October 1973 25p

studio sound

AND BROADCAST ENGINEERING

INDUSTRIAL TAPE RECORDERS

Concept of No Compromise

Music recording consoles designed and built to satisfy the creative needs of engineers, producers and artistes.

The practical systems engineering and DC logic control – established by our special understanding of studio operations – results in consoles setting new high standards of flexibility and performance, leaving you no alternative choice.

Consoles with stereophonic or quadrophonic formats by cadac.

Console designed and built for Scorpio Sound London.

cadac

Manufacturers of audio control equipment for the sound recording industry.

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studio sound
AND BROADCAST ENGINEERING

EDITOR DAVID KIRK
ASSISTANT EDITOR JOHN DWYER
ADVERTISEMENT MANAGER RICHARD WESTBROOK
AMERICAN REPRESENTATIVE STEPHEN H. LAMPEN

THE LINK HOUSE GROUP

Editorial and Advertising Offices: LINK HOUSE, DINGWALL AVENUE, CROYDON CR9 2TA. Telephone: 01-686 2599

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CONTENTS

FEATURES

COLUMNS

REVIEWS

CORRESPONDENCE AND ARTICLES

All STUDIO SOUND *correspondence should be sent to the address printed on this page. Technical queries should be concise and must include a stamped addressed envelope. Matters relating to more than one department should occupy separate sheets of paper or delay will occur in replying.*

Articles or suggestions for features on all aspects of communications and musical engineering will be received sympathetically. Manuscripts should be typed or clearly handwritten and submitted with rough drawings when appropriate. We are happy to advise potential authors on matters of style.

BINDERS

Loose-leaf binders for annual volumes of STUDIO SOUND *are available from Modern Bookbinders, Chadwick Street, Blackburn, Lancashire. Please quote the volume number or date when ordering.*

OCTOBER 1973 VOLUME 15 NUMBER 10

BUGS AND BUGGERY have been afforded more than their fair share of newspaper area since the Watergate hearings first touched that noxious subject. Telephone tapping, hidden microphones, audio faking and a host of other uglies were suddenly seen to be as widespread in some 'democracies' as they are in overt dictatorships; they have even been found in dear old Croydon.

A veritable industry has grown in recent years to meet an apparently increasing market for political and industrial espionage equipment. This has reached the point where there must now be scope for a trade paper written for, by and about buggers. For our part, we prefer to sweep both the theory and practice of this form of communication beneath the carpet where bugs of all kinds belong. Unhappy thought, though, that one can no longer hold a serious telephone conversation—least of all with anyone involved in the bug industry—without assuming that the recipient is recording the call.

The increasing application of bugs is one of the few unhealthy offspring of microelectronics. Low-price microelectronic calculators have already eliminated the tedium of repetitive arithmetic and, in the audio field, inexpensive Dolby micro-circuits may eventually reduce noise problems over a much wider commercial scale than has so far been achieved. R. M. Youngson's Chromatic Intervals from a Single Frequency' (page 42) and the GIM news item (33) both suggest that, at long last, the cost of electronic musical instruments can now be expected to fall dramatically. Once microcircuit technology is applied to voltage controlled and digital synthesisers, electronic music will undoubtedly develop into a highly popular art form. The facilities presently available to the largest music studios will come within financial reach of composers previously restricted to acoustic instruments, while the wealthier studios will be able to afford systems going far beyond the lightly disguised squarewaves currently achieved.

SUBSCRIPTIONS

STUDIO SOUND, *published monthly, enables engineers and studio management to keep abreast of new technical and commercial developments in electronic communication. The journal is available without charge to all persons actively engaged in the sound recording, broadcasting and cinematographic industries. It is also circulated by paid subscription to manufacturing companies and individuals interested in these industries. Annual subscription rates are £3 (UK) or £3.30 overseas.*

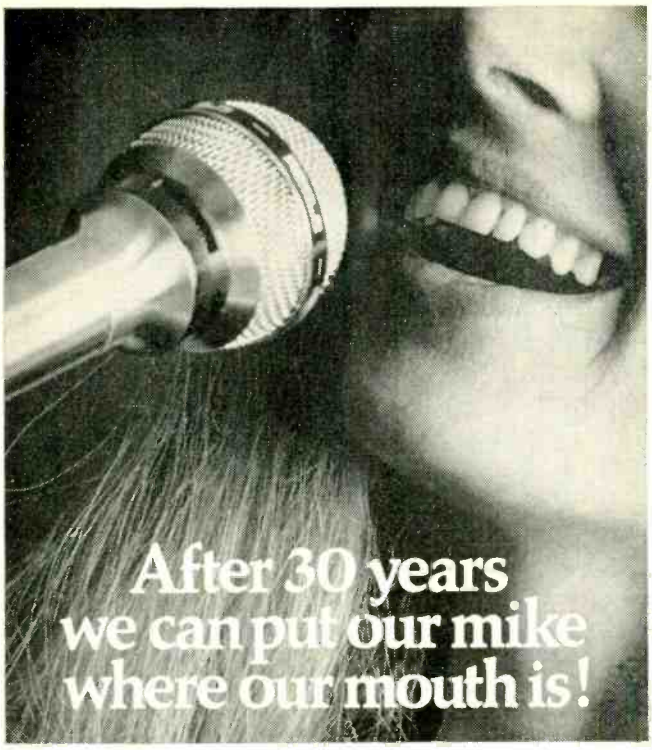
STUDIO SOUND *is published on the 14th of the preceding month unless that date falls on a Sunday, when it appears on the Saturday.*

COVER PICTURE

Kodalith based on the Leevers-Rich E200 master tape recorder, from a photograph by Roger Phillips.

ABC
MEMBER OF THE AUDIT BUREAU OF CIRCULATIONS

Total average net circulation of 7,374 per issue during 1972.



