very well, particularly on BASF Super LH cassettes, the incredibly low figure of 0.4% being measured at Dolby level, which increased to 1.7% at +4dB, still a very good figure. The ferric overall response measured very flat indeed and subjectively the overall sound quality was extremely good, certainly better than many machines costing a lot more. Chromium tape unfortunately produced an overall fall off at high frequencies and thus recordings sounded a little muffled, although the signal to noise ratio was perfectly acceptable whilst clearly not being as good as a Dolbyed cassette made on the better quality machines. The deck switching logic was most convenient and very similar to that made by Aiwa, who we understand make the machines for BASF. It is possible to go from play directly to wind and back to play again without pressing the stop button in which case the tape cues against the play back head, enabling the user to find a particular point on the tape easily. The wow and flutter measured a little high at 0.14%, and the speed unfortunately measured 1.2% fast which could upset some musicians although in general use it would not concern most users. Unfortunately the rewind speed was painfully slow, in excess of three minutes on average for a C90. This is more than four times slower than the equally unusual fast spooling speed of the Trio KX710.

Despite the recorder's extremely low noise circuits in the record and replay amplifiers, the input pre-amplifier was just a little noisy, and in some instances users will find a slight extra hiss being added if the record level has to be advanced to obtain a higher Input sensitivity. The microphone pre-amplifier worked well though, and was considered fairly quiet. It had very adequate sensitivity, even for recording speech with a moving coil microphone. The VU meters under read as usual and since no peak reading indicator is provided care will have to be taken not to record at too high a level. The cross talk performance was extremely good, certainly better than most other machines and in fact clearly better than any user would ever require. No cross talk could be detected on track 2 from a recording made on track 1. A limiter is provided which automatically sets peak recording level on an input programme. This worked well, although the release time seemed pretty fast. It had been set at just about optimum level. This and many other simplified functions makes this recorder very easy to operate, and it can be recommended providing Dolby B processing is not required and the user is not expecting to play back Dolbyed pre-recorded cassettes to a high standard. Whilst its performance on ferric tape was extremely fine, chromium tape was not fully satisfactory.

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Replay Azimuth Deviation from Average	34°
Microphone Input Sensitivity	210μV
Microphone Input Clipping	56mV
Microphone Input Impedance Average	2.6K
DIN Input Sensitivity	208μV
DIN Input Clipping	56mV
DIN Input Impedance Average	2.6K
Line Input Sensitivity	80mV
Line Input Clipping	)10V
Line Input Impedance Average	>100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+3
Ferric 10kHz Average Left and Right	−0.25
Chrome 10kHz Average Left and Right	+0.25

REPLAY NOISE

Ferric 20/20 worst channel	55dB
Ferric CCIR weighted Dolby Out	52.75dB
Ferric Dolby Improvement	–
Chrome CCIR weighted Dolby Out	56.25dB

Wow and Flutter Average	0.14%
Speed Average	+1.1%
Meter Under-read at 64ms	−6dB

DISTORTION

At Dolby Level monitoring input	–
Overall Ferric Av. L+R at Dolby Level	0.42%
Overall Ferric Av. L+R at +4dB	1.75%
Overall FeCRO2/LN Av. L+R at Dolby Level	–
Overall FeCRO2/LN Av. L+R at +4dB	–
Overall Chrome Av. L+R at Dolby Level	2.5%
Overall Chrome Av. L+R at +4dB	5.4%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−1.0
10kHz FeCRO2/LN Dolby Out Av. L+R	–
10kHz Chrome Dolby Out Av. L+R	−5.5

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0.5/ −2.75dB
Ref. 333Hz FeCRO2/LN	– –
Ref. 333Hz Chrome	+0.5/ −6.5dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	45.75dB
Dolby Improvement	–
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	–
FeCRO2/LN Dolby Improvement	–
Chrome CCIR weighted Av. L+R Dolby Out	49.75dB
Chrome Dolby Improvement	–

DIN Input Noise Degredation	0dB
Line Input Noise Degredation	6dB
Spooling Time	3m 0s

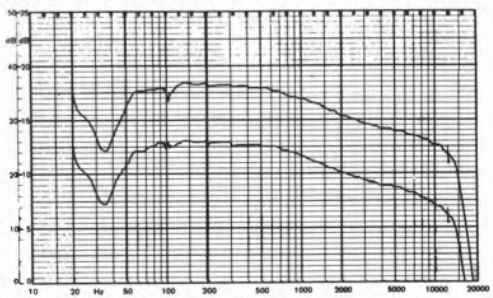
DYNAMIC RANGE

Ferric	57.5dB
FeCRO2/LN	–
Chrome	57dB

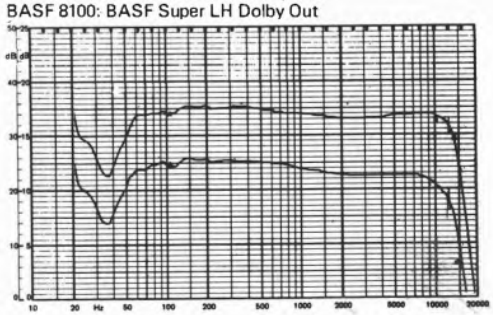
TAPE USED

Ferric	BASF SUPER LH
FeCRO2/LN	–
Chrome	BASF

Recommended Retail Price: £120.00



BASF 8100: BASF CRO2 SM Dolby Out
BASF 8100: BASF Super LH Dolby Out



BASF 8200

BASF United Kingdom Ltd., Knightsbridge House,
197 Knightsbridge, London SW7 1SA. 01-584 5080

The BASF 8200 is a very simple deck, incorporating Dolby B and DNL. It also includes a useful automatic gain control which overrides the position of the record level control when selected. DIN mic sockets are provided together with a 5 pole DIN socket for record and play back and phono sockets for line in and line out. Neither 5 pole DIN nor line out sockets are live during recording, which is inconvenient, and whilst this is normal practice for a DIN socket the phono sockets should have been permanently live. Mechanically the deck performed quite well although the phase jitter was not as good as many, but the wow and flutter measured extremely well at .09%. This was a very good figure, as was the speed accuracy at only 0.15% fast. The deck functions were very easy to use, and conveniently it was possible to go from play or record in to wind and back to play again without using the stop button.

The ferric replay response was exemplary as far as BASF test cassettes go, but experiments have proved that almost certainly these are slightly up in top and so extreme top was probably marginally down although pre-recorded cassettes sounded very good indeed. The machine was delivered almost precisely in azimuth. The chromium dioxide response was clearly up in top by about 2dB and this was proved not only by the response measurements but by the replay weighted noise measurements which showed only 2¾dB change. The replay noise was a little inferior on average but was adequate.

The overall frequency response on BASF Super LH was excellent and on chrome the response was also very good. The distortion on ferric tape was exceptionally low (only 0.45% at Dolby level, rising to only 1.3% at +4dB). This was confirmed by the excellent subjective quality and clarity of recordings made on Super LH. Chromium tape also sounded well and with a lower hiss level, but with noticeably more distortion, and the distortion measured markedly higher (3%) at Dolby level. Unfortunately a slight hum was audible on replay which was especially noticeable in quiet passages when chrome tape was used. Inadequate smoothing of the power supply would seem to be the cause.

The microphone input had very low noise and worked well with good sensitivity. It was quite well designed as its input impedance was optimum at 2.7k ohm, which was also the DIN input impedance. No clipping problems were noted on mic or DIN, but unfortunately the line output was most unsatisfactory since quite severe noise degradation occurred with even medium level input signals. A 100mV signal recorded showed 12dB more hiss overall than was present if the record level controls were reduced to minimum, and this design fault frankly is intolerable. BASF should have a switch selecting mic/DIN or line in which would obviate the problem. The VU meters were very average and under read 7dB on a 64m sec pulse. Since there is no peak reading light users will have to be careful not to over record, although BASF Super LH on this machine accepted a high recording level without distortion and thus produced the very wide dynamic range, CCIR weighted, of approximately 65dB. Chrome tape did not give such a wide dynamic range since far less level could be recorded if distortion was to be avoided. Although no cross talk problems were noted the erasure, whilst being adequate, was not quite as good as most, a figure of 62dB being noted on the left channel when a high level recording was made on chrome tape.

Subjectively, then, the performance on ferric tape when the DIN input was used was very good, the chrome performance less good, but adequate, and the machine can be recommended. The DNL worked as well as could be expected but was not liked. Nor did we like the smoked plastic covers over the cassette well and counter. The former could, of course, be kept raised in order to see the cassette, but the latter made the figures annoyingly dim. It was felt that despite the generally good performance the price was rather high and would only prove good value for money if bought at a reasonable discount. Unfortunately a retest was called for due to the chromium dioxide automatic switch being unreliable on the first sample, which also had a very poor high frequency response on chrome tape.

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Replay Azimuth Deviation from Average	0°
Microphone Input Sensitivity	170μV
Microphone Input Clipping	58mV
Microphone Input Impedance Average	2.7K
DIN Input Sensitivity	170μV
DIN Input Clipping	58mV
DIN Input Impedance Average	2.7K
Line Input Sensitivity	65mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+3
Ferric 10kHz Average Left and Right	−1¼
Chrome 10kHz Average Left and Right	+2*

REPLAY NOISE

Ferric 20/20 worst channel	47.5dB
Ferric CCIR weighted Dolby Out	48.75dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	51.5dB

Wow and Flutter Average	0.09%
Speed Average	+0.17%
Meter Under-read at 64ms	−7dB

DISTORTION

At Dolby Level monitoring input	–
Overall Ferric Av. L+R at Dolby Level	0.44%
Overall Ferric Av. L+R at +4dB	1.3%
Overall FeCRO2/LN Av. L+R at Dolby Level	–
Overall FeCRO2/LN Av. L+R at +4dB	–
Overall Chrome Av. L+R at Dolby Level	3.0%
Overall Chrome Av. L+R at +4dB	6.5%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	0
10kHz FeCRO2/LN Dolby Out Av. L+R	–
10kHz Chrome Dolby Out Av. L+R	0

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0.75/ −1.25dB
Ref. 333Hz FeCRO2/LN	– –
Ref. 333Hz Chrome	+0.5/ −1.0dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	43dB
Dolby Improvement	7.75dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	–
FeCRO2/LN Dolby Improvement	–
Chrome CCIR weighted Av. L+R Dolby Out	46dB
Chrome Dolby Improvement	8.75dB

DIN Input Noise Degredation	0.25dB
Line Input Noise Degredation	13.5dB
Spooling Time	2m 12s

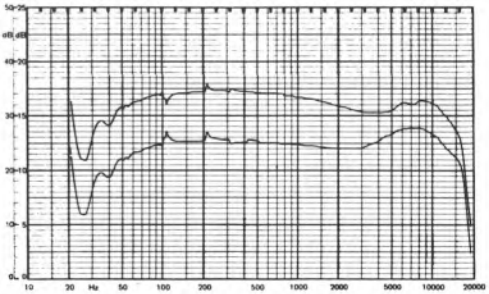
DYNAMIC RANGE

Ferric	62.5dB
FeCRO2/LN	–
Chrome	61dB

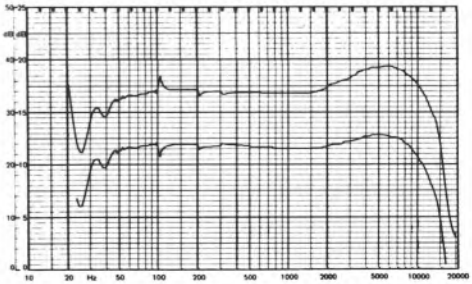
TAPE USED

Ferric	BASF SUPER LH
FeCRO2/LN	–
Chrome	BASF

Recommended Retail Price: £180.00



BASF 8200: Sony KR Dolby In
BASF 8200: BASF Super LH Dolby In



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A very modestly priced machine, it includes Dolby B processing and is a front loader. The mic/DIN and phono (line) inputs are switchable and this assists level compatability to improve the general overall noise performance. The VU meters have slightly better than average ballistics, under-reading a 64mS burst by 6dB but no peak reading lights are provided. The loading was found a little awkward, it being necessary to place the cassette sideways into the recorder and furthermore the deck control buttons were rather heavy. The wow and flutter performance measured well at 0.11% in relation to the price and the speed was extremely accurate, only 0.2% slow. On delivery the azimuth was reasonably good at +20° at 3kHz, but the stability was none too good, the azimuth changing slightly each time a cassette was re-inserted although this was not serious.

The microphone input (¼" jack sockets) had a sensitivity of 110 uV and clipped at the very low level of 10mV and thus, whilst being far more sensitive than average, loud sounds would definitely induce distortion. Moving coil microphones are therefore particularly recommended for use with this machine, for electrets might well overload if used for recording music, even fairly close to the microphone. The DIN input (5 pole socket) had the same sensitivity as the microphone input, but the impedance is reduced to 2k ohms, rather too low for comfort, but only slight hiss was added from a nominal DIN source. The line input was very satisfactory, having a sensitivity of 30mV into between 70 and 90k ohms, depending on the position of the record gain control. High input levels created no problem.

The line output impedance with the output level control at maximum was 3.3k ohms, but when the control was 6dB down from maximum the impedance rose sharply to 16k ohms, much too high, and the potentiometer chosen in the design should have been of much lower value, for example 10k ohms instead of 50k ohms.

The replay noise measured slightly better than average under all circumstances, but unfortunately the replay response fell rather noticeably at 10kHz to −3dB and thus a Dolby processed recording would play back with some 6dB cut at 10kHz at low levels since the Dolby deprocessing tends to exaggerate any HF losses present. For this reason pre-recorded cassettes all sounded rather dull, although the quality itself was fairly reasonable. The overall quality on ferric tape (BASF LH) was pretty good with a surprisingly flat response for so modestly priced a machine, but considerable high frequency squashing was noticed and climaxes lacked punch and sparkle although at low levels the sound quality was very good. The distortion was very low for the tape type used, 1.3% at Dolby level. BASF Super LH, used in the LH position of the bias and equalisation three position switch, had remarkably low distortion, below 0.5% at Dolby level rising to 0.8% at +4dB, which was regarded as an outstandingly low distortion figure at such a high level. Alas, though, the treble response was very bad indeed showing the tape to be badly over-biased, for at 10kHz the response was 12dB down on 333Hz. Notwithstanding recordings sounding very muffled, the basic quality was nevertheless good. BASF chrome cassettes gave over 5% distortion at Dolby level, rocketing to 11.2% at +4dB, and thus recordings sounded extremely distorted at even fairly modest levels. The response fell though to −4.5dB at 10kHz, but was no further down at 15kHz, surprisingly. The crosstalk measured well and the erase was just adequate.

In general then this machine performed quite well but individual samples may be below par, as indeed this review sample was on response. A good sample, though, would be good value for money and if you are interested in this machine make absolutely sure that you hear a comparison between an original sound from a good disc or broadcast and a recording made on the machine.

The machine is solenoid operated and includes ¼" headphone socket and a rewind memory system. The tape cannot be seen once playing and the buttons do not stay down when depressed, so that the mode of operation cannot be detected at a glance. The machine has a metal case and both the input and output controls are dual concentric types. Recommended, then, with considerable caution, as fairly good value for money.

At the last minute the laboratory discovered the LN bias/eq switch to be wrongly labelled, and clearly ferrichrome would have given considerably improved results.

Eagle International Ltd., Precision Centre, Heather Park Drive, Wembley, Middlesex, HAO 1SU. 01-903 0144

Beltek M1150

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Replay Azimuth Deviation from Average	28°
Microphone Input Sensitivity	112μV
Microphone Input Clipping	10.2mV
Microphone Input Impedance Average	8K
DIN Input Sensitivity	117μV
DIN Input Clipping	10mV
DIN Input Impedance Average	2K
Line Input Sensitivity	28mV
Line Input Clipping	)10V
Line Input Impedance Average	76K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+3
Ferric 10kHz Average Left and Right	−3
Chrome 10kHz Average Left and Right	−8

REPLAY NOISE

Ferric 20/20 worst channel	52.5dB
Ferric CCIR weighted Dolby Out	50.5dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	56dB

Wow and Flutter Average	0.11%
Speed Average	−0.24%
Meter Under-read at 64ms	−6dB

DISTORTION

At Dolby Level monitoring input	0.02%
Overall Ferric Av. L+R at Dolby Level	1.4%
Overall Ferric Av. L+R at +4dB	3.5%
Overall FeCRO2/LN Av. L+R at Dolby Level	0.4%
Overall FeCRO2/LN Av. L+R at +4dB	0.8%
Overall Chrome Av. L+R at Dolby Level	5.0%
Overall Chrome Av. L+R at +4dB	11.2%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+0.5
10kHz FeCRO2/LN Dolby Out Av. L+R	−7.0
10kHz Chrome Dolby Out Av. L+R	−2.5

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1.5/ −0.25dB
Ref. 333Hz FeCRO2/LN	+0.5/ −9.5dB
Ref. 333Hz Chrome	+1.0/ −2.75dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	44.75dB
Dolby Improvement	9.75dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	49.25dB
FeCRO2/LN Dolby Improvement	9.25dB
Chrome CCIR weighted Av. L+R Dolby Out	48.25dB
Chrome Dolby Improvement	9.25dB

DIN Input Noise Degredation	0.5dB
Line Input Noise Degredation	0dB
Spooling Time	1m 45s

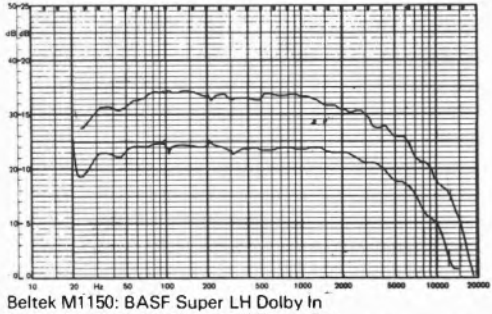
DYNAMIC RANGE

Ferric	63.5dB
FeCRO2/LN	67dB
Chrome	65dB

TAPE USED

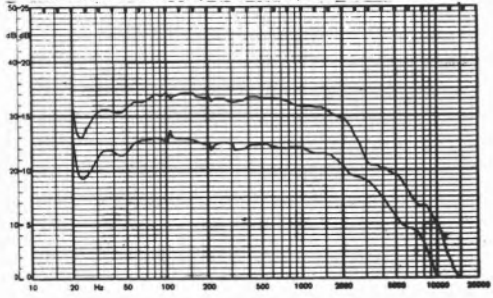
Ferric	BASF LH
FeCRO2/LN	BASF SUPER LH
Chrome	BASF

Recommended Retail Price: £126.40



Beltek M1150: BASF Super LH Dolby In

Beltek M1150: BASF Super LH Dolby Out



Beocord 2200

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

The Beocord 2200 is basically a deck having DIN inputs and outputs. The microphone input socket is a 6 pole DIN, but however a standard ¼" stereo jack socket is used for headphones. The machine is very simple to use and is provided with just two faders on the entire machine, left and right record levels. Despite its impressive styling, its technical performance unfortunately leaves a lot to be desired and there are some very basic elementary design faults around the machine's circuitry. The DIN input socket has far too high an input impedance (45k ohms) and to make matters worse the input circuit has a measured capacity of 260pF in parallel, so that when the machine is interconnected with some DIN tuner amplifiers a very severe high frequency loss becomes apparent (approximately 7dB at 10kHz). An alternative high level DIN socket is provided at a very high impedance which includes compensation for this treble loss but even so a 1.5dB loss at 10kHz was noted on the input circuitry. This auxiliary input, incidentally, feeds into the DIN input through a 1M ohm resistor, a practice which should be deprecated. The machine, when tested on the recommended BASF ordinary LH cassettes, had very high distortion at high levels, and it became necessary to reduce the general recording levels on programmes and thus noise problems resulted.

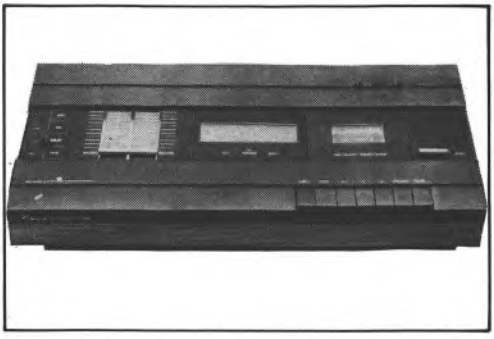
On replay the high frequency response was extremely good on ferric tape, but a shelf cut of only 2.5dB instead of the standard 4.7dB was noted on chrome equalisation. Whilst the replay noise levels were good, chrome tape will be noisier than it should be because of this. Unfortunately B & O have not yet adopted the new standard at low frequencies and severe bass distortion was apparent on loud passages. Since only minor circuit changes are required to put this matter right, we feel B & O should change immediately. The overall noise performance was also extremely good but spoilt, of course, by the restricted dynamic range, brought on by the distortion problem. The overall responses on ordinary ferric tape were good, both with and without Dolby processing. Because of the distortion produced by ordinary ferric tape, B & O agreed that we should retest the machine using BASF Super LH tape and results were dramatically improved, so that the distortion at Dolby level was 1/5th of that of ordinary LH tape. However, an excessive treble boost was noted, which worsened with Dolby processing and so the tape cannot really be recommended unless the machine is re-equalised by the manufacturer or dealer. Chromium tape was very poor overall both for distortion and response, a 4.5dB loss at 10kHz being apparent on the right hand channel.

The phase jitter was extremely low, only very small variations being noted, but when a cassette was replaced in the machine the general azimuth was inclined to be a little variable. If the cassette was manually wobbled, however, the azimuth usually corrected itself. The wow and flutter measured quite well at .11%, but degraded slightly at the end of a cassette. The high frequency energy response measured particularly well, but this was almost certainly due to the ferric tape being underbiased to obtain a flat frequency response, thus helping high frequencies to the detriment of low ones. No crosstalk problems were encountered in the machine.

The 48uV microphone input sensitivity seemed to be rather too sensitive for normal use and we confirmed the anticipated poor clipping level of 15mV, so that any microphone connected to the recorder would be likely to overload the machine's input when recording very loud sounds. The DIN input sensitivity, however, was adequate with a reasonable clipping margin.

In contrast to the major criticisms of this machine, the speed accuracy was extremely good, being amongst the best measured, and moreover the meter's read peak levels very accurately indeed. A pulse of tone lasting only 8 millisecs under-read by only 3dB, whilst a pulse of 64 millisecs under-read only 1dB. Meters like these are so very useful in setting peak recording level.

After being informed of the Laboratory findings, B & O have agreed to redesign the input circuitry along the lines suggested and also will be rebiasing machines at the factory to BASF Super LH tape. Modified machines will take a month or two to come through. These changes should considerably improve the sound quality on ferric cassettes, but unfortunately chrome tape would still not be recommended. Existing machines cannot be recommended unless they are modified by dealers, and B & O themselves will almost certainly give details of modifications to dealers on request.



Replay Azimuth Deviation from Average	27°
Microphone Input Sensitivity	48μV
Microphone Input Clipping	15.5mV
Microphone Input Impedance Average	760Ω
DIN Input Sensitivity	2.3mV
DIN Input Clipping	535mV
DIN Input Impedance Average	45K
Line Input Sensitivity	110mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+1½
Ferric 10kHz Average Left and Right	−1½
Chrome 10kHz Average Left and Right	−3.75

REPLAY NOISE

Ferric 20/20 worst channel	52.5dB
Ferric CCIR weighted Dolby Out	51.5dB
Ferric Dolby Improvement	9.25dB
Chrome CCIR weighted Dolby Out	53.5dB
Wow and Flutter Average	0.11%
Speed Average	−0.17%
Meter Under-read at 64ms	+1dB

DISTORTION

At Dolby Level monitoring input	—
Overall Ferric Av. L+R at Dolby Level	4.6%
Overall Ferric Av. L+R at +4dB	10%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	5.25%
Overall Chrome Av. L+R at +4dB	11%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−2.25
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	−3.5

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1.0/ −3.75dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+0.5/ −5.0dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	44dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	48.5dB
Chrome Dolby Improvement	9.25dB
DIN Input Noise Degredation	1.5dB
Line Input Noise Degredation	—
Spooling Time	1m 38s

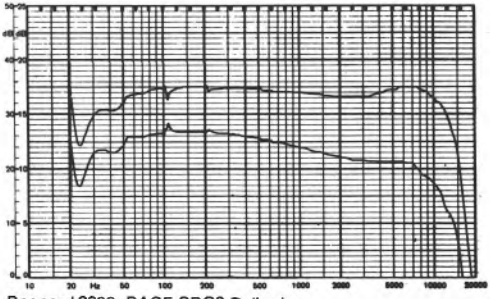
DYNAMIC RANGE

Ferric	59dB
FeCRO2/LN	—
Chrome	62dB

TAPE USED

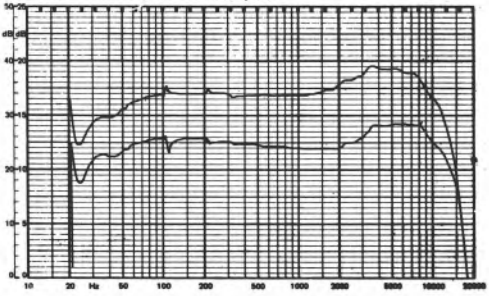
Ferric	BASF LH
FeCRO2/LN	—
Chrome	BASF

Recommended Retail Price: £170.00



Beocord 2200: BASF CRO2 Dolby In

Beocord 2200: BASF LH Dolby In



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Dokorder Mk. 50

Acoustico Enterprises Ltd., Unit 2, Space Wave, North Feltham Trading Estate, Feltham, Middlesex. 01-751 0141

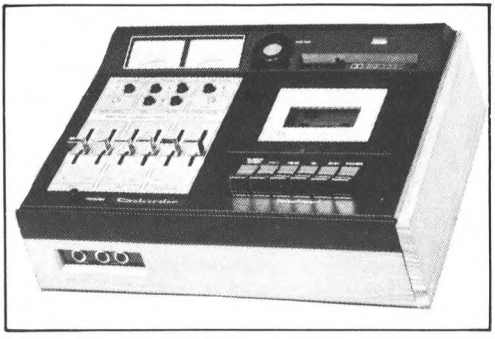
It is unfortunate that this review sample has to be very severely criticised for its extremely poor performance and lack of quality control, despite the fact that review samples are normally checked by importers before despatch. Dolby B processing is included and provision is made for ¼" jack microphone inputs, a 5 pole DIN input/output, and phono line in and out sockets. A stereo headphone jack allows headphone monitoring. No peak reading lights are provided, and the VU meters under read 8dB on a 64m sec tone burst. On replaying pre-recorded cassettes it was immediately evident that the quality was poor, since hum and hiss were continuously audible. As if this was not bad enough, the Dolby circuits seemed to pump badly and some azimuth wander was noticed. However, test tapes proved the basic response without Dolby to be quite flat, with a slight boost at 10kHz on the right channel of 2dB. The incorrect bass time constant was incorporated, but if any more bass had been allowed through the hum would have been even more noticeable. The record button would not operate unless a finger was inserted in to the cassette mechanism and a small spring depressed to allow the record button to lock on. Whilst in this state, a cassette could be inserted and recording could take place.

BASF Super LH gave a very poor distortion figure of 1.8% at Dolby level, rising to 2.9% at +4dB. This is very bad. Most machines using this tape are well below 1% at Dolby level. The frequency response pen charts with Dolby operating speak for themselves, and a brief analysis shows the response to have a very excessive high frequency boost which sounded quite intolerable. The distortion was also so bad that a recording copied from a master tape of the Royal Albert Hall organ gave the impression of having been recorded through a fuzz box. An orchestral recording of Dvorak's New World Symphony was attempted, but the shrillness and distortion were so oppressive and the background noise so marked that no enjoyment whatsoever could be obtained. The wow and flutter also measured very badly at 0.18% at the end of a cassette, although it was marginally better at the beginning. Musicians would be particularly upset with this machine since the speed at the beginning of the cassette was nearly 2% fast. Chromium tape was found even worse with an average of 4.5% distortion at Dolby level, rising to 8.4% at +4dB. The recorded sound here could only be described as excruciating, since if the level was held down to avoid distortion the already very poor signal to noise ratio became all too evident. The response on chrome tape overall measured between 7 and 8dB up at 5kHz, falling to between 2.5 and 7dB up at 10kHz. It was quite clear that just about everything which could be mis-set on record had been.

Whereas the replay noise actually measured some 6dB worse than average, the overall noise measured about 4.5dB below the optimum on ferric and 7dB below optimum on chrome, these figures being relative to Dolby level and without Dolby processing.

The microphone input had a sensitivity of 480uV and clipped at 54mV. The input impedance was very high at 45k ohms. It was impossible to check the noise performance here because of the machine's basic noise being so poor. Insufficient microphone sensitivity is provided for moving coil microphones, and an electret microphone would have to be held fairly close to a speaker to obtain full recording level. The DIN input sensitivity was 2.9mV and a very high clipping level of 320mV will be found useful. The DIN input impedance was also about optimum at 12k ohms. The line input gave severe noise degradation at a 100mV input level of some 8.5dB, thus deteriorating the already poor figure of 48dB overall with chrome tape and Dolby in to 39.5dB. No erase problem was encountered, but some high frequency cross talk was noticed averaging 23dB at 5kHz.

It is very difficult to understand how this review sample could possibly have left the factory in such a state of adjustment, despite the fact that many of the faults are probably design ones. It is hard to have any enthusiasm for this model, even ignoring the faulty record button and an eject mechanism which often jammed requiring a swcrewdriver to open the lid. If this sample is typical, the model cannot be recommended.



Replay Azimuth Deviation from Average	13°
Microphone Input Sensitivity	485μV
Microphone Input Clipping	54mV
Microphone Input Impedance Average	45K
DIN Input Sensitivity	2.9mV
DIN Input Clipping	320mV
DIN Input Impedance Average	12K
Line Input Sensitivity	94mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+1.5
Ferric 10kHz Average Left and Right	+1.25
Chrome 10kHz Average Left and Right	+1.5

REPLAY NOISE

Ferric 20/20 worst channel	48dB
Ferric CCIR weighted Dolby Out	44dB
Ferric Dolby Improvement	9.5dB
Chrome CCIR weighted Dolby Out	45dB
Wow and Flutter Average	0.17%
Speed Average	+1.6%
Meter Under-read at 64ms	−8dB

DISTORTION

At Dolby Level monitoring input	2.51%
Overall Ferric Av. L+R at Dolby Level	1.8%
Overall Ferric Av. L+R at +4dB	2.9%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	4.3%
Overall Chrome Av. L+R at +4dB	8.4%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+3.5
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	+2.75

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+4.0/ −1.25dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+3.5/ −0.5dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	40dB
Dolby Improvement	7dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	40.5dB
Chrome Dolby Improvement	7.5dB
DIN Input Noise Degredation	0.5dB
Line Input Noise Degredation	8.5dB
Spooling Time	2m 10s

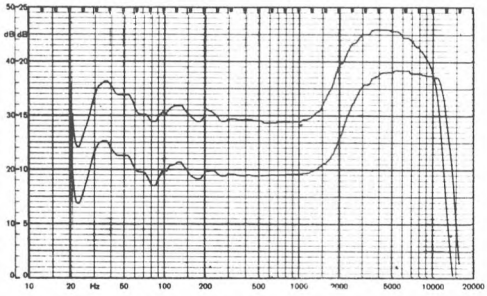
DYNAMIC RANGE

Ferric	57dB
FeCRO2/LN	—
Chrome	53dB

TAPE USED

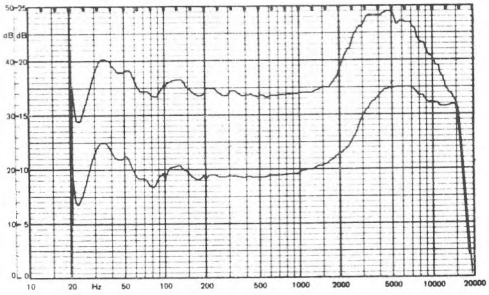
Ferric	BASF SUPER LH
FeCRO2/LN	—
Chrome	BASF

Recommended Retail Price: £112.00



Dokorder Mk.50: BASF Super LH Dolby In

Dokorder Mk.50: BASF CRO2 Dolby In



Dual C901

KF Products Ltd., Ashton Road, Bredbury, Stockport, Cheshire. 061 494 1441

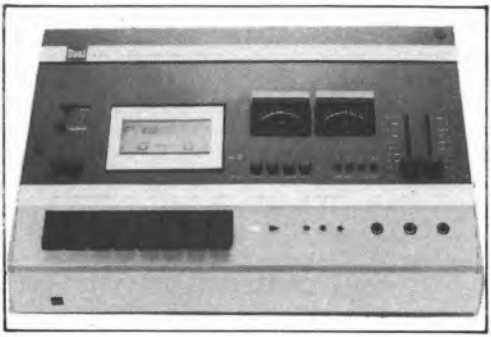
This machine offers the unique function of being able to record and play back in either direction, and is thus most useful for many applications, including rapid quality assessment and continuous background music. The first sample delivered had such serious input noise problems that a retest was called for before very much laboratory testing was done, and so all the remarks and figures quoted are for the 'retest' machine. The input circuitry includes two sockets for Dual capacitor microphones with built in provision for powering, a 5 pole DIN socket and line in and line out sockets. Dolby B circuitry is included, and also an extremely effective automatic record gain control, which adjusts the level to the loudest peak, backing down the gain after the peak to preserve the correct dynamic range. It has an extremely long recovery time, apparently of several minutes. Both VU meters and a peak reading light are incorporated, the latter coming on when Dolby level is reached. The machine is well styled and typically German in appearance. It includes an automatic chromium bias and equalisation switch, which tended to be unreliable on all the machines tested, despite a factory modification to try to improve it. The peak reading light did not respond to short duration peaks, but the VU meters had considerably better than average ballistics, under-reading only 4dB with a 64mSec pulse. Although in general the recorder was liked, the overall and replay noise measurements were average, and these were confirmed in the subjective listening tests.

The replay response had the correct bass time constant, but slight treble boost was noticed at 10kHz on both ferric and chrome tape (approximately 2dB). This boost emphasises the replay noise, and if the manufacturers reduced it a little the general noise performance would, of course, improve by about 2dB. Pre-recorded cassettes played back extremely well with pretty good stability and excellent response, although the high frequency end was clearly just a little predominant. On delivery, the replay azimuth was accurate. The wow and flutter measured an average of .08%, and the speed stability 0.25%, both considered very good.

Somewhat horrifying though was the overall distortion measured on both BASF ordinary LH and chrome cassettes, the exceptionally high figure of 4.5% being noted for the former and 5% for the latter at Dolby level. Both these figures rose to 10% when the input level was increased by 4dB. This unfortunately was confirmed by the excrutiating distortion audible when high recording levels were attempted in the subjective tests. In other respects though the sound quality was liked, and on ferric tape in particular the response was very flat, although on chromium a slight treble rise was noted. At the Laboratory's suggestion the manufacturer agreed to a further retest on BASF Super LH tape. The results immediately dramatically improved, for the average distortion at Dolby level became only 1% instead of 4.5%, but on the other hand there was a noticeable treble rise. The response was flattened again by increasing bias, thus transforming the entire machine in to one that could be recommended but only for its performance on ferric tape. Dual have now agreed to bias all machines coming into this country for BASF Super LH as from October 1, 1975. If you are considering this machine, you should insist on your dealer setting up for super ferric tape, and check that the overall response sounds even rather than toppy. Although the left/right cross talk was adequate, some trouble was experienced between the two tracks, and Dual will have to improve the break through, for on the machine tested the programme on the opposite track to that being monitored became just perceptible in quiet passages. It is presumed that slight break through exists in the track change switching.

The redesigned input circuitry performed extremely well on the DIN and line inputs, but slight overload might occur when recording loud instruments because the microphone's clipping margin measured only 23mV, and capacitor microphones normally give a much higher output than moving coil ones. Dual have obviously designed a very good basic machine, but they should appreciate that on the production line more rapid changes are necessary to keep up with improvements in technology.

With the cautions pointed out, this machine seems good value for money.



Replay Azimuth Deviation from Average	12°→3°←
Microphone Input Sensitivity	255μV
Microphone Input Clipping	23mV
Microphone Input Impedance Average	)100K
DIN Input Sensitivity	2.6mV
DIN Input Clipping	232mV
DIN Input Impedance Average	18K
Line Input Sensitivity	31mV
Line Input Clipping	2.75V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+3.25
Ferric 10kHz Average Left and Right	+2
Chrome 10kHz Average Left and Right	+4*

REPLAY NOISE

Ferric 20/20 worst channel	43dB
Ferric CCIR weighted Dolby Out	46.5dB
Ferric Dolby Improvement	10.0dB
Chrome CCIR weighted Dolby Out	50dB
Wow and Flutter Average	0.08%
Speed Average	−0.28%
Meter Under-read at 64ms	4dB

DISTORTION

At Dolby Level monitoring input	—
Overall Ferric Av. L+R at Dolby Level	4.5%
Overall Ferric Av. L+R at +4dB	10%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	5.6%
Overall Chrome Av. L+R at +4dB	10%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+1
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	0

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1.0/ −2.5dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+0.5/ −3.0dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	42dB
Dolby Improvement	9.5dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	46.5dB
Chrome Dolby Improvement	9.5dB
DIN Input Noise Degredation	0dB
Line Input Noise Degredation	1dB
Spooling Time	1m 16s

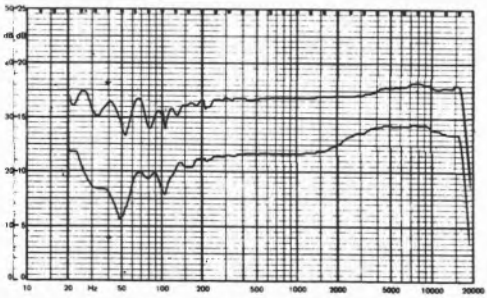
DYNAMIC RANGE

Ferric	56dB
FeCRO2/LN	—
Chrome	60.5dB

TAPE USED

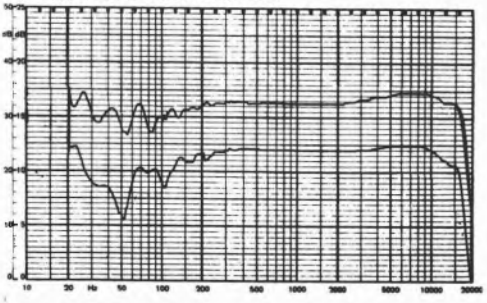
Ferric	BASF LH
FeCRO2/LN	—
Chrome	BASF

Recommended Retail Price: £176.00



Dual C901: BASF LH Dolby In

Dual C901: BASF CRO2 Dolby Out



Harmon Kardon HK1000

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

Quite comprehensive facilities are provided on this model, since the Dolby B processing feature is accompanied by a Dolby tone oscillator and both record and replay Dolby calibration user presets, thus allowing tapes of different sensitivities to be used. Peak reading VU meters are incorporated and read a 64mS tone burst virtually correctly and an 8mS short burst under-read only 4.5dB. Such meters must be praised very highly. A three position tape selector provides bias and equalisation for normal ferric tape, low noise ferric tape, and chromium types. The main deck controls were found easy to use and a memory counter is also incorporated on the rewind mechanism. The wow and flutter unfortunately was extremely poor at 0.2%. This is assumed to be a sample variation.

The microphone input (¼" jack sockets) had a very adequate input sensitivity at 165uV and a virtually infinite clipping margin, since a 1k ohm potentiometer is provided before the microphone amplifier. No DIN 5-pole socket is provided at all, although low and high level phono inputs are provided, the low one having an input sensitivity of 39mV into between 17k ohms and 30k ohms, depending on the potentiometer position, whilst the high level input requires 250mV into 42K ohms. Very high level input signals did not overload these inputs. The input circuit was very well designed, since no noise degradation occured on the 30mV input, but it is stressd that the machine is not really satisfactory for interconnection with DIN receivers.

On replay it was found that the bass response had not been brought up to the latest standard and so many pre-recorded cassettes sounded light in bass, the response measuring some 3dB down from optimum at 63Hz. and even further down at lower frequencies. The chromium replay response, however, was correct at the bass end. Both ferric and chromium replay responses at the HF end showed a treble rise averaging +1.5dB at 10kHz, but this is not at all serious. The replay noise level was about average, although the right channel had noticeably more hiss than the left, this probably being introduced in the Dolby preamplifier transistor, which was possibly faulty. The azimuth was badly out of adjustment on delivery (+60° at 3kHz) and more worrying was the availability to the user of a preset speed control, which had an extremely wide variation and by providing this user control, operators will probably fiddle with it and therefore maladjust it!

The overall performance on ordinary BASF LH cassettes showed the response to be very good indeed, extending from 25Hz to 15kHz, although at the bass end variations caused by the record/replay head produced a variable response, which is to be expected. The distortion, however, measured unevenly at 1.6% on the left and 2.5% on the right channel at Dolby level, which increased on the right to 7.1% at +4dB, a rather horrifying figure. Because of the considerable bass lift on record, distortion was clearly evident at low frequencies. Maxwell UD ferric tape proved to have a remarkably flat response, extending to 15kHz at the HF end, although showing a slight boost of 2.5dB here. The distortion averaged 1% at Dolby level, rising to 3% at +4dB. A slight tape/head contact problem again arose, but apart from this recordings reproduced very well, although distortion became apparent at very low frequencies rather earlier than on some other good alternatives, this being due to the incorrect replay bass equalisation. Harmon-Kardon will have to alter this, as soon as possible, to co-incide with the new international standard. Memorex chrome tape was stipulated and had a remarkably low distortion of 1% at Dolby level, rising to 3% at +4dB. These figures were amongst the very best chrome distortions measured. What a pity, then, that the 10kHz response was down to −4dB when the Dolby circuits were operating, but this only slightly reduced the high frequencies subjectively. The signal to noise ratio on chrome was pretty good and subjectively the sound quality very good indeed, although at high levels slight bass distortion was noticed.

A mono switch allows the inputs to combine to give a mono recording—ie: the same signal was sent to both channels. Four separate slider controls are provided for general input and output levels and the machine's layout was well liked. No crosstalk and erase problems were noted. The machine is not cheap but if the wow problem is overcome and the bass time constants corrected, for ferric tape, it is relatively good value for money.

Replay Azimuth Deviation from Average	68°
Microphone Input Sensitivity	162μV
Microphone Input Clipping	)10V
Microphone Input Impedance Average	1.1K
DIN Input Sensitivity	30mV
DIN Input Clipping	)10V
DIN Input Impedance Average	20K
Line Input Sensitivity	250mV
Line Input Clipping	)10V
Line Input Impedance Average	42.5K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+0.13
Ferric 10kHz Average Left and Right	+1
Chrome 10kHz Average Left and Right	−2

REPLAY NOISE

Ferric 20/20 worst channel	55½dB
Ferric CCIR weighted Dolby Out	50dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	52.75dB

Wow and Flutter Average	0.21%
Speed Average	*continually variable
Meter Under-read at 64ms	−½dB

DISTORTION

At Dolby Level monitoring input	0.18%
Overall Ferric Av. L+R at Dolby Level	2.1%
Overall Ferric Av. L+R at +4dB	5.7%
Overall FeCRO2/LN Av. L+R at Dolby Level	0.94%
Overall FeCRO2/LN Av. L+R at +4dB	2.9%
Overall Chrome Av. L+R at Dolby Level	1.1%
Overall Chrome Av. L+R at +4dB	3%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−¼
10kHz FeCRO2/LN Dolby Out Av. L+R	−½
10kHz Chrome Dolby Out Av. L+R	−3¼

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+¼/ −¾dB
Ref. 333Hz FeCRO2/LN	+¼/ −½dB
Ref. 333Hz Chrome	+0/ −4dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	43½dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	42dB
FeCRO2/LN Dolby Improvement	8¼dB
Chrome CCIR weighted Av. L+R Dolby Out	45dB
Chrome Dolby Improvement	10dB

DIN Input Noise Degredation	no DIN
Line Input Noise Degredation	0dB
Spooling Time	2m 35s

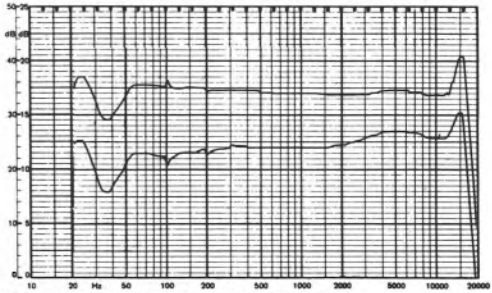
DYNAMIC RANGE

Ferric	61dB
FeCRO2/LN	61dB
Chrome	65dB

TAPE USED

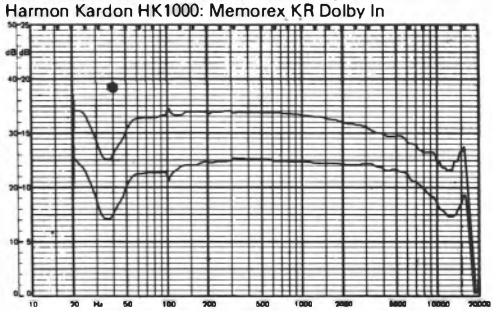
Ferric	BASF LH
FeCRO2/LN	MAXELL UD
Chrome	MEMOREX KR

Recommended Retail Price: £189.00



Harmon Kardon HK1000: Maxell LN Dolby In

Harmon Kardon HK1000: Memorex KR Dolby In



Hitachi TRQ 2040D

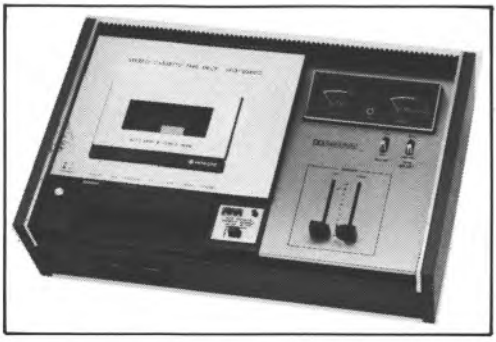
Hitachi Sales (UK) Ltd., Hitachi House, Station Road, Hayes, Middlesex. 01-848 8787

This very reasonably priced machine is a basic Dolby B deck with provision for microphone inputs, a 5 pole DIN input and phono/line inputs and outputs. It includes only one pair of input faders and the outputs are completely dead whilst recording, so it is not possible to monitor the input signal. Facilities are provided for ferric and chromium tape, but unfortunately the switch alters equalisation and bias on record for chromium, but does not change the replay equalisation as is now conventional, and thus no noise advantage is achieved with chromium tape. The machine incorporates many of the early type of thick film integrated circuits, and frankly the performance of the input pre-amplifiers is disappointing. The microphone input was rather noisy, although reasonably sensitive, but did not have a really adequate clipping margin. The DIN input impedance was much too high at 40k ohms and interconnection with DIN equipment might well result in a treble loss becoming apparent. The line input unfortunately clipped at 4.2V and whilst this is satisfactory for all normal domestic purposes, in some instances semi-professional equipment could overload the input. What was more serious however was the input noise degradation at 100mV since a signal to noise ratio with Dolby in circuit of only 41dB was achieved from 100mV souces on the line input. This figure should have been approximately 52dB.

The replay amplifier again unfortunately had the incorrect bass time constant only 1590uSecs being measured which should have been 3180uSecs. This in effect means that many pre-recorded cassettes would be light in bass, and furthermore low frequency distortion would become apparent at high recording levels. Nevertheless, the overall quality on Hitachi ferric tapes was very good, and the signal to noise ratio appeared to be reasonable when a high level signal peaking about 1½V was sent in to the line in sockets. Whilst the overall phase jitter and stability were very good, slight drop outs were noted on some pre-recorded cassettes, and so it would appear that poor cassette tape mechanics are likely to cause slight drop outs and stability problems. The wow and flutter was considered excellent for such a modestly priced machine (0.11% average) and the erasure on chrome tape was excellent. However, stereo cross talk suffered quite badly, only 18dB being measured at 5kHz for example, but no cross talk was noted between tracks in opposite directions. The overall response on ferric tape was pretty flat on the right, but showed a slight rise of up to 5dB at 12kHz on the left (see pen chart). Fortunately this did not sound as bad as it measured. The distortion on Hitachi ferric tape measured 1.6% and whilst this was a little disappointing it was certainly not considered bad. Chromium tape, on the other hand, gave an exceptionally high distortion of 6.5% at Dolby level, which rose to 12.5% at +4dB, but the response was fairly flat. Since the noise level on chrome was no better than ferric (no replay equalisation change) it was considered pointless to use chrome tape on this machine. Whilst listening tests showed the quality to be reasonable at intermediate levels, at high levels distortion became intolerable.

The VU meters were better than average under-reading a 64m sec pulse by only 4dB (most machines averaged 7dB under reading here). Mechanically the deck was a little irritating, since the order in which the functions buttons were placed is illogical. The record and replay buttons are adjacent, and an inexperienced user could easily make a mistake and possibly ruin an irreplaceable tape. It is possible to go from play in to wind and back to play, and this is convenient.

Despite its faults then, this machine is fairly good value for money, if only ferric tape is to be used, and provided reasonably high levels are sent in to the line inputs, and a medium impedance microphone is used. Hitachi should definitely improve the input circuitry and the chromium equalisation switching.