For just over 30 years now RESLO have been making microphones of all shapes and sizes.

We believe that entitles us to a little trumpet-blowing about the quality and performance you can expect from microphones backed by that sort of experience.

There are some eleven different types of basic wired microphones covering a whole range of applications.

In addition RESLO make three superb radio microphones designed to add an extra dimension to your act by enabling movement free of trailing leads.

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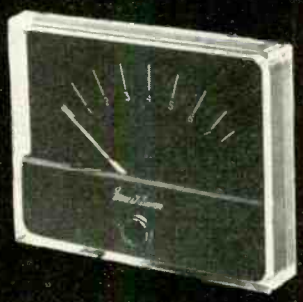
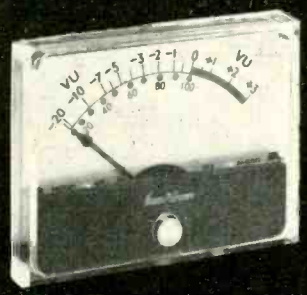


AND **VU METERS**
TO THE BELL SPECIFICATION



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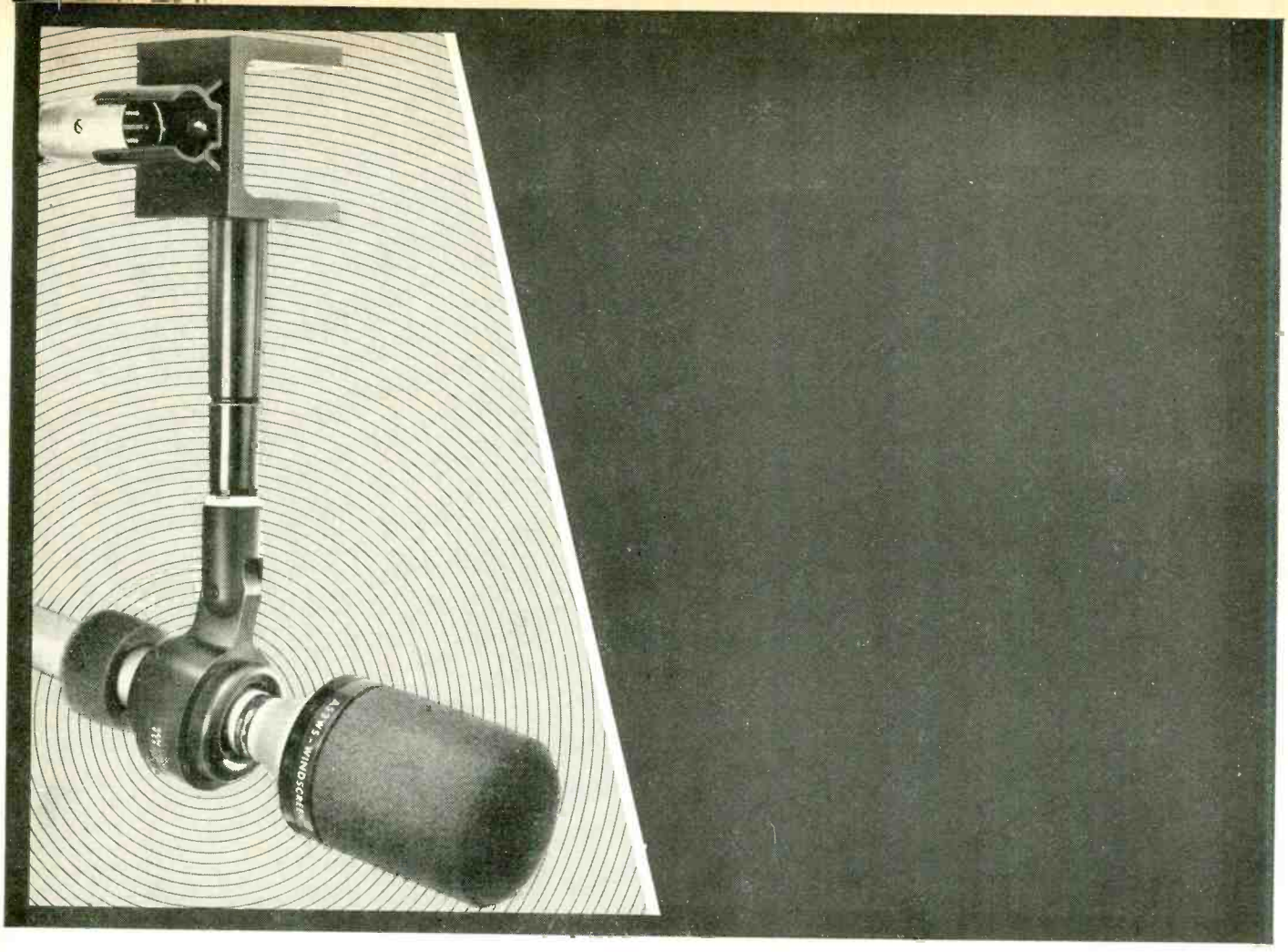


The ubiquitous SM53.

The *Shure SM53* professional unidirectional microphone is seen with increasing frequency in the best of company because it affords eight distinct performance advantages: (1) a wider front working angle with uniform tonal quality; (2) effective noise rejection through a true cardioid pickup characteristic; (3) a built-in shock mount for effective mechanical noise isolation; (4) extraordinary ruggedness for performance consistency after severe shocks; (5) a superior hum rejection system; (6) an integral breath "pop" filter; (7) a minimized proximity effect for constant tonal quality; and (8) full field serviceability. Interested?

Shure Electronics Limited
Eccleston Road, Maidstone ME15 6AU

SHURE

If there was one all-purpose microphone that was perfect for everything, Gulton would sell it. But there isn't.