Replay Azimuth Deviation from Average	17°
Microphone Input Sensitivity	230μV
Microphone Input Clipping	19½mV
Microphone Input Impedance Average	20K
DIN Input Sensitivity	2.2mV
DIN Input Clipping	190mV
DIN Input Impedance Average	40K
Line Input Sensitivity	51.5mV
Line Input Clipping	4.3V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	−0.38
Ferric 10kHz Average Left and Right	−0.63
Chrome 10kHz Average Left and Right	−0.63

REPLAY NOISE

Ferric 20/20 worst channel	52½dB
Ferric CCIR weighted Dolby Out	48dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	48½dB
Wow and Flutter Average	0.11%
Speed Average	+1.55%
Meter Under-read at 64ms	4dB

DISTORTION

At Dolby Level monitoring input	–
Overall Ferric Av. L+R at Dolby Level	1.58%
Overall Ferric Av. L+R at +4dB	4.2%
Overall FeCRO2/LN Av. L+R at Dolby Level	–
Overall FeCRO2/LN Av. L+R at +4dB	–
Overall Chrome Av. L+R at Dolby Level	6.7%
Overall Chrome Av. L+R at +4dB	13.3%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+¼
10kHz FeCRO2/LN Dolby Out Av. L+R	–
10kHz Chrome Dolby Out Av. L+R	−1.75

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+2.0/ −1.5dB
Ref. 333Hz FeCRO2/LN	–
Ref. 333Hz Chrome	+¾/ −1¾dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	42dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	–
FeCRO2/LN Dolby Improvement	–
Chrome CCIR weighted Av. L+R Dolby Out	42dB
Chrome Dolby Improvement	10dB
DIN Input Noise Degredation	0dB
Line Input Noise Degredation	11dB
Spooling Time	2m 20s

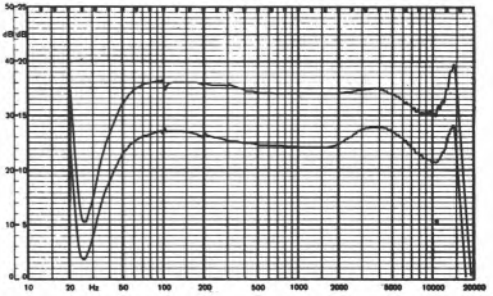
DYNAMIC RANGE

Ferric	61dB
FeCRO2/LN	–
Chrome	55.5dB

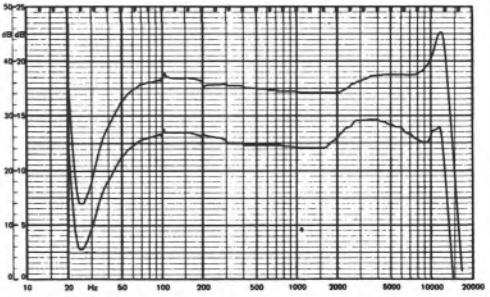
TAPE USED

Ferric	HITACHI UD
FeCRO2/LN	–
Chrome	BASF

Recommended Retail Price: £108.40



Hitachi TRQ2040D: BASF CRO2 Dolby In



Hitachi TRQ2040D: Hitachi UD Dolby In

Hitachi D3500

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

This machine should be available about the time this book is published, but it should be stressed that comments and tests were made on a pre-production prototype, and almost certainly production models will have most, if not all, the problems ironed out. The machine has very comprehensive facilities, and in particular allows off tape monitoring during recording. The record and replay heads are enclosed in the same head housing with a remarkable isolation between the two pairs of gaps. Dolby B noise reduction is incorporated, and both ferric and chromium tapes can be used, but no additional switched position is provided for ferrichrome. Separate phono/line in and mic/DIN input faders are provided, and a switch selects either phono input only or a mixing facility. Pre-recorded tapes reproduce very well, but with a slight lack of very low frequencies. The replay noise was more than adequate, but nowhere near as low as several of its competitors. The overall record quality on ferric Hitachi tape was very good indeed, with a flat response and pretty low distortion. The overall signal to noise ratio measured well, and a wide dynamic range could be recorded, although at extremely high levels slight bass distortion became noticeable.

The wow and flutter measured rather poorly, at 0.16%, but bear in mind that the recorder is a prototype which has been passed around the trade before coming to the laboratory for testing. The speed accuracy was good at +.35% on nominal. On chromium dioxide tape the overall response was extremely poor, and bad head to tape contact was evident. It must be assumed that the machine had been incorrectly set up by the manufacturers for chrome since the results were so disappointing. When making an A/B comparison whilst copying from a master tape of Dvorak's New World Symphony, it was fairly difficult to tell immediately which sound was the original and which the copy on Hitachi ferric tape. This fact alone shows that the machine is basically well designed. The replay response showed the machine to have the old bass time constant, and this explains the slight lack of bass on pre-recorded cassettes. The high frequency end was extremely clean and clear, and very flat.

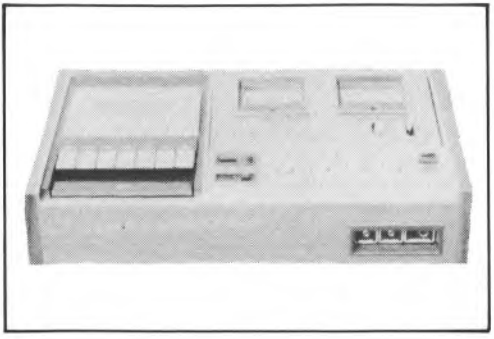
The phase jitter overall was extremely good. On delivery the azimuth of the double head was incorrectly set at −45° (3kHz) and this would lead to many pre-recorded cassettes sounding a little dull.

The review sample unfortunately had an instability problem, and with certain combinations of record and play back gain control settings, supersonic frequency was produced which caused, for example, the left hand VU meter to fly on to one end stop. This was probably due to some earth wiring becoming disconnected, and obviously should not be present in production line machines.

The pause control did not always work satisfactorily, for on some occasions rather than stopping, cassettes spooled through rapidly against the heads.

Although the microphone input circuitry had very low noise, it had totally insufficient gain for recording speech, even from a high output electret microphone. Some 12dB more gain is needed. Despite this insensitivity the clipping margin was not at all compatible since microphone signals above 26mV clipped severely, giving a margin of only 30dB. Almost all the recorders tested had a margin of at least 40dB. The DIN input impedance measured extraordinarily low at 1.6k ohms, and this could cause problems if driven from a DIN high source impedance. Some noise was introduced here from the standard DIN test source, and the manufacturers should raise the input to 4.7k ohms to improve matters. They would also have to lower the gain of the circuit to avoid clipping. The line input was not at all satisfactory, since it clipped at only 2.6V, a level frequently encountered in hi-fi equipment, since many reel to reel recorders have fixed gain output peaking voltages much higher than this, and in some circumstances bad distortion could result. It is clear that the input gain and clipping problems are due to the poor design of the input circuit, and Hitachi would be advised to redesign it as soon as possible.

This machine, then, shows very considerable promise, and includes some advanced techniques, though needing attention to several areas of circuit design.



Replay Azimuth Deviation from Average	37°
Microphone Input Sensitivity	795μV
Microphone Input Clipping	27mV
Microphone Input Impedance Average	14K
DIN Input Sensitivity	685μV
DIN Input Clipping	24mV
DIN Input Impedance Average	1.6K
Line Input Sensitivity	68mV
Line Input Clipping	2.6V
Line Input Impedance Average	80K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+1
Ferric 10kHz Average Left and Right	−1
Chrome 10kHz Average Left and Right	−5¼

REPLAY NOISE

Ferric 20/20 worst channel	47dB
Ferric CCIR weighted Dolby Out	48dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	52dB

Wow and Flutter Average	0.16%
Speed Average	+0.34%
Meter Under-read at 64ms	−2¼dB on peak

DISTORTION

At Dolby Level monitoring input	0.18%
Overall Ferric Av. L+R at Dolby Level	1.3%
Overall Ferric Av. L+R at +4dB	3.5%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	4.0%
Overall Chrome Av. L+R at +4dB	8.9%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−1
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	−6¼

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0.4/ −1.75dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+½/ −7½dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	43dB
Dolby Improvement	9¾dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	48½dB
Chrome Dolby Improvement	9½dB

DIN Input Noise Degredation	2½dB
Line Input Noise Degredation	1dB
Spooling Time	2m 00s

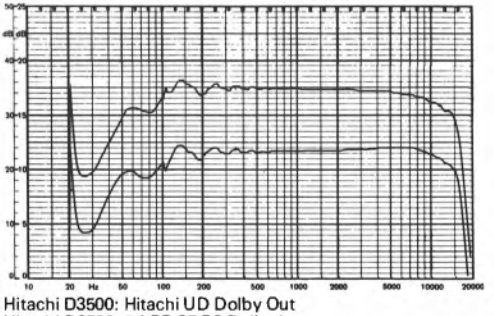
DYNAMIC RANGE

Ferric	62dB
FeCRO2/LN	—
Chrome	62.5dB

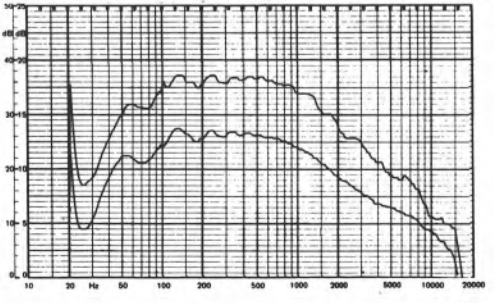
TAPE USED

Ferric	HITACHI UD
FeCRO2/LN	—
Chrome	BASF

Recommended Retail Price: £190.40



Hitachi D3500: Hitachi UD Dolby Out
Hitachi D3500: BASF CRO2 Dolby In



Again incorporating the JVC patented Automatic Noise Reduction System, this is the senior model of the two in the survey. Inputs are provided for microphone (¼" jacks), 5 pole DIN and phono sockets, with an additional pair for output. A ¼" stereo headphone jack allows headphone monitoring, but unfortunately all monitoring, whilst on record, is of the ANRS processed signal. All signals monitored therefore whilst recording sound extremely hissy and brittle. Much time was spent subjectively comparing the ANRS system with the Dolby B one, and in the opinion of the laboratories they are not fully compatible although there is a fair approximation.

The deck is solenoid operated and both calibration controls for record level and an internal oscillator are included for optimising before and after recording levels. Two VU meters under-read a 64m sec tone burst by 5dB and are thus quite good and in any case are complemented by a peak reading light, which indicated at 1.75dB above a Dolby reference level. Switching is provided for biasing and equalising normal, superferric and chromium cassettes. A mic/DIN and line in selector switch is also provided to optimise input levels.

The replay azimuth on delivery was set extremely accurately, but unfortunately the replay response on ferric tape was very poor, being 5.5dB down on the left channel and 3dB down on the right at 10kHz. Furthermore the bass response showed the incorrect time constant. Notwithstanding the extreme treble loss, pre-recorded Dolby processed cassettes sounded rather hard and produced a strange pumping effect at middle frequencies. Many users, though, might well accept a compatibility with Dolby. Some high frequency fuffing was audible, showing the ANRS system to have an inferior control chain to the Dolby type. The replay noise level measured slightly below average at −4dB weighted but some 10dB noise reduction was achieved. The wow and flutter was rather high at 0.15% and the speed a little bit too fast at +0.9%. Some phase jitter was noticed and when cassettes were replaced in the machine very considerable changes of azimuth were noted on each occasion, which showed insufficient care in the design of the tape transport.

The overall recording on BASF LH cassettes gave a very high distortion of 3.5% at Dolby level, rising to an alarming 8.5% at +4dB. The overall response with ANRS operating was very good, being flat on the right and +2dB on the left at 10kHz. The subjective quality, though, was of continual changes in response at different levels, high levels appearing flat but intermediate levels appearing slightly muffled with a small degree of pumping. The distortion was clearly noticeable at high levels but was reasonable at intermediate ones, but if the general recording level was reduced to avoid distortion tape hiss became disturbing. The actual measured noise with ANRS nevertheless was very good at −54.5dB below Dolby level. BASF Super LH had much higher distortion than usual for this type, being 1.3% average at Dolby level, rising to 4.5% at +4dB. The response was only slightly down at 10kHz (−2.5dB) and the overall sound quality was rather better, but still proved to have the rather odd ANRS effects. As agreed with the importer, Sony chrome tape was used, but proved to have an incredibly high distortion of 6.5% at Dolby level, rising to 12.5% at +4dB, and recordings had bad distortion subjectively and produced a breathy sound, presumably contributed by the noise reduction system. A treble rise of 4dB at 10kHz was measured, but there appeared to be far more problems caused by the ANRS system itself than by actually measured response errors. A microphone recording proved to give a very hard sound quality but with very low hiss level. Unfortunately, though, very bad hum was audible here due presumably to bad input circuit design. The microphone input sensitivity was poor at 500uV, which clipped at 36mV. The DIN input had 4mV sensitivity in to 9k ohms and clipped at 280mV. Approximately 4dB degradation of hiss level was produced from a standard DIN source. The line input had just 100mV sensitivity and did not clip. No erase or crosstalk problems were encountered. No effective multiplex filter is incorporated and whistles could easily result if recordings are attempted from tuners having inadequate filters. The 19kHz tone burst test showed a change of 3dB in the 1kHz level, so that in the presence of pilot tone the ANRS performance would be noticeably degraded anyway.

This machine was not particularly liked, and since the ANRS system is not completely compatible with Dolby B it is felt that many other machines would offer better value for money.

Replay Azimuth Deviation from Average	18°
Microphone Input Sensitivity	490μV
Microphone Input Clipping	36mV
Microphone Input Impedance Average	53K
DIN Input Sensitivity	3.9mV
DIN Input Clipping	280mV
DIN Input Impedance Average	9K
Line Input Sensitivity	10.3mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	−0.5
Ferric 10kHz Average Left and Right	−4.25
Chrome 10kHz Average Left and Right	−7.5

REPLAY NOISE

Ferric 20/20 worst channel	50dB
Ferric CCIR weighted Dolby Out	48dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	52.5dB

Wow and Flutter Average	0.15%
Speed Average	+0.9%
Meter Under-read at 64ms	5dB

DISTORTION

At Dolby Level monitoring input	0.3%
Overall Ferric Av. L+R at Dolby Level	3.4%
Overall Ferric Av. L+R at +4dB	8.5%
Overall FeCRO2/LN Av. L+R at Dolby Level	1.2%
Overall FeCRO2/LN Av. L+R at +4dB	4.5%
Overall Chrome Av. L+R at Dolby Level	6.4%
Overall Chrome Av. L+R at +4dB	12.6%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+0.5
10kHz FeCRO2/LN Dolby Out Av. L+R	−2.5
10kHz Chrome Dolby Out Av. L+R	+1.25

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0.75/ −0.5dB
Ref. 333Hz FeCRO2/LN	+0.5/ −2.25dB
Ref. 333Hz Chrome	+1.0/ −1.25dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	45dB
Dolby Improvement	9.25dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	44.25dB
FeCRO2/LN Dolby Improvement	9dB
Chrome CCIR weighted Av. L+R Dolby Out	46.5dB
Chrome Dolby Improvement	9dB

DIN Input Noise Degredation	4.25dB
Line Input Noise Degredation	1dB
Spooling Time	1m 52s

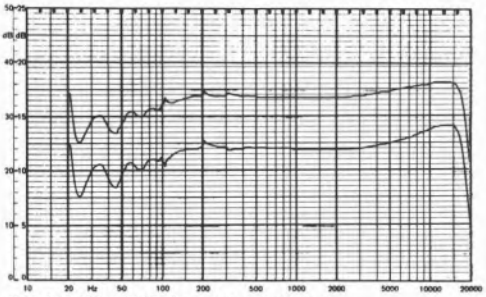
DYNAMIC RANGE

Ferric	60.5dB
FeCRO2/LN	62dB
Chrome	60dB

TAPE USED

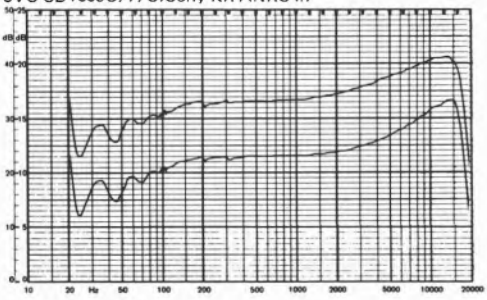
Ferric	BASF LH
FeCRO2/LN	BASF SUPER LH
Chrome	SONY KR

Recommended Retail Price: £272.00



JVC CD1669U/F/S: Sony KR ANRS Out

JVC CD1669U/F/S:Sony KR ANRS In



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

This, the cheaper of the two JVC recorders incorporating their ANRS system reviewed in this survey, is a medium priced front loader. The cassette had to be inserted upside down, and futhermore record and play buttons are adjacent, so that a careless stab could cause erasure of a previous recording. For some inexplicable reason the monitor circuits reproduce the processed signal during recording which is therefore extremely brittle and virtually unusable for entertainment value. The ANRS system itself worked satisfactorily, but high frequencies seemed to expand upwards in loud passages, and an effect that can only be called 'fuffing' occurred, caused by tape hiss audibly pumping. The replay response with ferric equalisation had an incorrect bass time constant and unfortunately the treble end drooped about 2dB at 10kHz. Chrome, however, was satisfactory. The replay noise levels measured about average, ferric being −50dB without ANRS ref. Dolby level. ANRS produced an improvement of 9dB, and the chrome equalisation position produced an improvement of only 2dB over ferric. Pre-recorded Dolby cassettes sounded strangely brittle when loud and muffled when quiet, showing that the ANRS system is not truly compatible with Dolby, although the reproduced sound was acceptable. The 19kHz/1kHz pulse test showed that the noise reduction would suffer bad interference from tuners having inadequate multiplex filtering and JVC will have to incorporate an effective multiplex filter.

BASF Super LH produced rather more distortion that it should at Dolby level (1.7%) which rose to 4.5% at +4dB. When attempting high recording levels bass frequencies seemed to distort quite noticeably because of the incorrect time constant. All recording sounded brittle when loud, but more mellow when quiet, and it must be assumed that this was due to the ANRS system itself. Slight tape/head contact problems were noted, but this could have been due to the recorder being slightly under biased which can over emphasise tape contact problems. The overall response, taken at 26dB below Dolby reference level ref. flux level proved to be pretty flat, as was the response for BASF chrome. The distortion, though, on chrome at Dolby reference level measured very high at +4dB (10.7%). Some wow and burbling were noted on a french horn passage in Dvorak's New World Symphony, the violins seemed to sound scratchy and in general the distortion was very evident at anywhere near peak recording level The VU meters under-read a 64m sec tone burst by 6dB, and although slightly better than average over recording might be encouraged since no peak reading light was provided. Two ¼" microphone jack sockets presented a high impedance of 68k ohms and had a sensitivity of 320uV with a very adequate clipping margin. A 5 pole DIN input/output socket presented an input impedance of 9K ohms, about optimum, at a sensitivity of 3mV, with an excellent clipping level of 400mV. Whilst the sensitivity is not high enough for DIN specification it will probably be found just sufficient. A standard DIN source produced 4.5dB of noise degradation and so JVC will have to improve the DIN input circuit somewhat. The phono line inputs had a sensitivity of 115mV and no noise degradation was noted.

Whilst the cross talk figures were really excellent the erase was definitely not good enough, averaging only −55dB on chrome tape but better on ferric. The overall noise performance was good at −56dB on chrome with ANRS and −53dB on ferric again with ANRS.

The wow and flutter measured rather poorly, averaging 0.18%, and the machine also gave some rather bad phase jitter at 10kHz. On delivery azimuth was some 70° out at 3kHz, and so pre-recorded cassettes would have sounded very muffled. The rewind speed was very slow at 2min 55sec for a C90 and this could be a little annoying. There are many better buys in this machine's price range and it is felt that one incorporating Dolby processing would probably be more satisfactory. JVC must change their monitoring philosophy and improve the wow and flutter.

Replay Azimuth Deviation from Average	62°
Microphone Input Sensitivity	310μV
Microphone Input Clipping	41mV
Microphone Input Impedance Average	68K
DIN Input Sensitivity	3mV
DIN Input Clipping	400mV
DIN Input Impedance Average	9K
Line Input Sensitivity	117mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+0.75
Ferric 10kHz Average Left and Right	−1.75
Chrome 10kHz Average Left and Right	−5.0

REPLAY NOISE

Ferric 20/20 worst channel	50dB
Ferric CCIR weighted Dolby Out	50dB
Ferric Dolby Improvement	9dB
Chrome CCIR weighted Dolby Out	52dB
Wow and Flutter Average	0.18%
Speed Average	+0.15%
Meter Under-read at 64ms	6

DISTORTION

At Dolby Level monitoring input	0.5%
Overall Ferric Av. L+R at Dolby Level	1.7%
Overall Ferric Av. L+R at +4dB	4.5%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	6.5%
Overall Chrome Av. L+R at +4dB	10.5%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−0.5
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	−0.5

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0.5/ −1.0dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+0.5/ −1.0dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	44.5dB
Dolby Improvement	8.5dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	46.75dB
Chrome Dolby Improvement	9dB
DIN Input Noise Degredation	6dB
Line Input Noise Degredation	2dB
Spooling Time	2m 52s

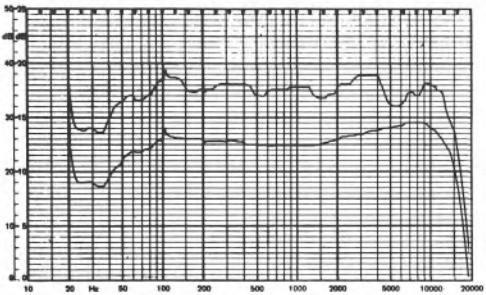
DYNAMIC RANGE

Ferric	61dB
FeCRO2/LN	—
Chrome	60dB

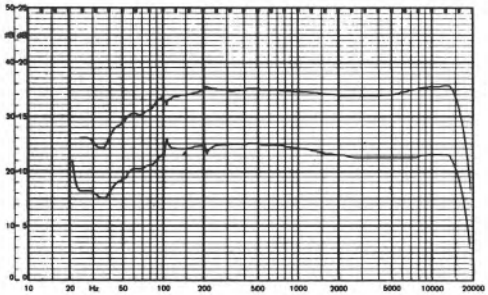
TAPE USED

Ferric	BASF SUPER LH
FeCRO2/LN	—
Chrome	BASF

Recommended Retail Price: £135 00



JVC CD1950: BASF Super LH ANRS In
JVC CD1950: BASF CRO2 ANRS Out

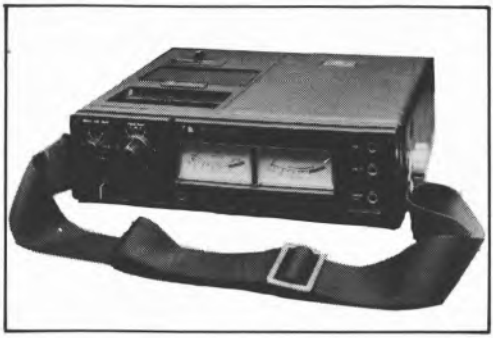


Nakamichi 550

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

Designed specifically to obtain maximum performance from internal battery operation (an external mains power supply is also provided) the recorder can further be operated from a 12V car battery and incorporates Dolby B processing and a record limiter. A programme time elapsed counter indicates when required on one of the VU meters and a preset can allow an alarm light to come on at any required point towards the end of a cassette, thus showing the user that a tape turnover will shortly become necessary. The machine is very smartly finished and easy to use, and includes peak reading VU meters which under-read a 64m sec burst by only 2dB and an 8m sec burst by 7dB, thus making it simple to adjust correctly for peak recording level. A tone oscillator allows both ferric and chromium cassettes to have compatible record/play back calibration levels. On replay the bass response was correct on both ferric and chrome but as with the model 700 a treble rise (averaging 1.5dB) was noted. The Dolby circuit on replay appeared to be slightly mis-set on the right channel, but this was not too obvious when playing back pre-recorded cassettes, since they sounded extremely good with a very extended high frequency response. The replay noise measured 2dB better than on the 700 and was thus about average and more than adequate. The stability and absence of dropouts was impressive and phase jitter also measured well, 10kHz reproducing $\pm 10°$. The overall wow and flutter was good for a battery operated machine, measuring an average of 0.12%. Some hum was noticed if the mains power supply unit was located too close to the recorder, but this completely disappeared when the supply was removed as far as possible. On ferric Maxwell UD tape the distortion measured 1% at Dolby level increasing to 3% at +4dB and this was considered good. The response was not altogether satisfactory, measuring 3dB down at 10kHz without Dolby processing, but flat again at 15kHz, but when the Dolby circuits were operating the apparent hole at 10kHz was exaggerated at low levels to be 5.5dB down. It seems that Nakamichi's philosophy of extending the response to well above 15kHz degrades the performance in the important region between 5 and 10kHz and this may not be considered altogether wise. Surely it is preferable to have a flat response at 10kHz, falling off at higher frequencies. Nevertheless the sound quality overall was extremely good and the clarity and lack of distortion commendable. Surprisingly the measured response anomaly did not seem to be too audible subjectively. Nakamichi chrome produced 1.5% distortion at Dolby level rising to 3.4% at +4dB. The response again had a hole at 10kHz (−3.5dB) but recovered to a flat response at 15kHz, thus showing almost certainly that the machine incorporated a resonance at about this frequency. The quality on chrome was very good indeed and the noise performance was excellent being −56.5dB below Dolby level with Dolby switched in. The distortion subjectively was very low and the machine had a brilliance which can only be assumed to be due to the ringing of the peaking circuit thus making up for the loss of response at 10kHz. The ferric noise was not altogether satisfactory, some 3dB below optimum.

Three ¼" mic jack sockets are provided for left, centre and right and had a sensitivity of 222uV into an impedance of 700 ohms. A Sony stereo electret worked extremely well with the recorder, but only just enough gain is available for recording speech with moving coil microphones. The microphone input circuit had an incredible overload capability of 400mV and even professional capacitor microphones would not cause overload problems. The 5 pole DIN input/output socket had an input impedance of 10k ohms, about optimum, but the sensitivity of 18mV was far below DIN specification, and interconnection with DIN equipment might well not be satisfactory. Even the rated DIN source would not fully load the recorder, let alone the specified .1mV/k ohm sensitivity demanded by DIN. The clipping margin, however, was virtually infinite. The phono line input sockets had a sensitivity of 60mV into a high impedance of 100k ohms. Only slight noise degradation occurred when the gain control was advanced fully. The erase was satisfactory but slightly below average and no particular cross talk problems were encountered. The machine performed very well on batteries, although the battery consumption was rather high since a DC/DC inverter incorporated has to raise the input voltage to 27V for the motor. Despite the response anomalies the machine was very well liked and can be recommended, for it was found very reliable and gave such a good overall performance. The price is pretty high and many users might prefer to consider the Yamaha battery portable as giving better value for money, although Nakamichi's better microphone sensitivity and noise performance will undoubtedly influence potential purchasers.



Replay Azimuth Deviation from Average	117°
Microphone Input Sensitivity	217μV
Microphone Input Clipping	397mV
Microphone Input Impedance Average	700Ω
DIN Input Sensitivity	18.6mV
DIN Input Clipping	)10V
DIN Input Impedance Average	10K
Line Input Sensitivity	60mV
Line Input Clipping	)10V
Line Input Impedance Average	100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+4¼
Ferric 10kHz Average Left and Right	+1½
Chrome 10kHz Average Left and Right	−2½

REPLAY NOISE

Ferric 20/20 worst channel	52dB
Ferric CCIR weighted Dolby Out	50dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	54dB

Wow and Flutter Average	0.12%
Speed Average	+0.27%
Meter Under-read at 64ms	2dB

DISTORTION

At Dolby Level monitoring input	0.04%
Overall Ferric Av. L+R at Dolby Level	0.95%
Overall Ferric Av. L+R at +4dB	3.0%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	1.5%
Overall Chrome Av. L+R at +4dB	3.4%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−3
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	−1.75

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+2/ −3dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+0.25/ −1.75dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	40½dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	46¾dB
Chrome Dolby Improvement	10dB

DIN Input Noise Degredation	1½dB
Line Input Noise Degredation	1½dB
Spooling Time	2m 04s

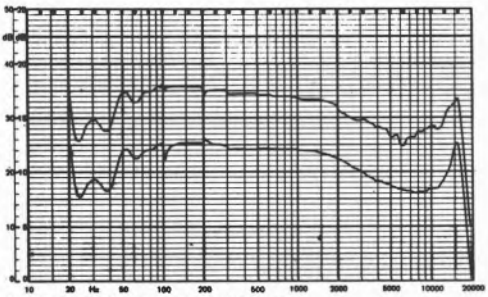
DYNAMIC RANGE

Ferric	60.5dB
FeCRO2/LN	—
Chrome	65.5dB

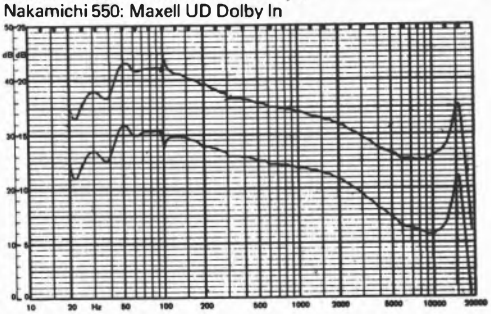
TAPE USED

Ferric	MAXELL UD
FeCRO2/LN	—
Chrome	NAKAMICHI CrO_2

Recommended Retail Price: £236.00



Nakamichi 550: Nakamichi KR Dolby In



Nakamichi 550: Maxell UD Dolby In

Nakamichi 700

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

The overall response on Nakamichi ferric tape surprisingly showed a slight top loss at 10kHz of approximately 3dB, but the response extended at this level to 15kHz. As the recording level was increased the relative response was still the same at 10kHz at −8dB, ref. Dolby level, but of course the 15kHz response was falling sharply because of squash. The machine produced an overall clarity on ferric tape which was remarkable and most pleasing, although the tape noise was some 4dB below optimum caused primarily by the incorrect replay response. The distortion on ferric tape measured 0.7% at Dolby level, rising to 2.4% at +4dB. It was felt nevertheless that the machine was slightly underbiased in order to give the extended treble response, and considerably under-equalised especially bearing in mind the replay boost. The stability was excellent and rewinding and replaying a high frequency tone produced only a marginal change of azimuth. The chrome tape also proved to have very low distortion, averaging 1.2%, although the left channel measured only 0.9%, rising to 2% at +4dB, whereas the right One of the very few three-head machines in the survey, this model also includes Dolby B processing, record limiter and provision for ferric and chromium tapes, but unfortunately none for ferrichrome. All the deck controls are touch sensitive types and are easy to operate once a user has acquired the knack. The cassette has to be loaded sideways and the deck section also includes a number of other interesting and helpful controls. A beacon system allows ease of azimuthing, the record head being adjustable. Unfortunately on delivery the beacon system, in fact, was set incorrectly, but a small modification incorporated by the importer put matters right. A pitch control, operable on replay, allows a considerable adjustment of ±5%. The wow and flutter measured .08%. The deck has a well deserved reputation for excellent stability and incredible tape/head contact. The bass response had the old 1590u sec time constant but the treble end rose to +2dB at 10kHz and showed a continued rise above this frequency. Both test tapes gave the same indication of treble lift. Since the head/tape contact was so good, virtually all pre-recorded cassettes sounded rather toppy. The chrome replay equalisation also showed a treble lift of approximately 1.5dB up at 10kHz but had the correct bass response. The replay signal to noise ratio measured some 2dB worse than average, but if the treble response is corrected by the importer clearly the hiss would be reduced.

increased to 3.8%. The response on the right hand channel was extraordinarily good. Although it measured 2dB down at 10kHz, it returned to a virtually flat response at 20kHz. The left channel had a similar characteristic (see pen chart) but showed a rise of 3.5dB at 5kHz. The overall noise on chrome tape was very much better than ferric, measuring −54dB reference Dolby level with Dolby operating. Again this figure would have been better with correct replay equalisation.

The deck incorporates a memory counter and has a fairly fast rewind time of 1 minute 20 seconds, and the speed was just 0.3% fast. Three ¼" mic jacks are provided for left, right and central injection and the sensitivity measured 400uV approximately into an input impedance of 700 ohms. A 5 pole DIN microphone socket is also provided with the same sensitivity and impedance. An excellent clipping point was measured (125mV). The DIN input varies in impedance from 26k ohms to 43k ohms, dependent upon the gain control position, a maximum sensitivity of 24mV being given with an infinite clipping margin. The input impedance is considered a little high here and furthermore the sensitivity is nowhere near sufficient to meet DIN requirements and so interconnection with DIN equipment might present problems. The line input had a 90mV sensitivity into 90k ohms and very high input levels can be accommodated without clipping. The record limiter had rather too high a threshold and so slight distortion resulted on peaks. The limiters on each channel were not ganged and so a peak on one channel, resulting in limiting, tended to swing the image to the other channel. The VU meters read peaks fairly well, under-reading a 64m sec tone burst by 3.5dB and an 8m sec burst by 8.5dB. This allowed optimum record level setting with ease.

This machine is extremely expensive and naturally one must expect superb performance for the price. It does perform well but Nakamichi should definitely attend to the lack of input sensitivity and the overall equalisation problem. Noise too could do with some improvement and finally the erase should be improved since the measurements were not altogether satisfactory, although the cross talk was excellent.

Replay Azimuth Deviation from Average	14°
Microphone Input Sensitivity	410μV
Microphone Input Clipping	125mV
Microphone Input Impedance Average	700Ω
DIN Input Sensitivity	23.5mV
DIN Input Clipping	)10V
DIN Input Impedance Average	26K–43K
Line Input Sensitivity	92mV
Line Input Clipping	>10V
Line Input Impedance Average	90K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	0
Ferric 10kHz Average Left and Right	+1.75
Chrome 10kHz Average Left and Right	3

REPLAY NOISE

Ferric 20/20 worst channel	50dB
Ferric CCIR weighted Dolby Out	47.75dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	52dB

Wow and Flutter Average	0,08%
Speed Average	+0.27%
Meter Under-read at 64ms	–3.5dB

DISTORTION

At Dolby Level monitoring input	0.22%
Overall Ferric Av. L+R at Dolby Level	0.7%
Overall Ferric Av. L+R at +4dB	2.3%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	1.25%
Overall Chrome Av. L+R at +4dB	2.6%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	–3
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	–1.75

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0/ –3.5dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+0/ –1.75dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	40dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	45dB
Chrome Dolby Improvement	9dB

DIN Input Noise Degredation	0dB
Line Input Noise Degredation	0dB
Spooling Time	1m 21s

DYNAMIC RANGE

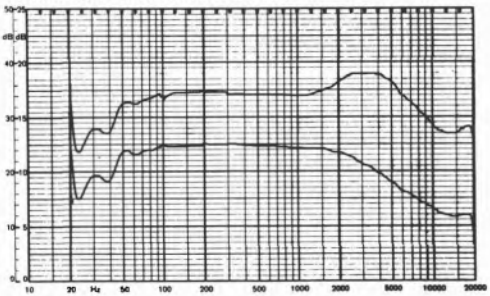
Ferric	61dB
FeCRO2/LN	—
Chrome	64dB

TAPE USED

Ferric	NAKAMICHI EX
FeCRO2/LN	—
Chrome	NAKAMICHI KR

Recommended Retail Price: £399.60

Nakamichi 700 Nakamichi KR Dolby In
Nakamichi 700: Nakamichi Fe Dolby In



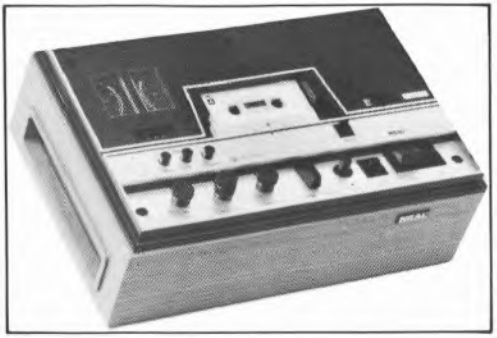
NEAL 102 Mk. II

North East Audio Labs Ltd., 5 Charlotte Square, Newcastle Upon Tyne. 0632 26660

Basically a slightly restyled and electronically improved version of the already established Mark 1, the recorder includes Dolby B processing and provision for ferric and chrome tape but not ferri-chrome. ¼" jack sockets are provided for micro-phone, a 5 pole DIN for interconnection with DIN equipment and also phono line in and out sockets. A ¼" stereo headphone jack gives ample level for both 8 ohm and 600 ohm type phones. An input switch selects mic. (slightly insensitive but with a reasonable clipping margin) DIN which is right along the optimum centre line of 10k ohms with adequate sensitivity and clipping, and line which is high impedance. This line input unfortunately clipped at 4V which is more than acceptable for normal users but might give clipping problems when inter-connected with semi-professional equipment. The machine employs the Wollensak deck but has British made electronics.

The unit is fairly well styled and is simple to operate, although the almost entirely mechanical deck is a little old fashioned in its operation. Rewind and wind could not be locked on but the machine requires only just over one minute to wind a complete C90 (rather noisily) which could possibly cause trouble to some cheaper cassettes. The record button is much better than that on the Wollensak machine but the pause control remains stiff in operation and rather inconvenient. Clearly the electronics are pretty well designed and the replay response was good with the correct bass time constants. The replay hum level was remarkably low and both replay and overall noise measured well. Whilst the response on ferric tape was excellent, both with and without Dolby, on chrome tape a slight hole in the response at around 4.5kHz was noted (see charts) and this gave a slightly spiky sound subjectively. The machine's overall distortion performance was excellent and in particular the remarkable low distortion figure of 0.5% was noted at Dolby level on ferric tape, which rose to only 2% when the level was increased by 4dB. Chrome tape also performed better than average, since distortion was only 1.3% at Dolby level. Slight squashing of high frequencies was noted on ferric tape due to the machine being set up for minimum distortion at middle frequencies, but this did not in any way cause problems subjectively. Unfortunately some phase jitter was noticed and the azimuth tended to vary somewhat when a cassette was re-loaded into the machine. The original model supplied had a faulty replay head, which had different azimuths for the two channels, and so it was necessary to re-test a second model, the subject of this review. The speed accuracy was remarkable, with an error of only 0.1%, and the wow and flutter varied between .07% and .1% through a cassette, again very good indeed considering the deck itself is quite an old design. Neal have carried out several mechanical modifications to the 3M deck to improve the performance and whilst this was clearly effective in general, occasional dropouts were noticed on the tested sample although not found previously in other models checked. The machine recorded speech extremely well with very low background noise and a good response, although a very slight distortion was suspected. The record level meters must be particularly highly praised for their very accurate reading of peak levels, a 64m sec pulse only under-reading by 1dB and even an 8m sec pulse only under-read 7dB!

No erase or cross talk problems were noted and in general the machine was found very reliable and functional. Electret or capacitor microphones are to be recommended with this machine because of its rather poor input sensitivity. Although TDK tape was used for the tests, other high quality high output types would also work well with the machine, but it might be necessary to adjust the internal record equaliser presets to obtain optimum response. Record and replay calibration presets are provided but these are best left untouched as should all internal presets since the manufacturers clearly set each machine up more than adequately. The machine is clearly pretty good value for money but does not contain some of the little trimmings avail-able on many imported machines. Interconnection with both DIN and phono equipment presents no problem and compatibility is clearly better than that of the Mark I version.



Replay Azimuth Deviation from Average	8°
Microphone Input Sensitivity	450μV
Microphone Input Clipping	38mV
Microphone Input Impedance Average	2.2K
DIN Input Sensitivity	2mV
DIN Input Clipping	180mV
DIN Input Impedance Average	10K
Line Input Sensitivity	40mV
Line Input Clipping	4V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	3.6
Ferric 10kHz Average Left and Right	−1.9
Chrome 10kHz Average Left and Right	−5.25

REPLAY NOISE

Ferric 20/20 worst channel	54dB
Ferric CCIR weighted Dolby Out	51½dB
Ferric Dolby Improvement	10½dB
Chrome CCIR weighted Dolby Out	54¾dB

Wow and Flutter Average	0.09%
Speed Average	+0.08%
Meter Under-read at 64ms	1dB

DISTORTION

At Dolby Level monitoring input	0.08%
Overall Ferric Av. L+R at Dolby Level	0.5%
Overall Ferric Av. L+R at +4dB	1.95%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	1.35%
Overall Chrome Av. L+R at +4dB	3.4%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	0
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	−½

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1½/ −1dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+1½/ −1.75dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	42.5dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	46½dB
Chrome Dolby Improvement	10dB

DIN Input Noise Degredation	0dB
Line Input Noise Degredation	1dB
Spooling Time	1m 06s

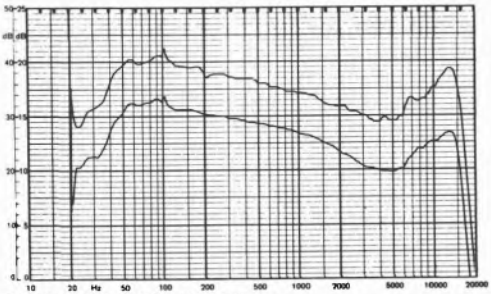
DYNAMIC RANGE

Ferric	64dB
FeCRO2/LN	—
Chrome	65.5dB

TAPE USED

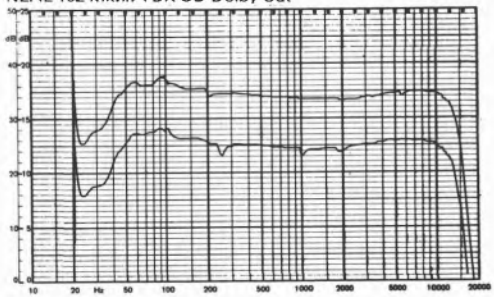
Ferric	TDK SD
FeCRO2/LN	—
Chrome	TDK KR

Recommended Retail Price: £195.00



NEAL 102 Mk.II: TDK KR Dolby In

NEAL 102 Mk.II: TDK SD Dolby Out



NEAL 103

North East Audio Labs Ltd., 5 Charlotte Square, Newcastle Upon Tyne. 0632 26660

Neal have realised over the last year that there are keen cassette recording enthusiasts who like to have not only a very good cassette recorder but one which will allow experimentation with different makes of cassette tape, obtaining optimum results on almost any brand. The model 103 is very similar to the 102 MkII, but includes separate mixer controls for mic, DIN and line inputs, each control having two separate concentric pots for the two channels and, like the 102 Mk II, user preset controls for ferric and chrome bias record equalisation and Dolby calibration levels. A push button permits the bias levels to be monitored, so that when changing a cassette tape type the bias can be reset to a different reading as explained in the extremely comprehensive and useful instruction book.

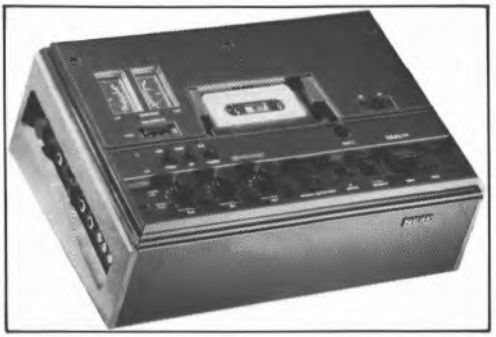
The general peformance was very similar to that of the 102 MkII but where differences were noted they were usually marginally better on the 103. The distortion levels, however, were very slightly inferior but our measurements show that this is primarily due to the bias settings adjusted by the manufacturer before delivery. Re-adjusting these produced an improvement in distortion at middle frequencies, but of course deteriorated the very high frequency squash performance. Whilst the ferric replay response was very good, the chrome one had insufficient shelf cut, and a further 1¾dB cut would have corrected the problem and improved the chrome replay and overall noise levels further. The deck itself was identical, wow and flutter was .09% and the speed accuracy was 0.45%, good but bettered (though perhaps unnecessarily) by many machines. No crosstalk or output clipping problems were encountered and whilst the DIN and line inputs were excellent the microphone input, although much more sensitive than the 102 MkII, had unfortunately a rather low clipping level of 15mV. This would definitely prevent users from recording loud pop music live without distortion. Input noise and distortion levels otherwise were excellent.

The Neal 103 incorporates a built in tone oscillator for setting Dolby level on recording very accurately and this can be switched in by depressing a button on the side panel. The pen charts show the ferric overall response with Dolby to be good but before the machine was re-biased more precisely a hole of some 3.5dB was noted in the response at 4kHz on chrome tape. NEAL agreed to a retest penchart recording with a lowering of bias level, and a resetting of Dolby calibration and equalisation on chrome tape. The second pen charts showed a considerable improvement at 4kHz but allowed the treble to rise somewhat at 14kHz, which was not considered serious.

The level meters surprisingly were even better than on the 102, having a most remarkable response at 64m sec (under-reading only −0.5dB) and 8m sec even more remarkably under-read only 4dB. This allows very precise setting of peak recording levels, so that if a user knows his favourite cassette tape brand well optimum performance can easily be obtained.

This machine in general performed excellently and reliably, although the tape itself had the same phase jitter, azimuth and slight dropout problem. It can undoubtedly be classed in many ways as one of the leaders and should therefore do very well.

After pointing out the chromium dioxide problem to NEAL they stated that they would redesign the record equaliser to match the new record head type that they are now fitting to this new model. It seems possible that part of the rise at 14kHz could be due to insufficient damping on replay, since test tapes are not available extending further than 12kHz for chromium and 10kHz for ferric. It is thus difficult to see whether the error in response at very high frequencies is on record or replay.



Replay Azimuth Deviation from Average	98°
Microphone Input Sensitivity	160μV
Microphone Input Clipping	16mV
Microphone Input Impedance Average	2K
DIN Input Sensitivity	4.6mV
DIN Input Clipping	580mV
DIN Input Impedance Average	10K
Line Input Sensitivity	68mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+3½
Ferric 10kHz Average Left and Right	+0.6
Chrome 10kHz Average Left and Right	−2½

REPLAY NOISE

Ferric 20/20 worst channel	54dB
Ferric CCIR weighted Dolby Out	52dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	55dB

Wow and Flutter Average	0.09%
Speed Average	−0.48%
Meter Under-read at 64ms	½dB

DISTORTION

At Dolby Level monitoring input	0.04%
Overall Ferric Av. L+R at Dolby Level	0.6%
Overall Ferric Av. L+R at +4dB	2.0%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	1.9%
Overall Chrome Av. L+R at +4dB	4.5%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−½
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	−1½

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1/ −1dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+½/ −1½dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	43½dB
Dolby Improvement	9½dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	46dB
Chrome Dolby Improvement	10dB

DIN Input Noise Degredation	0dB
Line Input Noise Degredation	0dB
Spooling Time	1m 08s

DYNAMIC RANGE

Ferric	64.5dB
FeCRO2/LN	—
Chrome	64dB

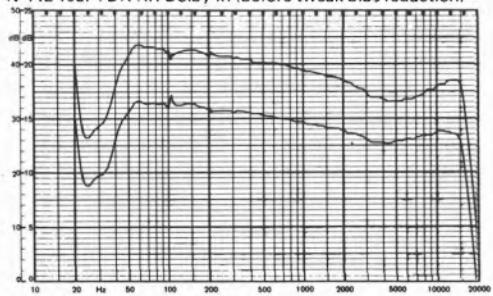
TAPE USED

Ferric	TDK SD
FeCRO2/LN	—
Chrome	TDK KR

Recommended Retail Price: £241.00

NEAL 103: TDK KR Dolby In (after tweak bias reduction)

NEAL 103: TDK KR Dolby In (before tweak bias reduction)



Philips N2515

Philips Electrical Ltd., Century House, Shaftesbury Avenue, London WC2. 01-437 7777

This deck does not include a Dolby noise reduction system, but has instead Philips DNL for replay only, which frankly serves purely as a hiss remover whilst unfortunately removing much of the sheen of quiet music as well. The overall noise performance was extremely good and indeed marginally superior to almost all machines incorporating Dolby but with the Dolby circuit not operating.

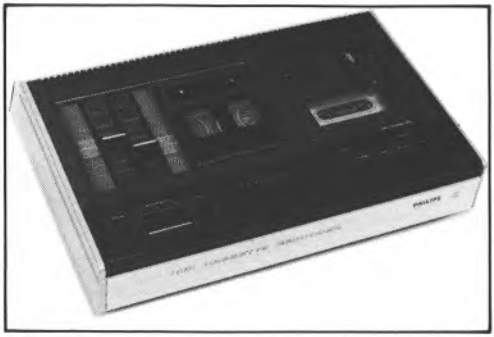
The mechanical functions were rather crude, and the stop button always had to be depressed before engaging any other function. The wow and flutter was very variable, measuring at worst 0.16% and at best 0.09%, and slight flutter was occasionally audible on pre-recorded cassettes. The comments are all based on a retest machine since the original machine regrettably had exceptionally bad wow and flutter measurements of 0.5%! The phase jitter was pretty low, but the azimuth was 30° out on delivery —not very good.

The overall response measured well on chrome, but unfortunately on ferric tape the right channel fell down very badly at 10kHz (—7dB). This was a pity, since otherwise the overall sound quality on ferric tape was very good. The distortion measured only 0.5% average at Dolby level, and rose fairly slowly at higher levels so that subjectively very low distortion was heard. In fact on an average programme using very high quality cassette tape the hiss level was almost acceptable, despite the absence of overall noise reduction.

The stereo cross talk performance left a little to be desired, although probably in normal practice few would be concerned with the figures which measured worse than they really sounded. The erase and cross talk between tracks were very satisfactory. A fairly inexpensive Philips microphone, type N8402 was supplied for testing with this machine, and whilst recordings were made with surprisingly low noise, the mic had almost no bass response at all, and a very hard top. The DIN input socket worked well, but note that no monitoring is possible whilst recording since there is not even a headphone jack. The input circuits were well designed and no noise degradation was noted on overall DIN or phono inputs.

Dolbyed pre-recorded cassettes had to have approximately 8dB cut at 10kHz added externally to produce a reasonably acceptable sound, although reverberation "pumping" was quite clearly audible. The hiss level under such circumstances was fairly low, but it was not felt that the machine was compatible with Dolbyed cassettes, from a really high quality stand point. The DNL system seemed to be more or less pointless, and more acceptable results could be achieved without noise pumping if treble was reduced externally to cut top on hissy cassettes. The machine worked reliably, though, and is extremely simple to operate. It is a great improvement on earlier Philips machines. It is unfortunate that since there are some good machines with Dolby noise reduction available at similar prices, this machine cannot really be said to be good value for money. It would work well, though, with an external Dolby B system if the user already has one working with a reel to reel recorder.

Incidentally, if the machine is in play and pause, and the stop button is accidentally half depressed, there is a tendency for the cassette to be mangled. This should be corrected.