Gulton's wide range of experience with all aspects of professional recording and broadcasting is reflected in an equally wide range of Electro-Voice microphones. The range - divided into three broad categories - includes a specially designed microphone for every professional requirement.

Model 635A

OMNI DIRECTIONAL SERIES

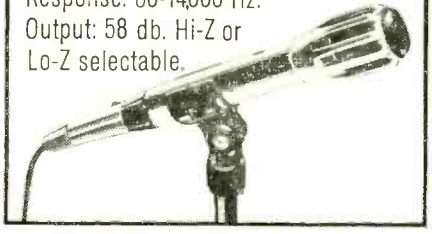
A really rugged microphone with a steel case. For extra-close work where feedback is no problem. An omni-directional mike gives minimum pick-up of breath noise at lowest cost. The Model 635A typifies the microphones in this section. Professional quality, hand-held or stand use...for film, recording, broadcasting and public address. Fitted with Switch-craft broadcast type connector.

Response 80-13,000 Hz
Impedance Low (250 ohms)
Output -55 db

Model 670

SINGLE-D CARDIOD DYNAMIC SERIES

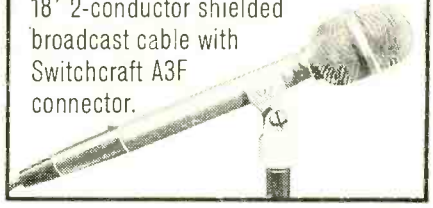
This series rejects unwanted sounds, thus helping to control feedback - and gives an increase in bass response for extra close work. The Model 670 is lightweight but rugged, and gives an extremely smooth and flat response. Built-in professional type Switchcraft A3M connector. With on/off switch. User replaceable head.
Response: 60-14,000 Hz.
Output: 58 db. Hi-Z or Lo-Z selectable.



Model RE16

VARIABLE-D CARDIOD DYNAMIC SERIES

This series gives top quality reproduction no matter how close you move to the microphone - and unprecedented control of feedback and unwanted sound. This Model RE 16 is an expensive instrument that's designed for people who require the very best in microphone performance.
Response: 80-15,000 Hz.
Impedance: Lo-Z. Output: -56 db.
18' 2-conductor shielded broadcast cable with Switchcraft A3F connector.



For full details on the Electro-Voice range and your free copy of 'The Microphone Primer' get in touch with Bruce Buck at Gulton.

Electro-Voice®
DIVISION OF
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The Hyde, Brighton BN2 4JU
Telephone: 0273 66271 Telex: 87172

Now a very sophisticated Hi-Fi stereo tape recording deck and pre-amp unit from Philips.

3 heads. 3 DC motors. Tip-touch Solenoid operation. Remote controllable. Every facility.

This is the N4510 – the tape deck from the Philips range of advanced Hi-Fi stereo tape recorders.

It easily surpasses the DIN Hi-Fi standard, and in every detail of styling and construction will satisfy the most critical user. It is ruggedly built, gives you every facility and precision control of sound, and is of such sophist cated design that operation is simple. Here are the most important features:

4 tracks. 3 speeds – $7\frac{1}{2}$, $3\frac{3}{4}$, $1\frac{7}{8}$ ips.

Suitable for stereo and mono recording and playback, multiplay, echo during recording, A–B monitoring.

Three motors – two DC motors for reel drive, one DC capstan motor electronically governed to keep tape speed constant.

Tape tension comparators for constant winding torque.

Three magnetic heads – one each for recording, playback and erase.

Detachable lower head cover for easy editing and cleaning.

For control of transport functions and recording mode, illuminated tip-touch controls are linked to solenoids – giving easier, quieter and more reliable operation.

Remote control unit (extra) with same tip-touch buttons as recorder.

Sliding switches for function selection–selected function illuminated.

Precise sliding faders for two microphones and another signal source.

Separate volume control for each headphone channel.

Recording stand-by (level adjustable with tape stationary).

Two illuminated calibrated VU type meters for recording/playback.

4-digit counter, zero reset, and on/off Autostop to halt tape at pre-determined position.

Reels lockable by means of metal hub locks.

Sockets for headphones and microphones easily accessible at front, concealed under sliding lid.

Removable transparent lid.

Frequency response:

40–20,000 Hz at $7\frac{1}{2}$ ips
40–15,000 Hz at $3\frac{3}{4}$ ips
60– 8,000 Hz at $1\frac{7}{8}$ ips
} DIN 45 500

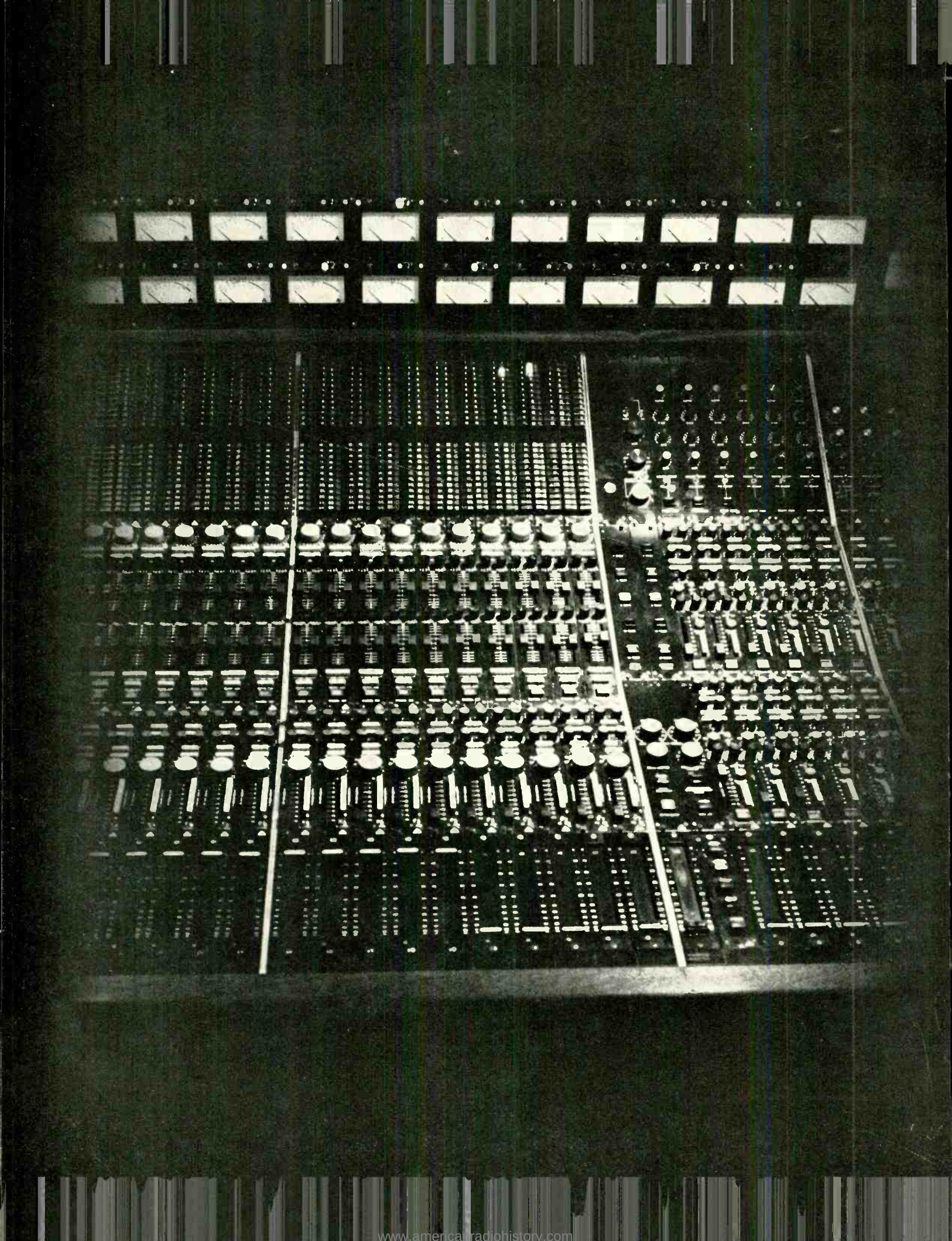
Wow and Flutter less than 0·15% at $7\frac{1}{2}$ ips.

See your Philips dealer for a demonstration. And for a free book on all Philips Hi-Fi stereo tape recorders, write to Philips Electrical Limited, Dept SP, Century House, Shaftesbury Avenue, London WC2H 8AS.

PHILIPS

Simply years ahead.

PHILIPS



In the wrong hands it's wasted.

This is the Triad 'A' Series.

A supremely sophisticated, all capable sound mixing console.

But, like any such equipment it must be handled by someone who knows what he's about.

An artist.

Someone with that almost indefinable something that sorts the men from the boys in sound engineering.

People will say we're cutting down our market saying things like this.

We think not.

Because if you are one of the best you deserve one of the best.

And this precisely is what we have to offer.

More than most guys can handle.

Trident Audio Developments Limited, 4-10 North Road, London N7 9HG. Telephone: 01-609 0087. Telex: 27782.

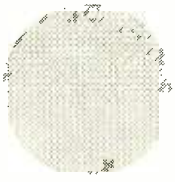
Take a QUAD 50E Amplifier (a good start for any installation)

plug it into your monitor system and it bridges 600Ω lines to drive your speakers.
Take that same amplifier and, without changing it in any way, plug it into another installation to deliver 50 watts into 100 volt line * from a 0.5 volt unbalanced source. This versatility and its attendant easing of stocking and maintenance problems is one reason why large organisations use the Quad 50E.

**or indeed any other impedance from 5 to 250 ohms.*

Other advantages appropriate to users of all sizes include:

Excellent power and frequency response (—1dB).
Low distortion (0.1% at 1kHz at all power levels).
Low background (better than 83 dB referred to full output).
Pre-set level control adjustable from front panel.
Unconditionally stable with any load.
Proof against misuse including open or short circuited output.
Small size ($4\frac{3}{4}$" x $6\frac{1}{4}$" x $12\frac{3}{4}$")— (120 mm x 159 mm x 324 mm).



QUAD

for the closest approach to the original sound

Send for details to Dept. SS2., ACOUSTICAL MANUFACTURING CO. LTD., Huntingdon, Hunts. Tel: **52561**

N2510 Hi-Fi cassette stereo recording deck.

Chromium dioxide Hi-Fi Compact Cassette.

The new Philips Hi-Fi cassette stereo sound. We challenge you to tell it from reel-to-reel.

This new Philips Hi-Fi cassette stereo recording deck gives you true pitch, wide frequency range, stable tape travel.

And especially a high signal-to-noise ratio – the reproduction you associate with good *reel-to-reel* recorders.

Not surprising, since this new deck conforms to the same DIN Hi-Fi Standard when used with CrO_2 cassettes.

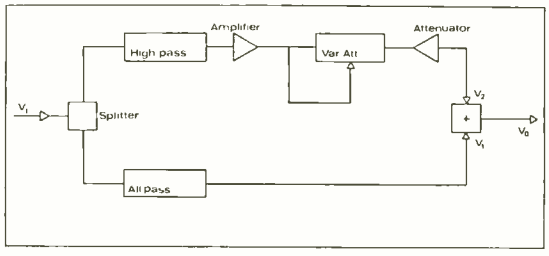
For fine speed stability, we've used a large flywheel and a servo system.