Replay Azimuth Deviation from Average	38°
Microphone Input Sensitivity	170μV
Microphone Input Clipping	40mV
Microphone Input Impedance Average	1.2K
DIN Input Sensitivity	2.5mV
DIN Input Clipping	660mV
DIN Input Impedance Average	18K
Line Input Sensitivity	132mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+1.2
Ferric 10kHz Average Left and Right	+0.63
Chrome 10kHz Average Left and Right	−1.88

REPLAY NOISE

Ferric 20/20 worst channel	50dB
Ferric CCIR weighted Dolby Out	52dB
Ferric Dolby Improvement	—
Chrome CCIR weighted Dolby Out	58dB

Wow and Flutter Average	0.13%
Speed Average	+0.1%
Meter Under-read at 64ms	6dB

DISTORTION

At Dolby Level monitoring input	—
Overall Ferric Av. L+R at Dolby Level	0.5%
Overall Ferric Av. L+R at +4dB	1.2%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	1.8%
Overall Chrome Av. L+R at +4dB	4.0%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−3
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	+2

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0.75/ −4.0dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+2/ −2dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	46.25dB
Dolby Improvement	—
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	50dB
Chrome Dolby Improvement	—

DIN Input Noise Degredation	0dB
Line Input Noise Degredation	—
Spooling Time	1m 48s

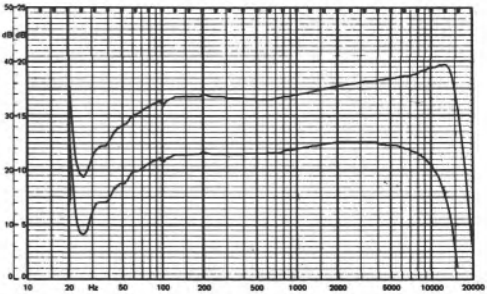
DYNAMIC RANGE

Ferric	58.5dB
FeCRO2/LN	—
Chrome	57.5dB

TAPE USED

Ferric	BASF SUPER LH
FeCRO2/LN	—
Chrome	PHILIPS KR

Recommended Retail Price: £120.00



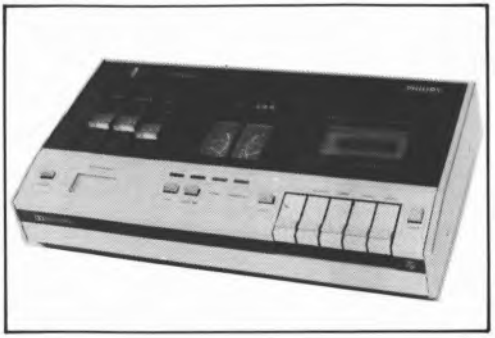
Philips N2515: Philips CRO2 without Dolby
Philips N2515: BASF Super LH without Dolby

Philips N2520

Philips Electrical Ltd., Century House, Shaftesbury Avenue, London WC2. 01-437 7777

This is the latest model from the Philips stable and includes both Dolby B processing and the Philips DNL system. The mic inputs have two separate faders allocated to them for left and right but the DIN input has a separate stereo ganged fader, so that the balance of the input signal must be corrected to achieve optimum recording levels on both channels. Record Dolby calibration presets are provided for setting A/B levels on both ferric and chromium cassettes and a tone oscillator is also included to facilitate this alignment. The two VU meters were significantly better than average, under-reading a 64m sec tone burst by only 3dB. It is thus fairly simple to set accurate peak recording levels. Two 5 pole DIN sockets are provided for microphone inputs, the left wired for a stereo mic, although a mono mic will plug through to one channel, whilst the other socket is purely wired for the alternate channel for mono. This allows either a single stereo mic or two mono mics to be used for a stereo recording. The input impedance was rather high at 25k ohms and the sensitivity was 280uV and thus electrets will be found more suitable than moving coil types. Although clipping was not noticed until 70mV was reached, distortion slowly increased from a somewhat lower level up to the clipping point. A normal 5 pole DIN in/out socket is complemented by an extra monitoring socket, wired for monitor only, live during recording, whereas the normal socket of course is muted during recording. The DIN input sensitivity measured 940uV into an impedance of 11k ohms and clipped at 170mV, all of which was very satisfactory, although 2dB noise degradation occurred from a standard DIN source. The output impedance measured rather high and treble loss could be experienced with long connecting leads. The machine did not prove to be sufficiently stable mechanically, for considerable head/tape contact problems arose on playing back pre-recorded cassettes. Furthermore some azimuth wander was detected and the 10kHz stability test proved most unfortunate, variations of up to 7.5dB being noted with the not over fast pen speed used for the chart. Not withstanding this problem, the wow and flutter itself measured about average at 0.11% and it had an excellent speed accuracy within 0.3%. As would be expected from the originators of the cassette system the azimuth was set very accurately, but the replay gaps were not perfectly in line with one another. Unfortunately some treble loss was noted on play back of 2.5dB at 10kHz, although the chrome response was virtually correct. The low frequency end was virtually correct on both tape types, showing Philips to be fully up to date with the new international standard. The replay response was not at all easy to measure because of the tape stability problem and pre-recorded cassettes tended to sound muffled. The replay signal to noise performance measured slightly better than average and the Dolby circuit gave a full 10dB noise reduction on replay.

The overall distortion on BASF Super LH tape measured very low on the left channel at 0.5%, but higher than optimum on the right channel at 1.1%. This showed uneven biasing. Thus at +4dB the left channel rose to only 1.7%, but the right shot up to a rather high 4.5%. Quite clearly the under-biasing also showed up in the response pen charts, for although the left channel was fairly flat, the right one reached an alarming boost of 6dB at 10kHz. This all showed lack of careful quality control. Philips chrome tape gave a similar uneven performance on the two tracks, the left channel reaching 6.3% at +4dB, whilst the right gave 10% at +4dB. The response showed 3.5dB lift at 10kHz on the left, but 4.5dB on the right. Unfortunately the sound quality on both ferric and chrome tape was rather unsatisfactory, mainly due to mechanical problems, but obviously caused in part by lack of correct biasing. Perhaps another sample might have measured better. It seems that electronically the machine was very well designed, for the overall signal to noise ratio with Dolby in measured 53dB for ferric, and 55.5dB for chrome. These figures would have been even better with correct biasing. Quality control and mechanical performance will have to be improved for this model to be competitive. Although no erase problem was encountered, a very poor high frequency cross talk was measured at 5kHz, averaging only 16.5dB and this is presumably due to the wiring of the DIN sockets. Bearing in mind the machine has no phono inputs and is thus only particularly recommended for interconnection with DIN receivers, it cannot be regarded as good value for money.



Replay Azimuth Deviation from Average	3°
Microphone Input Sensitivity	280μV
Microphone Input Clipping	70mV
Microphone Input Impedance Average	25K
DIN Input Sensitivity	940μV
DIN Input Clipping	170mV
DIN Input Impedance Average	11K
Line Input Sensitivity	—
Line Input Clipping	—
Line Input Impedance Average	—

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+5.5
Ferric 10kHz Average Left and Right	−2.25
Chrome 10kHz Average Left and Right	0

REPLAY NOISE

Ferric 20/20 worst channel	49.5dB
Ferric CCIR weighted Dolby Out	50.25dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	54dB
Wow and Flutter Average	0.11%
Speed Average	+0.15
Meter Under-cead at 64ms	3.25dB

DISTORTION

At Dolby Level monitoring input	0.04%
Overall Ferric Av. L+R at Dolby Level	0.8%
Overall Ferric Av. L+R at +4dB	3.1%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	3.75%
Overall Chrome Av. L+R at +4dB	8.1%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+2.5
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	+2.75

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+2.75/ −0.5dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+3.5/ −0.5dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	43dB
Dolby Improvement	9½dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	46.25dB
Chrome Dolby Improvement	9dB
DIN Input Noise Degredation	1.25dB
Line Input Noise Degredation	—
Spooling Time	1m 45s

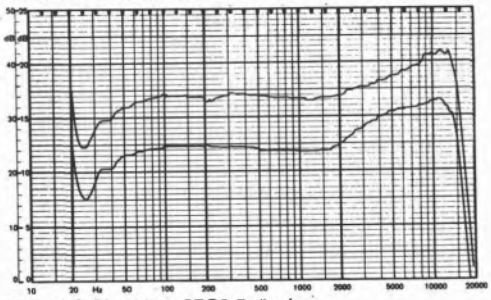
DYNAMIC RANGE

Ferric	63dB
FeCRO2/LN	—
Chrome	61dB

TAPE USED

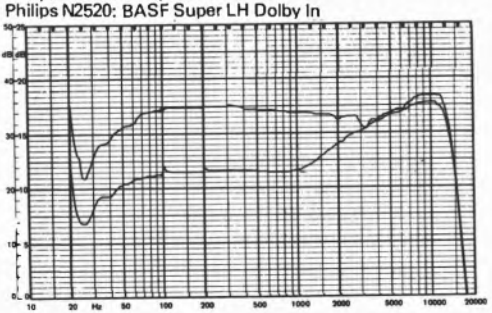
Ferric	BASF SUPER LH
FeCRO2/LN	—
Chrome	PHILIPS KR

Recommended Retail Price: £214.13



Philips N2520: Philips CRO2 Dolby In

Philips N2520: BASF Super LH Dolby In



Pioneer CT-F2121A

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

Despite this machine being modestly priced and having only basic facilities, with Dolby B processing, VU meters but no peak reading light, and mic/DIN and line inputs without mixing or switching, it produced a very fine overall performance, which was bettered by very few others in some respects. The replay response on ferric tape was very fine indeed, measuring virtually flat to 10kHz on both channels with the correct bass compensation and a similar excellent replay response for chrome tape. The unweighted signal to noise ratio was about the best measured, averaging −57.5dB below Dolby level, and quite remarkable for a cassette recorder. There was virtually no hum on either record or replay, and even the hiss was appreciably better than average, Dolby showing an improvement generally of about 9.5dB, and on chrome the improvement over ferric averaged 3.5dB. The overall noise measured well above average, the outstanding replay figures of 58dB (weighted) being measured ref. Dolby level, on chrome tape with Dolby processing switched in. The overall response was extraordinarily good with ferric, ferrichrome and chromium tapes. The machine was also superbly well set up with the correct bias voltages on all three tape types. Ferric tape (Sony HF) gave a distortion of only 0.55% at Dolby level, rising to only 1.9% at +4dB. Sony ferrichrome tape fared even better, with the same distortion at Dolby level but only 1.2% at +4dB, whilst chrome tape, as would be expected, had more distortion at Dolby level (1.6%) rising to 3.8% at +4dB. These figures alone are very remarkable, but when added to the flat overall response for all three types, the recorder gave a performance in the absolute top class, with a very wide dynamic range and brightness of sound which was a sheer joy to hear on the cassette medium. The frequency response at −10dB on ferric tape though did show some appreciable squash at 10kHz, although remarkably little at 8kHz, and this was produced by the bias setting which was optimised for lowest distortion at middle frequencies whilst accepting slightly inferior extreme hf power performance. The general sound though was so good that the squash was perfectly acceptable. Ferrichrome tape of course fared better as would be expected, and in any case had a noticeably better signal to noise ratio. In order to use ferrichrome Pioneer have arranged matters so that the bias switch should be on normal but the equalisation on chrome, the appropriate bias and equalisation being internally set up as necessary.

A Sony stereo electret microphone was used, and produced a very fine quality speech recording with low distortion and a wide frequency response. Slightly more hiss than usual was noted here, but this might well have been due to the recorder having such a flat response, whereas others frequently cut the hiss produced inherently in the cassette process because of poor hf performance. The sensitivity was adequate for an electret microphone, but was not high enough for 200ohm moving coil mics. The clipping margin was extremely good, some 73mV being required before distortion would become noticeable. The DIN input also fared very well with virtually the same sensitivity and clipping margin but with an input impedance at 2.8k ohms. No noise degradation was observed from a DIN source, and thus this machine would be very easy to match with any DIN receiver. The line input varied in impedance from 60 to 60k ohms depending upon the position of the record gain control, and had a sensitivity of 72mV. No clipping was noted even when 10V input was derived from a low distortion oscillator. The output impedance measured 3.8k ohms, and this would appear to be optimum for interconnection with external equipment. The VU meters were purely average, under reading 7dB on a 64m sec burst, and the lack of a peak reading light is probably the only minor criticism that could be made of the recorder, since care will have to be taken not to over record. The wow and flutter measured 0.12% which is average, and in general use wow would only be noticed on instruments such as the piano which are very susceptible to this effect. The speed accuracy was +0.45% average, and the A/B phase measured very slightly inferior, but averaging ±15°. The machine appeared to have a pretty consistent azimuth which on delivery measured −20° at 3kHz, perfectly acceptable.

This machine, then, must be regarded as extremely good value for money and is strongly recommended.

Replay Azimuth Deviation from Average	12°
Microphone Input Sensitivity	320μV
Microphone Input Clipping	73mV
Microphone Input Impedance Average	28K
DIN Input Sensitivity	465μV
DIN Input Clipping	73mV
DIN Input Impedance Average	2.8K
Line Input Sensitivity	72mV
Line Input Clipping	>10V
Line Input Impedance Average	68K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+2
Ferric 10kHz Average Left and Right	0
Chrome 10kHz Average Left and Right	−4

REPLAY NOISE

Ferric 20/20 worst channel	57.5dB
Ferric CCIR weighted Dolby Out	52.5dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	56dB

Wow and Flutter Average	0.12%
Speed Average	+0.45%
Meter Under-read at 64ms	−7dB

DISTORTION

At Dolby Level monitoring input	0.05%
Overall Ferric Av. L+R at Dolby Level	0.53%
Overall Ferric Av. L+R at +4dB	2.0%
Overall FeCRO2/LN Av. L+R at Dolby Level	0.5%
Overall FeCRO2/LN Av. L+R at +4dB	1.25%
Overall Chrome Av. L+R at Dolby Level	1.55%
Overall Chrome Av. L+R at +4dB	3.8%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	0
10kHz FeCRO2/LN Dolby Out Av. L+R	−2
10kHz Chrome Dolby Out Av. L+R	−1.5

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1/ −0.75dB
Ref. 333Hz FeCRO2/LN	+1/ −2.75dB
Ref. 333Hz Chrome	+1/ −1.75dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	44.5dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	48dB
FeCRO2/LN Dolby Improvement	9½dB
Chrome CCIR weighted Av. L+R Dolby Out	48dB
Chrome Dolby Improvement	9½dB

DIN Input Noise Degredation	0.25dB
Line Input Noise Degredation	0.5dB
Spooling Time	2m

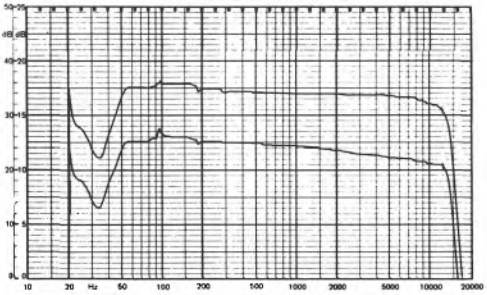
DYNAMIC RANGE

Ferric	66dB
FeCRO2/LN	70dB
Chrome	66.5dB

TAPE USED

Ferric	SONY HF
FeCRO2/LN	SONY $FeCrO_2$
Chrome	TDK KR

Recommended Retail Price: £138.08



Pioneer CT-F2121:TDK KR Dolby Out

Pioneer CT-F2121: Sony HF Dolby Out

Pioneer CT-F6161A

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

The Pioneer CTF 6161 is a front loader with Dolby B processing. It has a single dual concentric record level control used for all inputs. A similar line out control is provided to vary the output level. Phono line in, 5 pole DIN and ¼" mic jack inputs are provided. The microphone input sensitivity was very adequate, even for speech recording, and all the clipping margins were more than enough to cope with even special requirements. The DIN input impedance of 1.8k ohms was rather too low, and caused slight hiss to be added to low level DIN input signals. When the line input was used, considerable hiss was added on low level signals, and to obtain optimum noise performance quite a high level is required (eg 600mV). When copying master tapes the excellent signal to noise ratio (CCIR weighted) of 60dB was achieved on chrome tape, peaking 3dB over Dolby level. Unfortunately on chrome the high frequency response was noticeably muffled, and the pen chart shows a typical fall off of 5dB at 10kHz. Ferric tape sounded much better, although the originally recommended ordinary BASF LH did restrict the dynamic range somewhat, but was nevertheless better than other machines set up for this tape. BASF Super LH performed much better, and gave a solid firm sound with a fairly extended response. Prerecorded cassettes sounded pretty well, but a slight fall off of high frequencies was noted on the right channel. The wow and flutter did not measure too well (0.15%), and gave slight flutter on woodwind and some wow on horns and piano, but nevertheless the overall sound quality was more than acceptable, particularly considering the modest price of the machine.

The speed accuracy was extremely good (averaging +.15%). Rewind speed was about average at just under 2 minutes.

Mechanical operation of the deck was extremely smooth, and its ability to go directly from play in to wind and back again without the stop button being depressed was considered very useful. Furthermore when in play, a "skip" button allows the tape speed to increase considerably to reach a required point more quickly, the tape running in contact with the heads. The VU meters under-read a 64m sec pulse by 6dB and thus care will have to be taken to avoid recording at too high a level since no peak reading lights are provided.

Very good cross talk and erase figures were recorded. The distortion figures on chromium tape were extremely low at only 0.7% for Dolby level, making it about the best machine tested on chrome, but since the high frequency response was rather poor, clearly chrome tape was overbiased, and a little more distortion could be tolerated since the response would then be correct.

On delivery, the azimuth was incorrect (3kHz play back test giving 40° phas error). Nevertheless the azimuth was very stable as shown by the very low measured phase jitter of ±10° at 10kHz, with just occasional peaks outside these margins. The machine can be regarded as good value for money, although the DIN and line inputs require slight redesign to overcome the hiss problem if the record level control is used at a high setting, and chrome tape would be suitable if the bias was readjusted. It can therefore be recommended with caution, but check that in your installation you have an adequate input level to the recorder. Hiss was added if the record level was advanced beyond about 1 o'clock.

Replay Azimuth Deviation from Average	38°
Microphone Input Sensitivity	215μV
Microphone Input Clipping	135mV
Microphone Input Impedance Average	70K
DIN Input Sensitivity	222μV
DIN Input Clipping	135mV
DIN Input Impedance Average	1.8K
Line Input Sensitivity	55mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+0.75
Ferric 10kHz Average Left and Right	−2
Chrome 10kHz Average Left and Right	−6.5

REPLAY NOISE

Ferric 20/20 worst channel	51.5dB
Ferric CCIR weighted Dolby Out	50dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	52.75dB
Wow and Flutter Average	0.15%
Speed Average	+0.12%
Meter Under-read at 64ms	−6dB

DISTORTION

At Dolby Level monitoring input	0.13%
Overall Ferric Av. L+R at Dolby Level	1.9%
Overall Ferric Av. L+R at +4dB	4.75%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	0.72%
Overall Chrome Av. L+R at +4dB	2.0%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−2
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	−4.25

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1.0/ −2.0dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+0.5/ −6.0dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	43.5dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	47.25dB
Chrome Dolby Improvement	10dB
DIN Input Noise Degredation	3dB
Line Input Noise Degredation	1.25dB
Spooling Time	1m 55s

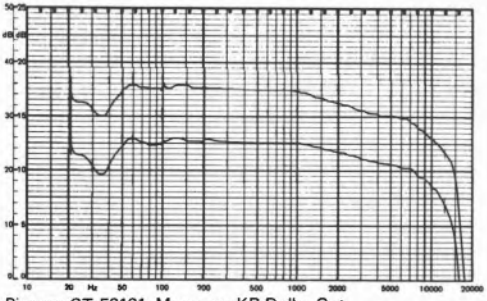
DYNAMIC RANGE

Ferric	61dB
FeCRO2/LN	—
Chrome	68.5dB

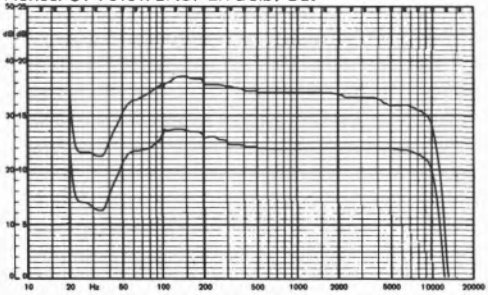
TAPE USED

Ferric	BASF LH
FeCRO2/LN	—
Chrome	MEMOREX KR

Recommended Retail Price: £168.50



Pioneer CT-F6161: Memorex KR Dolby Out



Pioneer CT-F6161: BASF LH Dolby Out

Pioneer CT-F7171A

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

This recorder, which incorporates Dolby B processing, has very comprehensive facilities allowing transfer from any function to any other including drop in to record whilst playing, and dropping out again. Line out controls are provided but these worked on play back only since whilst recording the monitor output level was purely controlled by the position of the record levels. Two microphone input ¼" jacks gave a sensitivity of 220uV at very high impedances. This input had an astounding clipping level of 120mV. The five pole DIN socket had a rather low input impedance of 1.8k ohms, and sensitivity and clipping identical to the microphone input's. Slight noise degradation of 1.5dB was added from the standard DIN source. The line inputs (phono) had considerable noise degradation of 7.5dB from a 100mV source, and quite clearly much too much attenuation was incorporated. The VU meters under read 8dB, but peak reading lights come on at 2dB above Dolby level, thus allowing recording levels to be reasonably easily set. A limiter is provided for the record amplifier, and worked satisfactorily, although it was not ganged. The ferric replay response had an incorrect bass end, and drooped 2dB at 10kHz, and some pre-recorded cassettes sounded slightly muffled. On delivery the azimuth was mis-set 45° phase at 3kHz, and would have degraded the reproduction of pre-recorded cassettes; however it was corrected for the tests. Chrome equalisation was correct at lower frequencies and very marginally up at high ones, and thus there was less than 2dB difference in the treble and equalisation between chrome and ferric. This difference of course should have been 4.7dB. This was also noticed in the replay noise characteristics which were almost identical for the two tape equalisations, averaging −50dB weighted without Dolby, improving by 10dB with Dolby. The chrome figure was frankly a little below average and disappointing. The overall ferric noise with Dolby measured quite well at 53dB below Dolby level (weighted with Dolby in), but chrome tape produced only 1dB noise improvement.

The wow and flutter averaged .1%, which was pretty good. Some phase jitter was noted at 10kHz, showing the deck to be rather below average, but this was probably a sample variation. The spooling time was adequate at just under two minutes. The erase was very satisfactory, but a very slight breakthrough at low frequencies at 46dB was noted between the right hand channel in each direction, showing the record/replay head to be slightly too low vertically.

Normal BASF LH C90 cassettes were stipulated originally for this machine, and produced distortion of 1.9% at Dolby level, rising to 4.6% at +4dB. The response was very uniform between the two channels, but showed a fall off of 2.5dB at 10kHz with Dolby processing in. When Dolby level was read as indicated by the meter the level played back approximately 4dB low, showing incorrect factory alignment. A more suitable tape would have been BASF Super LH which would have given markedly lower distortion and a flatter response, and its greater sensitivity would have given a more uniform A/B balance. With an ordinary LH C90 the subjective sound quality showed slightly higher distortion than average, particularly at lower frequencies, and one clear drop out was noted. Memorex chrome tape fared very well, giving distortion at Dolby level of only 1.3%, rising to only 3.2% at +4dB. The response, almost that without Dolby, showed a 2.5dB loss at 10kHz with Dolby in, but the sound quality produced was very fine indeed for chrome tape. Microphone recordings reproduced exceptionally well, with remarkably low distortion, showing that basically the machine is well designed. More attention is required, though, in the input circuitry and in optimising the replay noise particularly on chrome, and the bass time constant should also be corrected on ferric equalisation. This machine then shows considerable promise, and if used with one of the new Super ferric tapes should give good recorded quality since it already is excellent on Memorex chrome. Unfortunately, competition is so stiff that the CTF 7171 cannot really be regarded as good value for money unless the criticisms are heeded by the manufacturer.

Replay Azimuth Deviation from Average	53°
Microphone Input Sensitivity	220μV
Microphone Input Clipping	130mV
Microphone Input Impedance Average	70K
DIN Input Sensitivity	220μV
DIN Input Clipping	130mV
DIN Input Impedance Average	1.8K
Line Input Sensitivity	57mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+1.25
Ferric 10kHz Average Left and Right	−2
Chrome 10kHz Average Left and Right	−3.75

REPLAY NOISE

Ferric 20/20 worst channel	52dB
Ferric CCIR weighted Dolby Out	49.25dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	50.25dB

Wow and Flutter Average	0.1%
Speed Average	−0.3%
Meter Under-read at.64ms	8dB

DISTORTION

At Dolby Level monitoring input	0.12%
Overall Ferric Av. L+R at Dolby Level	1.9%
Overall Ferric Av. L+R at +4dB	4.6%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	1.2%
Overall Chrome Av. L+R at +4dB	3.2%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−1
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	+5

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1.5/ −2.0dB
Ref. 333Hz FeCRO2/LN	+ —
Ref. 333Hz Chrome	+0.75/ −1.25dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	43.25dB
Dolby Improvement	9.5dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	44.5dB
Chrome Dolby Improvement	9.5dB

DIN Input Noise Degredation	1.5dB
Line Input Noise Degredation	7.75dB
Spooling Time	1m 55s

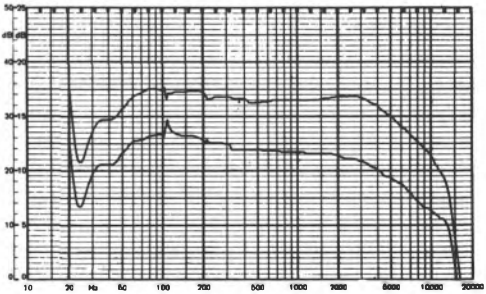
DYNAMIC RANGE

Ferric	61dB
FeCRO2/LN	—
Chrome	64dB

TAPE USED

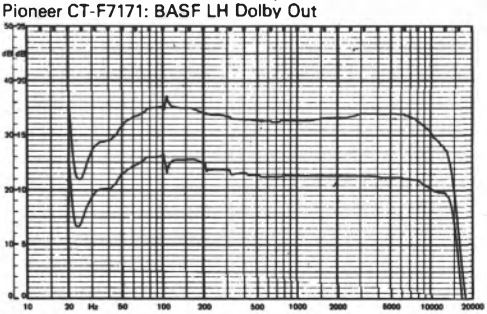
Ferric	BASF LH
FeCRO2/LN	—
Chrome	MEMOREX KR

Recommended Retail Price: £189.73



Pioneer CT-F7171: BASF LH Dolby In

Pioneer CT-F7171: BASF LH Dolby Out



The CTF 9191 can be regarded as a front loader with a difference in that it has many special features, and is one of the heaviest cassette recorders in the world (12 kg). Although it was conventional for early machines to keep weight and size down, this is to a degree irrelevant since performance and ease of use are far more important.

Separate pairs of concentrically mounted rotatable gain controls are provided for mic/DIN, line phono and output level (varying replay only and not monitoring levels). The machine has two heads and Dolby B processing, a record limiter, and a peak reading light between the fairly large VU meters. These meters, however, under-read a 64m sec burst by some 9dB. The peak reading light operated with peaks exceeding +2dB over Dolby level even on only an 8m sec transient, and could with advantage have been set to operate at a higher level, since the machine's distortion performance is extremely good and will permit recording of very high levels without distress.

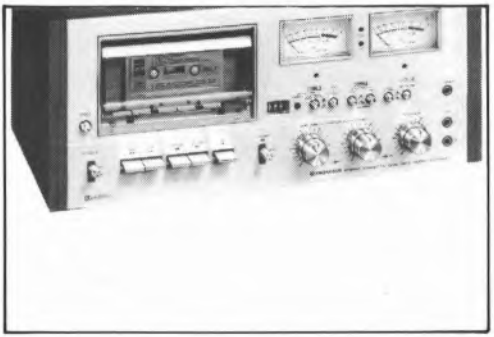
The rotary volume controls each have a flange which can be set as a marker for correct record level settings from different sources.

The microphone inputs (¼" jack sockets on the front) were just a little insensitive at 300uV, but the clipping margin was really excellent. A strange anomaly resulted when a stereo microphone having a common earth was plugged in, since bad hum resulted, which completely disappeared when only one jack was inserted, showing a bad earth loop in the chassis. The input impedance here also was a little high, and thus optimum hiss was not reached for low impedance moving coil microphones. The DIN input impedance was much too low at 2.1k ohm, and could tend to introduce noise from low output level DIN tuner amplifiers, although at specified DIN levels almost no noise degradation took place. The line input sensitivity was excellent, and any input level could be accommodated without distress. The record level limiter worked very well with its threshold set at a sensible tape distortion level, so that even when an input programme was driving it very hard, distortion was not apparent, although the recovery time was a little on the fast side, thus causing slight pumping when driven hard.

Pre-recorded cassettes played back extremely well, but on delivery a slight azimuth error was noted (30° at 3kHz). The replay response was good, particularly at the high frequency end, but unfortunately Pioneer still use the old bass time constant, so some pre-recorded cassettes will play back with slight bass loss.

Despite the bass boost necessary on record, however, to obtain an overall flat response, bass distortion was not really noticeable at fairly high recording levels on ferric tape, since both biasing and eq were exceptionally well adjusted. The ferric overall response with Dolby in was very good indeed, but quite outstanding was the remarkably low distortion on Sony HF and BASF Super LH—below 0.6% rising to only 1.5% at +4dB and 4.5% at 8dBl This gave an extremely clean sound up to very high levels. Although the chrome sound was good, it was clearly not biased correctly, since the left channel showed a fairly sharp rise at 10kHz and the right channel an equivalent fall off. This produced a rather lop-sided treble response, fairly evident on any normal input programme. Whilst the replay noise levels were only average, the overall noise performance, which after all is what really matters, was extremely good, and bear in mind the machine's amazing distortion performance and the very wide dynamic range that could be recorded, even though a very slight hum was audible on replay in very quiet passages. The stability was excellent, and no drop outs were audible at any time. There was no erase problem, and the cross talk measured well.

The overall sound on ferric was so good that for a moment it was thought that we were listening to the master rather than the cassette. High praise indeed. And, had the chromium biasing been more precisely set, results probably just as good, or even better, might have been noted. The wow and flutter measured just under .1% and the speed was 0.3% slow, whereas most machines seemed to run a fraction fast. This is perfectly satisfactory for all normal purposes. This machine should do well, since its price seems very fair, and the presentation excellent. The method of loading and unloading the cassette was not liked—but this is a matter for personal preference.



Replay Azimuth Deviation from Average	22°
Microphone Input Sensitivity	290μV
Microphone Input Clipping	105mV
Microphone Input Impedance Average	50K
DIN Input Sensitivity	305μV
DIN Input Clipping	105mV
DIN Input Impedance Average	2.1K
Line Input Sensitivity	82mV
Line Input Clipping	)10V
Line Input Impedance Average	92K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	0
Ferric 10kHz Average Left and Right	−1.3
Chrome 10kHz Average Left and Right	−5½

REPLAY NOISE

Ferric 20/20 worst channel	50dB
Ferric CCIR weighted Dolby Out	49.5dB
Ferric Dolby Improvement	10.5dB
Chrome CCIR weighted Dolby Out	53dB

Wow and Flutter Average	0.1%
Speed Average	−0.27%
Meter Under-read at 64ms	−9dB

DISTORTION

At Dolby Level monitoring input	0.03%
Overall Ferric Av. L+R at Dolby Level	0.56%
Overall Ferric Av. L+R at +4dB	1.5%
Overall FeCRO2/LN Av. L+R at Dolby Level	0.5%
Overall FeCRO2/LN Av. L+R at +4dB	1.0%
Overall Chrome Av. L+R at Dolby Level	1.8%
Overall Chrome Av. L+R at +4dB	6.0%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−2
10kHz FeCRO2/LN Dolby Out Av. L+R	−3.5
10kHz Chrome Dolby Out Av. L+R	−1

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+¼/ −2dB
Ref. 333Hz FeCRO2/LN	+¼/ −4dB
Ref. 333Hz Chrome	+¼/ −1.5dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	44.25dB
Dolby Improvement	9.5dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	47.75dB
FeCRO2/LN Dolby Improvement	8dB
Chrome CCIR weighted Av. L+R Dolby Out	47.75dB
Chrome Dolby Improvement	8.75dB

DIN Input Noise Degredation	0.5dB
Line Input Noise Degredation	0.25dB
Spooling Time	1m 30s

DYNAMIC RANGE

Ferric	66.5dB
FeCRO2/LN	68dB
Chrome	63.5dB

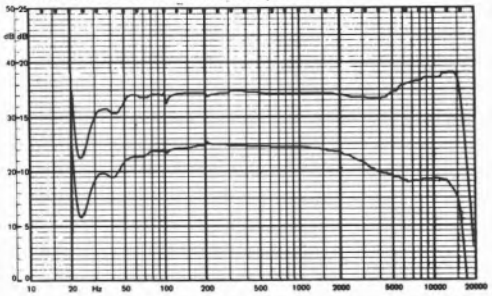
TAPE USED

Ferric	SONY HF
FeCRO2/LN	SONY $FeCrO_2$
Chrome	TDK KR

Recommended Retail Price: £277.55

Pioneer CT-F9191: Sony HF Dolby In

Pioneer CT-F9191: TDK KR Dolby In



A very simple machine to operate, it includes only basic facilities, Dolby B processing and a ¼" microphone jack, and 5 pole DIN and line in/out phono sockets. Four rotary gain controls provide settings for left and right input and output levels. The VU meters under read 6dB at a 64m sec burst.

On replay the response drooped slightly at 10kHz, being −3dB, and an equal droop was noticed on the chromium equalisation position. Unfortunately the replay hiss level was somewhat higher than average, and this added just noticeably to the hiss on pre-recorded cassettes. The Dolby circuits did, however, give a full 10dB noise reduction on replay. The stability was good and no drop outs were audible, although the phase jitter showed variations of up to ±15° at 10kHz which is only just below average.

The overall distortion on ferric TDK SD tape was exceptionally low at below 0.5%, and this therefore produced very clean recordings which subjectively had a very wide response, although there was a droop of approximately 3dB at 10kHz. Since the replay showed the same droop, it is clear that the record facilities were initially perfectly flat and had the factory adjusted the replay side correctly response and distortion would be virtually beyond criticism. The signal to noise was affected by the poor average replay noise figures, and the recording therefore reproduced on the machine with approximately 4dB more hiss than optimum. As it is possible to record very high levels without distortion, though, this is less worrying than it might have been. Chromium tape measured approximately 4dB down at 10kHz, and thus recordings began to lose their brilliance slightly. The distortion at Dolby level measured 1.6%, better than average, and decreasing the bias slightly would have considerably improved the response. The overall recorded sound was pretty good. The microphone input sensitivity was rather poor, since 480uV were required for Dolby level, and undoubtedly an electret microphone becomes essential for a reasonable recording level to be reached on most sounds. The input impedance was 8.2k ohms, and the clipping level excellent. The DIN input sensitivity was 14mV, which was rather insensitive considering the input impedance was 20k ohms, although the clipping margin was very good indeed. Unfortunately the sensitivity here nowhere near conforms to the DIN specification, although in practice, since any noise degradation occurred at the standard DIN input level, most DIN receivers will provide an adequate input. The line input sensitivity at 72mV into high impedance was very satisfactory. No degradation occurred at 100mV input level, and very high levels indeed did not cause any distress. The wow and flutter at 0.11% must be regarded as very good for the machine's most modest price, and the general stability was highly satisfactory. Subjectively, the recorder behaved very well and the deck controls were liked. It is a pity that the noise performance rather let down the machine which in other respects performed well, and if Sansui could improve this the 737 could be regarded as reasonable value for money. As it stands now it can still be recommended, but high quality cassette tape must be used to achieve a reasonable dynamic range. Perhaps another sample might have a better signal to noise ratio, but since both channels had the same problem it is almost certain that the noise is basically caused by a design fault rather than setting up. Still, a good buy for its price.

Replay Azimuth Deviation from Average	5°
Microphone Input Sensitivity	480μV
Microphone Input Clipping	115mV
Microphone Input Impedance Average	8.5K
DIN Input Sensitivity	14mV
DIN Input Clipping	)10V
DIN Input Impedance Average	20K
Line Input Sensitivity	72mV
Line Input Clipping	)10V
Line Input Impedance Average	100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+1.5
Ferric 10kHz Average Left and Right	−2¾
Chrome 10kHz Average Left and Right	−7¼

REPLAY NOISE

Ferric 20/20 worst channel	50dB
Ferric CCIR weighted Dolby Out	45¾dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	49½dB

Wow and Flutter Average	0.11%
Speed Average	+0.35
Meter Under-read at 64ms	6dB

DISTORTION

At Dolby Level monitoring input	0.07%
Overall Ferric Av. L+R at Dolby Level	0.4%
Overall Ferric Av. L+R at +4dB	2.0%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	1.6%
Overall Chrome Av. L+R at +4dB	4.3%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−1½
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	−1¾

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1.0/ −3.25dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+0.75/ −2.5dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	40dB
Dolby Improvement	9¼dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	44¾dB
Chrome Dolby Improvement	7¼dB

DIN Input Noise Degredation	0dB
Line Input Noise Degredation	0dB
Spooling Time	2m 12s

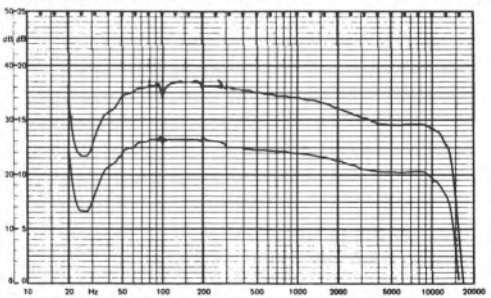
DYNAMIC RANGE

Ferric	61dB
FeCRO2/LN	—
Chrome	60.5dB

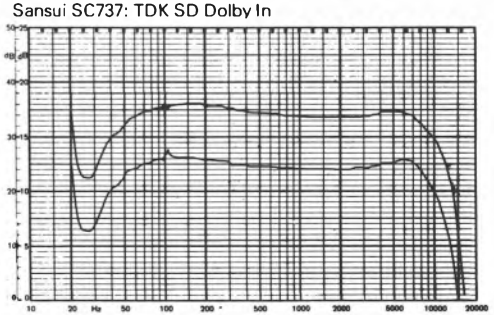
TAPE USED

Ferric	TDK SD
FeCRO2/LN	—
Chrome	TDK KR

Recommended Retail Price: £143.69



Sansui SC737: TDK KR Dolby In



Sansui SC737: TDK SD Dolby In

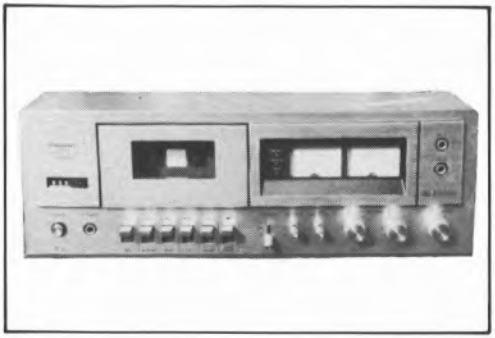
Sansui SC3000

Sansui London Showroom, 39/41 Maple Street, London W1P 5FU. 01-580 5353

Representing the very latest from the Sansui stable, the review sample was an early production prototype. The machine offers very basic facilities, having ¼" microphone jacks and 5 pole DIN and phono line input/output sockets. It is a front loader with Dolby B processing, and provision for ferric and chromium tapes. Two separate rotary record gain controls are complemented by a ganged stereo replay gain control. All the controls are on the front and apart from the stereo headphone jack and the two microphone jacks the remaining sockets are on the rear. The two VU meters have good ballistics, under reading a 64m sec burst by 5dB, 2dB better than average, and a peak reading light commenced to glow at a +3dB level—just about optimum.

The replay noise levels measured about average, and no significant noise was added to pre-recorded cassettes. On delivery the azimuth was slightly out at −30° (3kHz). The replay response was most impressive, within border-lines of only 2dB from 40Hz to 10kHz, one of the flattest replay responses measured in the tests. The chromium equalisation was similarly excellent. Pre-recorded tapes sounded extremely good, and reproduced with excellent head to tape contact and stability although just occasionally very slight flutter was audible (the wow and flutter measured 0.13%). On the review sample the stereo output control was of too high a value at 50k ohms, and Sansui have promised to reduce this to a much lower value on production models. The overall response on ferric TDK SD was very satisfactory, showing just a slight droop at 10kHz of approximately 2dB with Dolby processing. This very small droop was only approximately 1dB down without Dolby. The third harmonic distortion of 333Hz at Dolby level measured 0.8%, a very good figure, which increased to 3% at +4dB. Music reproduced very well indeed overall with fairly low noise but just a slight hum apparent at a low level. On TDK chrome tape the 10kHz response with Dolby showed a slight rise of approximately 3dB on the left but only 1.5dB on the right. The distortion at Dolby level was 2%, which was considered average and therefore satisfactory. Chromium tapes recorded well and in particular a Sony stereo electret microphone reproduced speech close to the mic exceptionally well although again a very slight hum was noticeable. Unfortunately the microphone input sensitivity was rather poor at 600uV, and thus ordinary moving coil microphones would be inadequate for recording many types of programme. The DIN input had a reasonable sensitivity of 3.2mV and had an almost infinite clipping margin. But unfortunately the input impedance varied from 23k ohms to 46k ohms—not satisfactory since, when the record level control is quite a way down, top loss will become apparent when interconnected with a DIN standard receiver. The line input had a sensitivity of 65mV, but unfortunately at 100mV in, noise degradation of 6dB was noted, showing that the optimum line input level required for no noise degradation would be at least 500mV. Clearly there is an incompatibility of input levels, impedances and microphone sensitivities, and Sansui are recommended to improve the circuit although many users would find no problems at all.

Both the erase and cross talk figures were extremely good, and no trouble whatsoever is likely to be experienced. The neat push buttons on the front allow the user to transfer from play to wind and back to play without pressing the stop button. The rewind mechanics also include a memory facility allowing the tape to stop automatically at a pre-set point. The front loading was not quite so neat as some, but bear in mind the modest price and the fact that it is likely to be discounted. The general performance makes it good value for money, and therefore it is recommended. Quite clearly this machine is one of a new range of Japanese manufactured products one generation further ahead. No problems were encountered with the integrated circuit Dolby which it uses although, strangely, marginally too much noise reduction was achieved but inside Dolby's tolerance.



Replay Azimuth Deviation from Average	22°
Microphone Input Sensitivity	590μV
Microphone Input Clipping	70mV
Microphone Input Impedance Average	9.5K
DIN Input Sensitivity	3mV
DIN Input Clipping	)10V
DIN Input Impedance Average	18K
Line Input Sensitivity	65mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+3½
Ferric 10kHz Average Left and Right	+¾
Chrome 10kHz Average Left and Right	−3¾

REPLAY NOISE

Ferric 20/20 worst channel	53dB
Ferric CCIR weighted Dolby Out	50dB
Ferric Dolby Improvement	11dB
Chrome CCIR weighted Dolby Out	52¼dB
Wow and Flutter Average	0.13%
Speed Average	−0.4%
Meter Under-read at 64ms	−5dB

DISTORTION

At Dolby Level monitoring input	0.04%
Overall Ferric Av. L+R at Dolby Level	0.78%
Overall Ferric Av. L+R at +4dB	2.95%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	2.0%
Overall Chrome Av. L+R at +4dB	4.2%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−1¼
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	+¾

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+½/ −2¾dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+¾/ −1¾dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	42½dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	45½dB
Chrome Dolby Improvement	9½dB
DIN Input Noise Degredation	1dB
Line Input Noise Degredation	5¾dB
Spooling Time	1m 55s

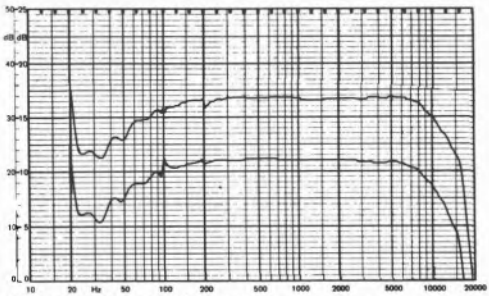
DYNAMIC RANGE

Ferric	62.5dB
FeCRO2/LN	—
Chrome	63dB

TAPE USED

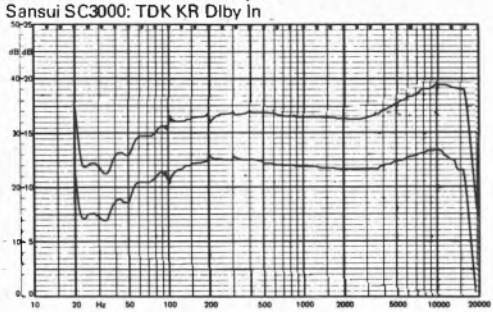
Ferric	TDK SD
FeCRO2/LN	—
Chrome	TDK KR

Recommended Retail Price: £159.00



Sansui SC3000: TDK SD Dolby In

Sansui SC3000: TDK KR Dlby In



Sanyo RD4250

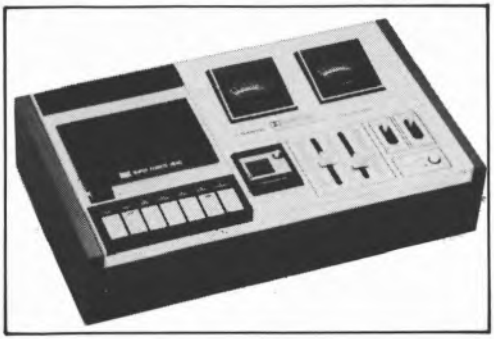
Sanyo Marubeni (UK) Ltd., Sanyo House, Bushey Mill Lane, Watford, Herts. Watford 30421

This is a very simple machine at virtually the bottom end of the price range of the survey. It incorporates Dolby B processing and includes ¼" mic jacks, a 5 pole DIN in/out socket and line (phono) in and out sockets. A stereo headphone jack is also included. There are two record faders for left and right channels and provision is made for ferric and chrome tape but not ferrichrome. The two VU meters were average but no peak reading light was provided so care will have to be taken to avoid too high a recording level. The wow and flutter was very poor, measuring 0.22%, and this was clearly audible on most music programmes. Furthermore azimuth variations were noted since the cassette was rather loosely held in the mechanism. The machine ran approximately 1% fast and this might disturb musicians.

On replay the machine had an extremely bad hum on the right channel, the 50Hz component measuring only 3dB below the Dolby level and 150Hz even measuring −48dB. The hiss levels on play back were fairly good but emphasised by the ridiculous boost incorprated in both ferric and chrome responses, which averaged +3.5dB at 10kHz. Ironically the chrome replay response was just about right for ferric! Pre-recorded cassettes played moderately well but hum was always noticeable even during climaxes.

The overall response on Sanyo LN ferric tape showed an exceptional rise of 7dB at 10kHz on both channels and this produced subjectively an objectionable screeching sound on virtually all music. When the Dolby was used continual fuffing was noted. Although part of the problem was the ridiculous rise on replay, the record side was still over-equalised. The distortion at 333Hz, however, measured well at 1% (Dolby level) but rose to 3.5% at +4dB. TDK chrome tape produced 3.8% distortion at Dolby level, rising to an alarming 10.3% at +4dB. Even more odd was the rise of 9dB at 10kHz, rising further to 14dB up at 15kHz, and words fail the writer to describe the subjective sound quality.

The microphone inputs had a sensitivity of 275uV clipping at 12mV and thus insufficient sensitivity is given for recording speech with 200ohm moving coil microphones, but electret types would probably overload the input circuit on loud sounds, so one is rather between the devil and the deep blue sea. The 5 pole DIN socket had 1.5mV sensitivity and clipped at 65mV into 12k ohms impedance. No noise degradation occurred here but unfortunately the line input showed 9dB noise degradation from a standard 100mV source, the sensitivity incidentally being 55mV which, however, was considered unusable because of noise. Notwithstanding this problem, the line input actually clipped as low as 2.5V and some hi-fi equipment could produce signals which could cause clipping here. It is unfortunate that this machine has had to be so severely criticised and it seems obvious that a severe lack of quality control must be the cause of the problems, although some such as the line input degradation are clearly design problems. If you are interested in this model you should check the criticised parameters but it will be better to pay slightly more for an alternative model such as the Sanyo model 4260. Even at its low price the RD4250G cannot be considered good value for money.



Replay Azimuth Deviation from Average	52°
Microphone Input Sensitivity	275μV
Microphone Input Clipping	12mV
Microphone Input Impedance Average	>100K
DIN Input Sensitivity	1.5mV
DIN Input Clipping	65mV
DIN Input Impedance Average	12K
Line Input Sensitivity	56mV
Line Input Clipping	2.5V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+2.9
Ferric 10kHz Average Left and Right	+3½
Chrome 10kHz Average Left and Right	+¾

REPLAY NOISE

Ferric 20/20 worst channel	38dB
Ferric CCIR weighted Dolby Out	48¾dB
Ferric Dolby Improvement	9½dB
Chrome CCIR weighted Dolby Out	51½dB

Wow and Flutter Average	0.22%
Speed Average	+0.95%
Meter Under-read at 64ms	7dB

DISTORTION

At Dolby Level monitoring input	0.2%
Overall Ferric Av. L+R at Dolby Level	1.0%
Overall Ferric Av. L+R at +4dB	3.5%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	3.8%
Overall Chrome Av. L+R at +4dB	10.3%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+3½
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	+4.5

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+4.5/ −1.5dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+5.75/ −1.5dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	41½dB
Dolby Improvement	9½dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	43dB
Chrome Dolby Improvement	9¼dB

DIN Input Noise Degredation	0dB
Line Input Noise Degredation	8¼dB
Spooling Time	1m 57s

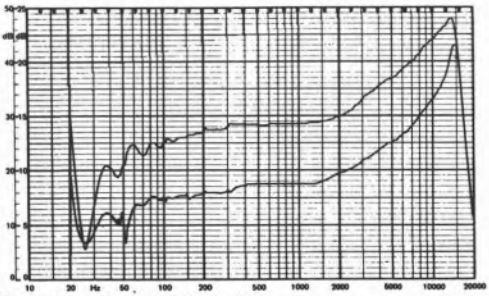
DYNAMIC RANGE

Ferric	60dB
FeCRO2/LN	—
Chrome	57dB

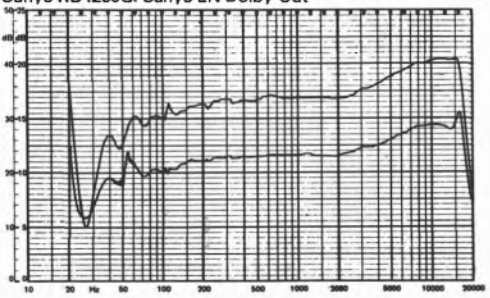
TAPE USED

Ferric	SANYO LN
FeCRO2/LN	—
Chrome	TDK KR

Recommended Retail Price: £101.56



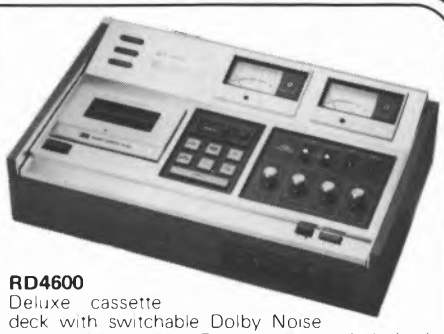
Sanyo RD4250G: TDK KR Dolby in
Sanyo RD4250G: Sanyo LN Dolby Out



Some Enchanted Evening

Sanyo audio units offer you all the facilities needed to satisfy the perfectionist in you ... with treble, bass and loudness controls plus filters.
In the medium price range the choice is wide.
To help you choose your Sanyo system, here's a collection of compatible separates that add up to a superb stereo package. For your own enchanted evenings ... install one this winter. And learn to relax again.