A tachogenerator on the motor shaft senses the slightest variation from a reference signal and promptly corrects the motor speed.

And friction can't affect winding torque, as the drive depends on hysteresis effects produced by a rotating magnet on the take-up spindle.

The deck takes either chromium dioxide or ferrous oxide Compact Cassettes, adapting itself automatically to the correct equalisation.

A Philips Dynamic Noise Limiter with defeat switch is built-in.



DNL suppresses only high-frequency components of low amplitude – tape hiss.

Active only during silent or quiet passages and when it is not detrimental to the music, DNL increases the subjective signal-to-noise ratio, suppressing hiss.

Besides autostop at end of tape, there's a zero-stop pushbutton linked to the tapecounter.

This halts the tape when moving through zero from either direction, automatically releasing the pinch roller and pushbuttons.

The hard, highly polished magnetic heads give low clogging, small losses and a better signal-to-noise ratio.

Gap widths are set accurately to 1·7 microns to ensure ample bandwidth.

And the double-gap erase head is extremely effective on the deeply magnetised CrO_2 tape.

Separate preamplifiers for the microphone, radio and phono inputs mean the best design can be used for each.

There's no 'doubling-up' with the head preamplifiers, which each have a signal-to-noise ratio of 60 dB when equalised for CrO_2 tape.

This music input has 19kHz and 38kHz active filters to eliminate stereo pilot tone interference, and ferrite beads in all input leads minimise h.f. radiation interference.

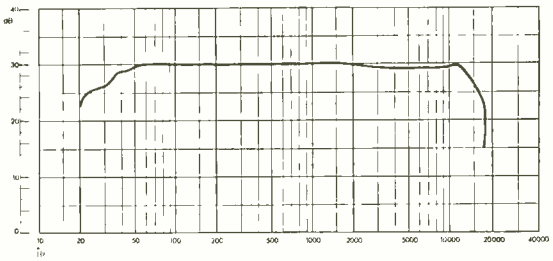
Low-noise silicon transistors are used throughout (almost 100 of them).

Three sliding faders let you mix two microphone inputs with a separate stereo source. And a low-level output enables the sum signal from all inputs to be monitored through loudspeakers (via amplifier).

The N2510 is a no-compromise design and you must be expecting it to cost the earth. Yet the suggested selling price of £125* is far lower than that of many lesser cassette decks.

Technical Data

Frequency response (CrO_2 tape)
25–14,000 Hz (DIN45 500).
Signal-to-noise ratio >48dB (DIN45 500).
Wow and Flutter <0·2% (DIN45 500).



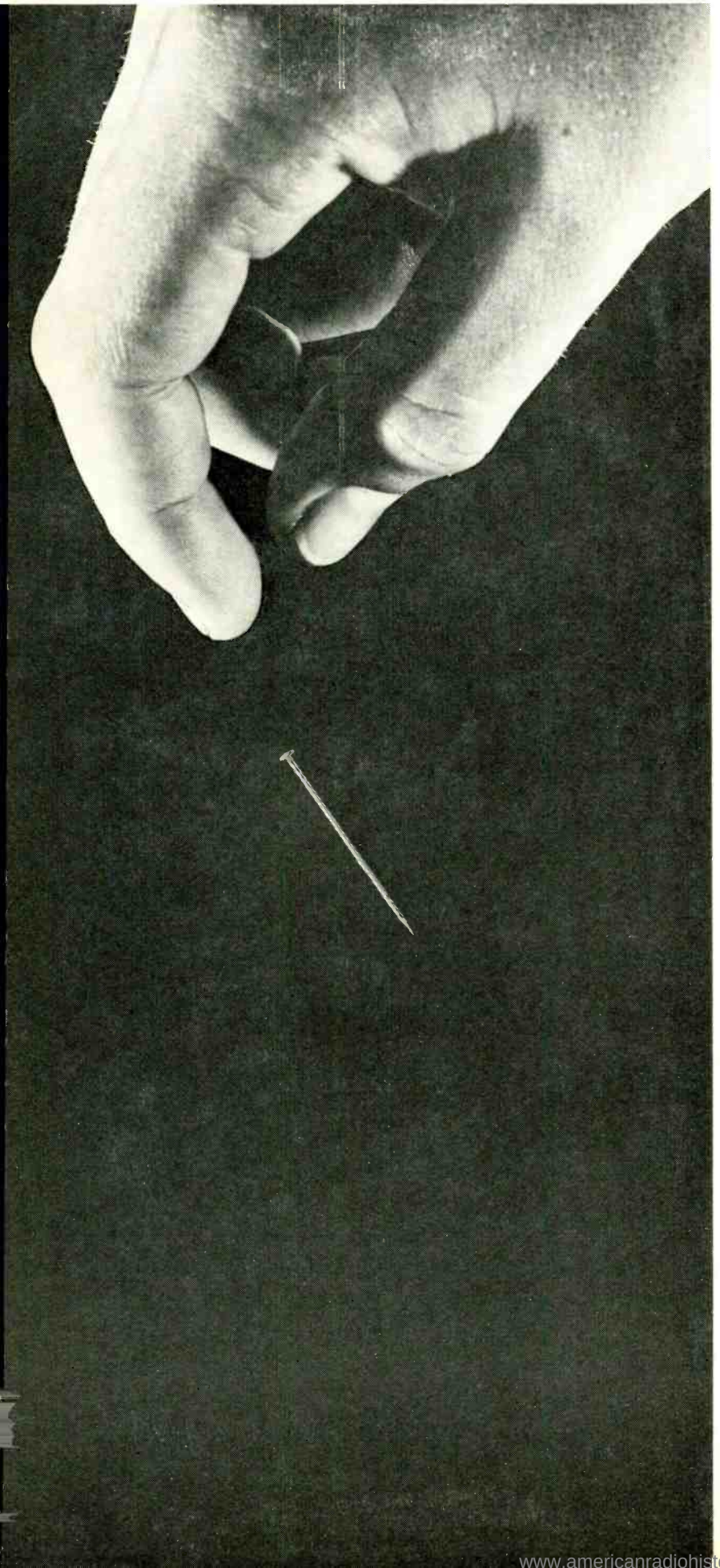
Typical 'flat response' frequency curve of Philips N2510.

PHILIPS

Simply years ahead.

*Price subject to change without prior notice.

The dropped pin meets its match.



If someone dropped a pin, a nail or a brick outside a studio insulated with rock wool – inside you wouldn't hear a thing. Just silence. Total silence.

Because rock wool insulates against all unwanted internal and external noise. It's the closest you can possibly get to perfect acoustic correction.

And the reason? Rock wool itself. A combination of rock fibre and air that produces the exceptionally fine acoustic products that form the Rockwool range.

Slabs and rolls you can use to 'float' a false floor above the foundation, line walls for additional insulation, and provide the basic treatment for the ceiling. *Wall panels* too. *Ceiling panels. Tile slabs. Absorber pads.* All from Rockwool. The Sound Proofer.

If you would like to know more about the application of our products, write or phone Dept. SS2. Rockwool Company (UK) Ltd, Arcade Chambers, Eltham High Street, London SE9 1BG Tel: 01-850 7761

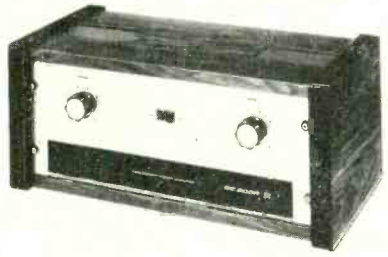
Rockwool the sound proofer.

Rockwool Company (UK) Limited.

amcron AMPLIFIERS

D.60 the 100 watt amplifier

Two channel extra-compact power amp. In stereo—40 watts per channel at clip point into 8 ohms; 62 into 4 ohms; in mono, 100 watts into 8 ohms. At 30 watts per channel into 8 ohms power response is ±1 dB from 5 to 30,000 Hz, THD is below 0.05% and hum and noise 106 dB below. Built-in protection against mis-use. Input sensitivity 0.75V into 25 K ohms. Size 17in x 8¾in x 1¾in high.



DC.300A the 1,000 watt amplifier

Power at clip point (per channel) 200 watts into 8 ohms: 350 watts into 4 ohms: 500 watts into 2.5 ohms. Used mono—greater than 650 watts into 8 or 4 ohms. This new unit will operate into loads as low as 1 ohm and no longer requires protection fuses as did its predecessor the DC 300. Power response ±1 dB from zero to 20,000 Hz at 150 watts per channel into 8 ohms. Total harmonic distortion 0.02% at 300 watts per channel into 4 ohms. Hum and noise below 110 dB at 150 watts per channel into 8 ohms. IM distortion 0.05% from 0.01 watt to 150 watts per channel into 8 ohms. Input sensitivity 1.75V for 150 watts out per channel into 8 ohms. Size, with front panel, 19in x 7in x 9¾in (suitable for standard rack mounting).

Amcron amplifiers carry a three years' warranty on materials and labour. Full descriptive leaflets gladly sent on application.

MACINNES LABORATORIES LTD.

MACINNES HOUSE
Carlton Park Industrial Estate, Saxmundham
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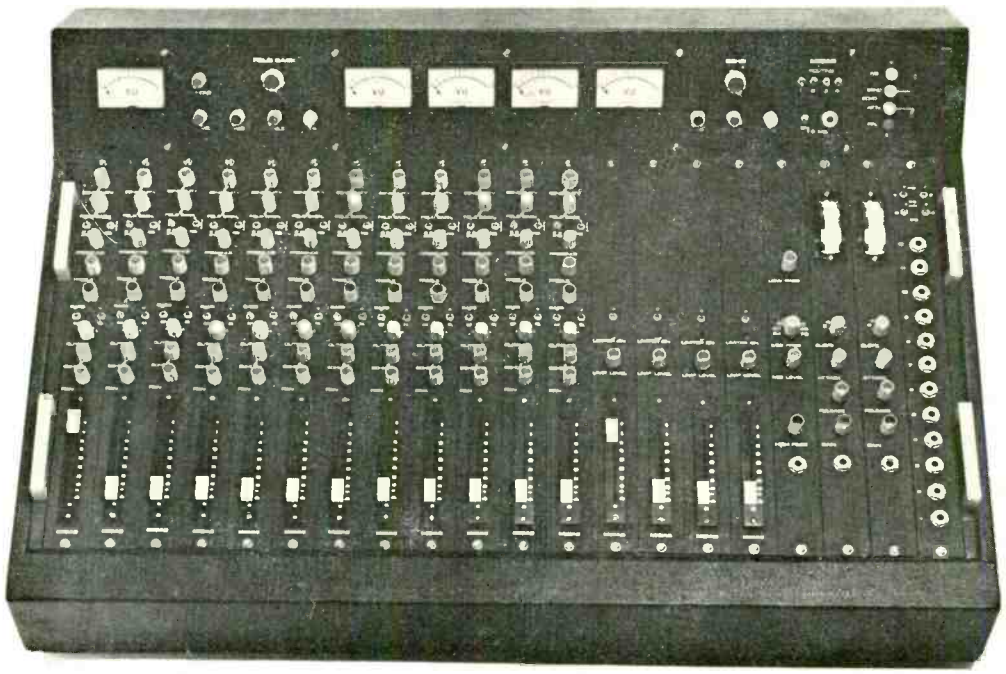
midas modular mixer system