RD4300 (featured above)
High performance Dolby cassette deck. For perfect recordings from your receiver in 2 channel stereo on cassettes. CRO² tape switch, memory rewind, cue key, pause button and variable output for matching to almost any amplifier. Employs servo motor for perfect speed regulation. Uses Dolby circuit for maximum dynamic range and reduction of tape hiss.



RD4600
Deluxe cassette deck with switchable Dolby Noise Suppression circuitry. For recording and playback through a hi-fi system. Near perfect speed accuracy is obtained with direct drive from a Saturable Magnetic Core type ultra-low speed DC brushless motor. Separate left/right adjustments for input and output levels. 3-position tape selector switch for chrome, low noise and normal tapes. Super Ferrite Heads. Auto stop. Auto return rewinds tape to original position. Auto repeat gives continuous music. Input select switch. Tilt-up panel with two large VU level meters. Memory rewind system. Remote control for pause and start.

RD4055G
Stereo cassette deck incorporating Dolby noise reduction system and presented in a teak veneered cabinet. Features 3-digit tape counter, piano key pushbuttons for record, rewind, fast forward, play, stop, pause eject. A large, easy-to-read VU meter together with input level control is included for each channel. Includes automatic shut-off system on either playback or recording mode and 2-position tape select switch for normal and CRO² tape.

SANYO
a world of difference

Sanyo Marubeni (U.K.) Ltd., 8 Greycaine Road, Greycaine Estate, Watford WD2 4UQ.
Telephone: Watford 30421

Although having relatively few facilities, this model performed very well overall. Dolby B is included, and line in, 5 pole DIN input/output and microphone inputs (¼" jack) are provided. Sensibly, Sanyo have incorporated a switch selecting either line in or microphone/DIN in and thus all inputs are working at optimum levels to avoid hiss. The microphone circuit has rather too low a sensitivity and even an electret microphone gave only just enough level for recording speech 1' away from the microphone. Unfortunately the mic input clipped at 19mV and so had rather a poor dynamic range capability. The DIN input, however, was very sensible, having an input impedance on 15k ohms with a reasonable clipping margin to DIN specification. The line in circuit worked well but was a little sensitive (125mV maximum sensitivity) and virtually no input degradation occurred at this level. The line in impedance, incidentally, was 70k ohms, varying slightly with the position of the record gain control.

On replay pre-recorded cassettes sounded very good but in general a little toppy, thus confirming the measurement of approximately 3dB boost at 10kHz. This should be corrected by Sanyo since obviously the replay noise would be slightly higher than optimum. As it stood, it measured slightly below average but adequate at −48dB CCIR weighted without Dolby and −57dB with Dolby in. Nominally the chromium replay response, although 4dB below that of ferric at high frequencies, measured correctly in ratio to ferric, thus proving that the replay overall equalisation was not optimally set up. The stability on both record and playback was excellent, and ferric recordings made on Sanyo LN tape reproduced very well with a fairly wide dynamic range and good clarity at high frequencies. The overall response on both ferric and chrome was very good indeed, the chrome response being reasonably flat to 14kHz. The distortion on ferric Sanyo LN was only 0.8% at Dolby level and remarkably low for chrome at 1.3%, one of the best chrome figures. Distortion only became apparent at very high recording levels, but because the VU meters under-read a 64m sec burst by 6.5dB, and there are no peak reading indicators, care will have to be taken to avoid over recording. Chromium tape (TDK C60) also fared extremely well, giving one of the best overall chromium sound qualities and with a wide dynamic range. Lower than average intermodulation distortion was heard on replay, and this together with the excellent performance on ferric cassettes allows this model to be recommended. The wow and flutter at 0.12% was only average, though, and just occasionally flutter was audible particularly on woodwind instruments. The phase jitter was only ±5° at 10kHz which was one of the best measured, although replacing the cassette in the machine sometimes produced a very slight azimuth offset. No cross talk problems were encountered by the erase performance, although adequate, was considerably below average at 60dB.

Mechanically, the deck worked extremely well and it is possible to transfer from any function to another smoothly without first engaging stop. On one occasion, though, on turning over a pre-recorded cassette and quickly reinserting it, the machine damaged a section of the tape, but this could have been co-incidental. Fast wind unfortunately did not have an auto stop function and this will have to be watched. Ergonomically, the machine is well designed and has a pleasant appearance and in general it felt to be good value for money. Sanyo will have to correct the replay equalisation though, thus making the chromium overall response even flatter than it is now, but a little more equalisation on record will be necessary for ferric if the replay is adjusted to be correct.

We've taken the lid off new Scotch High Energy Cassettes to show you an invisible revolution

This is the part of a cassette you never see. But we thought you'd like to take a good look at the inside story of the most advanced of the new "super" ferric oxide cassettes.

Count the improvements of new High Energy cassettes.

1 A unique new small-particle gamma ferric oxide tape. The uniformity and size of the needle-like crystals is controlled, during manufacture, to the highest standards of accuracy.

The result is a high performance coating which provides an extended response at all frequencies. A high frequency response up to 9dB better than standard cassettes.

2 New High Energy is one of the family of Scotch cassettes; all with a number of features that ensure smoother performance. Features like Posi-Trak anti-static back coating for a smoother wind and jam-free playing, and therefore gives better tape transport across the heads.

3 And features like fixed metal roller guides that do away with plastic moving parts.

4 And a larger pressure pad to make the tape track better against the playing head, and deliver a cleaner sound.

5 Finally, all Scotch cassettes have rigorous, built-in quality controls at all stages of manufacture. This together with the new high precision automated assembly, ensures uniformity of quality and minimises jamming problems.

The Scotch family of cassettes

There is now a complete range of Scotch cassettes. One for every kind of cassette deck or recorder there is.

For instance, if you have a chrome bias switch on your machine, there's new Scotch Chrome cassettes which are coated with chromium dioxide giving you a vastly better signal-to-noise ratio than ordinary cassettes and pure, crystal-clear sound.

There's the new Scotch Dynarange "Jambuster" cassettes for your everyday recording needs.

And of course, High Energy cassettes with new small-particle gamma ferric oxide tape, gives you fine performance at a very reasonable cost.

Discover the Scotch family of cassettes the next time you go into your hi-fi shop.

HFC/9/75

For further details write to Paul Edelston, 3M United Kingdom Limited, 3M House, Wigmore Street, London W1A 1ET. Telephone: 01-486 5522.

Name.....

Address.....

.....

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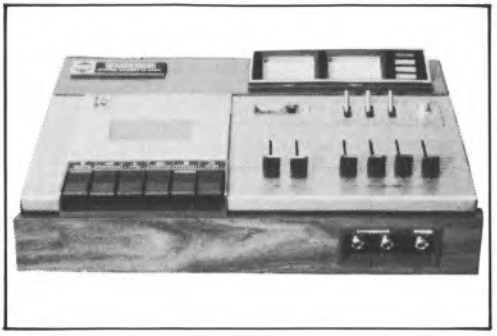
Sanyo Marubeni (UK) Ltd., Sanyo House, Bushey Mill Lane,
Watford, Herts. Watford 30421

Sanyo RD4260



Replay Azimuth Deviation from Average	27°
Microphone Input Sensitivity	360μV
Microphone Input Clipping	19mV
Microphone Input Impedance Average	)100K
DIN Input Sensitivity	980μV
DIN Input Clipping	54mV
DIN Input Impedance Average	15K
Line Input Sensitivity	125mV
Line Input Clipping	)10V
Line Input Impedance Average	72K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+2½
Ferric 10kHz Average Left and Right	+3.13
Chrome 10kHz Average Left and Right	−1.13

REPLAY NOISE

Ferric 20/20 worst channel	48dB
Ferric CCIR weighted Dolby Out	47½dB
Ferric Dolby Improvement	9¾dB
Chrome CCIR weighted Dolby Out	51½dB

Wow and Flutter Average	0.12%
Speed Average	1.12%
Meter Under-read at 64ms	6½dB

DISTORTION

At Dolby Level monitoring input	0.08%
Overall Ferric Av. L+R at Dolby Level	0.83%
Overall Ferric Av. L+R at +4dB	3.1%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	1.35%
Overall Chrome Av. L+R at +4dB	3.3%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−1¼
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	+1¼

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0.0/ −3.0dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+1.25/ −1.75dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	42dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	45dB
Chrome Dolby Improvement	9dB

DIN Input Noise Degredation	0db
Line Input Noise Degredation	½dB
Spooling Time	1m 53s

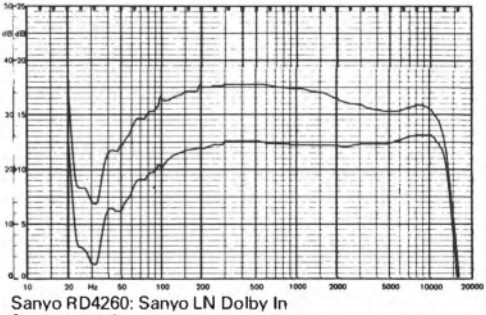
DYNAMIC RANGE

Ferric	62dB
FeCRO2/LN	—
Chrome	63.5dB

TAPE USED

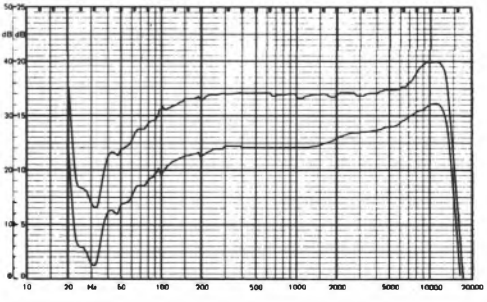
Ferric	SANYO LN
FeCRO2/LN	—
Chrome	TDK KR

Recommended Retail Price: £103.00



Sanyo RD4260: Sanyo LN Dolby In

Sanyo RD4260: TDK KR Dolby In



Sanyo RD4300

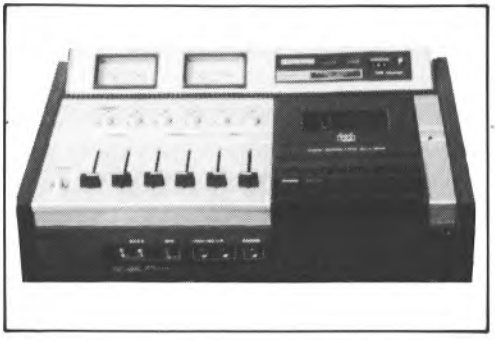
Sanyo Marubeni (UK) Ltd., Sanyo House, Bushey Mill Lane, Watford, Herts. Watford 30421

Despite the machine's good appearance and ease of operation, relatively little enthusiasm was felt for it because not only did the ferric/chrome switch do absolutely nothing but the general performance on ferric tape left a lot to be desired. The machine is equipped with Dolby B processing, and has the hydraulic type automatic meter panel raising device, which may be novel for the first hour or so but will be regarded as a gimmick thereafter. Single rotating controls are provided for record left and right and replay left and right levels; some people might dislike not having split concentric controls.

The replay response proved to have a noticeable rise of 2dB at 10kHz on both channels but unfortunately a similar error was also noted as low as 4kHz and thus pre-recorded cassettes tended to sound rather shrill. At 63Hz a considerable difference in response was noted between the two channels of 2.5dB and this could make some pop cassettes with heavy extreme bass sound rather lumpy on the right channel. The replay weighted noise measured well below average at only 46dB, which improved by 9.5dB (average) with Dolby de-processing. In the chromium position of the equalisation switch there was no change in response or replay noise, and this is considered very serious. Slight azimuth wander was noticed on pre-recorded cassettes, and there was a tendency to occasional drop outs. Overall, the performance on ferric tape was rather poor, a loss of 3¾dB being noted at 10kHz. The overall noise performance was not very good but the distortion was good on a Sanyo LN cassette. The overall sound quality on this type was just about acceptable but seemed to sound slightly clothy and at climaxes high frequencies squashed thus taking the life out of the sound of the original input signal.

The VU meters under read a 64m sec pulse by 7dB and since no peak reading lights are provided the user would have to take care not to over record. The line input, when driven with a signal of 100mV, produced a hiss degradation of some 11dB and to avoid this a very high input level of at least 700mV would be required. The DIN input had more than adequate sensitivity, optimum input impedance and a very good clipping margin, but 2dB of noise degradation occurred at the standard DIN input level, adding to the already poor noise level. Phono line in and line out sockets are provided on the rear, together with a 5 pole DIN input/output socket, and a ¼" stereo jack on the front for headphones is situated next to two miniature jack sockets for microphone input. These latter were disliked intensely especially since the plugs are awkward to solder reliably and only take very thin microphone cable, usually of rather poor quality.

In general, then, this machine cannot be recommended. It is understood that the model is being withdrawn shortly but obviously samples will be found in the shops for some while. One final most irritating point is that the monitor output, during recording, is provided with the recorded Dolbyed signal and is thus extremely toppy, which could completely mislead the user. Incidentally, the pen chart shows the response given on chrome tape, a 10dB rise at 10kHz being totally unacceptable and giving a recording that was so shrill as to be virtually unusable for obtaining any pleasurable play back.



Replay Azimuth Deviation from Average	53°
Microphone Input Sensitivity	305μV
Microphone Input Clipping	77.5mV
Microphone Input Impedance Average	25K
DIN Input Sensitivity	2mV
DIN Input Clipping	570mV
DIN Input Impedance Average	11K
Line Input Sensitivity	100mV
Line Input Clipping	)10V
Line Input Impedance Average	>100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+3
Ferric 10kHz Average Left and Right	+2
Chrome 10kHz Average Left and Right	+2

REPLAY NOISE

Ferric 20/20 worst channel	48.5dB
Ferric CCIR weighted Dolby Out	46.25dB
Ferric Dolby Improvement	9.25dB
Chrome CCIR weighted Dolby Out	46.25dB

Wow and Flutter Average	0.13%
Speed Average	+1.55%
Meter Under-read at 64ms	7dB

DISTORTION

At Dolby Level monitoring input	0.32%
Overall Ferric Av. L+R at Dolby Level	0.9%
Overall Ferric Av. L+R at +4dB	2.2%
Overall FeCRO2/LN Av. L+R at Dolby Level	–
Overall FeCRO2/LN Av. L+R at +4dB	–
Overall Chrome Av. L+R at Dolby Level	1.85%
Overall Chrome Av. L+R at +4dB	4.75%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−2¼
10kHz FeCRO2/LN Dolby Out Av. L+R	–
10kHz Chrome Dolby Out Av. L+R	+6

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+¼/ −4¼dB
Ref. 333Hz FeCRO2/LN	– –
Ref. 333Hz Chrome	+6½/ −1dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	41½dB
Dolby Improvement	9dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	–
FeCRO2/LN Dolby Improvement	–
Chrome CCIR weighted Av. L+R Dolby Out	39½dB
Chrome Dolby Improvement	7½dB

DIN Input Noise Degredation	1½dB
Line Input Noise Degredation	11dB
Spooling Time	1m 49s

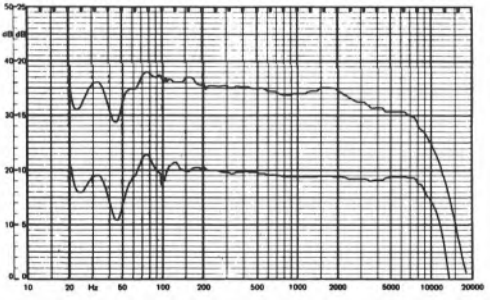
DYNAMIC RANGE

Ferric	62dB
FeCRO2/LN	–
Chrome	54.5dB

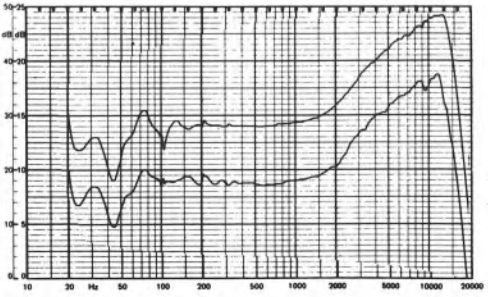
TAPE USED

Ferric	SANYO LN
FeCRO2/LN	–
Chrome	TDK KR

Recommended Retail Price: £103.96



Sanyo RD4300G: Sanyo LN Dolby In
Sanyo RD4300G: TDK KR Dolby In



Sanyo RD4600

Sanyo Marubeni (UK) Ltd., Sanyo House, Bushey Mill Lane, Watford, Herts. Watford 30421

The most expensive recorder of the Sanyo range, it includes Dolby B processing, a mic/DIN and line input switch and an internal oscillator which can be used to set A/B levels precisely on both tracks for ferric and chrome tapes independently. This ensures tape type. The VU meter panel including these presets raises and lowers on a hinge, but this seems rather an expensive gimmick. The replay response in general measured quite well on both ferric and chrome tapes, but the extreme treble end measured a little below optimum (averaging −1.5dB at 10kHz). The replay noise level was satisfactory but again slightly below average and the correct noise decrease resulted for chromium tape and for insertion of Dolby B processing. Pre-recorded cassettes in general played back with rather a muffled quality, and the azimuth seemed to vary continuously. This variation was proved by the presence of some phase jitter overall measuring ±20° at 10kHz. When a recorded cassette was withdrawn and reinserted the azimuth appeared to be unreliable.

Three positions of bias and equalisation are available for normal, LN and chrome. The distortion on TDK SD tape overall was exceptionally low at only 0.3% average, rising to 2% at +4dB and this was considered excellent. A very slight high frequency loss was apparent overall (see pen chart) but this did not detract from the relatively good performance, although it was slightly affected by the variations in azimuth. On Sanyo LN tape the high frequency response was extremely poor, the pen chart showing approximately −10dB at 10kHz with Dolby processing in use. This of course produced a very muffled sound overall and showed the machine to be rather badly set up at the factory.

Chromium tape gave a very flat overall response but the distortion at Dolby level was considerably higher than average at 3%. Nevertheless results subjectively on chrome were very good, provided the recording level was kept down. The overall noise performance was good and clearly the machine, if aligned correctly, and if the deck mechanics were more stable, could perform very well indeed.

It is possible that the review sample was below average in this respect. The wow and flutter, although averaging 0.16%, appeared to vary considerably from one cassette to another. The speed accuracy was +0.5% which was regarded as adequate. No cross talk problems were encountered and the erase was satisfactory, averaging 62dB.

The microphone input circuitry had relatively low noise but unfortunately had insufficient gain for speech to be recorded at a distance from the microphone, and an electret microphone will certainly be necessary to achieve sufficient recording level. The input impedance was about optimum at 4k ohms and the clipping level was satisfactory. The DIN input had a sensible impedance of 11.5k ohms with a reasonable sensitivity and clipping margin although at the rated DIN input level of 11.5mV, typical of values obtained from receivers designed to DIN specification, some 4dB of noise degradation resulted. At high levels, however, this input was satisfactory. The line input had a sensitivity of only 110mV, adequate for most purposes but insufficient for some. No significant noise degradation appeared on the line input and very high levels could be received without any distortion problems arising. Mechanically the machine was liked, although one pre-recorded cassette was ruined. There is one interesting feature, that of automatic rewind of a cassette at its end, then either stopping or playing again as required. The machine also includes a memory tape counter. Rotary controls rather than faders are incorporated for both input and output levels, and a remote control allows the user to stop and start from a preselected function.

Despite the VU meters being of the pop-up type, their ballistics were poor, since a 64m sec burst under-read 9dB. The peak reading light was also not very effective, since it operated at approximately Dolby level, which would encourage under-recording, as opposed to the VU meters, which encourage over-recording.

Replay Azimuth Deviation from Average	2°
Microphone Input Sensitivity	380μV
Microphone Input Clipping	28mV
Microphone Input Impedance Average	4K
DIN Input Sensitivity	2.5mV
DIN Input Clipping	180mV
DIN Input Impedance Average	11.5K
Line Input Sensitivity	110mV
Line Input Clipping	>10V
Line Input Impedance Average	67–86K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+2.5
Ferric 10kHz Average Left and Right	−1.75
Chrome 10kHz Average Left and Right	−5.5

REPLAY NOISE

Ferric 20/20 worst channel	48dB
Ferric CCIR weighted Dolby Out	48dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	51.5dB
Wow and Flutter Average	0.16%
Speed Average	+0.48%
Meter Under-read at 64ms	−9dB

DISTORTION

At Dolby Level monitoring input	0.28%
Overall Ferric Av. L+R at Dolby Level	0.33%
Overall Ferric Av. L+R at +4dB	1.9%
Overall FeCRO2/LN Av. L+R at Dolby Level	1.4%
Overall FeCRO2/LN Av. L+R at +4dB	4.1%
Overall Chrome Av. L+R at Dolby Level	3.3%
Overall Chrome Av. L+R at +4dB	8.0%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−0.5
10kHz FeCRO2/LN Dolby Out Av. L+R	−5.5
10kHz Chrome Dolby Out Av. L+R	−1.0

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1.5/ −0.75dB
Ref. 333Hz FeCRO2/LN	+1.5/ −5.5dB
Ref. 333Hz Chrome	+0/ −1dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	42.25dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	43dB
FeCRO2/LN Dolby Improvement	10dB
Chrome CCIR weighted Av. L+R Dolby Out	45.5dB
Chrome Dolby Improvement	10dB

DIN Input Noise Degredation	3dB
Line Input Noise Degredation	0.5dB
Spooling Time	2m

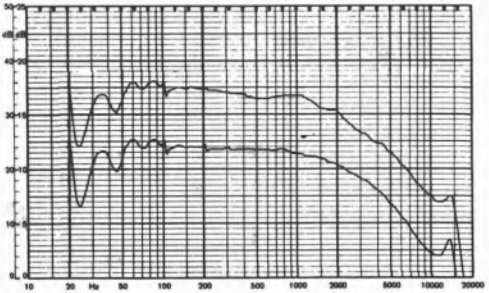
DYNAMIC RANGE

Ferric	64dB
FeCRO2/LN	61.5dB
Chrome	61dB

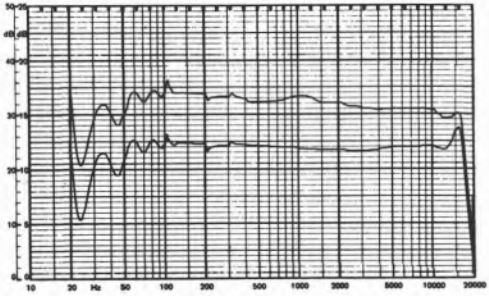
TAPE USED

Ferric	TDK SD
FeCRO2/LN	SANYO LN
Chrome	TDK KR

Recommended Retail Price: £204.76



Sanyo RD4600: Sanyo LN Dolby In
Sanyo RD4600: TDK KR Dolby In



Sonab C500

Sonab Ltd., PO Box 4, Oldfield Road, Hampton, Middlesex, TW12 2HN. 01-979 0134

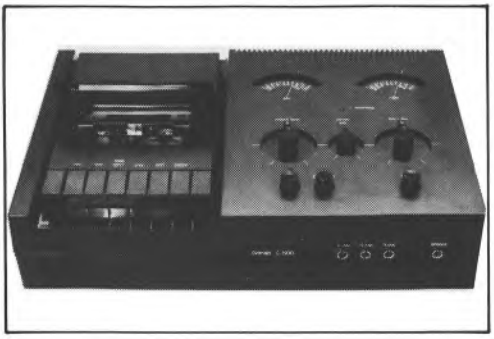
Most unusual styling is a feature of this machine and whilst it may attract some it will undoubtedly repel others. It includes Dolby B processing and very unusual meters, which for some reason have a treble boost added in the meter circuits on record and replay to over-emphasise the effect of energy at high frequencies generally. The machine is equipped with the usual ¼" jack sockets, a 5 pole DIN socket and phono line in and out sockets, in addition to a ¼" stereo jack socket for headphones. Ample level was given, incidentally, for 600ohm phones, which was useful.

When a microphone is plugged in, both DIN and phono inputs are disconnected, thus assisting permanent installation. A single concentric split record gain control is provided, together with a similar headphone level control. A line output level control, on the back of the recorder, can be pre-set to give any required output level up to a maximum of 1.1V for Dolby level. The machine incorporates the Nakamichi 550 deck mechanism which has proved to be a very stable one, and includes very high quality heads. The overall wow and flutter, however, although good, was not quite up to expectations, measuring an average of 0.11%. Very slight flutter was noticed occasionally but the stability and absence of phase jitter must be particularly commended. The speed accuracy was 0.8% slow—unusual, since most machines ran slightly fast on average, and this error could upset musicians with critical ears. The overall quality on Maxwell UD ferric was good, although the hiss level was a little inferior to average and the distortion was somewhat higher than usual for the tape used. However, to counter this, the high frequency intermodulation distortion was much better than average, virtually no treble squash being noted at 10kHz. A high bias, though, would have considerably reduced the distortion at middle frequencies but would slightly deteriorate the high frequency performance. The overall stability was excellent and virtually no drop outs were heard at any time. On chrome tape (Sonab) the response fell noticeably to —6dB average at 10kHz, and then maintained this response almost up to 15kHz. The distortion was slightly better than average for chromium tape, and despite the treble loss measured the machine subjectively sounded rather better than the figures suggested.

The Sony electret microphone produced a very good sounding recording on the Sonab, and had just enough gain in hand for speech recording at a distance of 2ft or so from the mic. Moving coil mics would be suitable provided they were held fairly close to the speaker.

The input impedance was only 1000ohms, ideal for almost all low impedance microphones but not suitable for medium impedance ones. The input clipping margin was a little lower than optimum and so care should be taken to keep microphones well back from loud sound sources. The DIN input impedance was rather high at between 32 and 84k ohms and no clipping resulted from a very high input level, the sensitivity being 13mV, which is quite adequate though not completely in accordance with DIN specifications. Inter-connection with DIN equipment, incidentally, might result in a treble loss becoming apparent if the receiver's source impedance is very high and the interconnection lead used is longer than 70cm or so but the treble loss will be very dependent upon the sensitivity used. The line input was more satisfactory, having a sensitivity of 70mV and very high impedance. No noise degradation occurred on either DIN or line inputs. This machine is one of the very few to incorporate an additional centre injection microphone input at a similar sensitivity to the left and right inputs, the signal being fed equally to both channels.

The Sonab had excellent cross talk figures and the erase was adequate, but not as good as many. The Nakamichi deck incorporated a memory counter and was easy to use, seeming very reliable. A little more care in alignment at the factory would clearly have improved performance so another sample could well be better than the review one. However, it performed well subjectively despite its figures being only average. It is felt that it will be a matter of personal taste whether it is favoured, bearing in mind that several other machines did perform better at a similar price.



Replay Azimuth Deviation from Average	62°
Microphone Input Sensitivity	165μV
Microphone Input Clipping	16.5mV
Microphone Input Impedance Average	1K
DIN Input Sensitivity	13mV
DIN Input Clipping	)10V
DIN Input Impedance Average	32/84K
Line Input Sensitivity	68mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+4.8
Ferric 10kHz Average Left and Right	+1.75
Chrome 10kHz Average Left and Right	−2.75

REPLAY NOISE

Ferric 20/20 worst channel	51dB
Ferric CCIR weighted Dolby Out	47.75dB
Ferric Dolby Improvement	9.5dB
Chrome CCIR weighted Dolby Out	55dB
Wow and Flutter Average	0.11%
Speed Average	−0.87%
Meter Under-read at 64ms	3.5dB

DISTORTION

At Dolby Level monitoring input	0.05%
Overall Ferric Av. L+R at Dolby Level	0.85%
Overall Ferric Av. L+R at +4dB	3.4%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	1.8%
Overall Chrome Av. L+R at +4dB	3.7%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−1.75
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	−3

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+5/ −2dB
Ref. 333Hz FeCRO2/LN	+ —
Ref. 333Hz Chrome	+5/ −4dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	40.75dB
Dolby Improvement	9dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	45.5dB
Chrome Dolby Improvement	9dB
DIN Input Noise Degredation	0dB
Line Input Noise Degredation	0dB
Spooling Time	2m

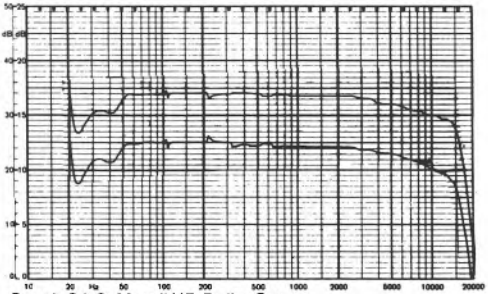
DYNAMIC RANGE

Ferric	59.5dB
FeCRO2/LN	—
Chrome	64dB

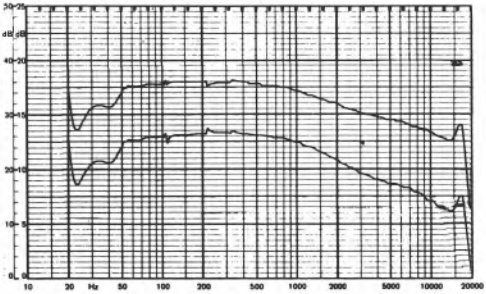
TAPE USED

Ferric	MAXWELL UD
FeCRO2/LN	—
Chrome	SONAB KR

Recommended Retail Price: £175.88



Sonab C5(0: Maxell UD Dolby Out
Sonab C500: Sonab CRO2 Dolby In



Sony TC138 SD

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

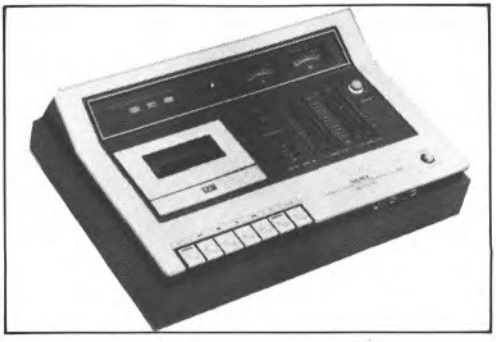
The TC138SD can be said to be a simplified version of the TC177SD incorporating most of the features of the 177 including Dolby B processing, a record limiter, bias and equalisation switching for ferric, ferrichrome and chromium cassettes and peak reading lights. The mechanical deck controls are very simple to use and the wow and flutter performance measured extremely well at only .08%. The tape speed was just a little fast at 0.9%. The VU meters had an average under-read of 7dB on the 64m sec pulse but the peak light operated at +3dB. ¼" jack sockets provide a sensitivity of 95uV, which allows very quiet sounds to be recorded even with moving coil microphones. Despite this astonishing sensitivity, clipping was not reached until 47mV and so the dynamic range of the microphone input is really excellent. A 5 pole DIN socket, impedance 3k ohms, gave a sensitivity of 100uV and clipped at 45mV, again really excellent. Virtually no noise degradation was obtained on either the DIN or line inputs from standard sources, the latter having a sensitivity of 40mV on phono sockets. Line output was given on two additional phono sockets as well as on the 5 pole DIN one and a stereo headphone jack also complements the output. The record limiter worked exceptionally well, the threshold being set on just about optimum to avoid both distortion and tape noise.

The replay response showed a slight bass rise of approximately 1.75dB generally. The 10kHz response on ferric was just slightly down, averaging −1.5dB. However, the chromium equalisation was totally wrong, being approximately 4dB down at 10kHz, referred to the theoretical optimum response. The replay noise measured a little below average, unfortunately, although this was partly due to the presence of a slight hum. Both the stability and tape/head contact were good, although very slight phase jitter was noted in the tests.

The overall distortion on Sony HF ferric tape was very low indeed, measuring only 0.56% at Dolby level, rising to 1.9% at +4dB, and the response also measured only 1.5dB down at 10kHz with Dolby processing in. Subjectively the sound quality was exceptionally good with an extended frequency response, although the overall noise was slightly marred by a noisy transistor on the left record channel. Sony ferrichrome also behaved very well despite the replay equalisation being incorrect, giving distortion of only 0.5% at Dolby level, rising to only 1.2% at +4dB, thus providing an extremely wide potential for dynamic range. The response was fairly similar to ferric, but extended to only −3dB at 15kHz even when the Dolby circuit was switched in, which is really remarkable. The overall signal to noise ratio on ferrichrome measured 55dB ref. Dolby level with Dolby operative. There can be no doubt that if the replay circuit had a lower noise level, this machine would give even better results. Chrome tape, as usual, had much higher distortion, reaching 4.6% at +4dB, and had a similar signal to noise ratio as ferrichrome, but the 10kHz overall response fell markedly to −4dB. Again if the replay response had been corrected, chrome would be virtually flat overall but ferrichrome would have shown a slight lift. Notwithstanding the loss of top on chrome, the sound quality was still good but clearly inferior to ferrichrome. No cross talk or erase problems were noted. The rewind time of 2 minutes was very satisfactory and a memory counter is included. Both the mic/DIN and line inputs had independent faders for mixing and a stereo ganged line out control allows the replay and monitoring level to be adjusted at will.

This recorder was very well liked in the laboratory and can be recommended, although its price is somewhat high. It proved reliable and had a pretty consistent azimuth, which was nearly correct on delivery.

Despite the generally excellent performance, the Laboratory asked Sony to provide a machine for retest to check the chrome replay equalisation and replay, and overall noise performance. The second sample was much better on chrome replay, showing only 1.5dB loss at 10kHz, and the ferric response was also improved, so that 10kHz was virtually flat. The ferric replay noise figures measured very well, showing a 3dB improvement, CCIR weighted. Chromium showed an improvement of 1dB despite the considerable increase of HF response. The overall ferric noise, however, showed virtually no improvement although ferrichrome improved by 2dB and chrome by 1dB. Although the chrome response measured virtually flat overall on the second sample, both ferric and ferrichrome tapes showed rather bad high frequency boosts between 5 and 10kHz, thus presumably being under biased. This appears to confirm that better quality control is required on this model.



Replay Azimuth Deviation from Average	12°
Microphone Input Sensitivity	92μV
Microphone Input Clipping	47mV
Microphone Input Impedance Average	8K
DIN Input Sensitivity	100μV
DIN Input Clipping	45mV
DIN Input Impedance Average	3K
Line Input Sensitivity	40mV
Line Input Clipping	10V
Line Input Impedance Average	70–80K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+4.75
Ferric 10kHz Average Left and Right	−1.5
Chrome 10kHz Average Left and Right	−8.5

REPLAY NOISE

Ferric 20/20 worst channel	49dB
Ferric CCIR weighted Dolby Out	47.5dB
Ferric Dolby Improvement	9.5dB
Chrome CCIR weighted Dolby Out	55.5dB
Wow and Flutter Average	0.08%
Speed Average	+0.9%
Meter Under-read at 64ms	7dB

DISTORTION

At Dolby Level monitoring input	0.04%
Overall Ferric Av. L+R at Dolby Level	0.56%
Overall Ferric Av. L+R at +4dB	1.88%
Overall FeCRO2/LN Av. L+R at Dolby Level	0.5%
Overall FeCRO2/LN Av. L+R at +4dB	1.2%
Overall Chrome Av. L+R at Dolby Level	1.9%
Overall Chrome Av. L+R at +4dB	4.6%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−1.5
10kHz FeCRO2/LN Dolby Out Av. L+R	0
10kHz Chrome Dolby Out Av. L+R	−1.5

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0.5/ −1.5dB
Ref. 333Hz FeCRO2/LN	+0.5/ −0.5dB
Ref. 333Hz Chrome	+0.5/ −2.0dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	42dB
Dolby Improvement	9dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	46.5dB
FeCRO2/LN Dolby Improvement	8.5dB
Chrome CCIR weighted Av. L+R Dolby Out	47.5dB
Chrome Dolby Improvement	7.5dB
DIN Input Noise Degredation	1dB
Line Input Noise Degredation	0.5dB
Spooling Time	2m

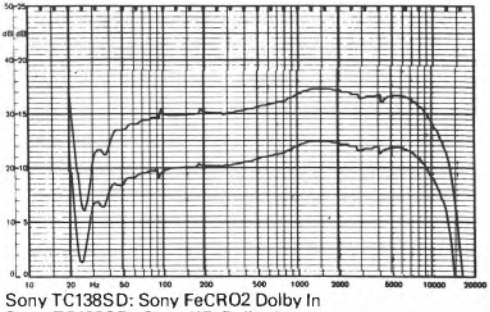
DYNAMIC RANGE

Ferric	62.5dB
FeCRO2/LN	69dB
Chrome	63.5dB

TAPE USED

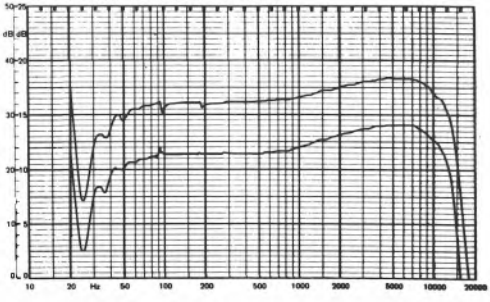
Ferric	SONY HF
FeCRO2/LN	SONY $FeCrO_2$
Chrome	SONY CrO_2

Recommended Retail Price: £157.36



Sony TC138SD: Sony FeCRO2 Dolby In

Sony TC138SD: Sony KR Dolby In



Sony TC153 SD

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

When cassette recorders were first introduced, battery portables immediately became very popular but the restriction to mono prevented many people from enjoying the more realistic effects of stereo. The Sony TC 153, though, is not only battery and mains operated with stereo facilities but also includes Dolby B noise reduction and very comprehensive input facilities particularly for microphone recording. This machine is easily portable and simple to operate and can make recordings, even off batteries, to an extremely high standard, particularly on ferric tape.

The replay response, whilst being excellent on ferrichrome and chromium, was a little toppy on ferric (a general 2dB boost being noted) and the replay hiss level was slightly higher than average. Pre-recorded cassettes sounded good, but just occasionally slight wow was heard. The Dolby circuitry worked well and overall the machine produced recordings above average. In particular the sound quality on ferrichrome was excellent with a pretty good signal to noise ratio and very low distortion. Ferric tape unfortunately was just a little noisy, although very high recording levels could be achieved without distortion. The microphone input circuits were very quiet, and included a switched attenuator so that a wide range of sounds could be taped without overloading the pre-amplifier. The DIN and line inputs gave no problems and had more than adequate sensitivity. The VU meters were rather small and tended to under-read transient sounds, and thus distortion could result quite easily when recording these if allowance was not made for the under-reading. A peak reading light operating, say, at +3dB would have been welcome, and perhaps Sony would incorporate one in a later model. The crosstalk was slightly below average, but perfectly adequate, and the erasure was extremely good. The speed was +0.35%, and held well even on batteries. The wow and flutter seemed very variable and depended almost entirely on the type of cassette in use, one having stiff mechanics, for example, giving the very poor figure of 0.27%, whilst one with more free running mechanics was much better at 0.14%. The wow, however, is adequate for normal purposes but would be just audible on some types of music on the best cassette. As delivered, the machine was quite badly out of azimuth (40° at 3kHz phase error) but overall the phase jitter was amongst the best measured. There was a tendency, though, towards azimuth shift when a cassette was withdrawn and replaced. To achieve battery economy the machine is switched off until a function is depressed and so a few seconds elapse before record or play back functions operate fully. A very small single monitor speaker is built in which, although of poor quality, serves its purpose well.

The machine incorporates a stereo headphone jack which can allow play back in stereo of recordings made on location. Mono jack sockets allow the Sony stereo electret microphone to be used direct in to the recorder and this microphone was found to be of surprisingly high quality considering its remarkably low price.

There can be no doubt that this recorder will give a lot of pleasure to many who wish to record wild life and other outdoor sound effects well. Users will, in general, obtain a pretty high standard of reproduction on these and other tapes in the home when the sender is connected to a hi-fi system. The slightly higher than average noise on ferric tape is partly attributable to the replay shelf boost which, if corrected, would improve the signal to noise ratio by 2dB. The machine is fairly light (11lb 10oz) and includes a carrying strap. Good value for money, then, but some recorders around the same price will be a little better for domestic use now, particularly if wow and flutter performance is the main criterion.

Replay Azimuth Deviation from Average	57°
Microphone Input Sensitivity	130μV
Microphone Input Clipping	45mV
Microphone Input Impedance Average	7.5K
DIN Input Sensitivity	160μV
DIN Input Clipping	45mV
DIN Input Impedance Average	4.3K
Line Input Sensitivity	49mV
Line Input Clipping	)10V
Line Input Impedance Average	90K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+3.25
Ferric 10kHz Average Left and Right	+1.2
Chrome 10kHz Average Left and Right	−4.25

REPLAY NOISE

Ferric 20/20 worst channel	51dB
Ferric CCIR weighted Dolby Out	46.25dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	50.75dB

Wow and Flutter Average	0.14%
Speed Average	+0.37%
Meter Under-read at 64ms	−7dB

DISTORTION

At Dolby Level monitoring input	0.03%
Overall Ferric Av. L+R at Dolby Level	0.65%
Overall Ferric Av. L+R at +4dB	2%
Overall FeCRO2/LN Av. L+R at Dolby Level	0.7%
Overall FeCRO2/LN Av. L+R at +4dB	1.3%
Overall Chrome Av. L+R at Dolby Level	1.9%
Overall Chrome Av. L+R at +4dB	5%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+0.5
10kHz FeCRO2/LN Dolby Out Av. L+R	+0.25
10kHz Chrome Dolby Out Av. L+R	+.75

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1/ −1.5dB
Ref. 333Hz FeCRO2/LN	+1.75/ −1dB
Ref. 333Hz Chrome	+1.5/ −0.75dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	40.5dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	45.75dB
FeCRO2/LN Dolby Improvement	7.5dB
Chrome CCIR weighted Av. L+R Dolby Out	44.75dB
Chrome Dolby Improvement	8.5dB

DIN Input Noise Degredation	0.25dB
Line Input Noise Degredation	0.75dB
Spooling Time	1m 52s

DYNAMIC RANGE

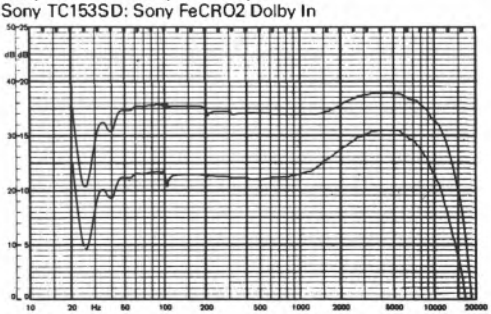
Ferric	62dB
FeCRO2/LN	66.5dB
Chrome	61dB

TAPE USED

Ferric	SONY HF
FeCRO2/LN	SONY FeCr
Chrome	SONY KR

Recommended Retail Price: £143.47

Sony TC153SD: Sony HF Dolby In
Sony TC153SD: Sony FeCRO2 Dolby In



Sony TC177 SD

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

It was decided to choose this machine as a high quality standard in order to judge other recorders in this survey, and after testing all the machines the choice of this one was clearly justified. Separate microphone/DIN and line input faders for both left and right input channels are provided. Since the machine has three heads, after and before tape monitoring is available allowing immediate comparisons of recorded quality with the original. The output gain can also be controlled so that an average recording can be made to peak around 1 ½V output if desired. Dual capstans are provided, which are partly responsible for the excellent stability and tape/head contact performance, and the deck also includes a memory tape timer.

The input circuitry seems exemplary in sensitivities, input impedances and clipping margins. The input noise performance is excellent, virtually no noise being added when a Sony electret stereo microphone was used. The record circuitry includes an extremely good limiter which seems to have a far better performance than most. A Dolby FM facility is provided for recording FM Dolbyed broadcasts should they one day be introduced, and also includes a Dolby tone oscillator with Dolby calibration user pre sets to allow precise setting of Dolby levels.

The replay noise levels were all astonishingly low, and when the pause button was depressed virtually no noise was audible at all. The remarkable figure of 67dB signal to noise ratio ref. Dolby level was achieved in the replay amplifier with chromium equalisation and Dolby switched in, and this excellent figure contributed to the very good overall noise performance. The distortion figures were most impressive and whilst Sony ferric tape sounded extremely well BASF Super LH seemed to take a slightly higher level. Sony ferrichrome, however, was startlingly good, and it was agreed by several of the laboratory staff that most users would find difficulty in telling the difference between a good original sound and a recording made on this recorder on ferrichrome. Chromium tape, although working well with the 177, had noticeably more distortion, but was still excellent by general standards. On delivery, the replay azimuth was slightly out (30° phase at 3kHz) but unfortunately the record azimuth was very seriously out, showing inadequate factory alignment, and this will have to be watched. Phase jitter measured very low and no drop outs were audible on any of the tapes used. Since a 5 pole DIN socket as well as line in/out phono sockets are provided, and the circuits are well designed, no interconnection difficulties should be experienced with DIN or phono equipment, provided the appropriate sockets are used. Considerable attempts were made to fault the machine in one way or another, but the only reservation that could be found was a tendency for extreme high frequencies to clip in the recording amplifier before the tape itself was completely saturated. Very slight sibilance was noted on high energy pop vocal recordings copied from master tapes, but notwithstanding this no average user would be likely to encounter the problem.

The VU meters, unfortunately, were only average in their performance but peak reading lights are incorporated which come on at +6dB above Dolby level. The overall frequency response was extremely good but at low frequencies slightly too little bass cut was apparent on replay although the overall response was pretty flat. This made some pre-recorded cassettes sound marginally heavier at low frequencies than they might otherwise have been. High frequencies play back very flat indeed and without the edginess present on many other machines.

Although it is realised that this machine is rather expensive, it is felt that the cost is fully justified since the record quality compares very favourably with that produced by the finest domestic ¼ track reel to reel recorders. It is very simple to use, and experience has shown it to be very reliable. Whilst it was possible to transfer from play or record to wind, unfortunately the stop button had to be depressed before re-engaging play back. This is, however, a small criticism.

Replay Azimuth Deviation from Average	22°
Microphone Input Sensitivity	170μV
Microphone Input Clipping	77mV
Microphone Input Impedance Average	7.6K
DIN Input Sensitivity	142μV
DIN Input Clipping	60mV
DIN Input Impedance Average	3.2K
Line Input Sensitivity	52mV
Line Input Clipping	)10V
Line Input Impedance Average	95K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+4.8
Ferric 10kHz Average Left and Right	0
Chrome 10kHz Average Left and Right	−5

REPLAY NOISE

Ferric 20/20 worst channel	55dB
Ferric CCIR weighted Dolby Out	55.5dB
Ferric Dolby Improvement	8.75dB
Chrome CCIR weighted Dolby Out	59dB

Wow and Flutter Average	0.1%
Speed Average	+0.85%
Meter Under-read at 64ms	7.5dB

DISTORTION

At Dolby Level monitoring input	0.06%
Overall Ferric Av. L+R at Dolby Level	1.2%
Overall Ferric Av. L+R at +4dB	3.5%
Overall FeCRO2/LN Av. L+R at Dolby Level	1%
Overall FeCRO2/LN Av. L+R at +4dB	2.25%
Overall Chrome Av. L+R at Dolby Level	2%
Overall Chrome Av. L+R at +4dB	4.5%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+1.75
10kHz FeCRO2/LN Dolby Out Av. L+R	+0.5
10kHz Chrome Dolby Out Av. L+R	+1.25

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1.75/ −1dB
Ref. 333Hz FeCRO2/LN	+0.5/ −0.5dB
Ref. 333Hz Chrome	+1.5/ −0.5dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	44.5dB
Dolby Improvement	8dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	47.5dB
FeCRO2/LN Dolby Improvement	8.5dB
Chrome CCIR weighted Av. L+R Dolby Out	48dB
Chrome Dolby Improvement	7dB

DIN Input Noise Degredation	1.25dB
Line Input Noise Degredation	0dB
Spooling Time	2m

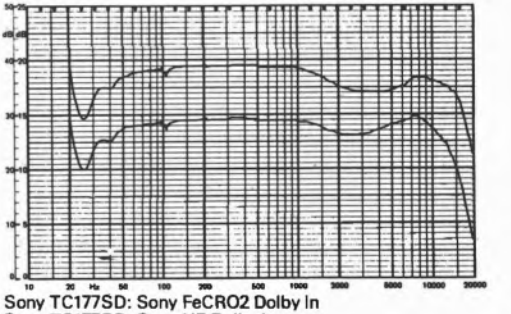
DYNAMIC RANGE

Ferric	62.5dB
FeCRO2/LN	67dB
Chrome	63dB

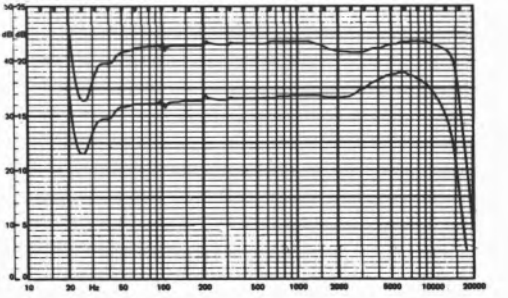
TAPE USED

Ferric	SONY HF
FeCRO2/LN	SONY $FeCrO_2$
Chrome	SONY KR

Recommended Retail Price: £305.51



Sony TC177SD: Sony FeCRO2 Dolby In



Sony TC177SD: Sony HF Dolby In

Sony TC209 SD

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

It seems that most of the Japanese manufacturers are now bringing out models such as this, which is a front loading type with all controls on the front including Dolby B processing. Although it was found relatively easy to work and the deck functions allowed transfer direct from play to spool and back to play again, the cassette loading itself was slightly inconvenient and a little practice was required to speed up the loading process.

Although the VU meters had average ballistics, under-reading a 64m sec burst by 7dB, peak reading lights were provided which lit on +5dB and shone brightly above +7dB and this was felt to be optimum for the recorder. Switching is provided for bias and equalisation separately, three positions being selectable appropriately for ferric, ferrichrome and chromium tape types.

¼" microphone jacks gave a sensitivity of 120uV into an impedance of 8k ohms and clipping was not reached until 65mV. This excellent sensitivity to clipping ratio allows almost any low impedance microphone type to be used for recording virtually anything from quiet speech to loud pop music live and the noise performance at this input was also very good. The 5 pole DIN input had an impedance of 8k ohms, about optimum, the sensitivity being 620uV, and clipping was reached at 300mV, again a very good clipping margin. The line input sensitivity was 45mV into 70k ohms and no clipping was noticed on very high level input signals. Quite clearly, then, this machine's input circuits were extremely well designed. The mic/DIN input and line input had separate concentric rotary gain controls, which allowed the two inputs to be mixed, and no problems were encountered in this area. A limiter was also incorporated which was found to work well and the Dolby circuits, when switched in, could have the multiplex filter in or out of circuit. The line input phonos at the rear were complemented by a stereo headphone type jack input socket on the front separate from a further stereo headphone jack actually for headphones. The line output level could be varied with a stereo ganged output control.