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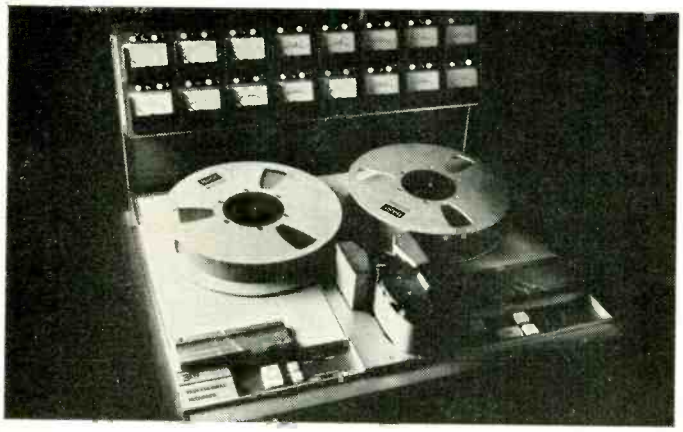
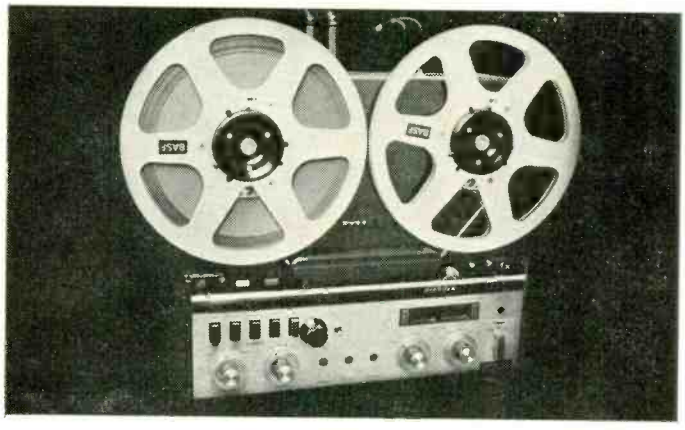
They're not much use without us.





There's nothing quite so frustrating in this world as a tape recorder without tape.

So BASF make a tape for every tape recorder manufactured anywhere in the world.

Everything from $\frac{1}{8}$" LH cassettes right through to 2" tapes for all major studios. More than 128 different types in all.

Which is not really surprising when you think that BASF were the first company in the world to make tape.

So if you've got a tape problem — we've got a tape answer — call us and see for yourself.

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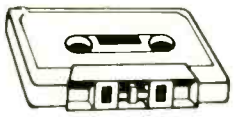
HEAD CLEANERS 30p; C120 58p, 10 for £5.50; EMPTY PLASTIC CASES 10p. P/P 20p



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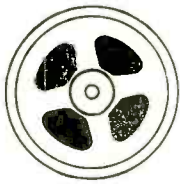
RECORDING TAPES



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Why not try one and cut your recording costs?

	Standard Play		Long Play		Double Play	
5″	600′	35p	900′	42p	1200′	60p
5¾	900′	40p	1200′	55p	1800′	80p
7″	1200′	48p	1800′	70p	1200′	98p

EMPTY SPOOLS 5″ 10p, 5¾″ 11p, 7″ 12p. P/P 20p

WALKERS (S) 16 Woodthorpe Road, Ashford, Mdx. 52136

High-speed Tape Copying Equipment

Reel to cassette

Reel to reel

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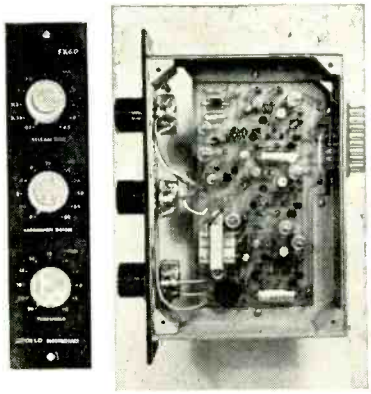
sole UK distributors of Infonics

APOLLO ELECTRONICS



PROGRAMME EXPANDER model EX60 plug-in unit

This plug-in unit that contains 14 silicon planar transistors and an equally reliable IC is capable of reducing electronic noise, tape hiss, hum, rumble, scratch, microphone feedback and crosstalk by as much as 60 dB.

Designed to operate at zero or +6dBm line level offers +19 dBm maximum input and output level, more than 90 dB S/N ratio, better than 0.5% output distortion, 10 K input and 50 ohms output impedance, 20 microseconds attack time, as well as a 0-60 dB expansion range control, 100 msec —4.5 sec release time control and zero to -22 dBm threshold level control, all three of them continuously adjustable.

96 MILL LANE, LONDON N.W.6

Telephone: 01-794 8326

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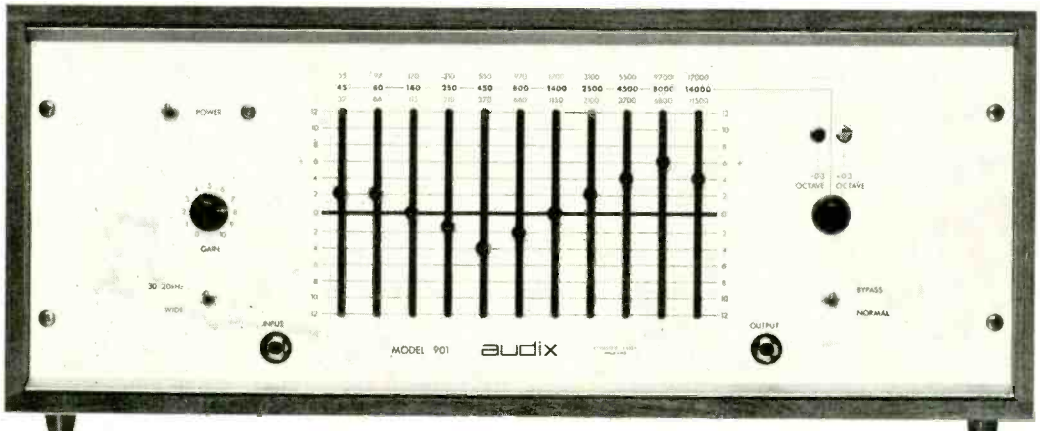