The replay response was one of the best measured, being virtually flat from 63Hz to 10kHz on both tracks, both on ferric and chromium tape types. The replay azimuth on delivery was found to be slightly out at −38° at 3kHz but, when corrected, was very stable, as was the general overall stability and phase jitter. Pre-recorded cassettes played back exceptionally well, and in particular, the Deccа cassette of "The World of Wagner" gave a most pleasant sound quality with a shining high frequency and extending well beyond 10kHz, missing from many other machines. The replay noise measured about average but was adequate and, since no hum was present to any audible degree, the nature of the replay noise wa such that it could not be heard adding to any cassette noise present. On replay the full Dolby noise reduction of 10dB was achieved but overall, unfortunately, only 8.5dB average noise reduction was given. The overall noise performance without Dolby was slightly below average, although the machine's very good distortion performance allowed pretty wide dynamic ranges to be recorded successfully.

Ferric tape (Sony HF) had an extremely low distortion of 0.65% average at Dolby level rising to only 1.9% at +4dB, thus allowing very high recording levels without distortion becoming too noticeable. The overall response, too, was good, being almost flat at 10kHz but showing a slight rise at 5kHz (see pen chart). The subjective sound quality was really superb on ferric tape and in particular the stability and lack of dropouts clearly contributed to this. Sony ferrichrome tape had extremely low distortion of 0.8% at Dolby level, rising to only 1.4% and thus, although very slightly more distortion could be measured at lower levels, the tape could accept even higher levels than ferric. What a pity, then, that the overall response was rather poor, averaging −4.5dB at 10kHz, showing the machine to be under-equalised in this position. Nevertheless, recordings did sound very good and clearly results would have been outstanding if the response had been corrected. Sony chrome tape did not give anywhere near so good a performance, since 2.5% distortion was measured at Dolby level, rising to a poor 5.8% at +4dB. The response, though, was very satisfactory, showing just a slight rise at 7kHz and only an average of 2.5dB down at 15kHz. At lower recording levels therefore, the quality was very good indeed but when higher levels were attempted the distortion became very marked.

The wow and flutter was only fair at 0.13%. The wind time was average and the speed just 0.4% fast. No problems were experienced with cross talk or erase and the attractive appearance, encased in metal, together with its general good performance allows it to be recommended, although slightly improved quality control would have allowed it to have been really good value for money.

Replay Azimuth Deviation from Average	30°
Microphone Input Sensitivity	120μV
Microphone Input Clipping	64mV
Microphone Input Impedance Average	7.7K
DIN Input Sensitivity	620μV
DIN Input Clipping	300mV
DIN Input Impedance Average	8.3K
Line Input Sensitivity	45mV
Line Input Clipping	)10V
Line Input Impedance Average	70K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+3½
Ferric 10kHz Average Left and Right	−0
Chrome 10kHz Average Left and Right	−4½

REPLAY NOISE

Ferric 20/20 worst channel	50dB
Ferric CCIR weighted Dolby Out	50¼dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	54¼dB

Wow and Flutter Average	0.14%
Speed Average	+0.37%
Meter Under-read at 64ms	7dB

DISTORTION

At Dolby Level monitoring input	0.03%
Overall Ferric Av. L+R at Dolby Level	0.65%
Overall Ferric Av. L+R at +4dB	1.9%
Overall FeCRO2/LN Av. L+R at Dolby Level	0.8%
Overall FeCRO2/LN Av. L+R at +4dB	1.35%
Overall Chrome Av. L+R at Dolby Level	2.45%
Overall Chrome Av. L+R at +4dB	5.8%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+2½
10kHz FeCRO2/LN Dolby Out Av. L+R	−¼
10kHz Chrome Dolby Out Av. L+R	

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+2¼/ −1¼dB
Ref. 333Hz FeCRO2/LN	+½/ −1dB
Ref. 333Hz Chrome	+2.5/ −0.5dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	41½dB
Dolby Improvement	9dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	46½dB
FeCRO2/LN Dolby Improvement	8¼dB
Chrome CCIR weighted Av. L+R Dolby Out	44¾dB
Chrome Dolby Improvement	8½dB

DIN Input Noise Degredation	1¼dB
Line Input Noise Degredation	¼dB
Spooling Time	1m 43s

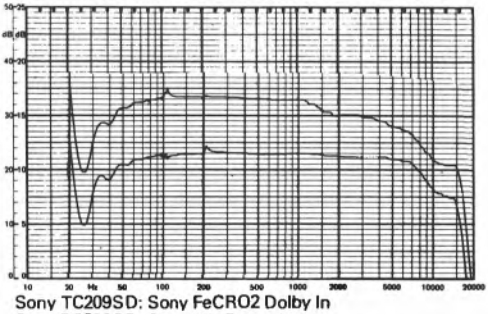
DYNAMIC RANGE

Ferric	62dB
FeCRO2/LN	68dB
Chrome	60.5dB

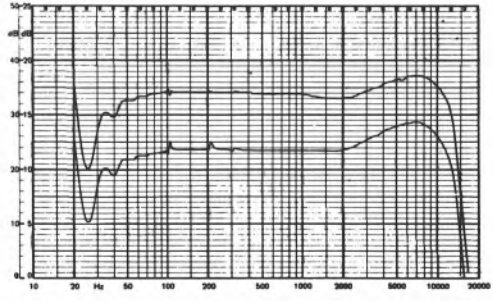
TAPE USED

Ferric	SONY HF
FeCRO2/LN	SONY FeCr
Chrome	SONY KR

Recommended Retail Price: £208.00



Sony TC209SD: Sony FeCRO2 Dolby In
Sony TC209SD: Sony HF Dolby In

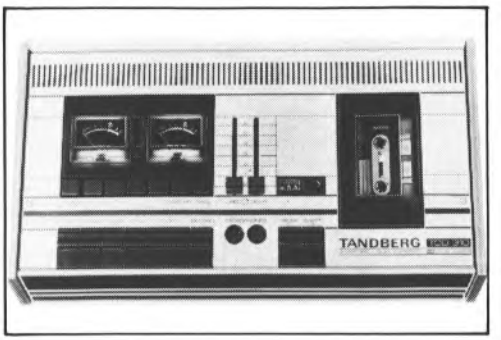


Tandberg CD310

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

Quite clearly the Tandberg model TCD 310 has a very advanced tape transport, including three motors, fully solenoid operation of all deck functions and dual capstans. Dolby B processing is incorporated. DIN microphone input sockets give an exceptional input sensitivity of 70uV into an impedance of 600ohms and are intended for use with balanced microphones. Tandberg supplied two of their own microphones for use with the recorder. This high sensitivity permitted speech to be recorded at a suitable distance away from the mics and the signal to noise ratio on this input was excellent. Clipping, however, occurred at 11.5mV and so some other types of microphone might well overload the input, when attempting to record loud sounds. A separate 5 pole DIN socket had a sensitivity of 7.5mV into an impedance of 44k ohms with clipping reached at 1.6V. The sensitivity was not sufficient to meet the DIN specification and the high input impedance would undoubtedly cause treble loss from many DIN receivers. No DIN noise degradation occurred, however, although top loss was noted from a DIN source. The phono line inputs had a sensitivity of 33mV and clipped at 4.8V, which was fairly satisfactory with no noise degradation at 100mV. Despite some very advanced technology employed in this machine the measured wow and flutter was 0.17%, which was most disappointing. As delivered the azimuth was exceptionally accurate and proved to be very stable, no problems being encountered. The replay response with ferric equalisation showed a slight loss at the base end of around 1.5dB at 63Hz and a similar loss at 10kHz. The chromium response was about optimum at 10kHz, but showed the same bass loss. Replay noise levels all measured about average and showed 10dB noise improvement with Dolby switched in. Pre-recorded cassettes played back pretty well with generally good stability, but one cassette was badly damaged by the mechanism. Replay hiss was subjectively reasonably low. The overall performance on Tandberg XD ferric tape was very good indeed, giving distortion of approximately 0.5% at Dolby level, rising to 1% at +4dB. Very high recording levels could thus be achieved with remarkably low distortion, giving a very wide dynamic range. The response showed a 2dB shelf from 4kHz to just above 10kHz but fell to only −1dB at 14.5kHz, these measurements being taken with Dolby processing in. Subjectively recordings had a very wide response indeed and the slight HF shelf was not disliked. Tandberg chrome tape produced 2% distortion at Dolby level, rising to 4.5% at +4dB and more distortion was audible than on ferric, particularly at very low frequencies. High frequencies, though, recorded with excellent clarity and transparency, although the measured response showed a hole of some 4dB at 3kHz, recovering to a flat response at 10kHz. This was purely an exaggeration of the Dolby out response, which also showed a hole at 3kHz but of only half the depth.

The deck push buttons operated most effectively and allow the user to transfer from one function to another directly. The machine's rewind time was exceptionally fast at only 55 secs average for a C90 and this surely is excessive, the wind being rather loose. Some low frequency cross-talk was noted (19dB at 63Hz) but this should not cause any problem to normal domestic users. The erase, whilst being adequate, was slightly below average, measuring only 60dB on chrome. The record level meters were particularly good, under-reading a 64m sec pulse by only 1dB, an 8m sec pulse under-reading by only 6dB, thus the meters allow very accurate peak levels to be set for optimum recording levels. As stated the meters showed an inbalance of 3dB between record and play back, on record the meter reading some 3dB too low on a continuous tone. The deck can be operated horizontally, or vertically, or in virtually any position desired by the user, and worked very reliably, apart from the tape mangle referred to. Both the DIN and line output sockets are always live and presented an extremely low output impedance, which could not possibly present any problems. No auto stop is provided on rewind. Since the subjective quality of the machine was well liked, many users would be very happy with it, although it will clearly perform at its best on microphone and on phono inputs only. Tandberg, though, will have to improve the wow and flutter peformance, although the review sample might well have been a rogue one in this respect. A little bit more trouble taken in manufacture would have made this machine a strongly recommended one.



Replay Azimuth Deviation from Average	10°
Microphone Input Sensitivity	70μV
Microphone Input Clipping	12mV
Microphone Input Impedance Average	580Ω
DIN Input Sensitivity	7.5mV
DIN Input Clipping	1.6V
DIN Input Impedance Average	44K
Line Input Sensitivity	33mV
Line Input Clipping	4.8V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+1.9
Ferric 10kHz Average Left and Right	−1¼
Chrome 10kHz Average Left and Right	−5¼

REPLAY NOISE

Ferric 20/20 worst channel	52½dB
Ferric CCIR weighted Dolby Out	49¼dB
Ferric Dolby Improvement	9¾dB
Chrome CCIR weighted Dolby Out	52½dB

Wow and Flutter Average	0.17%
Speed Average	+0.3%
Meter Under-read at 64ms	1¼dB

DISTORTION

At Dolby Level monitoring input	0.11%
Overall Ferric Av. L+R at Dolby Level	6.5%
Overall Ferric Av. L+R at +4dB	0.95%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	1.95%
Overall Chrome Av. L+R at +4dB	4.5%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+1
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	0

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+¾/ −½dB
Ref. 333Hz FeCRO2/LN	—, —
Ref. 333Hz Chrome	+1¼/ −1½dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	42½dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	46dB
Chrome Dolby Improvement	10dB

DIN Input Noise Degredation	½dB
Line Input Noise Degredation	½dB
Spooling Time	55s

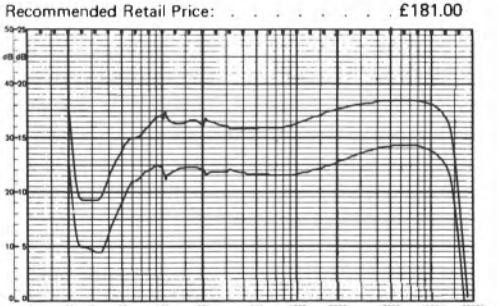
DYNAMIC RANGE

Ferric	65dB
FeCRO2/LN	—
Chrome	64dB

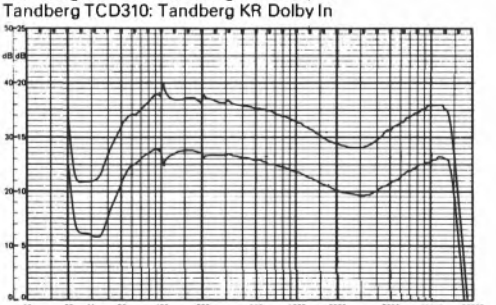
TAPE USED

Ferric	TANDBERG FeXD
FeCRO2/LN	—
Chrome	TANDBERG KR

Recommended Retail Price: £181.00



Tandberg TCD310: Tandberg XD Dolby In
Tandberg TCD310: Tandberg KR Dolby In



Teac A160

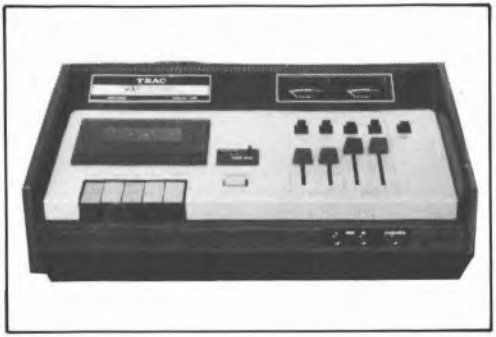
Acoustic Research International Ltd., High Street, Houghton Regis, Bedfordshire, LU5 2BR. 0582 603151

The cheapest Teac in the survey, this machine offers very basic facilities of Dolby B processing, ¼" jack microphone inputs, a 5 pole DIN input/output socket, and line in and output sockets. A ¼" stereo headphone jack is also provided. The VU meters were decidedly better than average, under-reading only 4dB when pulsed with a 64m sec burst. This is just as well, since no peak reading lights are provided. Mechanically the deck had a rather average wow and flutter figure of 0.1% with occasional deviations to 0.12%, but the stability was below average and in particular a cyclic variation on output at 10kHz was noted.

The noise level on replay was about average at −50dB (CCIR weighted) at Dolby level without processing, and this improved by a full 10dB when processing was switched in. Chromium equalisation improved the noise by about 3dB. The azimuth was out when the machine was supplied, but more disturbing were some irregularities in response. The bass end was decidedly up at 63Hz, particularly on the right channel, +2dB. The response at 10kHz drooped very badly indeed, especially on the left channel at −5dB. Pre-recorded Dolbyed cassettes thus reproduced with a very muffled sound, and some extraordinary distortion at lower frequencies was noticed on an EMI cassette of Scott Joplin arrangements. Azimuth wander was noticed and clearly the deck was mechanically rather below par.

The overall quality on ferric (Sony HF) was quite good with a reasonable flat response. Very low measured distortion of .5% at Dolby level rose to 1.7% at +4dB, quite creditable. The overall sound, then, was good on ferric tape, but lacked transparency. To overcome the bad replay HF droop, excessive HF boost was necessary on record, thus exaggerating high frequency distortion. The overall noise performance was in fact very good, but would be worse if the replay response had been correct. Chromium tape also fared quite well, the distortion averaging 1.5% at Dolby level, rising to 3.5% at +4dB, a level which many other recorders reached at Dolby level. The Dolbyed response measured 3dB up at 10kHz which was considered quite reasonable. The quality on chrome sounded very good with a better than average dynamic range, although naturally the chrome tape could not take such a high level as ferric. A speech recording made with the Sony electret stereo microphone was very good, with a wide dynamic range, but when the recording level was raised some spitch was noticed, presumably produced by the treble boost measured in the laboratory.

It is felt that this machine is fairly good value for money, and probably the bad treble loss on play back could well be a sample variation. There are many other machines in the survey though, which performed at least as well at around the same price, and personal taste may well influence the buyer. The deck controls were found a little stiff, but worked satisfactorily. No auto stop was provided on rewind. It is possible to transfer from play back to rewind and back again, and a cueing facility is provided. The mic/line input switch was useful. The microphone input produced adequate sensitivity with an electret microphone for speech recording, but not quite enough with a low output moving coil type. The clipping margin was excellent. The DIN input also had adequate sensitivity, and an amazing clipping level of 1.4V in to an impedance of 11k ohms, about optimum. Unfortunately severe noise degradation occurred on the DIN input from a standard DIN source, and this will have to be corrected by Teac in a redesign. Slight noise was added at 100mV on the line input, and in any case this level was only just sufficient to achieve Dolby level on record. Far too much attenuation was built in here, thus requiring the record level controls to be used rather high on average input programmes unless they were at a very high level.



Replay Azimuth Deviation from Average	64°
Microphone Input Sensitivity	257μV
Microphone Input Clipping	119mV
Microphone Input Impedance Average	2.1K
DIN Input Sensitivity	3.2mV
DIN Input Clipping	1.45V
DIN Input Impedance Average	10.8K
Line Input Sensitivity	100mV
Line Input Clipping	) 10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	4½
Ferric 10kHz Average Left and Right	−4¼
Chrome 10kHz Average Left and Right	−8

REPLAY NOISE

Ferric 20/20 worst channel	53dB
Ferric CCIR weighted Dolby Out	49½dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	53dB

Wow and Flutter Average	0.11%
Speed Average	+0.13%
Meter Under-read at 64ms	4dB

DISTORTION

At Dolby Level monitoring input	0.15%
Overall Ferric Av. L+R at Dolby Level	0.5%
Overall Ferric Av. L+R at +4dB	1.7%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	1.5%
Overall Chrome Av. L+R at +4dB	3.5%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−¼
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	+2

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1/ −1¼dB
Ref. 333Hz FeCRO2/LN	—
Ref. 333Hz Chrome	†2/ −¾dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	44½dB
Dolby Improvement	9dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	46dB
Chrome Dolby Improvement	9½dB

DIN Input Noise Degredation	9½dB
Line Input Noise Degredation	2½dB
Spooling Time	1m 29s

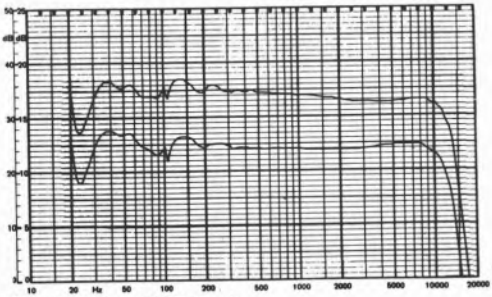
DYNAMIC RANGE

Ferric	65dB
FeCRO2/LN	—
Chrome	60dB

TAPE USED

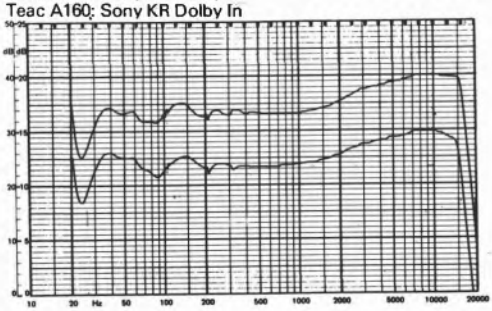
Ferric	SONY HF
FeCRO2/LN	—
Chrome	SONY KR

Recommended Retail Price: £119.50



Teac A160: Sony HF Dolby In

Teac A160: Sony KR Dolby In



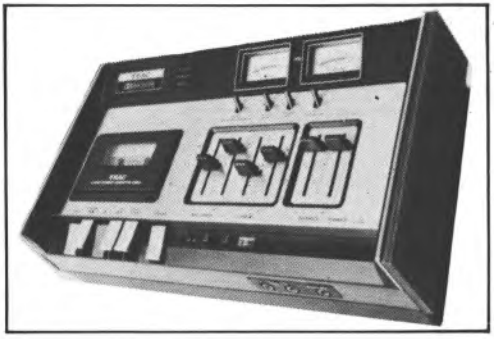
Teac A260

Acoustic Research International Ltd., High Street,
Houghton Regis, Bedfordshire, LU5 2BR. 0582 603151

Although one of the less expensive models in the Teac range, it includes some very useful facilities, particularly the ability to mix two separate phono/line inputs. Three pairs of faders on the main operating surface control the mic/DIN with line input A, line input B and monitor output level. Dolby B processing is included. The VU meters have a very average performance, under reading 7dB on a 64m sec pulse. The peak reading light glows with an input peaking above +2dB ref. Dolby level. Two ¼" microphone jacks on the front panel provide an input sensitivity of 245uV for Dolby level and clip at 71mV at middle frequencies (cf re hf break through problem). The input impedance was about optimum at just over 2k ohm and the pre amplifier had a pretty low input noise level. The 5 pole DIN socket had an input sensitivity of 3mV and an impedance of 11k ohms, which was about optimum, but the clipping level of 850mV at middle frequencies was astounding. The two pairs of line input phonos had a sensitivity of 100mV and no clipping resulted with inputs up to 10V. On the first pair of faders a switch is provided to select line or mic/DIN whereas the second pair are only fed from the line B inputs.

The replay response was just a little disappointing, drooping about 3dB at 10kHz with an equivalent fall off from optimum for chromium equalisation. This unfortunately produced a slightly muffled sound from Dolby processed pre-recorded cassettes, and this could be worsened since the machine was supplied badly out of azimuth, −80° at 3kHz. The replay noise was slightly below average and would have been worse if the high frequencies had been flatter. The stability was poor overall, the phase jitter being ±35° at 10kHz, and the wow and flutter was disappointing, averaging .14%, just bad enough for wow to be occasionally audible on many types of programme. The speed accuracy, however, was reasonable at +.4%.

The overall performance was slightly better and ferric tape (Sony HF) was good, with a distortion of 0.9% at Dolby level which increased to 3% at +4dB. This increase is a little sharper than average, and whilst subjectively distortion was lower at average levels, transients tended to distort when very loud. The response was slightly uneven, but acceptable (see pen charts). The head/tape contact was a little variable, and the quality was thus bettered by many other machines. Chromium tape (Sony) sounded much cleaner at lower levels, but as would be expected could not accept very high recording levels. High frequencies, though, were very clean, and the response was fairly even between the tracks, although a peak of 2.5dB was noted at 10kHz when Dolby processing was in use, this hardly affecting the overall sound quality. A Sony stereo electret microphone produced very good speech recordings, and the overall noise level was about average and certainly better than the two senior models reviewed. No cross talk or erase problems were encountered, but one unusual problem did arise, which appeared to be some form of breakthrough from the input circuitry to the Dolby circuitry at very high frequencies even when the record level control was at minimum. This produced a sharp rise at high frequencies at lower volume settings. It is felt that Teac need to rethink the design of the machine to improve the replay noise and remove the high frequency breakthrough problem on record. If these points were attended to, and the quality control on response was improved, the machine would be quite recommendable particularly for its useful input facilities. The DIN input circuit, incidentally, showed some noise degradation of 5dB from the standard DIN source. The poorer than average mechanical stability was exaggerated by azimuth variations, and this will also require attention. The deck functions worked well and it was possible to transfer from play to wind and back to play again without pressing the stop button. The spooling incorporated a memory counter, and worked well but no auto stop was provided. The review/cue facility allows the tape to be heard during rewinding which was felt to be very useful.



Replay Azimuth Deviation from Average	72°
Microphone Input Sensitivity	245μV
Microphone Input Clipping	71mV
Microphone Input Impedance Average	2.2K
DIN Input Sensitivity	2.9mV
DIN Input Clipping	845mV
DIN Input Impedance Average	10.8K
Line Input Sensitivity	100mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+4
Ferric 10kHz Average Left and Right	−3
Chrome 10kHz Average Left and Right	−7.25

REPLAY NOISE

Ferric 20/20 worst channel	48.5dB
Ferric CCIR weighted Dolby Out	48dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	52dB
Wow and Flutter Average	0.14%
Speed Average	+0.4%
Meter Under-read at 64ms	7dB

DISTORTION

At Dolby Level monitoring input	0.06%
Overall Ferric Av. L+R at Dolby Level	0.9%
Overall Ferric Av. L+R at +4dB	3%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	2.2%
Overall Chrome Av. L+R at +4dB	4.75%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+1
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	+2.5

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1/ −0.5dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+2.5/ −0.5dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	42.5dB
Dolby Improvement	8.75dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	44.25dB
Chrome Dolby Improvement	8dB
DIN Input Noise Degredation	5dB
Line Input Noise Degredation	0.5dB
Spooling Time	1m 30s

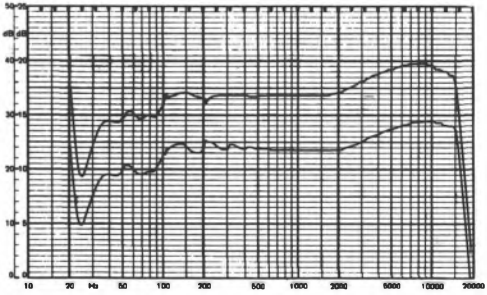
DYNAMIC RANGE

Ferric	61dB
FeCRO2/LN	—
Chrome	59.5dB

TAPE USED

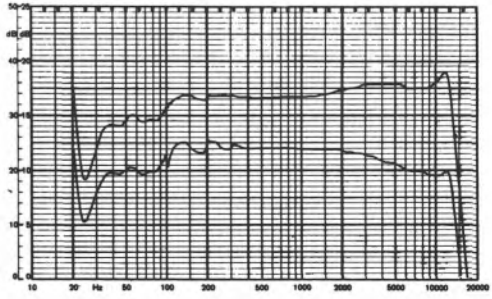
Ferric	SONY HF
FeCRO2/LN	—
Chrome	SONY KR

Recommended Retail Price: £175.00



Teac A260: Sony KR Dolby In

Teac A260: Sony HF Dolby In



Basically fairly similar to the A450 with almost identical electronics this model is slightly modified. The deck includes Dolby B processing, ¼" microphone input jacks, a stereo headphone jack and a 5 pole DIN input/output socket, complemented by the usual line/phono input and output sockets. A switchable multiplex filter is provided, which seemed rather pointless since there was very little audible difference in the sound quality when it was switched out. A single pair of input faders is driven from a switch selecting line in or the mic/DIN preamplifier. Unfortunately this model has an even more serious noise problem than the A450. The replay response measured extremely well, being ±1dB from 40Hz to 10kHz ref. 333Hz. Chromium was equally good with the correct compensation. Pre-recorded cassettes replayed with a very good response and reasonable stability, but a very high hiss level was noticed on all play backs, the signal to noise ratio being some 9dB inferior to the average. This caused the overall signal to noise ratio also to be very poor indeed, some 6dB worse than optimum. The design fault was investigated and proved to be due to severe attenuation on replay of the pre-amplified and equalised signal down to a level of 1mV in to a transistor from a source impedance as high as 12k ohms. An electronics engineer only has to do a brief calculation here to confirm that this level in the pre-amplification stage before the Dolby circuitry is ridiculous. No wonder, then, that the noise performance is so very poor, and Teac really must redesign the circuit optimally—which indeed is not difficult.

Three bias and eq positions are provided for normal and super ferric tapes with the third position for chrome tapes. TDK SD C90 was used as specified by Teac for the normal ferric positions of bias and equalisation, and the distortion at Dolby level measured 1.6% which was fairly reasonable. The response showed a rise of 3.5dB at 10kHz on the left but the right channel was better at 1.5dB. The overall sound quality on this tape was marred by the treble rise giving a slightly "chrome plated" sound and distortion was noticeable at high recording levels. Far more disturbing, though, was the extremely high hiss level. TDK SD C60, measured in the medium bias and eq positions, had a serious high frequency loss, averaging 5.5dB down at 10kHz, but had noticeably lower distortion at only .6% at Dolby level. Since the sound quality was very muffled. Maxwell UD tape was then used with the same settings and proved very much better, having a response almost flat at 10kHz and subjectively marginally lower distortion still. The sound quality was very good, but was again marred by bad background noise. TDK chrome again proved to have a noticeable high frequency loss at 10kHz, 2.5dB down on the left but 5dB down on the right, again giving a rather muffled sound. The right channel had very low distortion, 1% at Dolby level, but the left was higher than average at 3.1%, showing incorrect biasing. Whilst the overall noise on chrome was marginally better it was still far below optimum, since the noise of the replay amplifier was clearly higher than the noise of the cassette tape itself. Teac really must redesign their circuit for in its present state the machine just cannot be recommended.

The microphone input sensitivity, whilst being adequate for electret microphones, would not allow speech recording to reach full recording level with a moving coil type. The clipping margin was almost unnecessarily good, since 130mV were required to clip the input circuit. The DIN sensitivity and clipping was identical to the mic input but the impedance measured extremely low at 2.1k ohms. The noise level overall was so poor that any noise degradation occurring in the input circuit, due to its very low impedance, would be masked. The line input was very insensitive, requiring 120mV for Dolby level to be reached, but no clipping was noticed at very high input levels in to the high line input impedance.

The VU meters had average ballistics but the peak reading lights were adjusted usefully to operate at approximately 2.5dB above Dolby level, about optimum. The wow and flutter measured exceptionally well at .06% and the stability also was good, showing only ±5% phase jitter at 10kHz. The azimuth on delivery was fairly accurate at −25° at 3kHz and so it is a pity that the design faults mentioned and the rather poor quality control severely affected the performance, which could have been so much better with relatively minor internal changes and correct adjustment of pre-set controls.

Replay Azimuth Deviation from Average	18°
Microphone Input Sensitivity	300μV
Microphone Input Clipping	128mV
Microphone Input Impedance Average	33K
DIN Input Sensitivity	310μV
DIN Input Clipping	128mV
DIN Input Impedance Average	2.1K
Line Input Sensitivity	117mV
Line Input Clipping	)10V
Line Input Impedance Average	55K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+2.75
Ferric 10kHz Average Left and Right	–0.5
Chrome 10kHz Average Left and Right	–4.75

REPLAY NOISE

Ferric 20/20 worst channel	46dB
Ferric CCIR weighted Dolby Out	41.5dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	42.5dB

Wow and Flutter Average	0.05%
Speed Average	+0.11%
Meter Under-read at 64ms	7dB

DISTORTION

At Dolby Level monitoring input	0.1%
Overall Ferric Av. L+R at Dolby Level	1.62%
Overall Ferric Av. L+R at +4dB	5.9%
Overall FeCRO2/LN Av. L+R at Dolby Level	0.58%
Overall FeCRO2/LN Av. L+R at +4dB	1.8%
Overall Chrome Av. L+R at Dolby Level	2.0%
Overall Chrome Av. L+R at +4dB	5.9%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+3.25
10kHz FeCRO2/LN Dolby Out Av. L+R	–2.5
10kHz Chrome Dolby Out Av. L+R	–0.5

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+3.5/ –0.75dB
Ref. 333Hz FeCRO2/LN	0.75/ –3.5dB
Ref. 333Hz Chrome	+0.5/ –1.25dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	39dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	39dB
FeCRO2/LN Dolby Improvement	10dB
Chrome CCIR weighted Av. L+R Dolby Out	40.5dB
Chrome Dolby Improvement	9.9dB

DIN Input Noise Degredation	0dB
Line Input Noise Degredation	0dB
Spooling Time	

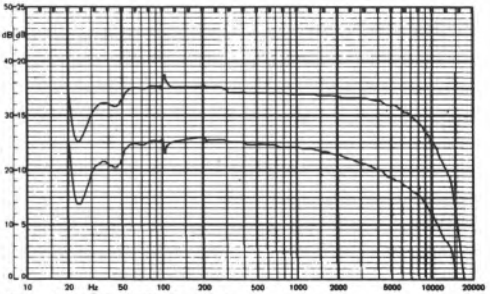
DYNAMIC RANGE

Ferric	56.5dB
FeCRO2/LN	61dB
Chrome	56.5dB

TAPE USED

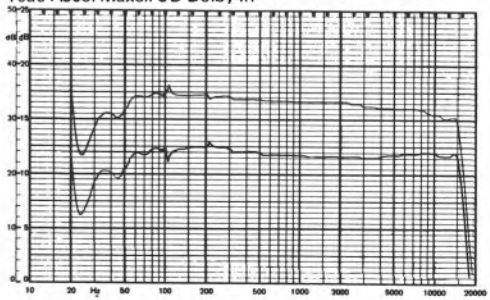
Ferric	TDK SD 90
FeCRO2/LN	TDK SD 60
Chrome	TDK KR

Recommended Retail Price: £198.00



Teac A360: TDK SD Dolby In

Teac A360: Maxell UD Dolby In



Teac A450

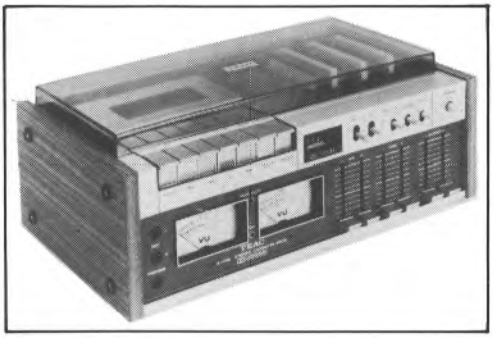
Acoustic Research International Ltd., High Street,
Houghton Regis, Bedfordshire, LU5 2BR. 0582 603151

The most expensive model in the Teac range in the UK, it has Dolby B processing with bias and equalisation switched positions for ferric, super ferric and chromium cassettes. There are input sockets for line in and out (phono), 5 pole DIN, and ¼" mono jack sockets for left and right channels, allowing the use of low or medium impedance microphones. mic/DIN and line in have separate pairs of faders allowing mixing, the mic/DIN input passing through a pre-amplifier whilst the line in mixes passively. As is usual with many recorders the pre-amplifier on record serves also as the pre-amplifier/equaliser for the replay head, and unfortunately in the Teac A450 and A360 compromises have had to be made which seriously affect the signal to noise ratio. A ¼" stereo headphone jack allows monitoring of both record and play back signals. A Dolby FM recording facility is also included, should Dolby B broadcasts ever be transmitted.

On replay, pre-recorded cassettes sounded extremely good with excellent stability and head to tape contact. Just a slight treble cut was measured at 10kHz (2dB) on both ferric and chrome equalisation positions. Because of the machine's excellent stability the cut was not too noticeable. However, the replay signal to noise was rather poor, the machine's noise being inherently about equal to the noise produced by the cassette itself, causing the effective noise power to be exaggerated by about 3dB. This rather poor play back noise affected the overall noise, which gave only a 40dB weighted reading ref. Dolby level when the Dolby circuits were inoperative. The Dolby circuit, however, did improve the figure by 10dB, the maximum improvement theoretically possible.

The overall response on TDK SD ferric was pretty flat, a rise of 3dB at 10kHz being noted on both channels. The distortion on this tape was exceptionally low, well below 0.5%, and thus very high levels could be recorded without distortion. On Sony HF ferric the distortion was slightly higher, averaging 0.8%, but still very good, whilst the response showed a slight rise at 10kHz, particularly on the right. Both ferric biasing positions gave very good subjective listening qualities, and the cleanness, clarity and excellent stability with low wow and flutter (.075%) would make the machine highly recommendable. However, some 4dB more tape hiss was noted on ferric tape than should have been present, thus reducing the potentially very wide dynamic range. Unfortunately chrome tape (Sony) fared very badly, since there was a 4.5dB overall boost at 10kHz extending to a 5.5dB boost at 15kHz, with only average distortion. Again the noise was far higher than it should have been, and recordings sounded toppy and gritty on chrome, distortion being clearly audible even at average recording levels.

The microphone inputs had a very high sensitivity of 140uV and had a very good clipping margin, 96mV being required for distortion to become apparent. The hiss produced by the input pre-amplifier was reasonably low. The DIN input sensitivity was 285uV with the same clipping point, but with an input impedance of 2k ohms—rather too low. Some 3dB of noise degradation occurred from a standard DIN source and this could so easily be optimised by Teac if the input impedance here was raised to 6.8k ohms for example. The line input also degraded the noise slightly, there being too much attenuation, and the sensitivity was therefore only 120mV. The multiplex filter had a very steep notch of 34dB but was unfortunately tuned incorrectly at 20kHz, thus giving only 16dB at 19kHz. This is outside specification and whistle problems could occur with some stereo tuners. The meters under-read a 64m sec pulse by 44dB, and the peak reading light came on at Dolby level. This could with advantage be adjusted by Teac to light about 4dB higher as otherwise users could tend to under record. A timer facility is provided which, with an accessory allows a recording to be made automatically at a pre-set time, the machine switching off at the end of the cassette. The deck functions all work very well, and ergonomically the machine was easy to use, so it is a pity that it must be criticised so heavily for its rather poor signal to noise ratio.



Replay Azimuth Deviation from Average	32°
Microphone Input Sensitivity	138μV
Microphone Input Clipping	95mV
Microphone Input Impedance Average	35K
DIN Input Sensitivity	285μV
DIN Input Clipping	93mV
DIN Input Impedance Average	2K
Line Input Sensitivity	117mV
Line Input Clipping	)10V
Line Input Impedance Average	74.5K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+2.75
Ferric 10kHz Average Left and Right	−2
Chrome 10kHz Average Left and Right	−6.5

REPLAY NOISE

Ferric 20/20 worst channel	52.5dB
Ferric CCIR weighted Dolby Out	45.5dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	45.5dB
Wow and Flutter Average	0.07%
Speed Average	+0.15%
Meter Under-read at 64ms	4dB

DISTORTION

At Dolby Level monitoring input	0.2%
Overall Ferric Av. L+R at Dolby Level	0.35%
Overall Ferric Av. L+R at +4dB	1.1%
Overall FeCRO2/LN Av. L+R at Dolby Level	0.85%
Overall FeCRO2/LN Av. L+R at +4dB	2.6%
Overall Chrome Av. L+R at Dolby Level	1.9%
Overall Chrome Av. L+R at +4dB	4.3%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+3.25
10kHz FeCRO2/LN Dolby Out Av. L+R	+1.5
10kHz Chrome Dolby Out Av. L+R	+3

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+3.5/ −0.5dB
Ref. 333Hz FeCRO2/LN	+1.5/ −0.25dB
Ref. 333Hz Chrome	+3.5/ −0.5dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	40dB
Dolby Improvement	10dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	41.5dB
FeCRO2/LN Dolby Improvement	9.5dB
Chrome CCIR weighted Av. L+R Dolby Out	44.5dB
Chrome Dolby Improvement	8.5dB
DIN Input Noise Degredation	2.5dB
Line Input Noise Degredation	1dB
Spooling Time	2m 20s

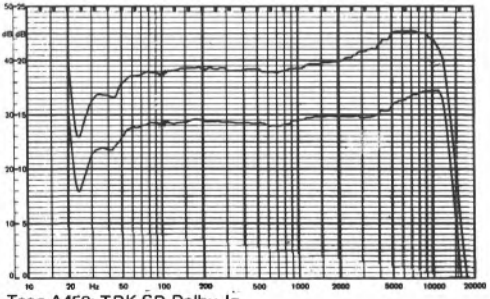
DYNAMIC RANGE

Ferric	62.5dB
FeCRO2/LN	62dB
Chrome	61dB

TAPE USED

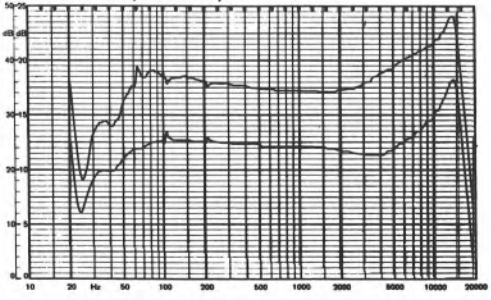
Ferric	TDK SD
FeCRO2/LN	SONY HF
Chrome	SONY KR

Recommended Retail Price: £232.00



Teac A450: TDK SD Dolby In

Teac A450: Sony KR Dolby In



Technics RS-273US

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

The 273US is a two head machine with Dolby, and is in the lower price bracket. It is a horizontal top loading machine of conventional design and appearance. As delivered, the azimuth was very accurately set at +8° at 3kHz. The replay responses on both chrome and ferric tape were good, though slightly down in top on the left. This top loss was accentuated when the Dolby was switched in, tending to indicate a slight alignment error. Some second harmonic distortion was introduced by the replay amplifier which, although not serious, was above that expected. Play back of pre-recorded cassettes was generally impressive with low background noise and good stability and very good wow and flutter (0.09%).

Phono line inputs and outputs are provided as well as a 5 pole DIN socket and two miniature microphone jacks which were disliked. A ¼" stereo headphone jack socket is situated on the front of the machine. Either line or mic/DIN inputs are selected with a switch on the back panel. It was felt that this switch and the microphone sockets would be easier to use if they were on the front panel, and also that standard ¼" microphone sockets would be better than the miniature ones fitted. Left and right input and output levels are set with four rotary controls. The VU meters are equipped with a peak check switch which increases the speed at which they can respond to short duration transients. With this switch on, the meters under-read only 4dB on an 8m sec tone burst, a very marked improvement on their performance in the ordinary position.

As with the Technics 676, it is clear that the ordinary position of the VU meters becomes redundant since the peak reading facility was found very accurate, and enables input programme levels to be adjusted to give optimum distortion/signal to noise performance. On Maxell UD ferric tape the overall distortion/sn performance at Dolby level was very low at 0.65%, rising to 2.2% at +4dB. The frequency response was very flat indeed but showed a very slight rise at the extreme hf end (see pen chart). The overall noise was pretty low and the subjective sound quality on ferric tape was very good indeed, particularly since the machine is relatively low priced. It seems that the overall quality on a cassette recorder is not necessarily dependent upon price, and undoubtedly users will be very pleased with the quality of this machine.

On chromium tape (TDK) the machine again performed extremely well, with a very flat response which extended to 15kHz on the right channel but fell sharply above 12kHz on the left. The signal to noise ratio (CCIR weighted) ref. Dolby level, was extremely good at 56.5dB, especially since the distortion on chrome was reasonable at 1.8% for Dolby level. All the high frequencies were recorded cleanly and thus the machine was regarded as very satisfactory.

Speech recording produced a very clean sound with a low hiss level, although only just enough gain was provided for speech only a few inches away from the microphone. An electret microphone with an inherently higher output is therefore desirable. The clipping margin was very good and would allow the recording of fairly loud instruments in close proximity to the microphone without distortion. Whilst the DIN input had good sensitivity and clipping margins, it had a very low input impedance of 2.1k ohms, and as anticipated some hiss degradation of 4dB was noted from the standard DIN source. This could be improved if the manufacturers raised the DIN input impedance to 4.7k ohms since an adequate clipping margin is still available. The line input had a high input impedance and a sensitivity of 85mV, but would accept very high level input signals without distortion. Again, unfortunately, very slight hiss was added for an input level of 100mV, and therefore it is recommended that at least 300mV should be sent into the recorder to avoid hiss degradation. More than average phase jitter (±20°) was noted but this did not seem ot affect the overall performance too noticeably since the jitter was of very short duration. This machine, then, can be recommended at its price, but Technics are advised to make some minor modifications to the input circuitry to improve the compatibility on both the DIN and line inputs.

Replay Azimuth Deviation from Average	0°
Microphone Input Sensitivity	305μV
Microphone Input Clipping	41mV
Microphone Input Impedance Average	36K
DIN Input Sensitivity	310μV
DIN Input Clipping	43mV
DIN Input Impedance Average	2.1K
Line Input Sensitivity	85mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+3
Ferric 10kHz Average Left and Right	−1.5
Chrome 10kHz Average Left and Right	−5.5

REPLAY NOISE

Ferric 20/20 worst channel	52.5dB
Ferric CCIR weighted Dolby Out	50dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	54.5dB
Wow and Flutter Average	0.09%
Speed Average	+0.3%
Meter Under-read at 64ms	6dB

DISTORTION

At Dolby Level monitoring input	0.06%
Overall Ferric Av. L+R at Dolby Level	0.65%
Overall Ferric Av. L+R at +4dB	2.2%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	1.75%
Overall Chrome Av. L+R at +4dB	4.8%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+1
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	−0.5

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1.5/ −1.0dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+0.5/ −1.25dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	42.5dB
Dolby Improvement	9dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	
FeCRO2/LN Dolby Improvement	
Chrome CCIR weighted Av. L+R Dolby Out	47.75dB
Chrome Dolby Improvement	9dB
DIN Input Noise Degredation	3.75dB
Line Input Noise Degredation	2.25dB
Spooling Time	1m55s

DYNAMIC RANGE

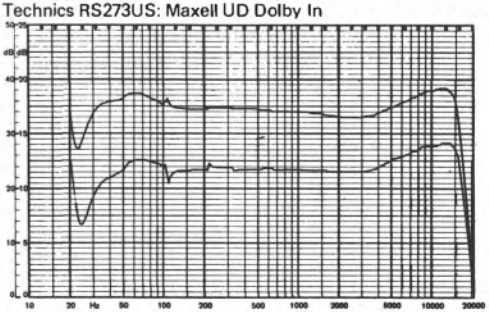
Ferric	63dB
FeCRO2/LN	—
Chrome	64.5dB

TAPE USED

Ferric	MAXWELL UD
FeCRO2/LN	—
Chrome	TDK KR

Recommended Retail Price: £135.96

Technics RS273US: TDK KR Dolby In



Technics RS273US: Maxell UD Dolby In

Technics RS-610US

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

As it is at the bottom price limit of machines reviewed in this survey, any criticisms of this recorder should be related to the value it offers an average user. Dolby B processing is included with ¼" mic jacks, a 5 pole DIN socket, and line in and out sockets together with a stereo headphone jack. All the basic controls are on the front but the cassette is loaded in the top. The record level control is a ganged stereo one with a separate balance control and the VU meters, not complemented by peak reading lights, under-read a 64m sec burst by 6dB and were thus reasonable. The wow and flutter performance was poor, the first sample measuring 0.25% average, whilst a second one submitted at the request of the manufacturer was still below average at 0.17%. The speed accuracy on both machines averaged 0.9% slow and was thus noticeably slightly flat.

Both samples had a very good HF response, being within ±1dB ref. 333Hz to 10kHz, but the bass response appeared to be incorrect, showing approximately a 2.5dB loss at 50Hz. The replay weighted noise on ferric equalisation measured excellently at −52dB without Dolby and when this was switched in an improvement of 10dB occurred. Pre-recorded cassettes sounded remarkably good but some azimuth wandering was noted and quite clearly the wow and flutter performance was not really satisfactory. The ovreall noise on ferric Maxell UD measured very well, averaging 43.5dB without Dolby, improving by 10dB when processing was switched in and this, surprisingly, was one of the best measured overall noise figures for ferric tape. The frequency response was remarkably flat, being within a dB or so to 10kHz on both channels, extending to 15kHz with a slightly rising response (see pen chart). The distortion measured pretty low at Dolby level, averaging 0.9%, but this deteriorated rapidly to reach an average of 3.4% at +4dB and thus high recording levels began to sound rough, although subjectively at reasonable levels the quality was very good. On TDK chrome tape the distortion averaged 2.1% at Dolby level, but rose to a somewhat poor 5.8% at +4dB, and thus the same comments apply on subjective distortion. The response on chrome showed a 3dB shelf loss from 2kHz right up to 14kHz, but the overall response sounded surprisingly flat notwithstanding this.

The microphone input sensitivity measured 400uV, which was too insensitive for moving coil microphones but sufficient for electrets. A Sonyy stereo electret gave excellent speech reproduction with a very wide dynamic range but with a suspicion of slight hardness. The clipping point of 44mV was very good. The DIN input was identical to the mic one, but the impedance was reduced from 6.6k ohms to 1.7k ohms which was rather too low, thus some hiss degradation was noticeable (2.5dB) from the standard DIN source. The line input was very noisy at 100mV, some 10dB hiss being added, but this was virtually at maximum sensitivity. Higher input levels reduced the hiss and above 500mV no hiss degradation occurred. Technics could definitely decrease the input attenuation of the line input to provide more sensitivity and less hiss at lower levels. No clipping problem was encountered at all on this input.

Although this machine has very simple facilities, it was reliable and felt to be very good value for money, but potential users sensitive to pitch variations would probably find the wow and flutter unacceptable. No cross talk or erase problems were found and the machine's basic simplicity again helps to recommend it. It may well be worthwhile, though, considering spending another £20 or so for a machine that performs better.

Replay Azimuth Deviation from Average	43°
Microphone Input Sensitivity	400μV
Microphone Input Clipping	43.5mV
Microphone Input Impedance Average	6.6K
DIN Input Sensitivity	400μV
DIN Input Clipping	43.5mV
DIN Input Impedance Average	1.7K
Line Input Sensitivity	105mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+1½
Ferric 10kHz Average Left and Right	−1
Chrome 10kHz Average Left and Right	−5.13

REPLAY NOISE

Ferric 20/20 worst channel	54dB
Ferric CCIR weighted Dolby Out	52¼dB
Ferric Dolby Improvement	9½dB
Chrome CCIR weighted Dolby Out	55¾dB

Wow and Flutter Average	0.25% *see retest
Speed Average	−0.95%
Meter Under-read at 64ms	6dB

DISTORTION

At Dolby Level monitoring input	0.45%
Overall Ferric Av. L+R at Dolby Level	0.9%
Overall Ferric Av. L+R at +4dB	3.4%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	2.1%
Overall Chrome Av. L+R at +4dB	5.9%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+½
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	−2½

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+2/ −1dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+¼/ −2½dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	43.5dB
Dolby Improvement	9¾dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	47dB
Chrome Dolby Improvement	9½dB

DIN Input Noise Degredation	2¾dB
Line Input Noise Degredation	11½dB *see retest
Spooling Time	2m 10s

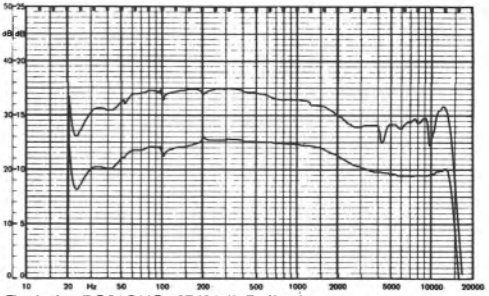
DYNAMIC RANGE

Ferric	61.5dB
FeCRO2/LN	—
Chrome	63dB

TAPE USED

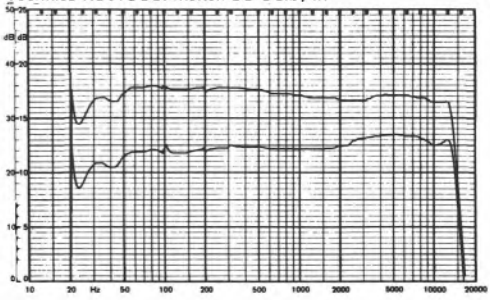
Ferric	MAXWELL UD
FeCRO2/LN	—
Chrome	TDK KR

Recommended Retail Price: £106.35



Technics RS610US: TDK KR Dolby In

Technics RS610US: Maxell UD Dolby In



Technics RS-676US

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

The RS 676, a two head machine incorporating Dolby, is at the top of the wide range of Technics cassette recorders. A front loader, it has all front operated controls, including the transport functions which are solenoid operated, and may be remotely controlled from an optional plug in unit. The winding time for a C90 cassette was fairly fast at 1min 36sec, but neat. The memory counter facility was accurate and useful. As delivered, the azimuth was reasonably well set at + 18° at 3kHz.

The replay response showed the bass to be incorrect but the hf end very flat indeed, although just beginning to droop at 10kHz by an average of 1dB on ferric and slightly less than this on chrome. Pre-recorded cassettes sounded consistently good with excellent head to tape contact. The replay signal to noise ratio was marginally below average, although adequate, and showed a 3.5dB improvement on chrome, and a 10dB improvement when the Dolby circuit was switched in. Cassettes played back with good stability and virtually no audible wow and flutter, which measured .07%, one of the best measurements.

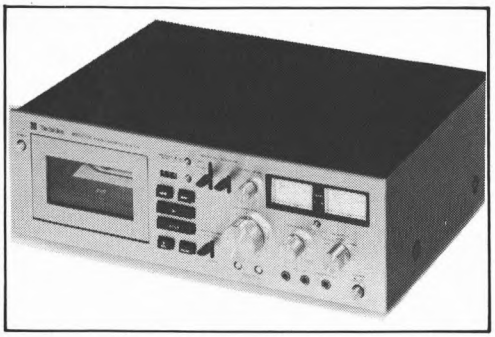
The phono line input sockets had a sensitivity of 90mV in to 100k ohm, and would accept virtually any input level without clipping. This input was extremely quiet, having virtually no hiss at full sensitivity. A Dolby FM switch allows Dolby processed broadcasts to be recorded at a pre-set level, whilst being monitored with the processors switched to de-process, and this will be found useful if broadcasts are ever processed in the UK. Early samples had the incorrect equalisation here, but Technics have now corrected this. The 5 pole DIN input/output socket had an input sensitivity of 420uV in to the somewhat lower impedance of 2k ohms, and some slight noise degradation occurred from the muted DIN source, thus showing that Technics should raise the input impedance to 4.7k ohms or so, since there is an adequate clipping level of 42mV. The two ¼" microphone jack sockets on the front panel presented an input impedance of 19k ohms and a sensitivity of 400uV, certainly too insensitive for moving coil microphones but just satisfactory for electrets. The clipping level of 42mV is certainly satisfactory. A switch selects which source is to be recorded, the levels being set with a single stereo ganged control. Differences in levels between the channels are corrected with a separate balance control. The VU meters have a peak check switch which when selected enables them to respond to short transients only under-reading by 4dB on an 8m sec tone burst, thus making the ordinary position of the switch somewhat redundant.

The overall performance on the recommended ferric tape (Maxell UD) was most impressive, and the measurements of flat frequency response, low distortion (0.7% at Dolby level) and very good azimuth stability were all confirmed by the listening tests.

The overall response on chrome tape was most disappointing, the frequency response with Dolby in being 6dB down at 10kHz. Distortion was apparent at high levels but was not serious. Erasure of high level recordings made on chrome tape was very good, and cross talk between left and right channels and between programmes recorded in opposite directions was good at all frequencies. The overall noise was just a little higher than it should be, but the low distortion at high levels, on ferric tape, permits a good signal to noise ratio still to be obtained.

The deck includes a useful memory counter and all the controls were smooth. It is a pity that Technics have not incorporated a switch position for Ferrichrome, for this tape type would undoubtedly work well on the machine. Since chrome tape will be almost certainly on the way out within two years or so, perhaps the chrome position could be replaced with a ferrichrome one with appropriate changes of record equalisation and bias. Loading a cassette was very simple, and no trouble was experienced with any jamming or azimuth variations.

The RS 676 is pleasantly designed and was liked by the laboratory staff for its ease of operation and reliability. Notwithstanding its relatively excellent performance on ferric tape its rather high price should be considered. Readers should be reminded that Technics do not recommend chrome tape, and incorporate the facility only in passing.



Replay Azimuth Deviation from Average	26°
Microphone Input Sensitivity	400μV
Microphone Input Clipping	42mV
Microphone Input Impedance Average	19K
DIN Input Sensitivity	420μV
DIN Input Clipping	42mV
DIN Input Impedance Average	2K
Line Input Sensitivity	89mV
Line Input Clipping	10V
Line Input Impedance Average	100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+2.63
Ferric 10kHz Average Left and Right	−1.13
Chrome 10kHz Average Left and Right	−5¼

REPLAY NOISE

Ferric 20/20 worst channel	51dB
Ferric CCIR weighted Dolby Out	49dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	52½dB

Wow and Flutter Average	0.07%
Speed Average	−0.04%
Meter Under-read at 64ms	1½dB

DISTORTION

At Dolby Level monitoring input	0.13%
Overall Ferric Av. L+R at Dolby Level	0.65%
Overall Ferric Av. L+R at +4dB	2.85%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	2.6%
Overall Chrome Av. L+R at +4dB	6.4%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+½
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	−3

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1.25/ −0.25dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+0.25/ −3.5dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	42dB
Dolby Improvement	8½dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	46dB
Chrome Dolby Improvement	9½dB

DIN Input Noise Degredation	2dB
Line Input Noise Degredation	½dB
Spooling Time	1m 38s

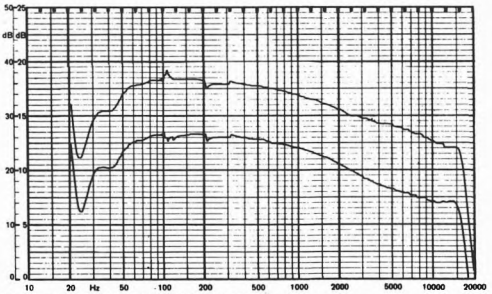
DYNAMIC RANGE

Ferric	61.5dB
FeCRO2/LN	—
Chrome	62.5dB

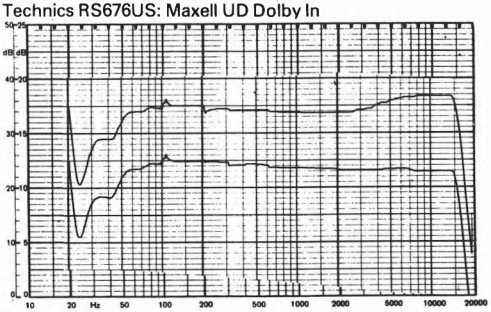
TAPE USED

Ferric	MAXWELL UD
FeCRO2/LN	—
Chrome	TDK KR

Recommended Retail Price: £223.80



Technics RS676US: TDK KR Dolby In
Technics RS676US: Maxell UD Dolby In



Telefunken MC2200

AEG (Telefunken) Ltd., Bath Road, Slough, Bucks, SL1 4AW. Slough 872110

This machine has only one 5 pole DIN input socket for interconnection with DIN equipment and a 5 pole DIN socket for microphone. There is also a DIN socket for headphone monitoring. The normal DIN input has about the optimum impedance on 6.5k ohms and is very sensitive, but unfortunately has bad clipping problems, thus possibly causing difficulties interconnecting with some DIN equipment. A normal phono type receiver would overload it very badly unless fitted with very high value source resistors. The microphone input was tested with the Telefunken capacitor microphone supplied and whilst this was of very good quality clipping was produced when recording some singing about 18" away from the mic. Some strange transient spits occurred, mainly on the left channel, confirming the laboratory's diagnosis that a serious problem exists in the Dolby processing which is shown in particular on the pen charts for chromium tape. The 5 pole input/output socket is located rather inaccessibly very close to the mains input lead, the plug having to be inserted sideways rather than straight.

The recorder also includes an automatic record level control, in addition to two faders for left and right respectively. The meters were quite effective under reading only 4dB on a 64m sec pulse, but no peak reading indicator is provided. A switch selects either the 5 pole DIN input at the rear or the mic socket at the front, and this at least works well and optimises the hiss levels so that, provided that the correct input level is achieved from a DIN receiver, distortion and noise should not be a problem. On play back the azimuth was found rather unstable and it seemed that the two gaps were out of line. This meant that no correct azimuth could be reached for a pre-recorded cassette if the external hi-fi system was switched to mono, thus effectively paralleling the two outputs. The Dolby circuitry seemed to be at fault, since most pre-recorded cassettes caused the sound to swing over to the left channel on quiet passages. This gave a very unstable sound picture. The replay noise level was just adequate, but some slight hum was noticeable overall, although the hiss levels were in general good. On ferric tape the response sounded reasonable although the pen chart recordings showed a fairly considerable loss. This was investigated and the pen chart loss was produced by the effect of a large capacitor in parallel with the input circuit, the fault being similar to that found on the B & O. This, in effect, means that approximately 5dB loss at 10kHz was produced in the input circuit from the DIN specified source impedance of 470k ohms. The loss was not noticed subjectively since the machine was then driven from a very low source impedance. Quite considerable phase jitter was noticed of $\pm 20^{\circ}$ at 10kHz. Despite these mechanical problems, the wow and flutter measured very low at .08%. The speed accuracy was very poor, the machine running approximately 1.5% fast, certainly enough to disturb a musician.

The overall distortion on ordinary BASF LH cassettes measured only 1.3% at Dolby level, rising to 3% at +4dB, and this was considered very good since ordinary LH tape has much more distortion than super LH. Chromium tape measured about average at 1.8% at Dolby level but slightly better than average at 4% at 4dB. The response on chromium tape with Dolby in, however, showed the machine to be totally mis-set by the factory with incorrect Dolby settings and equalisation.

The record and replay buttons were adjacent, and this is unwise because accidental erasure could occur if the users depressed both buttons at once with one finger. The styling of the machine was very good and it was most unfortunate that the electronics have had to be so severely criticised. Because of the response and very bad input clipping problems, this machine cannot really be recommended, and the DIN input circuitry design did not even anywhere approach the DIN specification for response, which is very surprising since the manufacturers are one of the most important German companies.

Between the devil of DIN specified inputs and the deep blue sea of the treble loss encountered from a DIN source, it was found extremely difficult to measure the overall response. Telefunken must correct this anomaly.

Telefunken were consulted re the input problem and have agreed to reduce the input impedance to 2.2k ohms and to remove the offending input capacitors on future samples. This will improve the clipping margin and remove the high frequency loss on the DIN input.

Replay Azimuth Deviation from Average	23°
Microphone Input Sensitivity	165μV
Microphone Input Clipping	16.5mV
Microphone Input Impedance Average	6.5K
DIN Input Sensitivity	165μV
DIN Input Clipping	17mV
DIN Input Impedance Average	65K
Line Input Sensitivity	–
Line Input Clipping	–
Line Input Impedance Average	–

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+1
Ferric 10kHz Average Left and Right	+1
Chrome 10kHz Average Left and Right	+1.25

REPLAY NOISE

Ferric 20/20 worst channel	46dB
Ferric CCIR weighted Dolby Out	48dB
Ferric Dolby Improvement	6dB
Chrome CCIR weighted Dolby Out	52.25dB

Wow and Flutter Average	.08%
Speed Average	+1.5%
Meter Under-read at 64ms	3dB

DISTORTION

At Dolby Level monitoring input	–
Overall Ferric Av. L+R at Dolby Level	1.3%
Overall Ferric Av. L+R at +4dB	3.3%
Overall FeCRO2/LN Av. L+R at Dolby Level	–
Overall FeCRO2/LN Av. L+R at +4dB	–
Overall Chrome Av. L+R at Dolby Level	1.85%
Overall Chrome Av. L+R at +4dB	3.9%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−4.75
10kHz FeCRO2/LN Dolby Out Av. L+R	–
10kHz Chrome Dolby Out Av. L+R	−3.5

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0/ −6dB
Ref. 333Hz FeCRO2/LN	–
Ref. 333Hz Chrome	+0/ −5dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	42.75dB
Dolby Improvement	12dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	–
FeCRO2/LN Dolby Improvement	–
Chrome CCIR weighted Av. L+R Dolby Out	46.5dB
Chrome Dolby Improvement	11.25dB

DIN Input Noise Degredation	0.25dB
Line Input Noise Degredation	–
Spooling Time	1m 50s

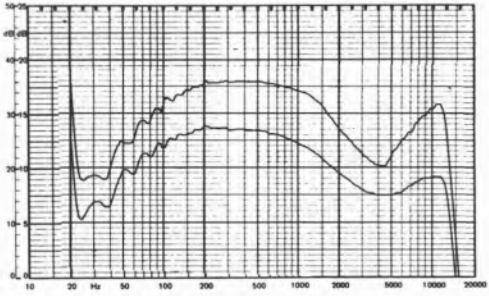
DYNAMIC RANGE

Ferric	60dB
FeCRO2/LN	–
Chrome	65.5dB

TAPE USED

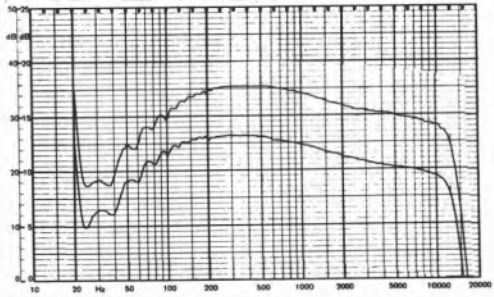
Ferric	BASF LH
FeCRO2/LN	–
Chrome	BASF KR

Recommended Retail Price: £128.00



Telefunken MC2200: BASF KR Dolby In

Telefunken MC2200: BASF KR Dolby Out



Telefunken MC3300

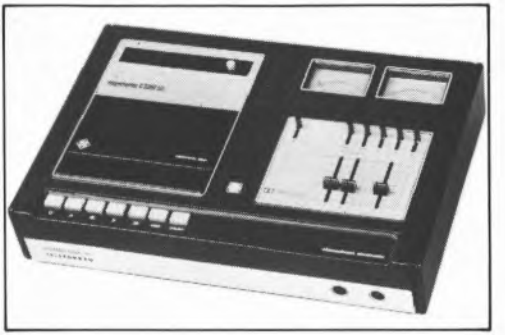
AEG (Telefunken) Ltd., Bath Road, Slough, Bucks, SL1 4AW. Slough 872110

Senior to the 2200, this machine performed very much more satisfactorily. The deck, built in precise accordance to DIN specifications, is provided with a 5 pole DIN input/output socket, a stereo mic socket and a DIN headphone socket. No phono input or output was provided, and because of the machine's extremely low input impedance and very poor input clipping margin it must be driven from a receiver designed precisely to DIN specifications, since the input clips at only 10mV. Microphone or DIN inputs are switch selectable and no output is available for monitoring, with the exception of the headphone output which has its own gain control. The recording level meters have very strange ballistics, since they actually over-read a 64m sec pulse by 2dB and under-read an 8m sec pulse by 7dB. In practice on a music programme they seemed to under-read transients by about 4dB, which is good when compared with most recorders having normal VU meters. The styling was extremely good and the deck function push buttons very easy to use, most of their operations controlling solenoids and micro switches. It is possible to change from any function to another rapidly, and in general the deck performed well but had a wow and flutter figure which is rather high at 0.18%, enough to give audible wow on many music programmes. Phase jitter was not too good and each re-insertion of a cassette produced a slightly different azimuth. Unfortunately, like its sister model, the speed was 1.5% fast, which will affect musicians wishing to accompany tapes.

The replay signal to noise was adequate and the frequency response measured extremely flat being within ±1dB (ref. 333Hz) from 63Hz to 10kHz of the new internationally recommended standard of 3180/120u secs on both channels. This gave a very even clarity of sound replaying pre-recorded cassettes, and the azimuth was pretty stable. Head to tape contact was good, but audibly very slight pumping was heard in the replay Dolby circuits, although this could have been due to production faults in the pre-recorded cassettes played. Despite Telefunken setting the recorder up for ordinary BASF LH tape, which in the tests consistently gave much higher distortion than Super LH the overall response when Dolby was switched in was fairly reasonable and sounded well. The distortion, of course, was not as good as many other machines, and would have been dramatically better if the machine had been biased for Super LH; AEG/Telefunken are advised to reset all their machines for the better tape. The overall signal to noise ratio was quite reasonable at 43dB, showing a 9.5dB improvement when the Dolby circuits were operative on both record and play back. Chrome tape produced an overall signal to noise ratio with Dolby of 56.5dB, a very good figure, but alas produced a rather high distortion of 3% at Dolby level, reaching 8% at +4dB, which did not deteriorate when the Dolby circuits were operative. The response on chrome was very bad on the left channel, but better on the right, and showed a Dolby level record calibration error which is surprising, since the specified tape was used.

The microphone input was tested with the Telefunken capacitor microphone supplied for use with the recorder, and the speech quality recorded was extremely good. Ferric recordings made from the DIN input, incidentally, were also good but remember that the recorder needs an extremely low level to avoid clipping (see section in the forward explaining interconnection with other equipment). Apart from the poor wow and flutter figures, the DIN input specified circuitry and the poor performance on chrome tape, this machine was liked, and it is felt that the manufacturers should heed the criticisms when developing new models. It might be said somewhat sarcastically that this is the most DIN type machine in the survey, and shows clearly the serious ergonomic errors with the DIN specified connection parameters. Is it not time for Germany to come in to step with the rest of the world by acknowledging phono sockets and line input/output connections and standards, rather than attempting to force everyone to adopt the old-fashioned German standard? Notwithstanding these criticisms, this machine can be recommended specifically for interconnection with DIN equipment.

Telefunken have now agreed to modify the input circuitry to give 30mV clipping on mic/DIN but also reducing the mic/DIN sensitivity to 180uV—still adequate. This considerably improves DIN input compatibility.



Replay Azimuth Deviation from Average	82°
Microphone Input Sensitivity	100μV
Microphone Input Clipping	9.5mV
Microphone Input Impedance Average	2K
DIN Input Sensitivity	105μV
DIN Input Clipping	9.9mV
DIN Input Impedance Average	2K
Line Input Sensitivity	—
Line Input Clipping	—
Line Input Impedance Average	—

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+2.25
Ferric 10kHz Average Left and Right	−0.5
Chrome 10kHz Average Left and Right	+1.5

REPLAY NOISE

Ferric 20/20 worst channel	51dB
Ferric CCIR weighted Dolby Out	47.5dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	51dB
Wow and Flutter Average	0.18%
Speed Average	+1.5%
Meter Under-read at 64ms	+2dB

DISTORTION

At Dolby Level monitoring input	—
Overall Ferric Av. L+R at Dolby Level	2.2%
Overall Ferric Av. L+R at +4dB	6.3%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	3.8%
Overall Chrome Av. L+R at +4dB	7.6%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+0.25
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	−1.25

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1/ −1.75dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+0.5/ −3dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	42.75dB
Dolby Improvement	9.75dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	47.25dB
Chrome Dolby Improvement	9.25dB
DIN Input Noise Degredation	0dB
Line Input Noise Degredation	—
Spooling Time	1m 22s

DYNAMIC RANGE

Ferric	60dB
FeCRO2/LN	—
Chrome	61.5dB

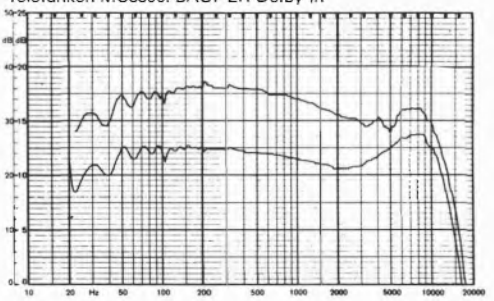
TAPE USED

Ferric	BASF LH
FeCRO2/LN	
Chrome	BASF KR

Recommended Retail Price: £208.00

Telefunken MC3300: BASF KR Dolby In

Telefunken MC3300: BASF LH Dolby In



Trio KX620

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

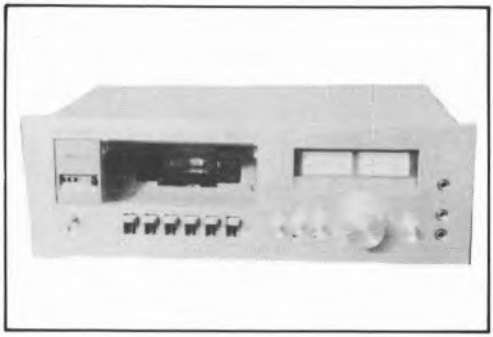
Fortunately, this machine performed much better than the rather poor KX710 and it incorporates Dolby B processing and provision for ferric, ferrichrome and chrome cassettes. A switch selects either line or mic/DIN with two available sensitivities, the recording level control being a dual concentric one. The VU meters under-read a 64m sec tone burst by 8dB and therefore setting peak recording levels was difficult especially since no peak reading lights are provided. The machine is a front loader, including two ¼" jack sockets for mic input and a stereo headphone jack on the front panel with all the other inputs and outputs on the rear, which include line in and line out phono sockets and a 5 pole DIN socket. The microphone input automatically switches to mono if only the left mono jack is used and the sensitivity measured 320uV. The clipping level was 38mV, which increased to 150mV with an input sensitivity decreased to 1.3mV in the lower sensitivity position. The DIN input was identical in sensitivity and clipping to the microphone input and the input impedance was 3.7k ohms instead of 8.3 for the microphone input. The impedance on microphone is halved if only one microphone is inserted.

The wow and flutter measured 0.13%, which was adequate and the speed accuracy was excellent. The stability was in general good, although the cassette itself was held rather loosely in the mechanism, thus causing the azimuth to vary slightly on each insertion. The deck controls allow rewind to be selected directly from play and back again without depressing the stop button. No cross talk or erase problems were encounterd.

On replay the response was found to be extremely flat, having a measured response of ±1dB from 50Hz to 10kHz ref. 333Hz on both tracks. The chrome response was equally good and so indeed was the replay noise performance, one of the best measured at −66.5dB average with Dolby switched in. Prerecorded cassettes played back excellently with good head/tape contact but just a suspicion of azimuth wander. The noise was also subjectively very low.

Bias positions are provided for ferric and chrome tapes and equalisation for normal ferric and chrome with a third position bearing the legend 'reserve'. The importers were unable to provide us with any concrete information about this reserve equalisation, but subjectively it appeared to being in a top boost on record and improved the overall response performance on ferric tape. B.H. Morris indicated that the machine had been set up for TDK C90 SD and this unfortunately gave an appalling distortion figure of 3.4% at Dolby level, rising to 9% at +4dB. The treble response also was poor, measuring some 5dB down at 10kHz. On our advice the importers agreed to our testing the machine with BASF Super LH, which proved to have far better distortion at Dolby level (0.5%), rising to 2% at +4dB. The response was slightly better but still −3.5dB at 10kHz on the left but the right was clearly overbiased on both tapes since the response still measured about 6dB down at 10kHz. The sound quality on BASF Super LH and Maxell was very good, although slightly muffled, and the overall tape noise measured very well at −43.5dB without Dolby, improving by 9.75dB with Dolby. Trio have obviously done well in their basic electronic design, but perhaps the factory quality control needs some improvement because the response figures were a little unsatisfactory. TDK chrome gave a very acceptable distortion figure of 1.6% at Dolby level, rising as usual to 3.7% at +4dB. With Dolby processing in the excellent signal to noise ratio (weighted) of 57.5dB was measured, this being one of the best overall noise figures checked in the tests. The response was rather odd, showing an average dip at 2kHz of some 3.75dB, but rising again to approximately flat at 10kHz (see pen charts). The overall quality here, though, was good, although a lack of presence was noted. The machine was liked and seemed to be reliable and it is fair to mention that since it was a prototype virtually no technical data or circuits were available and the machine was a very late entry for review. On a listening test the reserve eq seemed to give much better high frequency performance on ferric tape, but it was not found possible to get anywhere near a flat response on Sony ferrichrome tape. It is hoped that B.H. Morris will be able to improve on Trio's quality control and no doubt they will be doing extensive sample checks on the new model to ensure that they come up to the manufacturers' specifications.

The importers are part of the Audiotronics group, who also own Laskys, the well known discount house.



Replay Azimuth Deviation from Average	2°
Microphone Input Sensitivity	320μV
Microphone Input Clipping	38mV
Microphone Input Impedance Average	83K
DIN Input Sensitivity	315μV
DIN Input Clipping	38mV
DIN Input Impedance Average	3.7K
Line Input Sensitivity	153mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+3.13
Ferric 10kHz Average Left and Right	−¾
Chrome 10kHz Average Left and Right	−5.32

REPLAY NOISE

Ferric 20/20 worst channel	56dB
Ferric CCIR weighted Dolby Out	53dB
Ferric Dolby Improvement	9¾dB
Chrome CCIR weighted Dolby Out	56½dB

Wow and Flutter Average	0.13%
Speed Average	+0.27%
Meter Under-read at 64ms	8dB

DISTORTION

At Dolby Level monitoring input	0.14%
Overall Ferric Av. L+R at Dolby Level	3.4%
Overall Ferric Av. L+R at +4dB	8.95%
Overall FeCRO2/LN Av. L+R at Dolby Level	0.87%
Overall FeCRO2/LN Av. L+R at +4dB	2.3%
Overall Chrome Av. L+R at Dolby Level	1.6%
Overall Chrome Av. L+R at +4dB	3.7%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−2¼
10kHz FeCRO2/LN Dolby Out Av. L+R	+3.75
10kHz Chrome Dolby Out Av. L+R	−¾

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0.5/ −4.5dB
Ref. 333Hz FeCRO2/LN	+3.75/ −1.25dB
Ref. 333Hz Chrome	+0.5/ −2.5dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	43½dB
Dolby Improvement	9¾dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	43¾dB
FeCRO2/LN Dolby Improvement	10½dB
Chrome CCIR weighted Av. L+R Dolby Out	48dB
Chrome Dolby Improvement	9½dB

DIN Input Noise Degredation	2¼dB
Line Input Noise Degredation	1dB
Spooling Time	1m 52s

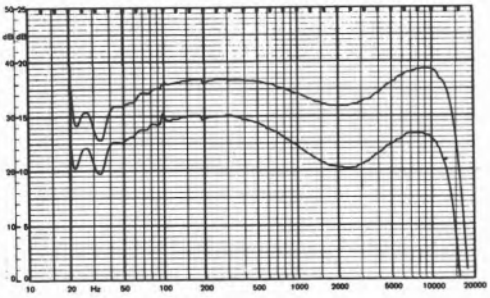
DYNAMIC RANGE

Ferric	58.5dB
FeCRO2/LN	65dB
Chrome	66dB

TAPE USED

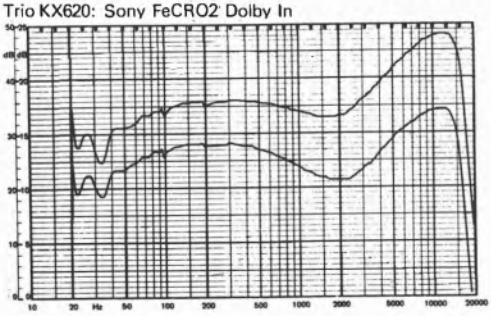
Ferric	TDK SD
FeCRO2/LN	SONY FeCr
Chrome	TDK KR

Recommended Retail Price: £158.00



Trio KX620: TDK KR Dolby In

Trio KX620: Sony FeCRO2 Dolby In



Trio KX710

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

This machine is basically a typical stereo cassette deck including Dolby B processing and limiters on record. The usual phono line in and output sockets are provided, in addition to a 5 pole DIN, and ¼" jacks. The mechanics allow the user to go from play into spool direct, and the tape remained in contact with the replay head during spooling, which was found very useful. Unfortunately the machine's performance leaves a lot to be desired and whilst the replay noise was a little below average the overall record noise performance was very poor indeed. The distortion overall was also very poor and thus available dynamic range very limited.

The replay frequency response, whilst being good on the left channel for both ferric and chrome, had a shelf up of 2dB on the right channel which tended to spread high frequency transients to the right. Some azimuth wander was noticed when pre-recorded tapes were replayed, and this was confirmed by the poor phase jitter measurement of ±30° at 10l Hz. When a recorded cassette was withdrawn from the machine and then replaced the azimuth slowly wandered and ultimately approached the correct one. It is assumed that this was due to the pinch wheel assembly being incorrectly set by the factory. The wow and flutter measured about average at 0.12% but the speed was set extremely accurately, averaging only 0.1% fast, which was quite remarkable. The spooling time for a complete C90 was extremely fast, averaging 50 secs, and this could be serious with some makes of cassette.

On BASF LH cassettes the overall distortion at Dolby level averaged 2.9% which increased to 7.5% average at +4. Chromium tape fared even worse, 9.5% average at Dolby level, and the incredible figure of 17% at +4, about the highest distortion at this level measured in the tests.

The overall response on ferric on the left channel showed a 5dB boost at 5kHz and 3½dB at 10kHz when the Dolby was in use (see pen chart) and on the right channel a 6dB boost was noted at 8kHz. This produced a very spikey high frequency quality which was rather objectionable at high level. Distortion sounded very bad. On chromium tape the response was pretty good on the left channel, but had odd variations on the right (see pen chart). Quite clearly this machine could not have been properly quality controlled at all and was badly underbiased.

There was a serious input pre-amplifier noise problem, for even when the record gain controls at minimum hiss could be heard before recording whilst monitoring. This hiss level was so bad that the Dolby circuitry only gave approximately 5dB hiss reduction, since the hiss was introduced before the Dolby record circuit. Some rather poor input circuitry was responsible for this hiss, since all input signals were attenuated to a very low level before being amplified all the way up again. It was not possible to judge seriously the quality of the microphone pre-amplifiers because of the hiss and distortion problems on this model but the microphone recording was felt to be as good as could be expected. The VU meters performed fairly well and the peak reading light was helpful. The microphone input circuit had adequate sensitivity for speech recording, whilst the DIN and mic input had very good clipping margins and reasonable impedances. The line input was a little insensitive, since it required just over 100mV with the record levels at full gain to reach Dolby record level.

It is a pity that this machine has had to be criticised so severely, and although most of the problems arose because of bad quality control and alignment the input circuit should also be modified by the manufacturers to remove the hiss problem. A Dolby FM record facility is provided, and when this was depressed a considerable decrease of hiss resulted, but the response of course changed in accordance with Dolby's specification. It could not, therefore, be used to remove hiss since quite a severe top loss would become apparent.

Replay Azimuth Deviation from Average	20°
Microphone Input Sensitivity	258μV
Microphone Input Clipping	97mV
Microphone Input Impedance Average	9.1K
DIN Input Sensitivity	258μV
DIN Input Clipping	97mV
DIN Input Impedance Average	4.3K
Line Input Sensitivity	103mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+2
Ferric 10kHz Average Left and Right	+1
Chrome 10kHz Average Left and Right	−4.75

REPLAY NOISE

Ferric 20/20 worst channel	49dB
Ferric CCIR weighted Dolby Out	43.75dB
Ferric Dolby Improvement	10dB
Chrome CCIR weighted Dolby Out	47dB

Wow and Flutter Average	0.11%
Speed Average	+0.07%
Meter Under-read at 64ms	6dB

DISTORTION

At Dolby Level monitoring input	0.06%
Overall Ferric Av. L+R at Dolby Level	2.9%
Overall Ferric Av. L+R at +4dB	7.4%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	13.4%
Overall Chrome Av. L+R at +4dB	20%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+2.5
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	+1.25

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+2.75/ −1.25dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+1.75dB/ −0.75dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	38.5dB
Dolby Improvement	3.75dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	41dB
Chrome Dolby Improvement	5dB

DIN Input Noise Degredation	1.5dB
Line Input Noise Degredation	2.5dB
Spooling Time	1m 50s

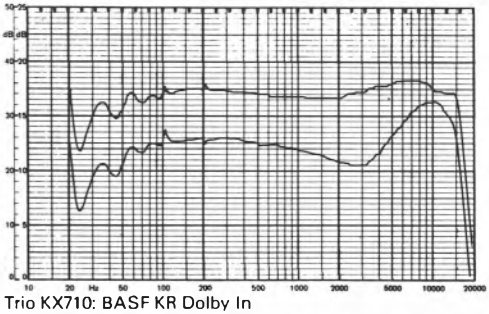
DYNAMIC RANGE

Ferric	48.5dB
FeCRO2/LN	
Chrome	49dB

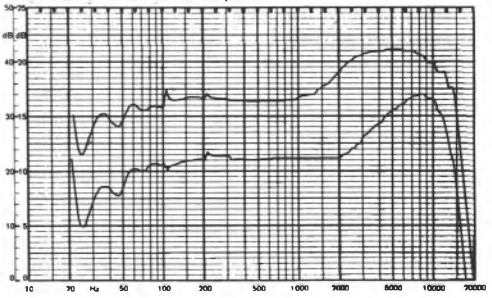
TAPE USED

Ferric	BASF LH
FeCRO2/LN	—
Chrome	BASF

Recommended Retail Price: £140.00



Trio KX710: BASF KR Dolby In



Trio KX710: BASF LH Dolby In

Uher CG320

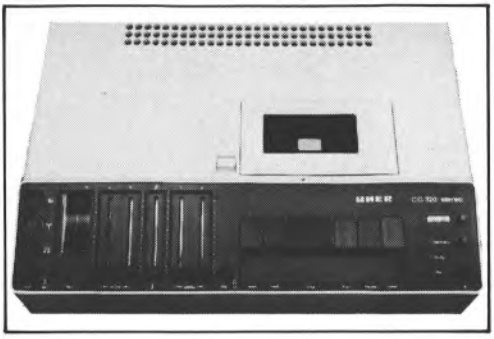
Uher (UK) Ltd., PO Box 30, Braintree, Essex, CM7 7RG.
0376 23192

Without Dolby, this machine is very overpriced, although DNL is provided on replay. There are only DIN sockets for the main input and output circuits but the machine does include a stereo monitoring amplifier. A DIN headphone socket is provided on the front panel, together with stereo microphone and dubbing sockets, the remainder being on the back panel. The monitor amplifier, incidentally, is capable of 5W output rms in to 4 ohms externally, although the power is reduced in to the two internal speakers provided. Whilst the replay response at the bass end showed it to have the incorrect time constant of 1590u secs the treble end was extremely flat to 10kHz. Dolbyed pre-recorded cassettes played back on the machine were much too toppy, although by reducing the treble with the internal tone control the reproduced sound using the internal power amplifiers was reasonably good, but pumping was audible because there is no Dolby. Unfortunately, an intermittent contact in the monitor circuit caused considerable variations in gain on one of the loudspeakers, which was corrected by applying a considerable thump on the right of the machine. When monitoring externally the replay noise level was average, but some intermittent head/tape contact was noted which added to some azimuth wander. Much better results overall were obtained and thus it is assumed that the machine is rather sensitive to the cheaper Cr type cassettes used for pre-recorded products. The chromium replay equalisation was also very flat and the noise was reduced by approximately 4.5dB which is precisely correct. The machine was tested overall with BASF Super LH tape and whilst distortion was very low at Dolby level (0.6%) a slight treble roll off of approximately 2.5dB at 10kHz was noted, showing the machine to be slightly over biased. The overall signal to noise was very good at −44dB weighted although, as the machine had no noise reduction, hiss was clearly noticeable even when recording at a high level. Whilst the distortion subjectively was generally low at high volume levels, some bass distortion became apparent. The head to tape contact was clearly better overall, and stability and phase jitter were reasonable. On chromium tape distortion was very bad at Dolby level, reaching 3.4% which worsened to 7.3% at +4dB. Quite intolerable distortion was audible at low frequencies. As with ferric tape the response was approximately 3dB at 10kHz overall. Chrome tape was clearly under biased and under equalised, since drop outs were continuously noted here. More bias would have considerably improved the drop out performance but then much more equalisation on record would be necessary to obtain an overall flat response. The noise level referred to Dolby level was significantly better on chrome but since the distortion was so bad chrome tape was virtually unusable.

The record level meters unde-read a 64m sec tone burst by 3.5dB and were thus reasonably good. They would be satisfactory for estimating programme levels on ferric tape, but chrome tape would have to be considerably under-recorded to avoid distortion.

The microphone input was quite sensitive at 130uV. The mic input circuitry had a very low noise level and, although good quality could be achieved with a high quality microphone, the Uher one supplied gave rather a muffled sound. The DIN input impedance measured 49k ohms, much too high, and thus treble loss would become apparent when the equipment is driven from a DIN receiver. This was almost certainly the reason for the overall drooping treble response measured on the pen charts, since the input signal was supplied to the machine through the typical DIN specified external circuit. Uher should decrease this impedance and thus improve compatibility. The wow and flutter measured well at 0.09% and the speed accuracy was reasonable at 0.5% fast.

In general, this machine performed fairly well on ferric tape, considering no Dolby is included, and no cross talk or erase problems were encountered. The machine can be driven from an external 12V supply and, since stereo monitoring is provided, could give quite an acceptable performance on a boat or in the field, for example, although it is felt that the battery recorders incorporating Dolby also reviewed in this book would give much better value for money.



Replay Azimuth Deviation from Average	2°
Microphone Input Sensitivity	130μV
Microphone Input Clipping	190mV
Microphone Input Impedance Average	5.8K
DIN Input Sensitivity	4.2mV
DIN Input Clipping	1.65V
DIN Input Impedance Average	49K
Line Input Sensitivity	82mV
Line Input Clipping	)10V
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	−0.25
Ferric 10kHz Average Left and Right	−1
Chrome 10kHz Average Left and Right	+0.75

REPLAY NOISE

Ferric 20/20 worst channel	53dB
Ferric CCIR weighted Dolby Out	49.25dB
Ferric Dolby Improvement	–
Chrome CCIR weighted Dolby Out	43.75dB
Wow and Flutter Average	0.09%
Speed Average	+0.38%
Meter Under-read at 64ms	3.5dB

DISTORTION

At Dolby Level monitoring input	–
Overall Ferric Av. L+R at Dolby Level	0.55%
Overall Ferric Av. L+R at +4dB	1%
Overall FeCRO2/LN Av. L+R at Dolby Level	–
Overall FeCRO2/LN Av. L+R at +4dB	–
Overall Chrome Av. L+R at Dolby Level	3.5%
Overall Chrome Av. L+R at +4dB	7.3%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−2.75
10kHz FeCRO2/LN Dolby Out Av. L+R	–
10kHz Chrome Dolby Out Av. L+R	−3.25

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+1/ −3dB
Ref. 333Hz FeCRO2/LN	–
Ref. 333Hz Chrome	+1.5/ −3dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	44dB
Dolby Improvement	–
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	–
FeCRO2/LN Dolby Improvement	–
Chrome CCIR weighted Av. L+R Dolby Out	47.5dB
Chrome Dolby Improvement	–
DIN Input Noise Degredation	0dB
Line Input Noise Degredation	–
Spooling Time	1m 7s

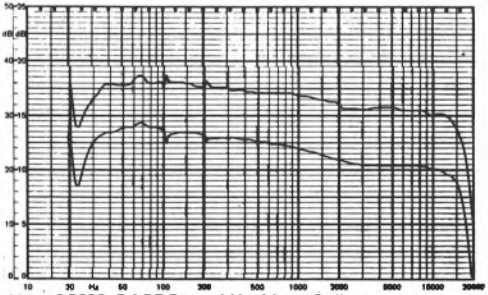
DYNAMIC RANGE

Ferric	57dB
FeCRO2/LN	–
Chrome	52.5dB

TAPE USED

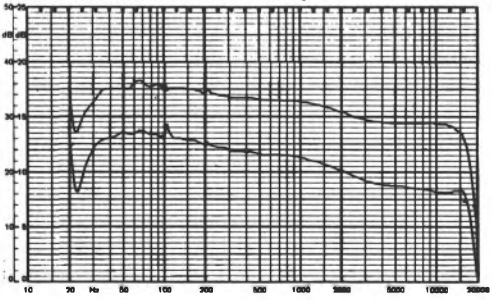
Ferric	BASF SUPER LH
FeCRO2/LN	–
Chrome	BASF KR

Recommended Retail Price: £280.00



Uher CG320: BASF Super LH without Dolby

Uher CG320: BASF KR without Dolby



Uher CG360

Uher (UK) Ltd., PO Box 30, Braintree, Essex, CM7 7RG.
0376 23192

This machine includes Dolby B processing and is literally sprinkled with DIN sockets for every possible requirement but no phono sockets are provided at all. The machine will play back in either direction, but only records from left to right. Optional extras are available including a plug-in stereo power amplifier and a remote control unit. The cassette is inserted in a post-box type slot and is engaged in its operating position when the mechanism is started. If the eject button is operated at all fiercely the cassette is inclined to exit with force and, if not caught, may land on the floor!

All the operating controls are on the front with the dubbing and headphone sockets, and the inputs and outputs are on the rear. All labelling is unfortunately in German, or by DIN type signs, but the user manual is very explicit. However, the user will have to study this manual for some time to gain a clear understanding of all the functions.

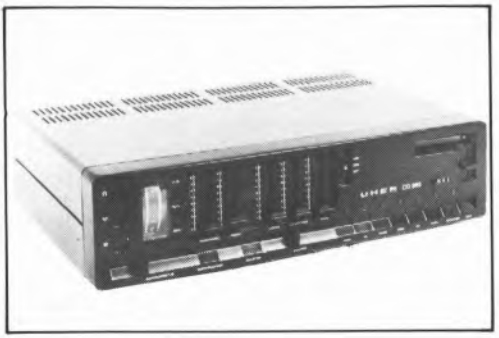
The CG 360 was supplied fairly close to the correct azimuth, although the two tracks are nowhere near co-incidental since the errors were in opposite directions from nominal (ie forward and backward azimuths). The replay response on the left track was very good indeed for both ferric and chrome, but on the right channel an anomaly was present in that there was some 3dB cut at 10kHz on ferric but 2.5dB lift on chrome. Unfortunately the old DIN time constant of 1590u secs was used at the brass end and this meant that pre-recorded cassettes tended to be light in bass. Uher should put this matter right immediately as bass distortion was quite noticeable when recordings were made at a high level. It was useful to be able to change tracks on replaying pre-recorded cassettes and both tracks were surprisingly compatible on response. The machine includes an auto reverse function, which will be found useful for continuous playing of background music. The replay noise measured average, and no significant problems were encountered here.

The spooling was very fast at 53 secs. average, but was neat. The wow and flutter measured fairly well at 0.11% and whilst the general phase jitter and stability were good there was a tendency for the azimuth to change slightly when a cassette was withdrawn and reinserted. BASF Super LH tape produced recordings of fairly high quality, the distortion at Dolby level measuring only 0.6% rising to 1.6% average at + 4dB, but the response had a shelf cut of approximately 3dB above 4kHz. Subjectively, although slightly muffled, the quality was good. On chrome tape the distortion was average at 1.9% at Dolby level and the frequency response was reasonably good, although a valley of 2.5dB was noted on both channels at around 3kHz, the response rising again to be reasonably flat at 10 and 15kHz (see pen chart). The hiss level on chrome was low, and the response sounded very wide, but the distortion was apparent at high recording levels although the sound quality at lower levels was very good. On ferric tape, though, the overall hiss level was very low, −54.5dB average weighted, and since ferric tape would accept a much higher level than chrome a wide dynamic range can be recorded.

The VU meters were very good, under-reading a 64m sec burst by only 1.5dB, and thus could be used to gain a good impression of peak recording levels. The machine unfortunately had second harmonic distortion in various parts of the circuitry, although if all levels are compatible the effect might not be too marked.

The main DIN input impedance was 21k ohms and had a sensitivity of 13mV, and no clipping problems should be experienced when interconnected with DIN equipment. A second DIN socket is provided for use with non-DIN equipment, and had a sensitivity of 320mV which is not really enough for many users. Although the microphone input sockets worked well with the Uher mics supplied, and recordings were produced with a pretty low background noise level, the mics were of extremely poor quality. A dubbing socket is provided to copy from or to the recorder at DIN levels. Bass and treble controls are provided for replay, which operate on the headphone socket, and stereo loudspeaker amplifier if fitted, but the DIN output socket is not affected by the tone controls. Separate faders are provided for mic and DIN inputs. Quite considerable cross talk was produced at 5kHz, presumably in the DIN sockets. As with the Telefunken machines it is felt that Uher should acknowledge standards used in the rest of the world and phono sockets should be provided for line in and out at compatible levels.

This machine is very complicated and since it is priced so highly is frankly not good value for money.



Replay Azimuth Deviation from Average	22°→ 13°←
Microphone Input Sensitivity	1.7mV
Microphone Input Clipping	—
Microphone Input Impedance Average	—
DIN Input Sensitivity	13mV
DIN Input Clipping	—
DIN Input Impedance Average	21K
Line Input Sensitivity	320mV
Line Input Clipping	—
Line Input Impedance Average	)100K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+0.5
Ferric 10kHz Average Left and Right	−1.5
Chrome 10kHz Average Left and Right	+1

REPLAY NOISE

Ferric 20/20 worst channel	53dB
Ferric CCIR weighted Dolby Out	50dB
Ferric Dolby Improvement	9dB
Chrome CCIR weighted Dolby Out	51dB

Wow and Flutter Average	0.11%
Speed Average	+0.8%
Meter Under-read at 64ms	1.75dB

DISTORTION

At Dolby Level monitoring input	—
Overall Ferric Av. L+R at Dolby Level	0.6%
Overall Ferric Av. L+R at +4dB	1.7%
Overall FeCRO2/LN Av. L+R at Dolby Level	—
Overall FeCRO2/LN Av. L+R at +4dB	—
Overall Chrome Av. L+R at Dolby Level	2%
Overall Chrome Av. L+R at +4dB	4.5%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−1.25
10kHz FeCRO2/LN Dolby Out Av. L+R	—
10kHz Chrome Dolby Out Av. L+R	+1.75

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0/ −1.75dB
Ref. 333Hz FeCRO2/LN	— —
Ref. 333Hz Chrome	+1.75/ −1dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	44.25dB
Dolby Improvement	9.5dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	—
FeCRO2/LN Dolby Improvement	—
Chrome CCIR weighted Av. L+R Dolby Out	45.5dB
Chrome Dolby Improvement	10.25dB

DIN Input Noise Degredation	−0.5dB
Line Input Noise Degredation	—
Spooling Time	55s

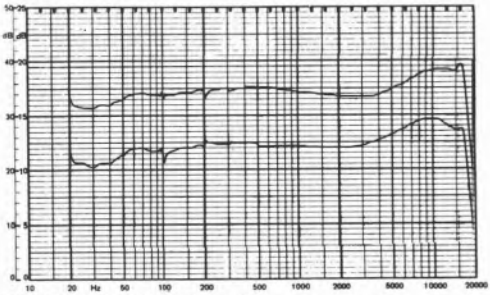
DYNAMIC RANGE

Ferric	66.5dB
FeCRO2/LN	—
Chrome	65dB

TAPE USED

Ferric	BASF SUPER LH
FeCRO2/LN	
Chrome	BASF KR

Recommended Retail Price: £457.50



Uher CG360: BASF KR Dolby Out

Uher CG360: BASF Super LH Dolby Out

Wollensak 4766

3M(UK) Ltd., 3M House, Wigmore Street, London W1A 1ET. 01-486 5522

Facilities for recording on ferric, ferrichrome and chromium cassettes are available on the 4766. It includes Dolby B noise reduction with a Dolby FM facility which switches the circuitry to deprocessing a Dolbyed broadcast, whilst switching the motor on only on record. Bascially just a deck, it includes four rotary volume controls, two for record and two for line out levels, arranged unfortunately with the input and output knobs adjacent, so setting a recording level requires adjustment of two controls several inches apart. The phono input (impedance approximately 28k ohms) has an adequate input sensitivity, and a switch chooses either the phonos (line) or the DIN input socket. When microphones are inserted into the ¼" jack sockets the DIN input is disconnected. A third position of the input selector switch allows both phono and microphone inputs to be live simultaneously. The machine incorporates the latest version of the Wollensak deck. All the deck functions are operated mechanically and are a little clumsy. It is possible to switch direct to rewind/wind from record or play, but although the reverse is possible it is likely to cause damage to the cassette, and so the stop button should be used. A simple counter is incorporated and the machine also includes a stereo headphone jack. As delivered, the azimuth setting was found very accurate and prerecorded cassettes reproduced pretty well with a wide frequency response but rather more replay hiss was noticed than should have been present. The lab tests proved both the replay and overall noise performance to be rather poor, even when chromium tape was used, although the overall distortion figures were very good. The pen chart shows the overall ferric response to be too far up at high frequencies, and this contributed to a slightly hard overall sound. Ferrichrome seemed better, but the right channel had a noticeable top loss. Chromium tape sounded brittle, particularly on the left track, and the pen chart shows a clear rise here. Phase jitter was average, but the machine consistenty played back tapes with a good azimuth correlation.

The recording level meters had very poor ballistics, thus under-reading programme levels and encouraging the user to record at too great a volume, producing distortion. Conversely, the peak reading lights lit up at much too low a level (-2dB), thus discouraging even a normal recording level. The wow and flutter measured 0.12%, which was only just acceptable, and the spooling time was very fast indeed, just over one minute to spool through a C90 cassette in either direction—a slower speed would probably be safer.

A Sony electret microphone produced good recordings of speech with a wide response and showed the microphone pre-amplifier to be a relatively low noise one. The DIN input circuitry was just a little noisy, though, approximately 2.5dB hiss being added to the already poor noise level via tape when the input levels were adjusted for standard DIN sensitivity. When monitoring line in whilst recording, a slight hum was noticed. The machine has a rather dated styling, and both the record and pause controls are very stiff in operation.

The replay responses and Dolby processing were all excellent, although slight second harmonic distortion was measured in the machine's general circuitry. Unfortunately the machine's idler wheel fractured after the lab tests and had to be replaced before the listening test. In short, we feel this machine to be over-priced and rather noisy, although its basic simplicity and logical ease of operation were attractive. More care should have been taken in the electronics design to avoid the hiss problem.

It was felt that the noise problem was not typical, and 3M supplied a retest sample which had considerably better noise performance but unfortunately still not as good as average, the replay noise measuring approximately 3dB better then the original sample. A similar improvement of 3dB to 42dB weighted noise was observed on ferric tape overall without Dolby, and this improved to 52dB with Dolby. This figure is just about acceptable, but unfortunately on the retest sample the distortion on ferric tape measured approximately four times worse at Dolby level, averaging 2.1%. Chromium tape deteriorated from 1.5% to 5.5% on the second sample, which is intolerable. Ferrichrome measured virtually the same (1.3%). The chromium response measured slightly better. Ferric and ferrichrome responses showed a fairly severe high frequency loss and so unfortunately the latest machine in many ways was inferior to the original sample. Bearing this in mind, it is difficult to recommend the model.

Replay Azimuth Deviation from Average	18°
Microphone Input Sensitivity	238μV
Microphone Input Clipping	150mV
Microphone Input Impedance Average	3.1K
DIN Input Sensitivity	2mV
DIN Input Clipping	152mV
DIN Input Impedance Average	11K
Line Input Sensitivity	65mV
Line Input Clipping	)10V
Line Input Impedance Average	26K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+4
Ferric 10kHz Average Left and Right	−0.25
Chrome 10kHz Average Left and Right	−5

REPLAY NOISE

Ferric 20/20 worst channel	44.5dB
Ferric CCIR weighted Dolby Out	43,5dB
Ferric Dolby Improvement	10.5dB
Chrome CCIR weighted Dolby Out	47.75dB

Wow and Flutter Average	0.12%
Speed Average	+0.5%
Meter Under-read at 64ms	9dB

DISTORTION

At Dolby Level monitoring input	0.28%
Overall Ferric Av. L+R at Dolby Level	0.5%
Overall Ferric Av. L+R at +4dB	1.7%
Overall FeCRO2/LN Av. L+R at Dolby Level	1.3%
Overall FeCRO2/LN Av. L+R at +4dB	3.7%
Overall Chrome Av. L+R at Dolby Level	1.6%
Overall Chrome Av. L+R at +4dB	4%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	+3
10kHz FeCRO2/LN Dolby Out Av. L+R	−1
10kHz Chrome Dolby Out Av. L+R	+2.5

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+3/ −1.75dB
Ref. 333Hz FeCRO2/LN	+0.25/ −1.25dB
Ref. 333Hz Chrome	+2.5/ −1.5dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	39dB
Dolby Improvement	9½dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	43.75dB
FeCRO2/LN Dolby Improvement	10dB
Chrome CCIR weighted Av. L+R Dolby Out	43dB
Chrome Dolby Improvement	10dB

DIN Input Noise Degredation	2.5dB
Line Input Noise Degredation	0dB
Spooling Time	1m 6s

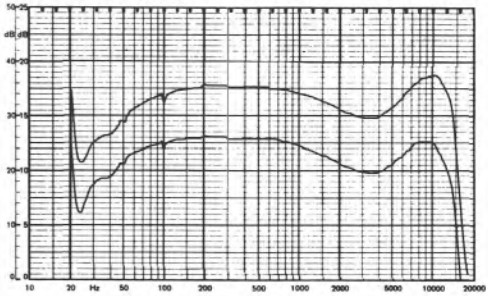
DYNAMIC RANGE

Ferric	60.5dB
FeCRO2/LN	63dB
Chrome	61.5dB

TAPE USED

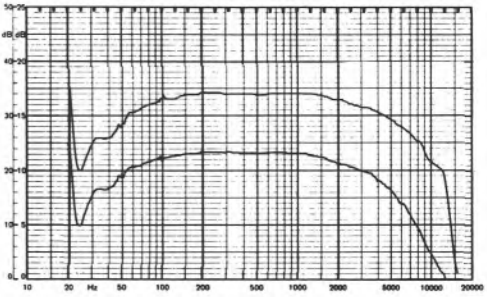
Ferric	SCOTCH HI-EN
FeCRO2/LN	SCOTCH CLASSIC
Chrome	SCOTCH CHROME

Recommended Retail Price: £230.56



Wollensak 4766: Scotch CRO2 Dolby In

Wollensak 4766: Scotch High Energy Dolby In



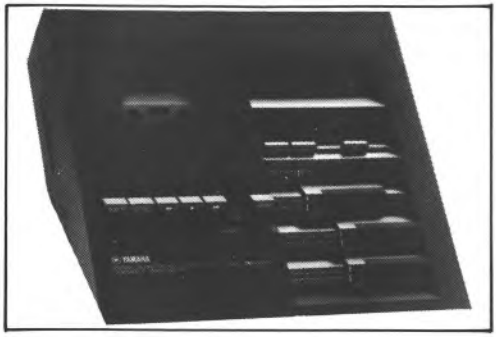
Yamaha TC800GL

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

Unusually styled, this recorder includes many interesting features giving an adaptability that makes it very useful. In addition to having Dolby B it can be driven off normal mains or internal batteries or even from an external 12V supply, eg a car battery. The gain controls are all arranged to slide from right to left in steps, giving half the width of the machine the appearance of a staircase. The tone controls work simply and it is possible to transfer from play to wind, but the stop button has to be depressed before re-engaging another function. Two ¼" jack sockets are provided for microphone input, which has a maximum sensitivity of 620uV into a high impedance of 86k ohms, and thus requires for optimum results medium impedance microphones which will give adequately sensitivity. Lower impedance microphones will not in general give sufficient volume for an adequate recording level to be achieved. No 5 pole DIN socket is provided, and the phono line in sockets have a sensitivity of 60mV in to an input impedance varying from 20k ohms to 40k ohms, depending on the position of the gain control. Separate pairs of faders are provided for the microphone and line inputs so that mixing becomes possible. An additional pair of faders provide control of line input monitoring level. A speed control with a centre click position gives an adjustment of approximately ±4% (just under a semi tone), and the centre position is incredibly accurate, the laboratory measurement being within 0.1%. The wow and flutter also measured exceptionally well at 0.06% average, and no wow was heard on any programme recorded. The VU meters had extremely poor ballistics, under reading a 64m sec pulse by some 11dB, but fortunately green and red peak reading lights come to the rescue, reading at −3dB and +4dB ref. Dolby level. If only the VU meters are used to set recording levels, serious over recording will occur, but used carefully in conjunction with the peak reading lights a reasonable peak level can be set. Although the user will have to get used to the poor ballistics. The deck includes a memory rewind mechanism, and a stereo unganged record limiter permits recordings to be made without significant distortion, although after the limiters had ducked full gain was not reached for a further few seconds.

The replay response was really excellent, showing only a marginal rise above nominal at the bass end of about 1dB at 40 and 63Hz. This very fine tolerance was maintained right up to 10kHz, no deviation of more than ±1dB from the response at 333Hz being noted. The chrome response also was good but showed a rise of 2dB at 10kHz. Unfortunately, the right replay amplifier suffered from a slightly noisy transistor which degraded the noise by about 2dB below the left channel's figure of −48dB ref. Dolby level, without Dolby de-processing. This noise figure, though, was about 2dB below the average of other machines, and just a slight hiss was noticed, adding to general cassette tape hiss. Pre-recorded cassettes played back extremely well but just a few had noticeably too much bass; Decca cassettes seemed to reproduce better than EMI ones. The overall response was so good as to be virtually flat (see pen charts) and furthermore the distortion levels were quite remarkably low, Maxell UD giving a figure of 0.6% at Dolby level rising to only 2% at +4dB. Sony ferrichrome fared even better, giving an astonishingly low figure of 0.4% at Dolby level, rising to an even more astonishing 0.8% at +4, thus allowing very high levels to be recorded without distortion, although the frequency response did fall to −3.5dB on the left and −2dB on the right at 10kHz. This fall off, however, was certainly not considered serious but just noticeable subjectively. Nakamichi chrome tape had very significantly higher distortion but nevertheless about average for chrome, reaching 2% at Dolby level rising to 4.8% at +4dB, and this gave noticeable distortion if high levels were attempted. Although the overall sound quality of ferric and ferrichrome was superb, slightly more hiss than usual was noted but this was counteracted by the machine's capability of recording such high levels, thus restoring the overall dynamic range.

The laboratory staff were all very enthusiastic about this machine, notwithstanding the poor meter ballistics and overall noise performance, and it can therefore be recommended as good value for money.



Replay Azimuth Deviation from Average	17°
Microphone Input Sensitivity	620μV
Microphone Input Clipping	87mV
Microphone Input Impedance Average	86K
DIN Input Sensitivity	—
DIN Input Clipping	—
DIN Input Impedance Average	—
Line Input Sensitivity	58mV
Line Input Clipping	)10V
Line Input Impedance Average	20–40K

REPLAY RESPONSE

Ferric 63Hz Average Left and Right	+4
Ferric 10kHz Average Left and Right	+0.5%
Chrome 10kHz Average Left and Right	+2

REPLAY NOISE

Ferric 20/20 worst channel	49dB
Ferric CCIR weighted Dolby Out	57dB
Ferric Dolby Improvement	9dB
Chrome CCIR weighted Dolby Out	49.5dB
Wow and Flutter Average	0.06%
Speed Average	0.05%
Meter Under-read at 64ms	11dB

DISTORTION

At Dolby Level monitoring input	0.02%
Overall Ferric Av. L+R at Dolby Level	0.6%
Overall Ferric Av. L+R at +4dB	2%
Overall FeCRO2/LN Av. L+R at Dolby Level	0.35%
Overall FeCRO2/LN Av. L+R at +4dB	0.75%
Overall Chrome Av. L+R at Dolby Level	2%
Overall Chrome Av. L+R at +4dB	4.8%

OVERALL RESPONSE

10kHz Ferric Dolby Out Av. L+R	−0.75
10kHz FeCRO2/LN Dolby Out Av. L+R	−2.25
10kHz Chrome Dolby Out Av. L+R	−2

OVERALL DEVIATION (100Hz–12kHz)

Ref. 333Hz Ferric	+0.25/−2.0dB
Ref. 333Hz FeCRO2/LN	+0/ −2.25dB
Ref. 333Hz Chrome	+0/ −2dB

OVERALL NOISE

Ferric CCIR weighted Av. L+R Dolby Out	41.75dB
Dolby Improvement	9.5dB
FeCRO2/LN CCIR weighted Av. L+R Dolby Out	45dB
FeCRO2/LN Dolby Improvement	9.25dB
Chrome CCIR weighted Av. L+R Dolby Out	45.5dB
Chrome Dolby Improvement	9.5dB

DIN Input Noise Degredation	–
Line Input Noise Degredation	0dB
Spooling Time	1m 8s

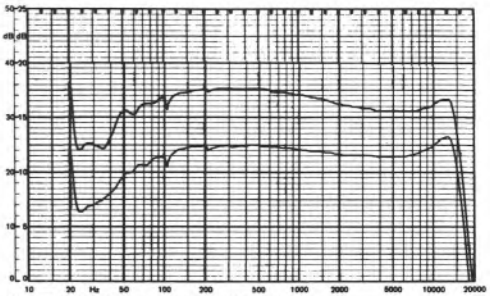
DYNAMIC RANGE

Ferric	63.5dB
FeCRO2/LN	68dB
Chrome	63dB

TAPE USED

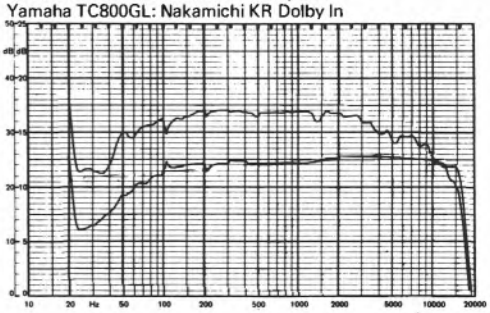
Ferric	MAXELL UD
FeCRO2/LN	SONY $feCrO_2$
Chrome	NAKAMICHI KR

Recommended Retail Price: £179.00



Yamaha TC800GL: Maxell UD Dolby Out

Yamaha TC800GL: Nakamichi KR Dolby In



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LASKYS – making sense of Dolby.

Fifty-two actual reviews have been published in this survey. But my colleagues and I have measured the complete performance characteristics of nearly 70 recorders in three months and quite clearly we have been able to see trends in design and circuit problems in a way that possibly no other reviewer has done before.

I must emphasise the rather alarming sample variability. Although a particular machine that might interest the reader measures badly in a specific area, another sample might well be satisfactory. Conversely a purchased sample may well have a performance well below that of the review one.

It is clear that the quality control and lining-up departments in most cassette recorder manufacturers' factories leave a lot to be desired and this is evident in many of the cases where re-tests have been called for. I have tried to separate design problems from quality control ones in the reviews, and there are clearly many models which just cannot be recommended because of basic design problems.

The area which shows the most serious general problem is that of the input pre-amplifier, in which manufacturers have often tried to save costs by using a single pre-amp to cater for phono inputs, DIN inputs and microphone inputs. This is most unwise, since this means frequently that a level, say, of 500mV has had to be reduced to one of perhaps 2 or 3mV, so that a 100mV level may well be reduced to a few hundred uV before amplification.

This ridiculous attenuation frequently leads to noise degradation, since the record level controls have to be brought up to near maximum to cope with low level line input signals and thus any noise produced in the pre-amplifier will be carried through the entire system. The DIN inputs have varied wildly in impedance from well below 2k ohms to as high as 50 k ohms, and whilst both these extremes are within the DIN specification this is so wide as to be almost ludicrous.

To avoid noise degradation caused by too much attenuation on the DIN input, and high frequency loss caused by the input impedance being too high, my colleagues and I feel strongly that the DIN specification should be changed, so that the minimum input impedance becomes 3.9k ohms and the maximum 20k ohms.

We also noticed that the input impedance of the microphone circuits again varied wildly and this should be more carefully controlled, not by using just a resistor across the input but by negative feedback to give optimum noise performance. Laboratory experiments have proved that the input impedance for optimum noise from a moving coil or low output low impedance microphone should be between a minimum of 600 ohms and an absolute maximum of about 10k ohms. Input pre-amplifiers would be much better if the circuit was organised actually to vary in gain for the different inputs, the inputs and gain being selected by a switch. This type of circuit is already in use in both the Revox model 77 and 700 reel-to-reel recorders and proves pretty effective.

VU meters have again varied considerably in performance, some having peak reading capabilities whilst others under-read so seriously on programme that bad distortion results if the programme is allowed to peak anywhere near a OVU indication. Some machines have peak reading lights, but in the case of the Wollensak, for example, these indicated at much too low a level. It is doubtful whether the majority of the meters on the cassette recorders tested could even legally be called VU, since the name VU meter implies a performance to the original American standard established about 35 years ago. Manufacturers such as Harmon-Kardon, Neal, Tandberg, Technics, Nakamichi, Sonab, etc, must be particularly commended for incorporating peak reading type meters.

Almost all the Dolby circuits showed about the correct noise reduction and worked well. Dolby processing, though, must not be regarded by manufacturers as a means of saving quality control time on the assumption that the noise is so much lower and so they need not take very much trouble to eliminate the noise from circuits. One or two recorders actually produced more noise when the Dolby circuits were operating than the machines not incorporating Dolby at all. This, of course, is ridiculous. Any recorder that has a poor replay noise figure without Dolby switched in must be heavily criticised, and I must draw attention to the practice of many Japanese manufacturers in which, throughout the record and replay circuitry, levels are severely attenuated to 1mV or so before being boosted up again. One of the worst offenders here was Teac in their model A360 (see review). With minor redesigning both the A360 and A450 could give a

dramatically improved performance and it seems incomprehensible that manufacturers do not spend a few more days' work on their electronic designs to get their gain parameters correct.

I am extremely concerned that some importers were not able to tell me what tape best suits their recorders and surprisingly quite a number had to telex Japan to find out. What an incredible situation, since quite obviously those importers could not possibly quality-control the machines to the manufacturers' specifications without this knowledge. It was also surprising that many of the recorders failed to meet their published specification anyway, even when tested with the correct brand of tape. Legally minded readers might well have a heyday with their local trading standards organisations if they wanted to be difficult.

The inaccuracies of frequency response found were exaggerated when Dolby processing was in use and this may well cause a machine to measure out of specification with Dolby processing, although it may be just within when measured without processing. This is, of course, no fault of Dolby but can be blamed on bad quality control again. Let me emphasise once more that if Dolby is incorporated quality control must be better and results can be dramatically improved with Dolby and a good quality tape.

Many manufacturers are just not keeping up with current advances in tape technology and we were all surprised to find that many eminent ones were setting up their models on old tapes. Perhaps the most outstanding examples of this are those of B & O and Dual, for both these machines were improved dramatically when BASF Super LH was used. A competent dealer should be able to re-bias machines quite easily for any of the modern superferric cassettes and thus pass on the advantages of modern technology to the user directly.

Sony and 3M classic ferrichrome cassettes proved to be better than even the better superferric types, since the distortion seemed to rise less rapidly and the high frequency performance was clearly superior. Only very rarely, though, did any brand of pure chrome tape give a better performance than superferric types and it thus seems probable that chromium tape, as we now know it, will be virtually obsolete fairly soon. Many manufacturers would be well advised, therefore, to change their chromium switch to accommodate ferrichrome instead. It would be necessary only to reduce the bias on record and increase the equalisation slightly for ferrichrome tape.

We were surprised to find that almost all the superferric cassettes had very similar properties and are thus almost interchangeable. They were certainly not anywhere near compatible with earlier ferric tapes, though, since they require a different bias and equalisation setting. The distortion figures quoted, relevant to the tape itself, were always of the 3rd harmonic only of pure tones, recorded from a low distortion oscillator set at 333Hz. The distortion was measured with a fairly wide bandwidth around 1kHz to allow for wow and flutter. An ordinary distortion meter cannot be used unless it has at least 10Hz bandwidth at 333Hz, as otherwise the fundamental rejection may lead to bad errors in distortion readings. In any case noise would be included in the distortion reading, which is generally undesirable.

Published specifications are almost useless, unfortunately, since so many sail extremely close to the wind, whereas others give a very reasonable margin to allow for sample variation. Wow and flutter is a case in point and it seems quite incredible that the best machine was some ten times better here than the worst, which had to be replaced by a re-test sample. Wow and flutter also can depend on the quality of the cassette itself and so if you notice wow on a particular brand of cassette, try changing to an equivalent type made by another manufacturer. Some cassettes present a noticeable drag on the recorder's capstan, whereas others run much more freely. I remember a friend of mine who complained about bad wow on one famous brand of small cassette recorder, which was completely eliminated by changing to another make of tape.

Unfortunately many published reviews have quoted ridiculous distortion figures for cassette recorders, which just do not tally with ones taken correctly. The 3rd harmonic distortion on any tape recorder should always measure appreciably higher than the 2nd harmonic, since the tape medium does not itself introduce any even harmonics. Such harmonics can, however, be introduced in the record or replay amplifiers and if this had any significance it receives a comment in the review. All noise measurements, quoted as weighted, were made with a CCIR weighting filter as recommended by Dolby Laboratories Ltd., but with unity gain set at 1kHz. Many manufacturers were not able to quote CCIR weighted

figures and queried the laboratory measurements. Since all recorders had to be tested in an identical manner, we did not take any measurements at all with other weighting networks, as it was decided that it was far more important to compare all the recorders in the survey with one another rather than with their manufacturers' specification.

Many models included record limiters and I was horrified to find that in general they were not ganged together. If a large peak presents itself on one channel, both channels must duck to avoid image shifting, so that a crash of cymbals to the left will not cause a singer who is centre normally to shift suddenly over to the right. This effect is well known to professional recording engineers but apparently has not yet been noted by most cassette recorder designers. Some of the limiters were set to operate at much too high a level, so that all loud passages of music were limited to an equal high level, which consistently distorted. I must particularly compliment Sony on their excellent limiter design, for it was almost impossible to create distortion when the limiter was in use, although of course limiters ruin dynamic range of a classical performance if they are driven too hard.

The Philips DNL replay noise reduction system seemed to be an attempt to shut the stable door after the horse had bolted. It was certainly effective at removing hiss but so often it removed presence in quiet passages. The threshold seems to be set arbitrarily and this is not surprising since when set at too low a level no hiss reduction occurs at all but when set at a higher level programme degradation occurs.

JVC, part of the Matsushita empire, introduced their ANRS system some time ago and have modified it a number of times. The basic electronic design does not appear to offer either complete compatibility with Dolby or overall results which are subjectively as good. I am surprised that JVC went ahead with their system anyway, since Matsushita holds a Dolby licence and it seems possible that the ANRS system might be deemed to infringe the Dolby patent, which unfortunately for so many manufacturers is a very tight and wide one.

Many companies have tried to get round the patent but in the opinion of the writer not altogether successfully and since the Dolby process offers such outstanding advantages it is clearly going to be the established system for a long time to come. Remember that almost all pre-recorded cassettes are now Dolby processed and will only give of their best when played through a Dolby play back system.

The original Philips tolerance on record/replay head azimuth was rather wide and I was most concerned to see that so many manufacturers had delivered machines well outside this azimuth. Pre-recorded cassettes would sound very muffled on such machines, but be very careful if you attempt to re-adjust the azimuth on your recorder. Make sure that you adjust it either to a high quality test cassette or to an average found on various makes of pre-recorded programmed cassettes. If you do this your own recorded cassettes will be likely to sound better on your friends' machines.

Many recorders gave a rather poor head/tape contact or showed instabilities in the transport due either to poor quality machined parts, insufficient back tension or even misalignment of the capstan's pressure wheel. Frequently this problem appeared to be a simple fault and if you experience difficulty you should ask your dealer to exchange your particular sample for another. Only by continuous pressure from the public and dealers for better quality control will manufacturers learn that setting up equipment roughly will just not do. Is it not better to increase the price by £5 or so and then supply a machine in which the manufacturer, retailer and user can have more confidence?

This brings up the vexing subject of discounting. A machine that is discounted 15% will only save you £15 in every £100, but it might represent halving of the dealer's gross profit. Since a dealer has high expenses the net profit on a discount sale may well be 1/5th of what would normally be obtained. Such a dealer must rely on dramatically increased turnover and somehow or another a reduction of service either before or after sales. Most but by no means all discount houses clearly offer a reduced service and this is evident when a customer returns faulty equipment. A fully comprehensive service department to meet all hi-fi requirements must be equipped with at least £5000 worth of test gear and qualified engineers, although only part of this equipment may be used to check a cassette recorder. Firms having many branches may well not have each outlet equipped with its own service bay. Thus there will be delays in obtaining service from a central service work shop.

Our investigations have shown many multi outlet

companies to have quite adequate facilities, but others make a pretence of having a comprehensive service department when in reality the equipment is merely returned to the importer who must thus carry the burden of what can be a ridiculous fault which may be even as silly as dirt on the heads or possibly 'finger trouble' by the user. Such manufacturers' or importers' servicing must be paid for and in the long run the consumer has to carry the burden of inefficiency. One importer told me that it costs him over £5 just to look at a machine let alone service it and some 40% of alleged faulty returns are not really faulty at all. If general price increases are to be avoided the entire retail industry must improve servicing facilities either at the point of sale or rapidly at a main branch.

I do not want to appear to be preaching but just stating facts as I see them in the interests of the reader. Undoubtedly though, many users will be content with a machine that is just outside specification. In many cases a minor excursion from a printed specification may be relatively unimportant and each user will have to make his own mind up about any particular brand.

The microphone input circuit of each recorder was checked by recording my own voice with a compatible microphone. Most users, though, will probably never use a microphone at all after the first few days of ownership and thus any remarks made relevant to the microphone input can be disregarded if only the occasional recording might be attempted. The same applies to either the DIN or phono inputs if only one input pair and one output pair are to be normally used. Remember that any receiver will not necessarily work into any particular cassette recorder, since the two must be compatible. Each review discusses this factor.

Note that the majority of machines, incorporating a 5 pole DIN in/out socket, do not meet the DIN specification which states that whilst recording the output pins shall be muted to avoid crosstalk. Japanese manufacturers do not seem to be aware of this and would be advised to observe it whilst leaving the phono output sockets always live. A good retailer will inform you about interconnection with external equipment but a bad one may either bluff his way through or give you incorrect information. If you have a problem probably the best person to help is a manufacturer's or importer's technical public relations manager. Even he, though, may not be prepared to admit that a product is not necessarily compatible with all installations. Reviews in magazines may thus be found additionally helpful, although do not forget that one reviewer's standard may be very different from another's.

I was very surprised to find that the speed accuracy of nearly all the recorders reviewed was excellent and even the poorest measurements were really not too bad. Rewind times, though, were variable and frequently receive comment in reviews. Crosstalk between left and right channels of stereo is relatively unimportant and it is surprising that quite bad measured figures on some machines give only a marginal degradation to sound quality.

More important is the measurement of crosstalk between the right channels of each track, for a poor figure here will mean that a programme in one direction will be heard slightly muffled and at a low level when playing back a programme recorded in the opposite direction. Fortunately very few recorders had a problem here, although you should watch for this on a machine that you have purchased. Erasure too was usually very good, although a slight mumbling sound was clearly audible on a few machines, having insufficient erase particularly on chrome tape. Chrome tape requires substantially more erase current to wipe it clean—not a problem for users of ferric tape which erased adequately on almost every machine.

Many hi-fi addicts have tended to turn their nose up at Dolbied cassettes but the time has come for the cassette recorder to be taken very seriously since it offers a medium which can give very high quality at relatively low cost per recording. It is also very convenient. Hours of programmes can be stored in so small a space. Because of the azimuth problem, compatability between different machines will always be more difficult than with reel-to-reel ones and another unfortunate misconception of the original Philips standard reared its ugly head towards the end of the survey. Some recorders do not record and play back tracks in the position standardised by Philips. The original specification showed a narrow guard band between left and right channels but a wider one between the two stereo tracks. Some recorders have heads not quite conforming to this and thus will play back pre-recorded cassettes both commercial and ones made on other machines at too low a level on either one or both tracks, since the relevant section of the head will not be scanning a

complete track width in some cases.

Manufacturers will have to watch this much more closely and British pre-recorded cassette factories have indeed been looking into the matter very comprehensively in the last few months. They all are now conforming to the Philips standard to my knowledge but some machines may reproduce such cassettes incorrectly particularly on the right channel. Such cassettes now are of pretty good quality at best but are frankly abysmal at worst and I suggest that a really badly duplicated cassette should be returned to a retailer if the user is convinced that his own recorder is satisfactory. Only by continued pressure for improved quality will such cassettes be made to a good standard.

Whilst stereo records are still almost always preferable to pre-recorded cassettes the absence of clicks and surface noise on the latter obviously attracts the consumer. A very good hi-fi installation, though, can provide superior quality from records and it is probably best to make your own high quality cassettes from a good tuner or receiver, as such recordings can be noticeably better than even records. Remember that BBC broadcasts are free, although to satisfy legal requirements you have to apply for a licence to record radio broadcasts.

Finally, remember that extra trimmings on some machines may appear attractive at first but will possibly become redundant when the novelty has worn off. As I see it the basic priorities should be good performance from one pair of inputs to the output with low distortion, a good signal to noise ratio, a reasonably wide frequency response, good wow and flutter and stability performance. A three head machine will clearly make this easier for the user to obtain as he can check a recording whilst it is being made but such machines are very expensive.

Most people will obviously go for medium priced machines, which can perform very well indeed and a trial of any particular model in a shop to check its ease of operation will always be important, for there may be particular points about a model which a reader may dislike but which have not received comments in the reviews. Similarly it may be considered that I have commented unfavourably about some minor point which will not particularly concern a reader. I hope that the general comments and reviews in this book will give the reader a far better understanding of the cassette recorder scene and that he will be able to bear with some of the technicalities for these, unfortunately, are rather important in the weighing up of which one to buy.

Analog Audio

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Akai GXC36D	£99.95
Akai GXC46D	£171.25
Akai GXC39D	POA
Akai CS34D	£96.25
Akai GXC510D	£171.25
Aiwa AD1300	POA
Aiwa AD1600	POA
Aiwa AD1800	POA
Aiwa AD6500	POA
Beltek M1150	POA
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Harmon Kardon HK1000	£199.95
JVC CD1656	£99.50
JVC CD1667	£135.00
JVC CD1950	£154.00
JVC CD1669	£229.00
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Nakamichi	POA
Pioneer CTF3131A	£87.50
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Pioneer CTF5151A	£135.25
Pioneer CT2121	£111.95
Pioneer CT6161	£143.25
Pioneer CT7171	£171.75
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Sanyo RD4260	£101.50
Sanyo RD4300	£119.95
Sanyo RD4600	£192.50
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Toshiba PT430	POA
Toshiba PT470	£122.80
Toshiba PT490	£140.80
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Trio KX710	POA
Trio KX910	POA
Technics	POA
Yamaha TB800A	POA

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Leak 2300	£101.95
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Marantz	POA
Nikko FAM500	£95.00
Nippon Sound ST606	£51.50
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Goldring GL78/G800E	£57.50
Pioneer PL12D	£48.25
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Prices on application

SOME READERS may not be technically inclined enough to decide which machine best suits their purposes at a given price. So I am listing the models that we feel can be safely recommended in three price brackets. Do not forget that all the comments are based on the review samples, but nevertheless I feel pretty sure that most samples of the models mentioned should be up to a good standard. Sample variation and personal experience have been borne in mind in these final recommendations. The publishers, the editor and I cannot, of course, accept responsibility if your particular machine disappoints you.

In the budget range I outline the best 'value for money' machines between £100 and £150 excluding VAT. The prices were actual (or as quoted for new models) in the first week of August 1975, when the actual written material was passed over to the publishers by the laboratories. Some manufacturers were only able to give an approximate estimate of retail price for models not being released until October, and at this stage the publishers and I would particularly like to thank them for making available prototypes or early production samples for the tests.

£100—£150

• **Sanyo Model RD 4260** (£103.00 ex. VAT), the most inexpensive model recommended, seemed to perform very well and gave very reasonable quality without serious problems for a remarkably low price. You may well see this new model discounted, and it shows very clear technical advances in design and circuitry over its predecessors.

• **Aiwa AD1300** was very well liked, and gave a very good performance on ferrichrome cassettes and is again a brand new model. Aiwa incidentally is part of the large Sony empire and also make the BASF range of cassette recorders under sub-contract. No doubt the excellent performance is due not only to a good Aiwa design team but also to influence from Sony, who in fact supply the record/play back heads. The price is £127.75 ex. VAT.

• **Technics RS273US** (£135.96 ex. VAT) was liked by all of us. It worked well and was felt to be good value for money. Technics and its sister company National Panasonic are part of the Matsushita empire, one of the largest Japanese companies, who also control, incidentally, JVC.

• **Pioneer CTF 2121A**, at £138.08 ex. VAT, is towards the high end of the budget range but is likely to be discounted and in any case offers remarkable value for money. It has exceptionally good overall performance particularly on ferrichrome, and can be very strongly recommended. One of the very latest Japanese designs, ours was the only sample in Europe at the time of the tests. On looking over all the machines tested, it probably becomes the best buy, although, of course there are machines costing very much more that perform better and have more facilities. If you want a good, reasonably priced work horse, it is likely to give you excellent service.

• **Sony TC153SD** (£143.47 ex. VAT) will undoubtedly give much pleasure to those wanting a good battery portable at a modest price. It seemed very reliable and gave remarkably good quality, especially on ferrichrome, recording out of doors with a Sony stereo electret microphone. Recording sound effects and outdoor events can be a lot of fun, but do not forget that this model also performs well off mains when connected to a hi-fi installation.

£150—£200

• **Sansui Model 3000**, officially retailing at about £159 ex. VAT, is likely to be discounted almost everywhere—bringing it down, in fact, to the budget category. To be fair, though, it has been included in the mid price bracket. Again a brand new design, the review sample being the first one to enter Europe, it performed well and produced very good quality recordings.

• **Sony TC138SD** (£157.36 ex. VAT) impressed us and we feel that the price is most reasonable considering all its functions. It is clearly capable of producing superb quality recordings, but note in the review that the first sample was just a little hissy, whereas the second one was much better in this respect but was rather toppy on ferric and ferrichrome cassettes. A good well aligned sample will clearly be excellent value for money.

• **Sonab C500** (£175.88 ex. VAT) uses the Nakamichi tape transport, which gave a most impressive performance particularly on chrome. It is understood

that the machine is actually made by Nakamichi for Sonab. Its styling is very unusual and may put off some users but if you are interested in pure performance undoubtedly it can be recommended, although some of the measurements did not quite relate with the excellent subjective quality heard.

• **Yamaha YB800** battery machine (£179.00 ex. VAT) was very impressive in almost every way, although again the styling is rather unusual. Bellini, a well known Italian designer, was deeply involved in the layout and ergonomic design and some users will be most attracted to its presentation. It gave very good sound quality on both battery and mains operation. Although the basic noise performance on the review sample, again one of the first to come into Europe, was not quite as good as might be expected, probably the later samples will be better. More facilities are provided than on the Sony Model 153 battery machine and the performance was noticeably better. The distortion performance was so good that very high recording levels were possible.

• **Aiwa AD1800** (£189.74 ex. VAT) gave a remarkable performance. Again one of the latest designs from Japan, it has many interesting features and will obviously satisfy users with its excellent all round performance.

• **Neal 102 MkII** (£195.00 ex. VAT) is British made, but incorporates the well tried American Wollensak deck. It includes only very basic facilities but worked well and was reliable. When tied in with a hi-fi system, it gives results that will undoubtedly please many owners. It is mentioned as a very good performer, but surely the price is just a little high now.

Over £200

• **Technics RS676US** (£223.96 ex. VAT) was found very simple to use and is a front loader. Whilst its performance was very good indeed on the best ferric tapes, the price surely is too high and 10% lower would have been perhaps fairer. Its inclusion was marginal because of the purely average signal to noise ratio.

• **Nakamichi 550** (£236.00 ex. VAT) is basically a battery operated machine but is supplied with an external mains power supply. It gives quite clearly very good stereo out-of-doors recordings of remarkable fidelity, which were comparable with the well known Uher stereo reel-to-reel battery operated recorders. Working off mains, it produced recordings of very high fidelity when coupled to a hi-fi system.

• **Neal 103** (£241.00 ex. VAT) again British made, but with an American Wollensak deck, performed superbly and the facility of monitoring and changing bias levels will undoubtedly make it a very attractive proposition to technically minded users. Once more, though, the price is somewhat high but the manufacturers' quality control appears to be so good that a user is likely to get a machine set optimally on purchase.

• **Pioneer CTF 9191A** (£277.77 ex. VAT) is a really outstanding design and gave a truly remarkable performance, which showed the cassette medium at its best. The price, of course, is very high, but clearly great pains have been taken to optimise performance to obtain the best possible sound quality from the cassette medium.

• **Sony TC177SD** is by far the best buy among the three head machines, since virtually no criticism of any kind could be made of it. At £305.51 ex. VAT, it is the machine for the enthusiast or musician. It offers very wide and exceptional facilities and gives incredible quality on ferrichrome cassettes, which will be found almost indistinguishable from an original sound by most people. There are other 3 head machines available but either these had design problems or did not give a significantly better performance for the price asked.

Summary

A quick perusal of the recommendations shows that most of the machines have been designed very recently and will be virtually new to the reader. Do not be put off by a shop that tries to sell an earlier model at an extra discount, for predecessors in many cases offer very poor value for money by comparison. When you have made up your mind, then, you may have to shop around before you track down your chosen machine. But it's worth the trouble.

HAVING CHOSEN both your shop and your model, ask for a demonstration. Do not put up with a quick repaly of a pre-recorded cassette, since this will almost certainly br either a commerical one (which will probably be of considerably lower quality than your machine will be capable of recording from a stereo tuner) or one that the shop may have made on another recorder. You should request the shop to record direct from a high quality stereo tuner or record player straight into the machine and hear the recording made on a cassette tape recommended for that machine.

Do not pick loud pop music since you may not be able to hear the amount of hiss present. Pick, if possible, music including long sustained notes either of woodwind or brass instruments, or even better piano, and listen for wow on play back. Check that the hiss or high notes are not varying on either channel, whilst the cassette is playing back.

If you hear a swishing hiss or high frequencies seem to be coming and going the tape transport may unstable. Listen for hum on play back. If it is there suggest to the shop that they may have an earth loop but be highly suspicious if they make an excuse and cannot clear it.

Be specific to the shop about the equipment with which you are going to interconnect the recorder and make sure you get a receipt giving the date of purchase and the amount paid for the equipment, listing the serial number. Remember that a shop is in business to make money but will not continue to do so if it earns a bad reputation. A good shop will, therefore, take a lot of trouble in helping you but do not over stress unnecessary points since their time naturally costs money.

If you stick to the important points and show yourself to be knowledgeable but sympathetic, particularly if you have a problem later, I am sure you will find a good shop helpful and reasonable.

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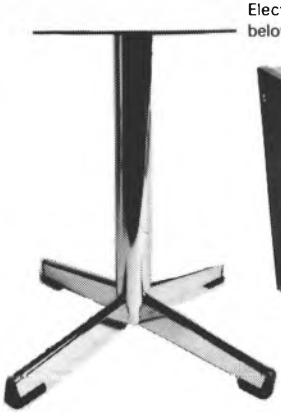

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To assist readers in selecting the best cassette recorder for their requirement and also to help manufacturers have a better insight of the general requirements of most users, I felt that it would be rather interesting to publish a proposed list of parameters for an ideal cassette recorder which would be excellent value for money by excluding some costly features. So here goes with complete details of my proposed recorder, which might cost around £150 plus VAT.

The machine would include ¼" jack sockets for microphone, a 5 pole DIN input/output socket with the output pins muted whilst recording and phono line in and output sockets, the output always being live to monitor on record or play back as appropriate. Only two high quality input faders need be provided or alternatively a very high quality stereo ganged volume control with a separate balance control as on the Technics 676. The inputs should be switched with positions as follows:

(1) High gain low impedance microphone input, sensitivity 100uV, into an impedance of 2k ohms, clipping at 20mV.
(2) a 500V microphone input, impedance around 10k ohms, clipping at 150mV.
(3) DIN input with impedance and gain identical to (2).
(4) A phono line input, sensitivity 50mV, clipping at above 10V into 100k ohms.

The line input, incidentally, should connect directly to the top of the record level controls and thus jump over the input pre-amplifier.

Dolby B processing should, of course, be provided and the metering should be taken from the calibration point immediately before processing on record and after deprocessing on replay. The meter should be peak reading with a nominal 0dB representing Dolby level and having a scale up to +dB with the top 3dB marked in red. Record and replay equalisation together with bias and gain changing should be provided on only one switch with positions for ordinary ferric tape, superferric tapes and ferrichrome tape. A fourth position for chrome tape would not be mandatory and thus could be omitted. User's presets for record bias should be provided for superferric and ferrichrome positions and should be located either on the rear of the recorder on underneath and should be accompanied by wording to the effect that they should not be touched unless adequate test equipment is available.

The Dolby processing circuits should include permanently a multiplex filter having a response not more than 2dB down at 15kHz and at least 30dB down at 19kHz. This filter should be operational in both record and play modes for technical reasons concerned with high frequency distortion on cassette tape, possibly affecting the replay Dolby deprocessing again. The relay pre-amplifier should have just two basic time constants, 3180/120 uS for ferric positions and 3180/70 uS for ferrichrome and chromium positions and these are automatically selected appropriately when the record bias/eq. switched position is selected.

The machine should have an output level controllable up to 1V out for Dolby level to satisfy semi-professional users and enthusiasts who have high quality monitoring equipment which usually works on higher output and input levels. A headphone socket with an independent gain control should be provided, which should give as least 1V for Dolby level into 600 ohms headphones.

The deck functions should be very simple and include stop, pause, play, rewind, wind and record and the logic should allow immediate change from one function to another. If the rewind or wind button is depressed from play back or record, queing should be possible as on the Aiwa models. The cassette should be very simple to insert, but should be firmly gripped once inserted. The wow and flutter should be better than .08% and the speed accuracy within ±0.5% of nominal. Obviously considerable pains should be taken by the designer to ensure a very stable tape transport. A tape timing counter must be included and a warning light as supplied on the Nakamichi 550, should indicate the point where only two minutes' recording time is left. However I feel that a memory counter is rather an unnecessary luxury. An auto stop should be included to stop the mechanism completely when the cassette has been wound to one end or the other and this should bring the entire mechanism to its normal resting position.

The replay noise, measured with CCIR weighting with unity gain set at 1kHz, should be better than 54dB ref. Dolby level without deprocessing and 64dB with deprocessing. Ferrichrome/chrome equalisation

should provide a noise improvement of 4dB. The unweighted 20/20kHz noise again ref. Dolby level should be better than 56dB. The hum components of the noise should be better than 60dB below Dolby level.

The overall noise, CCIR weighted, should be better than 54dB for ferric, with Dolby, 58dB on ferrichrome and 57dB on chrome (if available) these latter figures being again relative to Dolby level. The 3% distortion point (333Hz x 3rd harmonic) should be at least +6dB ref. Dolby level on the best quality superferric tape. Ferrichrome cassettes should have a similar distortion performance at middle frequencies. The record amplifier/head combination shall not distort at any frequency up to a flux level equivalent to that which should give + 10dB ref. Dolby level on an ideal tape, although the margin at the very high frequency end could be reduced by a few dB, perhaps. The electronics themselves should not have more than 0.1% distortion throughout at all levels which would be normally encountered ie. approaching +10dB ref. Dolby level.

The replay equalisation shall be within ±1dB ref. 333Hz from 63Hz to 10kHz, on both equalisations and between ±2dB down to 30Hz. The replay head should be capable of reproducing frequencies up to 15kHz but not above and should not require more than a very small amount of extreme treble lift for compensation. This extra compensation is best done by a damped resonance. I suggest that the resonating capacitor should be a manufacturer's preset variable resistor in series with it for adjusting the high end response.

The overall response on normal ferric cassettes should be within ±1.5dB from 100Hz to 12.5kHz and should not rise significantly above 10kHz. The optimum would be a fairly sharp roll off above 13kHz. Below 100Hz the tolerance should be ±2dB down to 30Hz. Superferric tapes should produce a response up to 14kHz again with a rapid roll off above this frequency. Ferrichrome cassettes should have a response extending to 15kHz with a tolerance of ±1.5dB at 10kHz and +0-3dB at 15kHz. I have purposely chosen reasonable overall responses and not ridiculously tight ones, as the latter would be virtually impossible to achieve in the quality control department of a manufacturer's production line.

Crosstalk at all frequencies should be better than 30dB from left to right channels and batter than 70dB between the right channels of the two tracks. Erasure should be at least 66dB.

The record/replay head shall be azimuthed at the factory as accurately as possible to the centre line of the Philips specification and this is best done with a phase meter. If the relevant factory is sufficiently happy with their capability of setting azimuth properly, it should not be made simple for the user to re-adjust azimuth but it should be made relatively simple for a dealer to make an adjustment when necessary. To allow for servicing requirements when head replacement, for example, is necessary, all internal presets should be adequately labelled in situ, so that even without a service manual an intelligent dealer will be able to perform quick adjustments. However, adjustments to the Dolby circuitry itself should be made less easy to discourage anyone from making adjustments to circuits which are almost certainly adequately set up in the first place. The Dolby circuitry could well be incorporated in a separate printed circuit board which should be made in such a way as to allow easy complete replacement.

I have intentionally omitted such luxuries as record limiters, input mixing, built in tone oscillators, remote control sockets and pop up VU meters, since all these should not really be required by 99% of users once they get used to the operation of a really properly lined up and easy to use recorder. One useful facility, though, could be incorporated and this would be the provision of an automatic external tape start/stop counter, starting the cassette at a pre-described time or indeed completely switching off the mains to it at the end of a cassette. It is no use providing a facility for such an external device unless the counter itself is made available as an accessory. By excluding unnecessary gimmicks, but still allowing a price as high as £150, I am suggesting that much more money should be allocated for quality control at the manufacturer's premises and arranging the distribution of the equipment through responsible companies or importers with first class service departments and furthermore arranging for agencies only to be given to dealers who themselves have excellent service departments.

It should be designed in such a way that any intelligent member of the family can use it and even Grandma should be able to set recording levels since if a needle peaks somewhere around the beginning of the red section of the scale the recording will probably be satisfactory. The general styling of the machine should be attractive and the meters should

be made as large as possible consistent with the styling. Whether lever type switches or push buttons are provided clearly depends on the overall styling, but once a prototype has been made it should be shown to as many well known technical journalists as possible. It would probably be a good idea to make at least a dozen such prototypes and submit these to such journalists for their impressions with a fairly lengthy time period, after the first prototype has been evaluated by a very competent consultant, who should have an intimate knowledge of European requirements as opposed to American and Japanese ones.

It has probably been fairly obvious to the reader that I intensely dislike DIN standards but nevertheless as such a standard exists it must be strictly adhered to on the DIN socket. However, manufacturers of DIN equipment absolutely must observe other standards, such as phono ones and thus acknowledge that many users will clearly prefer phono sockets to DIN types. Phono sockets are not likely to go away' as many European manufacturers might wish and similarly manufacturers outside Europe should also realise that the 5 pole DIN socket was, after all, introduced in Germany and if fitted should be incorporated correctly. Perhaps it is time for DIN to introduce a new input/output standard for use with transistorised equipment, since their existing standard was formulated specifically for valve equipment. Perhaps the new standard, when introduced, could stipulate low source impedances and high input impedances. Crosstalk could still be very low and interconnection with phono equipment and the new proposed DIN type equipment could be so much simpler and reduce costs of production dramatically.

Finally, manufacturers should remember the poor dealer who tries to service a faulty machine, It is in the manufacturer's interest for dealers to be able to service equipment quickly and effectively and this can only be done if mother board and printed circuits are far more adequately labelled. A few manufacturers print the complete circuit diagram on the inside of the bottom cover. If everybody did this it would save dealers a lot of time.

Surely a machine built to these suggested specifications should not be difficult to produce for each and every parameter has been achieved on virtually one or another machine reviewed, although no complete machine is within the complete specification outlined above. The first manufacturer who brings out a machine along my suggested lines and who dramatically improves quality control and customer relations throughout the selling chain will, in my opinion, stand to make a lot of money and gain a reputation that will surely become world wide. Remember that all the average customer wants is an easy-to-use machine which will reliably record an input programme and play it back with optimum response and signal to noise and without audible wow and flutter and bad head/tape contact.

PHILIPS N2520	C	B	–	C	B	–	B	B	B	–	B	A	B	B	–	F	E	A	C
PIONEER CTF 2121A	A	A	A	A	A	B	B	C	A	A	D	A	A	A	A	C	A	A	C
PIONEER CTF 6161A	B	C	–	A	A	B	D	B	C	F	D	C	A	D	–	B	B	C	D
PIONEER CTF 7171A	C	C	–	A	A	F	B	B	C	F	A	C	A	D	–	C	C	E	B
PIONEER CTF 9191A	C	A	A	B	B	B	B	B	B	B	B	A	A	A	A	D	A	B	B
SANSUI SC737	D	C	–	C	C	A	A	C	B	A	D	B	A	A	–	D	B	A	C
SANSUI SC3000	B	B	–	B	A	E	B	D	C*	B*	B	A	A	B	–	D	A	B	C
SANYO RD 4250	F	C	–	E	B	F	A	B	A	–	D	D	A	B	–	F	F	E	F
SANYO RD 4260	D	B	–	B	A	B	A	C	A	B	D	B	B	B	–	C	B	B	C
SANYO RD 4300G	D	B	–	F	C	F	B	C	E	F	D	D	B	B	–	D	D	E	C
SANYO RD 4600	D	A	C	C	A	B	D	C	C	B	D	D	A	A	C	F	D	A	E
SONAB C500	D	D	–	A	B	A	A	B	C	A	B	A	B	B	–	D	A	F	C
SONY TC 138 SD	C	B	A	B	C	B	B	A	B	A	B	A	A	A	A	D	B	A	B
SONY TC 153 SD	B	B	A	C	B	B	B	A	B	B	D	A	B	A	A	D	B	E	D
SONY TC 177 SD	A	B	A	B	D	A	B	B	B	A	B	A	A	C	B	D	A	B	B
SONY TC 209 SD	C	B	A	C	B	B	B	A	B	A	B	A	A	A	B	E	A	B	D
TANDBERG TCD 310	C	A	–	A	A	B	B	A	C	B	B	B	A	A	–	D	B	A	E
TEAC A160	C	A	–	C	B	C	F	B	F	C	C	C	A	A	–	C	C	F	C
TEAC A260	D	C	–	D	B	B	F	B	E	B	C	A	A	B	–	E	D	F	D
TEAC A360	F	E	C	E	A	A	A	B	B	B	B	B	A	D	A	D	B	A	A
TEAC A450	D	B	B	C	B	B	C	A	C	C	B	D	A	A	B	D	A	C	A
TECHNICS RS 273	B	B	–	A	B	C	D	C	D	C	A	A	C	A	–	D	C	A	B
TECHNICS RS 610	B	C	–	B	A	F	D	C	B	E	D	E	C	B	–	D	C	D	F*
TECHNICS RS 676U	C	C	–	B	B	B	C	C	C	A	A	C	B	A	–	E	A	B	A
TELEFUNKEN MC2200	D	C	–	A	C	–	B	B	D*	–	B	–	B	C	–	D	D	B	B
TELEFUNKEN MC3300	D	C	–	C	A	–	A	A*	B*	–	A	–	A	D	–	F	D	F	E
TRIO KX620	A	D	A	A	A	B	C	C	C	C	C	C	A	F	B	D	C	A	C
TRIO KX 710	E	F	–	F	E	D	B	B	F*	F*	C	A	B	E	–	F	F	A	C
UHER CG320	F*	E	–	F	–	–	A	A	B	D	C	–	A	A	–	F	B	A	B
UHER CG360	C	A	–	A	A	–	B	D	B*	E	A	–	C	A	–	D	D	A	C
WOLLENSAK 4766	D	C	B	C	A	A	C	B	D	B	E	D	B	A	C	D	E	A	C
YAMAHA TC800GC	D	B	A	B	B	A	–	D	–	B	C	A	A	A	A	D	C	A	A

Overall Comparison Chart

MAKE/MODEL	REPLAY NOISE	DYNAMIC RANGE FERRIC	DYNAMIC RANGE $FeCrO_2$/LN	DYNAMIC RANGE CHROME	OVERALL NOISE REDUCTION	LINE IN NOISE	DIN IN NOISE	MICROPHONE SENSITIVITY	DIN COMPATIBILITY	LINE ADAPTABILITY	METERING	INPUT DISTORTION	REPLAY AMPLIFIER DISTORTION	OVERALL DISTORTION FERRIC	OVERALL DISTORTION $FeCrO_2$/LN	OVERALL DISTORTION CHROME	STABILITY	AZIMUTH SETTING	WOW & FLUTTER
AIWA AD 1300	C	C	A	A	A	A	C	C	B	A	C	B	A	B	A	C	B	A	C
AIWA AD 1600	C	B	A	C	B	A	B	C	B	A	D	B	A	A	B	D	B	F	A
AIWA AD 1800	B	B	A	A	B	A	A	B	B	A	A	A	F	A	A	D	A	F	A
AKAI GXC 39D	D	B	B	D	B	F	A	C	B	E	C	C	A	B	C	F	B	A	D
BASF 8100	F*	E	–	E	–	E	A	B	B	B	C	–	A	A	–	E	B	C	C
BASF 8200	D	B	–	C	C	F	B	B	B	E	D	–	A	A	–	E	B	A	B
BELTEK M1150	B	B	A	A	B	A	B	A	C	A	C	A	A	C	A	F	C	B	C
BEOCORD 2200	B	D	–	B	A	–	B	A	C	F	A	–	A	F	–	F	B	B	C
DOKORDER Mk 50	E	E	–	F	E	F	B	C	B	F	E	F	E	D	–	F	E	A	E
DUAL C901	E	E	–	C	A	B	A	B	A	C	B	–	A	F	–	F	B	A	B
HARMON KARDON HK1000	B	C	C	A	B	A	–	B	–	A	A	C	A	D	B	C	D	F	F
HITACHI TRQ 2040 D	C	C	–	F	A	F	A	B	B	E	B	–	A	D	–	F	C	A	C
HITACHI D3500	D	B	–	B	A	B	C	D	D	C	B	C	C	C	–	F	B	C	E
JVC 1669UFS	C	C	B	C	B	B	E	C	D	C	C	A	C	F	C	F	C	A	D
JVC 1950	C	C	–	C	B	C	E	C	D	C	C	E	C	D	–	F	C	F	E
NAKAMICHI 550	B	C	–	A	A	B	B	B	E	B	A	A	A	B	–	C	A	F	C
NAKAMICHI 700	C	C	–	A	A	A	A	C	D	A	B	D	A	A	–	C	A	A	B
NEAL 102 MkII	A	A	–	A	A	B	A	C	A	B	A	B	C	A	–	C	C	A	B
NEAL 103	A	A	–	A	A	A	A	B	B	A	A	A	B	A	–	D	C	F	B
PHILIPS N2515	F*	D	–	E	–	–	A	B	A	C	E	–	A	A	–	D	C	C	C

Overall Comparison Chart

BATTERY OPERATION	REPLAY RESPONSE FERRIC	REPLAY RESPONSE CHROME	OVERALL RESPONSE NORMAL FERRIC	OVERALL RESPONSE SPECIAL FERRIC	OVERALL RESPONSE $FeCrO_2$/LN	OVERALL RESPONSE CHROME	VALUE FOR MONEY	REMARKS
–	B	A	A	–	B	B	A	Excellent
–	B	B	B	–	D	E	C	Promising, but inadequate quality control
–	B	B	B	–	A	E	B	Excellent
–	A	B	A	–	C	C	D	Disappointing
–	A	A	C	–	–	F	E	Overpriced since it has no Dolby
–	A	C	B	–	–	A	D	Good but serious input noise problem
–	C	C	B	F	–	C	C	Good but inadequate quality control
–	B	B	D	–	–	E	E	Disappointing
–	E	F	D	–	–	D	F	Very poor
–	C	E	C	–	–	C	C	Good and has useful features
–	C	B	A	A	–	D	C	Good but poor wow and flutter
–	D	F	B	–	–	B	C	Good on ferric but input noise problem
–	B	B	B	–	–	F	C	Quite promising but several faults on prototype
–	E	C	A	C	–	B	E	ANRS disliked and monitoring ridiculous
–	C	A	A	–	–	A	E	ANRS disliked and monitoring ridiculous
A	B	C	C	–	–	B	B	Very good and enjoyable to use
–	C	B	D	–	–	B	D	Excellent but overpriced
–	B	A	B	–	–	B	C	Very good, easy to use with just basic facilities
–	A	C	A	–	–	B	C	Very good, user bias preset found useful
–	B	B	D	–	–	B	E	Quite liked but no Dolby
–	B	B	C	–	–	D	E	Electronics good but mechanically rather poor
–	A	A	A	–	C	B	A	Excellent and remarkable value for money
–	C	B	B	–	–	F	D	Quite good but more recent models better
–	B	C	B	–	–	B	D	Good
–	C	B	B	–	D	B	C	Superb sound quality and very much liked
–	C	C	D	–	–	C	C	Reasonable
–	B	B	C	–	–	B	B	Very good indeed but needs highish line input level
–	D	F	E	–	–	F	E	Outclassed by model 4260
–	D	D	C	–	–	B	A	Excellent considering the low price
–	D	F	E	–	–	F	E	Outclassed by 4260
–	B	A	B	–	F	A	D	Reasonable but has too many gimmicks
–	C	C	B	–	–	D	B	Very good
–	B	F*	B	–	A	B	A	Excellent but watch quality control
A	C	B	B	–	B	B	B	Very good particularly on battery operation
–	B	B	B	–	A	B	C	Excellent
–	A	A	C	–	A	C	C	Good but slightly overpriced
–	A	B	A	–	–	B	D	Very good but poor wow and flutter
–	D	C	B	–	–	B	C	Fair
–	C	C	A	–	–	C	D	Disappointing
–	A	A	D	–	D	B	E	Fair but very poor noise performance
–	B	B	D	–	B	D	D	Very good but poor noise performance
–	A	A	B	–	–	B	B	Very good and well liked
–	B	B	B	–	–	C	D	Good but very poor wow and flutter
–	A	A	B	–	–	D	C	Very good indeed but slightly overpriced
–	D	C	F	–	–	E	E	Serious DIN input problem
–	A	B	B	–	–	C	D	Average but overpriced
–	B	A	E	–	D	C	C	Quite good and promising
–	B	A	C	–	–	B	F	Very poor and has serious input problems
–	C	C	C	–	–	C	E	Good but extremely expensive since no Dolby is included
–	C	C	B	–	–	B	E	Very good but extremely expensive
–	A	A	C	–	B	C	F	Very disappointing and overpriced
A	A	C	B	–	C	B	B	Excellent, slightly noisy but very good on batteries

*–see review

ANRS: The JVC automatic noise reduction system.
AZIMUTH: Please refer to foreword and conclusion.
BIAS: This term, in the context of this book, refers to a high frequency current passing through the record head which allows the audio current also passing through the head to produce reasonably linear magnetisation of the tape at all levels permitted by the combination of each machine with the cassette tape. The lowest level of bias is required for ferric cassettes, a slightly higher one for super ferric, an even higher one for ferrichrome, and the highest for chromium. Very few machines indeed have this parameter set correctly for all positions of the bias switch.
CENTRE INJECTION: This refers to an input whose sound is recorded equally on both channels so that when replayed it appears to come from the centre of the sound stage.
CLIPPING: This refers to the level above which bad distortion becomes evident, due to a circuit being overloaded by being overdriven.
CROSS TALK: Breakthrough of frequencies from one channel or direction to another.
DECIBEL (dB): The logarithmic ratio between two volume levels which represents either a difference of level from a nominal one, or the gain or loss in volume of a particular circuit sometimes at a specific frequency. A 1dB change of volume is approximately the lowest change of volume on a programme or tone that can be heard by a fairly expert musician or engineer. 3dB represents double the power and 6dB a doubling of apparent volume which is also equal to doubling the voltage. 10dB represents 10 times the power and $\sqrt{10}$ times the voltage, and 20dB represents 10 times the voltage and 100 times the power. dBs can be used to represent increased or decreased level changes or differences.
DIN COMPATIBILITY: The ability of a 5 pole DIN socket to be interconnected with external equipment designed approximately or precisely to DIN specifications, without problems arising in mismatching, of hiss, response or distortion.
DNL: The Philips dynamic noise limiter system, active on play back only.
DOLBY PROCESSING AND DEPROCESSING: This term refers to changes introduced in recording and play back in order to achieve noise reduction.
DOLBY LEVEL: This level represents a record flux equivalent to 213 Nanoweber per metre measured by the DIN method or 200nWb/m by the American method. It is an arbitrary level set by Dolby Laboratories, and serves well as a reference to which almost all the measurements have been taken. It represents very approximately 6dB below peak domestic recording level as would be measured by a very good peak programme meter. It also happens to be the level required for calibrating Dolby B processing units.
DROP OUTS: Momentary reductions of programme level due to inadequate head/tape contact caused by oxide particles shedding off the tape on to the head gap, and becoming displaced, or inadequacies in tape transport.
DYNAMIC RANGE: The ratio in dBs between the quietest sound that can be successfully recorded and the loudest which can be accepted by the tape without serious distortion on an average programme. The overall dynamic range has been calculated by adding 6dB, overall CCIR weighted noise, and adding or subtracting a further amount to allow for distortion measured both at Dolby level and at the point of 3% distortion. This range is reduced slightly if a recorder permits very high levels to be recorded successfully at just middle frequencies only. The figures quoted should only be regarded as a comparison, and should not be compared with figures quoted in other literature as they will probably not have been calculated on the same basis.
EARTH LOOP: A situation produced, usually in interconnecting equipment, but sometimes unfortunately present in the equipment itself, in which more than one earth path is present. It usually refers to earth paths connected to the earth pin of a mains plug. See reference to this in the foreword.
EQUALISATION: This refers to the necessary change in frequency response of an amplifier required so that an overall flat frequency response is obtained from a tape medium. Equalisation is required both on record and replay. Any tape recorded on a good cassette recorder should have the same inherrent response when played back on another correctly set up machine since all play back equalisations should have been standardised.
ERASE: The first head over which the tape passes has a very high supersonic frequency (the same as for bias) passing through it at a considerable level, and this should completely remove any trace of a previous recording before a new recording is magnetised on to the tape.
FADERS: Most volume controls in the past have been of a rotary type, but in recent years these have frequently been replaced by levers acting up and down or even sideways to adjust level.
FREQUENCY RESPONSE: The accuracy with which an amplifier or recorder reproduces high notes and low notes at the same intensity as middle notes. In particular it refers to a reproduction of such intensities identical to the intensities that would be measured on the input. It is usually expressed as being a range over which the medium has a fairly constant response with respect to the level at the middle frequencies, ie one lying between 333Hz and 1kHz.
FUFFINESS: A word coined by the writer in an attempt to describe noise modulation of one form or another, ie for a form of hiss which is added to the sound during louder passages, particularly at high frequencies.
HUM: A low frequency interfering sound produced by break through or interference from mains wiring or circuitry with audio circuitry. If this is audible it can sometimes be produced by bad design, but also through earth loops or bad, or even no earthing. It can also be produced by placing some recorders too close to external mains operated

equipment.

IMPEDANCE: The approximate equivalent resistance in ohms presented by a circuit measured at a frequency of 1590Hz in the tests for this book. Resistance in ohms equals the voltage at a point divided by the current taken at that point (Ohm's law).

JACK SOCKET: A socket into which a jack plug can be inserted. Both mono and stereo types are used on cassette recorders, stereo ones normally only being used to feed headphones. Mono types are in three basic sizes, 2.5mm, 3.5mm and ¼" (6.35mm).

LIMITER: An electronic device which limits the recording level to a pre-determined maximum value but allows levels below the set threshold to be reproduced accurately.

LINE ADAPTABILITY: The ease with which phono sockets or an extra DIN socket can be interconnected with non DIN type external equipment, without distortion, noise or frequency response problems.

MEMORY COUNTER: Please refer to foreword. (See pages 27/28).

MICROSECONDS (μS): The time constant of a resistor/capacitor combination involving a frequency response change (equalisation). This is normally calculated as the equivalent change introduced by the combination of a resistor in ohms, x the capacitor in μfd (alternatively K ohms x nano farads).

MODULATION: The amount of volume that the medium can accept and reproduce, or alternatively the actual sound present on the recording.

MULTIPLEX FILTER: A circuit which introduces severe attenuation at supersonic frequencies to decrease interference encountered with the outputs from some stereo FM tuners.

NOISE DEGRADATION: An effect which occurs when hiss, or occasionally hum, is added to the potential best hiss performance of each recorder when the record levels are at minimum. Most recorders produce noticeable additional hiss when their record level controls are advanced above a certain point.

PEAK READING LIGHTS: These are visual indicators which usually come on when a certain level has been achieved. A few gradually increase in brightness above a pre-set point. They are usually designed as a complement to the action of the recording level meters.

PEAK RECORDING LEVEL: A level above which distortion becomes apparent. This distortion is introduced when the oxide particles almost reach magnetic saturation, and thus will accept no more level. Sometimes distortion is introduced by the recorder's electronics' incapability of providing the required high levels to fully magnetise the tape. In some cases the record head itself starts saturating, ie magnetically distorting above a certain level.

PHONO (LINE) SOCKETS: These sockets are coaxial and accept a special plug (termed phono plug) with a long pin in the centre (live) and a cylindrical section around it providing an earth connection. Inputs are normally high impedance and outputs are low impedance, and are provided for interconnection with many types of external hi-fiequipment.

REPLAY AMPLIFIER HISS: This is produced since very great amplification is required to increase the minute electrical energies produced by the play back head to a level sufficient to drive external equipment. Well designed circuits hiss less than poorly designed ones.

STABILITY: In this book stability refers to either poor head to tape contact or variations in the angle with which this is achieved.

TAPE HISS: This is produced by the minute particles of iron or chrome oxide passing the replay head gap in a random fashion. It can be emphasised by hiss introduced in the record amplifiers or input circuits, and is reduced if noise reduction is employed.

THUTHINESS: A lisping effect caused particularly on speech by high frequency tape compression when too high a recording level is being attempted.

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

VU METERS: Some level meters are calibrated in VUs, and these represent volume units in 1dB steps. 0vu, approximately half way across most meters, does not necessarily represent Dolby level, and most certainly must not be confused with peak recording level on constant tones. It does, however, represent very approximately peak recording level on an average programme, but see comments in individual reviews.

WEIGHTED NOISE: This refers to noise in which equalisation has been introduced to emphasise frequencies that cause most subjective annoyance, and which also reduces noise of less concern to the average ear. Throughout the tests a CCIR filter has been employed. Please see foreword for frequency chart giving filter response.

WOW AND FLUTTER: Pitch variations due to mechanical imperfections of the tape transport.

1kHz: This frequency used to be referred to as 1KC or 1000c/s and is a note of approximately 2 octaves about middle C on a piano. 1Hz represents one vibration per second, and the human ear can easily hear from 40Hz to approximately 16kHz in an average room, although with increase in age a listener begins to lose sensitivity at the high frequency end.

5 POLE DIN SOCKET: Special socket designed in Germany having two live input connections, an earth and two output connections. One some recorders the output connections become low sensitivity inputs on record, whereas on most Japanese equipment two pins provide a monitor signal on record and a replay signal on replay. Various types of DIN socket will be found on many European recorders for microphone, loudspeaker and remote control facilties.

CORRECT ALIGNMENT IS VITAL FOR ANY TAPE MACHINE

This is the conclusion reached by Hi-Fi Choice, Angus McKenzie and Audio T. A misaligned £250 machine can sound worse than one half the price.

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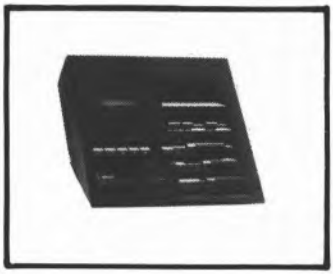

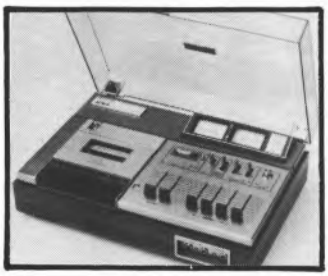

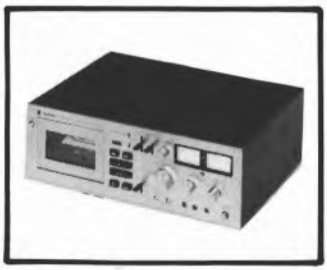

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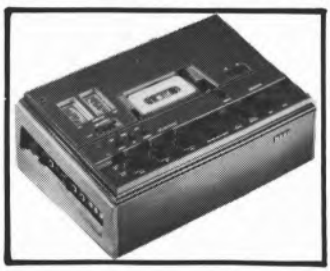

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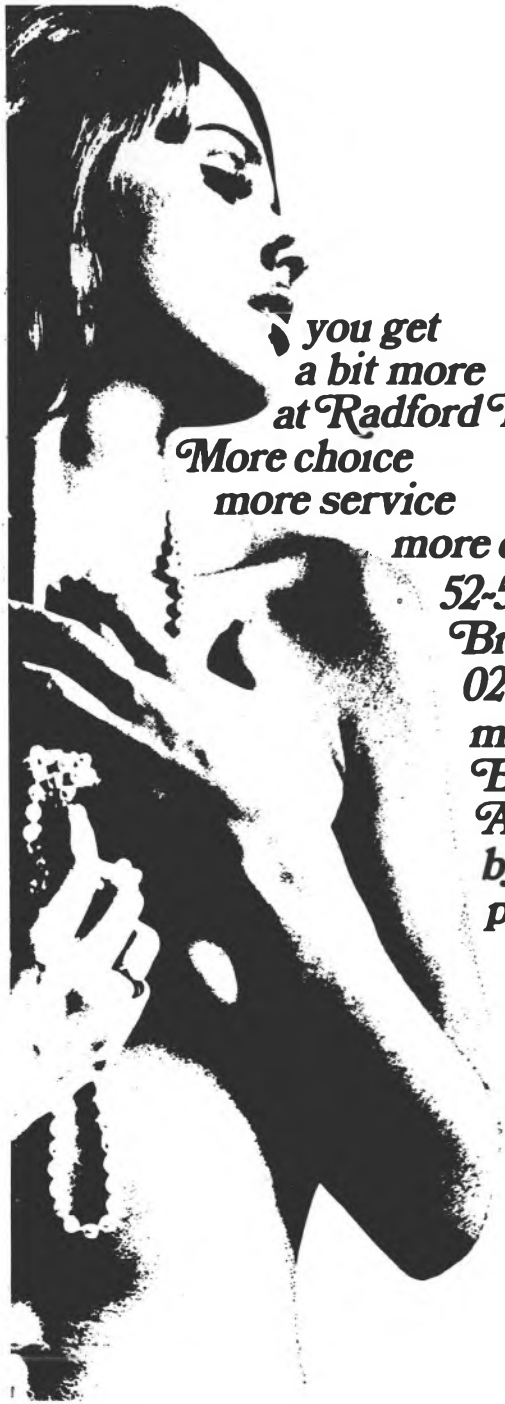

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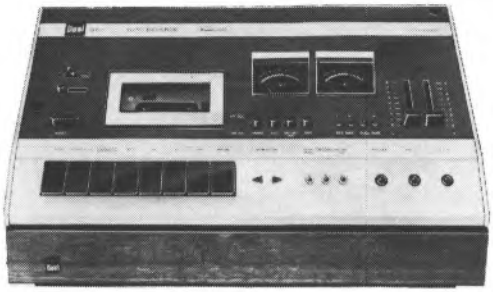

Dual C 901 (walnut finish)
Dual C 901 W (white enamel)

HiFi 4-track tape cassette deck for recording and playback in both tape directions (Auto Reverse System). A Dual tape cassette deck for the international HiFi market, designed and produced in West Germany. Universal model for all Compact Cassettes with automatic change-over to standard or chromium dioxide tape (Auto bias). Tape noise suppression during recording and playback by means of "Dolby NR" *

The Dual C 901 HiFi tape cassette deck exceeds the requirements for home studio use (HiFi) specified in DIN Standard 45 500.

Dimensions: $16\frac{1}{2}$ x $4\frac{3}{4}$ x 11 in. (W x H x D)

Weight: approx. 14,3 lbs.

Special features

Outstanding speed stability provided by *Dual synchronous/continuous-pole motor* with radially flexible mounting; extremely high centrifugal mass and separate drive to capstans and cassette wind. The cassette wind is driven directly from the motor by a second belt, so that faults emanating from the cassette have no effect on the drive to the capstans.

A photoelectric resistor monitors tape payout, prevents tape loops from forming and at the end of the tape initiates reversal of direction of travel or switches off the unit. This device functions independently of the type of cassette and of automatic stop foils. The direction of tape travel is indicated in each case by an illuminated arrow. For brief interruption of play, the "pause" key is used; the operating set-up condition previously selected is retained. Function switchover is carried out directly and without bypass by the stop key. At the end of the tape the automatic cut-out switches the unit off mechanically as well as electrically.

Master Shutoff: the mains switch is designed for connection of receiver or power amplifier, so that they can be switched on and off with the Dual C 901.

Auto reverse: after playing back the cassette in one direction, change-over to the opposite direction takes place automatically. Thus it is not necessary to turn the cassette over to play back the second side. When play is completed in both directions the unit switches off automatically. Immediate reversal of direction of travel is possible at any time.

Continuous play device: the automatic cut-out is switched off, the unit will now play continuously in both directions until the stop key is depressed.

Auto bias device: change-over of bias and erase current from iron oxide (standard) tape to chromium dioxide (CrO_2) tape takes place automatically when the cassette compartment is closed. Manual change-over is possible for unmarked CrO_2 cassettes. 3-digit tape length counter with reset.

Dolby NR noise suppression – can be switched off – reduces the tape noise during recording and playback by approximately 10 dB, with pilot light, test generator and separate setting control for standard and chromium dioxide (CrO_2) tapes.

A double-acting recording lock prevents unintentional erasing. Readiness for use is indicated by a pilot light. *Automatic level control (ALC).* Two output control slides for manual recording level control for both channels. Recording level indication by two illuminated volume unit meters, folding out upwards; indication during playback as well. *Viscous-damped opening of cassette compartment.*

Overloading indication: additional overloading indication by means of a warning light.

High friction-resistant hard *Permalloy* 4/4 track recording and playback head. Automatically positioning erase heads: to minimize wear on erase heads and tape only the erase head for the tape direction concerned is in contact with the tape.
Jacks for headphones and two microphones on the front with supply voltage for the Dual capacitor microphone. On the back inlets and outlets in accordance with RCA Standard (Cynch jacks), with parallel connected 5-pole DIN jack.
Fittings are also supplied for vertical operation.

Technical Features

Recording speed 4.75 cm/s ($1\frac{7}{8}$ in/sec).
Deviation from nominal speed < 1%.
Pitch fluctuations in normal direction, (evaluated in accordance with DIN 45 507) < 0,12%.
W.R.M.S. < 0,09%
Frequency range
with standard (STD) tape 30–14 000 Hz, with chromium dioxide (CrO_2) tape 30–16 000 Hz
Dynamic range
(evaluated in accordance with IEC, curve A) > 50 dB, with Dolby NR > 59 dB.
Harmonic distortion < 1.5% at 1 kHz – 2 dB.
Oscillator frequency: 100 kHz.
Signal-to-erase ratio > 70 dB, cross-talk attenuation, in opposite direction > 60 dB, in stereo direction > 30 dB.
Inputs: 2 x microphone ($\frac{1}{4}$" coaxial plug) 0.15 mV.
Radio: 1 x DIN jack 0.15 mV – 2 x RCA jack 40 mV.
Outputs: $\frac{1}{4}$" coaxial jack for headphones.
Radio: 1 x DIN 0.75 V – 2 x RCA 0.75 V.

*The word "Dolby" is a registered trademark of the Dolby Laboratories, Inc.

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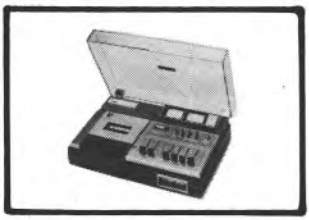
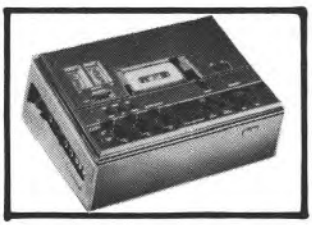


Neal 102 Mk II	£195.00
Neal 103	£241.00



Sansui SC636	poa
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Technics RS269	£81.94
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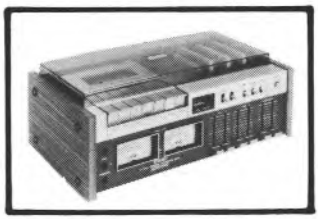

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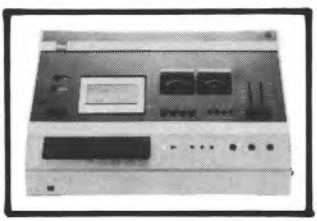

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Marantz full range	poa
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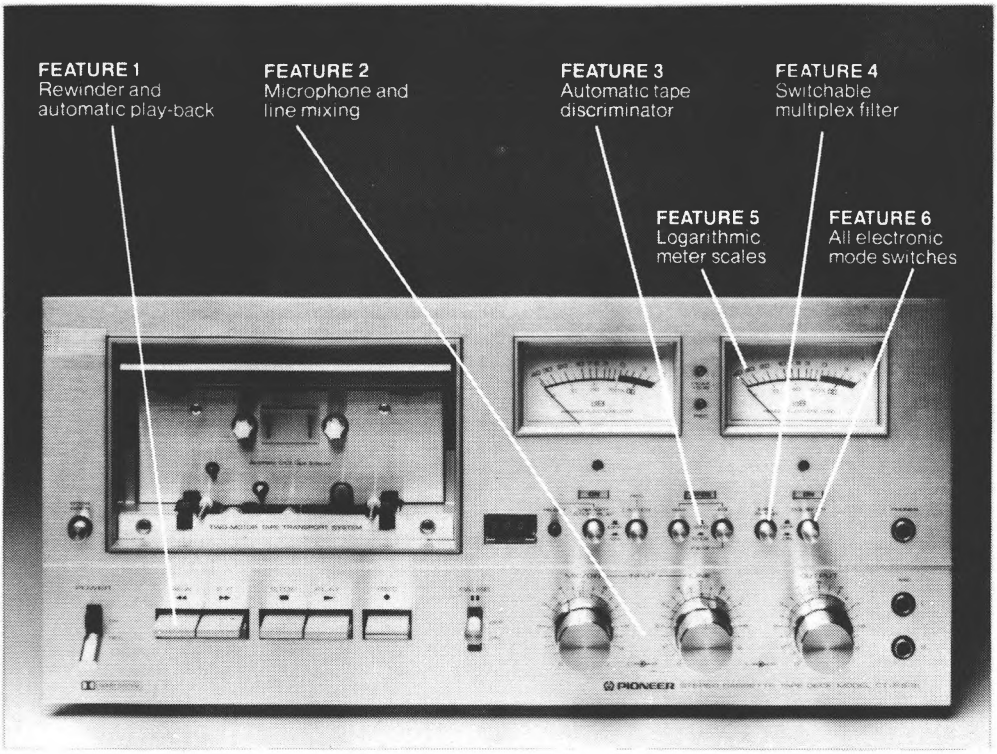

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It takes the six best features in decks and puts them all together.

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5. Logarithmic scales simply mean everything can be measured more accurately.

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Everything's nicely together, perfectly in time.

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Many people still think of a Dolby noise reduction unit as a very special feature. However, we reckon that when you're in this class, something like a Dolby ought to be standard.

It means almost total elimination of tape hiss, through the complete volume range. Like the man said, try turning up another unit that matches this one for recording quality.

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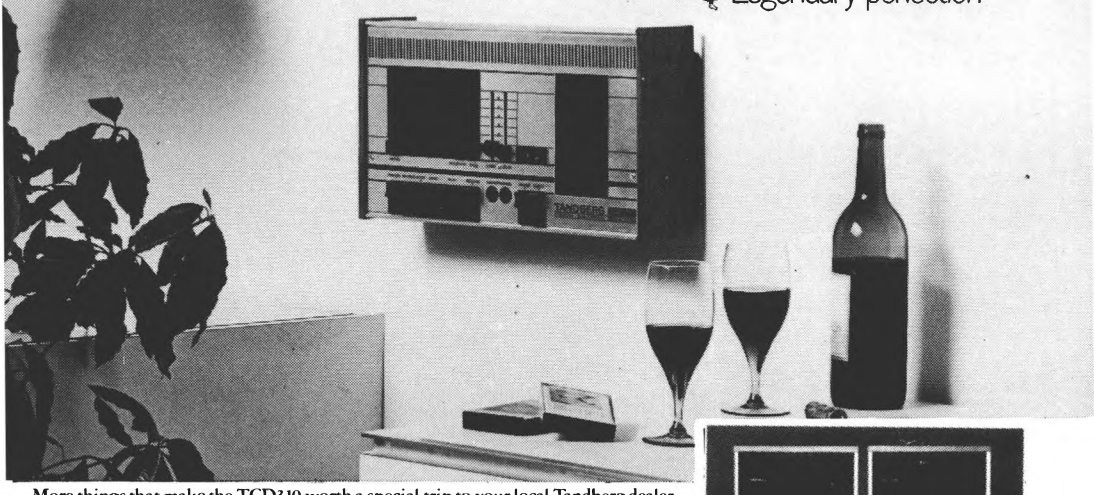

More things that make the TCD310 worth a special trip to your local Tandberg dealer.

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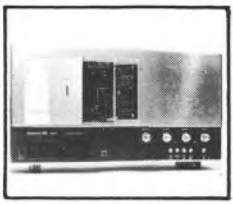
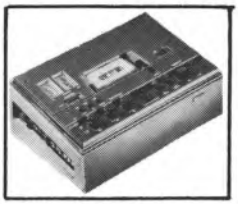
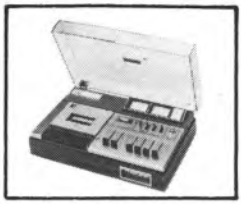
CASSETTE PERFORMANCE



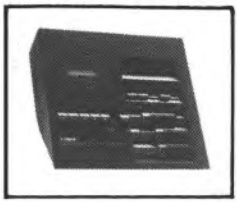
Nakamichi 700



NEAL 103



Aiwa AD1800



Yamaha TC800

Again, just as our tests on amplifiers and speakers have shown, the best way to ensure top cassette performance is to use your ears. For example the NEAL, which is neither impressive or glamourous in looks, has a performance that is unrivalled on the British shores. It is only superceded by the Nakamichi in cosmetics and ease of operation. At the cheaper end of the market, the performance and finish of the Aiwa is second to none. For people requiring performance and a little more by way of aesthetic appearance the Yamaha TC800 must be heard and seen.

Don't forget, our state of the art system is still the Naim NAP160, NAC12, Dahlquist DQ10, Linn Sondek, Supex and Grace combinations which, with a NEAL 102MkII or 103 offers a system of unrivalled performance which will probably remain as a reference standard for some time to come.

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But other recording companies can claim that, too.

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We've got people such as Sweet, Perry Como, John Denver, Elvis Presley, Jim Reeves, Artur Rubinstein, The Tymes, David Bowie, Glenn Miller and Jack Jones.

But to know just how fine RCA tapes can be you should see the RCA tapes catalogue. It contains details of all the RCA artists on tape.

Ask to see it at your local record shop today.

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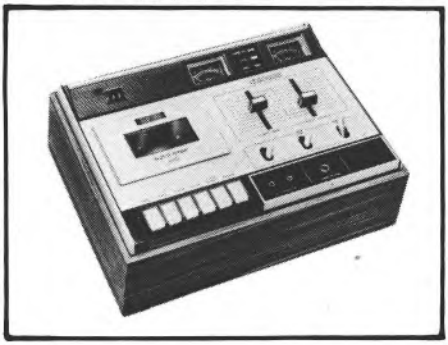
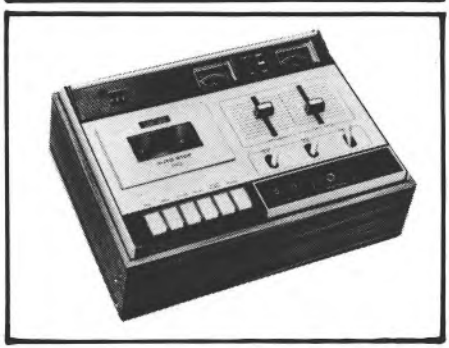


AMSTRAD 7000

Incorporating the famous Dolby noise reduction system, the Amstrad 7000 is a stereo cassette deck designed to give immaculate results. Features include independent left and right channel record level slider controls, twin meters, chrome tape switch, DIN and phono sockets, plus all the other facilities that you would normally expect on cassette decks costing twice as much. The cost when you buy from Linavale? Only £67.84 inc. VAT.



AMSTRAD 6000

Without Dolby, the Amstrad 6000 still offers a host of features designed to give you superb recordings. Again, it provides all the necessary features to line up with your high fidelity set-up. Again, when you buy from Linavale, it is excellent value for only £52.06 inc. VAT.

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Gem TV & Radio Limited, 355 High Road, Leytonstone, London, E11. *Tel.* 556 7288
Golding Audio Limited, 12a Culver Street, Colchester, Essex. *Tel.* 48101
J. R. Gough Limited, 27 East Smithy Street, South Shields. *Tel.* 3663
Gratispool Limited, 10/12 Martineau Way, Birmingham, B2 4UN. *Tel.* 236 1024
Green Bros. Limited, 19 New Bond Street, Bath, Somerset. *Tel.* 63146
Greenside Electrical Co. Limited, Queen Street, Morley, Leeds, LS27 8DX. *Tel.* 3925
Greenside TV Services Limited, Tingley Bar Estate, Bridge Street, Morley, Leeds.
Gregson Limited, 89 Outram Street, Sutton In Ashfield, Notts. *Tel.* 3885
D. E. Hadaway & Son Limited, 95 Watling Street, Gillingham, Kent. *Tel.* 50058
F. W. Haines Limited, 31/32 Oxford Street, Swansea, Glamorgan. *Tel.* 54747
Hal Purves Limited, 8 New Oxford Street, Workington, Cumbria. *Tel.* 3086
Hamish Robertson Limited, 228 Fenwick Road, Giffnock, Glasgow. *Tel.* 638 3457
Hammonds Of Watford Limited, 60 Queens Road, Watford, Herts. *Tel.* 39733
Hardman Radio Limited, 33 Dale Street, Liverpool, L2 2HF. *Tel.* 236 2828
Hardman Radio Limited, 26 Exchange Street East, Liverpool, L2 3TN. *Tel.* 236 2828
Hardman Radio Limited, Guild Hall Arcade, Lancaster Road, Preston, Lancs. *Tel.* 59264
Harold Stott Limited, 18 Westfield Street, St. Helens, Merseyside. *Tel.* 34141
Harold Stott Limited, 96 Chapel Street, St. Helens, Merseyside.
Harrow Audio Limited, 27 Springfield Road, Harrow, Middlesex.
Harrow Audio Limited, 33 Bridle Path, Watford, Herts. *Tel.* 33018
E. R. Harveyson & Co. Limited, Albert Place, Nether Street, Finchley, N3. *Tel.* 346 2622
Havant Radio Centre Limited, 5 North Street Arcade, Havant, Hants. *Tel.* 3853

Haven Hi-Fi Limited, 196 South Ealing Road, London, W5. *Tel.* 560 0194
A. R. Hawkins Limited, 2 The Parade, Northampton. *Tel.* 39674
Hector MacDonald & Son Limited, 83 Titchfield Street, Kilmarnock, Ayrshire. *Tel* 21641
F. P. Henty Limited, 16 The Martlets, Crawley, Sussex. *Tel.* 25539
Hermlyn Hi-Fi Limited, 64 High Street, Orpington, Kent. *Tel.* 33101
Hi-Fi Centre Limited, Green Lane, Wilmslow, Cheshire, SK9 1LW. *Tel.* 22112
Hi-Fi & Components Limited, 84 Battersea Rise, London, SW11 1EH. *Tel.* 223 1110
High Fidelity Limited, 31 Pall Mall, Hanley, Stoke On Trent. *Tel.* 25194
Hi-Fi Opportunities Limited, 33/35 Handysides Arcade, Percy Street, Newcastle. *Tel.* 27791
Hi-Fi Shop Limited, 27a Kingsgate Street, Coleraine, Co. Derry, NI. *Tel.* 52843
Hi-Fi Studio Limited, 8 Byram Street, Huddersfield, Yorks. *Tel.* 35333
Hi-Fi Systems Limited, 15 Orford Avenue, Warrington, Cheshire. *Tel.* 32981
Hi-Fi Western Limited, 48/52 Cambrian Road, Newport, Gwent. *Tel.* 62790
R. S. Hill Limited, 25 High Street, St. Neots, Hunts. *Tel.* 72172
Hockley Audio Centre Limited, 22 Spa Road, Hockley, Essex. *Tel.* 6835
Hodgson's Limited, Chestergate, Macclesfield, Cheshire. *Tel.* 22665
Holburn Hi-Fi Limited, 445 Holburn Street, Aberdeen, Scotland. *Tel.* 25713
Holdills Limited, 39/41 Mincing Lane, Blackburn, BB2 2AF. *Tel.* 59595
Holt Hi-Fi Limited, 8 Portland Street, Swansea, Glamorgan. *Tel.* 41032
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Hughes Limited, 161 Beccles Road, Oulton Broad, Lowestoft. *Tel.* 5454
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John Ham Limited, 75 Mansel Street, Swansea, Glamorgan. *Tel.* 50968
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John Savill & Sons Limited, 7 Goodramgate, York. *Tel.* 25775
Johnsons Sound Service Limited, 43 Friar Street, Worcester. *Tel.* 25740

K. J. Leisuresound Limited, 48 Wigmore Street, London, W1. *Tel.* 486 8263
K. J. Leisuresound Limited, 101 St. Albans Road, Watford, Herts. *Tel.* 45250
Kelleys Radio Limited, 8 High Street, Brentwood, Essex, CM14 4AB. *Tel.* 215519
Ken Dean Limited, 112/114 St. James Street, Brighton, Sussex, BN2 1TH. *Tel.* 61550
Ken Rose Audio Limited, 283 Fleet Road, Fleet, Hants. *Tel.* 5053
Ken Whittle Limited, 788 Stratford Road, Sparkhill, Birmingham, B11 4BP. *Tel.* 7775964
James Kerr Limited, 98 Woodlands Road, Glasgow, G3 6HB. *Tel.* 332 0988
Kingsons Limited, 28 Winslade Way, Catford Shopping Centre, London, SE6. *Tel.* 6903875
H. Kirby Limited, 11/13 Aswell Street, Louth, Lincs. *Tel.* 249415

Lanes Radio Limited, 94 Church Road, Hove, Sussex, BN3 2EB. *Tel.* 738517
Lancs Hi-Fi Limited, 248 Wilmslow Road, Manchester 14.
Lawbak Electronics Limited, 213 High Street, Eastleigh, Hants. *Tel.* 2868

Lectro-Mek Sound Systems Limited, 45 Roxburgh Street, Greenock. *Tel.* 27026
Lee Longlands Limited, 224 Broad Street, Birmingham 15. *Tel.* 643 9102
Leicester Hi-Fi Centre Limited, 215/219 Melton Road, Leicester. *Tel.* 666653
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Les Wright Limited, 101 Mary Street, Scunthorpe, Lincs. *Tel.* 67738
Levells Of Huddersfield Limited, Market Street, Huddersfield, Yorks. *Tel.* 32294
R. G. Lewis Limited, 6 Foregate Street, Worcester, WR1 1DB. *Tel.* 26697
Libby's Limited, 244 Soho Road, Birmingham, B21 9LR. *Tel.* 554 8557
Lincoln Hi-Fi Centre Limited, 271a High Street, Lincoln, Lincs. *Tel.* 20265
Lloyd Paton McGlynn Limited, 34 Moorfield Walk, Ormston, M31 1TT. *Tel.* 747 9722
London Sound Limited, 70 West Street, Harrow On The Hill, Middlesex. *Tel.* 864 6781
Look-N-Listen Limited, 1a Eaves Street, Blackpool, Lancs. *Tel.* 20420

H. W. Maclaine Limited, Seskanore, Omagh, Co. Tyrone, NI. *Tel.* 204
Malcom Audio Limited, 12 South Street, Chichester, Sussex. *Tel.* 87562
Manx Audio Limited, Ellerslie Road, Crosby, Isle Of Man. *Tel.* 437
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Marshall Bros. Limited, 57 St. Leonards Road, Windsor, Berks. *Tel.* 62635
Martins Electronic Centre Limited, 85/87 Ber Street, Norwich, Norfolk. *Tel.* 27010
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McKay Sound & Music Limited, 100 Westgate Road, Newcastle, Northumberland. *Tel.* 24449
McKenna & Brown Limited, 190 Linthorpe Road, Middlesborough, Cleveland. *Tel.* 46647
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Melodonia Limited, Hogue Du Pommier, Castel, Guernsey. *Tel.* 56647
Melodye Fayre Limited, 35/36 Market Place, Derby, Derbys. *Tel.* 41960
Merrow Sound Limited, 205 Epsom Road, Merrow, Guildford, Surrey. *Tel.* 33227
Metrosonic Hi-Fi Limited, 21 Devonshire Court, New Hall Road, Salford 7. *Tel.* 7925605
Micron Audio Limited, 172 Baslow Road, Totley, Sheffield, S17 4DR. *Tel.* 360295
Micron Audio Limited, 135 Sheffield Road, Chesterfield, S41 7JH. *Tel.* 34927
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A. R. Mitchell Limited, 2 Walker Street, Wellington, Salop. *Tel.* 2026
Moores Hi-Fi Limited, 58 Frances Street, Newtownards, Co. Down, NI. *Tel.* 2417
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Newbury Radio Limited, 272/274 Romford Road, London, E7. *Tel.* 534 3100
Newdwan Hi-Fi Limited, 1/3 Castle Street, Lower Bridge Street, Chester. *Tel.* 24179
Newmart Electronics Limited, 15 Whitechapel, Liverpool 1. *Tel.* 236 0738
Newmart Electronics Limited, 4 New Market Street, Leeds, LS16 6DG. *Tel.* 42708
Nicholl Bros. Limited, 11/15 Wellington Street, Ballymena, Co. Antrim, NI. *Tel.* 2187
Norman Boult Audio Limited, 7 Hastings Close, Bray, Maidenhead, Berks. *Tel.* 21744
Norman Butler Limited, 7 Dicconson Terrace, Lytham, Lancs. *Tel.* 6464
Norman Whiteney Limited, 4 Deansgate, Blackpool, FY1 1BN. *Tel.* 28357
Northstar Sound Systems Limited, 34 Heron Close, Knutsford, Cheshire. *Tel.* 0706 69571
Norvic Hi-Fi Limited, 22/24 St. Benedicts, Norwich, NOR 24J. *Tel.* 26086
Norwich Hi-Fi Centre Limited, 23 Timberhill, Norwich, Norfolk. *Tel.* 22792
Nusound Limited, 191 Plashet Road, Upton Park, London, E12. *Tel.* 472 2185

Oakley & Lee Limited, 45/49 Upper High Street, Epsom, Surrey. *Tel.* 26555
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Overend Electrics Limited, 129 High Street, Rickmansworth, Herts. *Tel.* 74804

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Park Radio Limited, 700 Romford Road, London, E12. *Tel.* 478 1176
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S. Proctor Limited, 125 Soho Road, Handsworth, Birmingham 21. *Tel.* 554 8953
Provincial Relay Limited, 19 High West Street, Dorchester, Dorset. *Tel.* 2948

Quality Hi-Fi Limited, 55 North Road, Poole, Dorset. *Tel.* 4215

R.E.W. Audio Visual Limited, 20/21 St. Giles High Street, London, WC2. Tel. 836 9183
R.E.W. Audio Visual Limited, 10/12 High Street, Colliers Wood, London, SW19. *Tel.* 5409684
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Radio Maintenance Limited, Wards End, Loughborough, Leics. *Tel.* 63094
Radio Unlimited, 50/$\frac{53}{54}$ Hoe Street, Walthamstow, London, E17. *Tel.* 520 3789
Ralph Hales Limited, 154 Worcester Road, Malvern Link, Worcs. *Tel.* 4433
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Realsound Limited, 156 Bradshawgate, Bolton, BL2 1BA. *Tel.* 26639
Record Centre Limited, 128 Poulton Road, Fleetwood, Lancs. *Tel.* 4286
Record Centre Limited, 18 Breck Road, Poulton-Le-Fylde, Lancs. *Tel.* 6163
Record Corner Limited, 108 High Street, Ashford, Kent. *Tel.* 20636
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Rediffusion Limited, 2/3 Broad Plain, Bristol, Gloucs. *Tel.* 23332
Rediffusion Limited, 11 Pitville Street, Cheltenham, Gloucs. *Tel.* 39229
Red Radio Shop Limited, 31 Crowtree Road, Sunderland, Wearside. *Tel.* 72087
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Rhythm Agencies Limited, 30 Station Road, Redhill, Surrey. *Tel.* 63286
Richlow Electronics Limited, 20 Roundhill Road, Broad Park, Torquay. *Tel.* 65028
W. Robb & Son Limited, Fore Street, Hexham, Northumberland. *Tel.* 2151
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Sands Hunter Limited, 37 Bedford Street, Strand, London, WC2. *Tel.* 836 8858
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Seen & Heard Hi-Fi Limited, 12 Fitzalan Road, Roffey, Nr. Horsham, Sussex. *Tel.* 4764
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Southport Hi-Fi Centre Limited, 11 The Cloisters, Formby, Lancs.
Southport Hi-Fi Centre Limited, 51/53 Ormskirk Road, Wigan, Lancs.
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Surrey Sound Equipment Limited, Royal Oak Centre, Purley, CR2 2BG. *Tel.* 668 4800
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Suttons Limited, Hardye Arcade, Dorchester, Dorset. *Tel.* 3544
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Turner Electrical Limited, 47 King Street, Bridlington, East Yorks. *Tel.* 4775
TV & Audio Centre Limited, 9 Queensmead, Farnborough, Hants. *Tel.* 47095
TV & Audio Centre Limited, 28 Alexandra Road, Farnborough, Hants. *Tel.* 49101

TV & Hi-Fi Centre Limited, 35 Castle Street, Cirencester, Gloucs. *Tel.* 4756

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University Audio Limited, 1/2 Peas Hill, Cambridge. *Tel.* 54237
Unique Radio Limited, 772 High Road, Goodmayes, Essex. *Tel.* 590 8277
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Upton Electronics Limited, Churchill Court, Bolton Street, Brixham, Devon. *Tel.* 51893

Valley Electronics Limited, 133 King Street, Kilmarnock, Ayrshire. *Tel.* 28480
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Vickers Hi-Fi Limited, 18 Market Street, Scarborough, Yorks. *Tel.* 67081
Victor Morris Limited, 340 Argyle Street, Glasgow C2. *Tel.* 221 8958
Victor Wright Limited, 116 The Rock, Bury, Lancs. *Tel.* 061 764 2931

M. R. Walker & Son Limited, 26 Chapel Ash, Wolverhampton. *Tel.* 0902 26581
Walton Audio Limited, 27 High Street, Walton, Surrey. Tel. 43278
Wanstall Hi-Fi Limited, 25 The Parade, Barbican, Plymouth. *Tel.* 20750
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J. G. Windows Limited, 1/7 Central Arcade, Newcastle Upon Tyne, NE1 5BP. *Tel.* 21356
Wireless Supplies Unlimited, 264 Old Christchurch Road, Bournemouth, Dorset. *Tel.* 24567
Witney Audio Limited, 29 Corn Street, Witney, Oxon. *Tel.* 2414
Woodley Hi-Fi Limited, 65 Wokingham Road, Reading, Berks. *Tel.* 666372
Woods & Porter Limited, 23 West Hill, Dartford, Kent. *Tel.* 20002
L. Wright Limited, 101 Mary Street, Scunthorpe, South Humberside. *Tel.* 67738

Yeovil Audio Limited, 8 Wyndham Street, Yeovil, Somerset. *Tel.* 25430
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10½" DP	4200'	£12.27

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5" TP	1800'	£3.24
5¼" SP	900'	£2.28
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5¼" DP	1800'	£3.24
5¼" TP	2400'	£4.08
7" SP	1200'	£2.99
7" LP	1800'	£3.24
7" DP	2400'	£4.08
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MEMOREX

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45 min	£1.27
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C90	£1.05
C120	£1.40

BASF CrO2

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SCOTCH Dynarange

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SCOTCH CrO2

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C90	£0.76
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Cassette Head cleaner £0.75

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B&K 4409 Automatic Control
B&K 2426 AC Auto range voltmeter
Hewlett-Packard 3310B Function Generator
Hewlett-Packard 3575A Gain/phase Meter
Hewlett-Packard 182C Oscilloscope
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Telequipment DM64 Storage Oscilloscope
Sound Technology 1400A Low Distortion Oscillator
Sound Technology 1700A Distortion Meter
Woelke ME102B Wow and Flutter Meter
Revox A700 Tape Recorder
A301 Dolby Noise Reduction System
Amcron IC150 Pre-amplifier
Spendor BC1 and BC3 Loudspeakers
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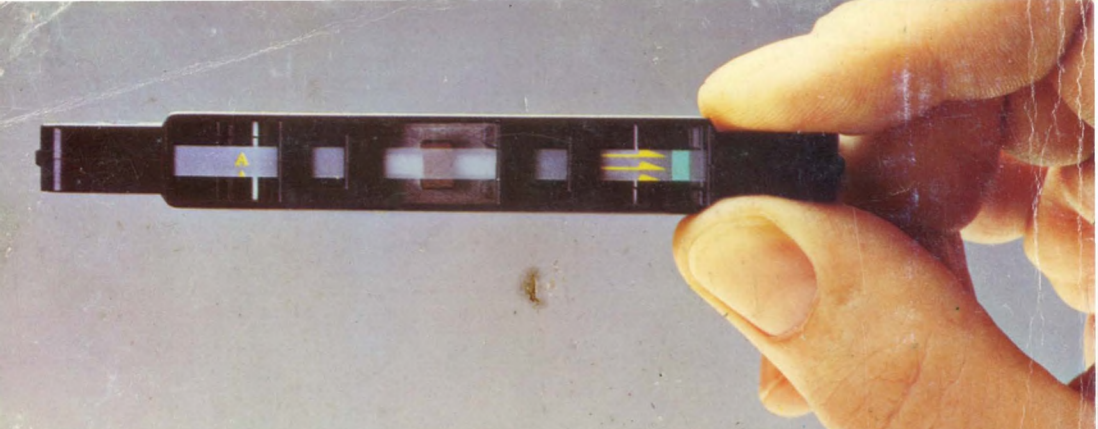


OUR FIRST 5 SECONDS WILL TRANSFORM YOUR NEXT 45 MINUTES.

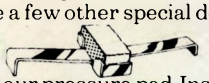
Maxell Ultra Dynamic tape is the most remarkable thing ever to happen to your cassette deck. Not only does it sound better than any other tape, but it actually improves the performance of your tape deck.

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

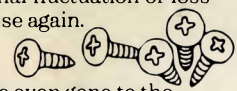
And because it's non-abrasive, it keeps your tape heads perfectly clean without wearing them down.

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

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



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



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

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

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

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

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Before it plays, it cleans.

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