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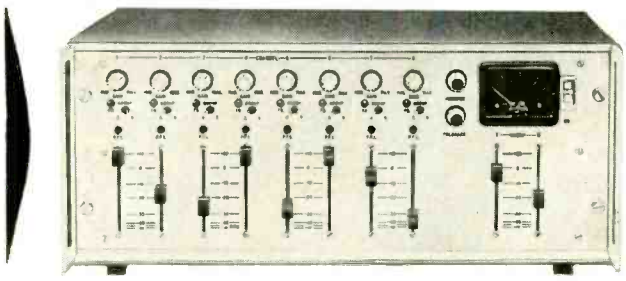

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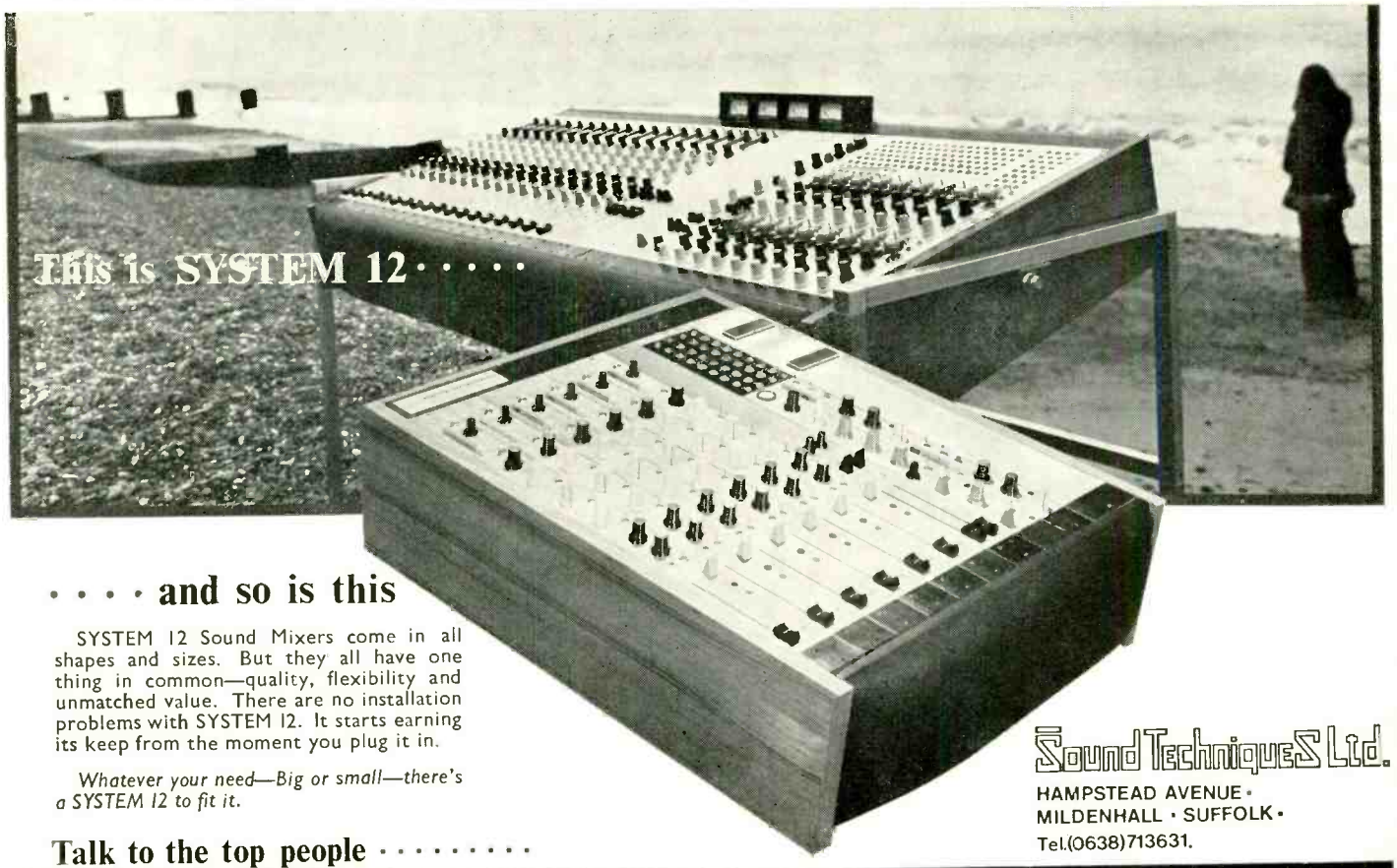

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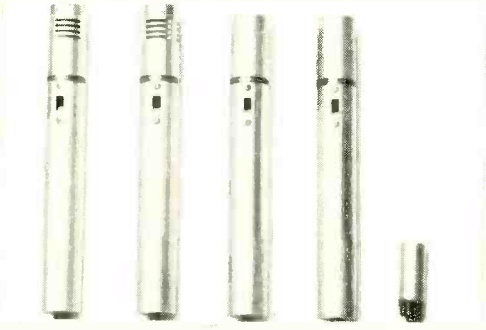

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Distributors of cartridges, styli, condenser microphones and headsets. Guaranteed 24 hour delivery.

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reading time: 60 minutes
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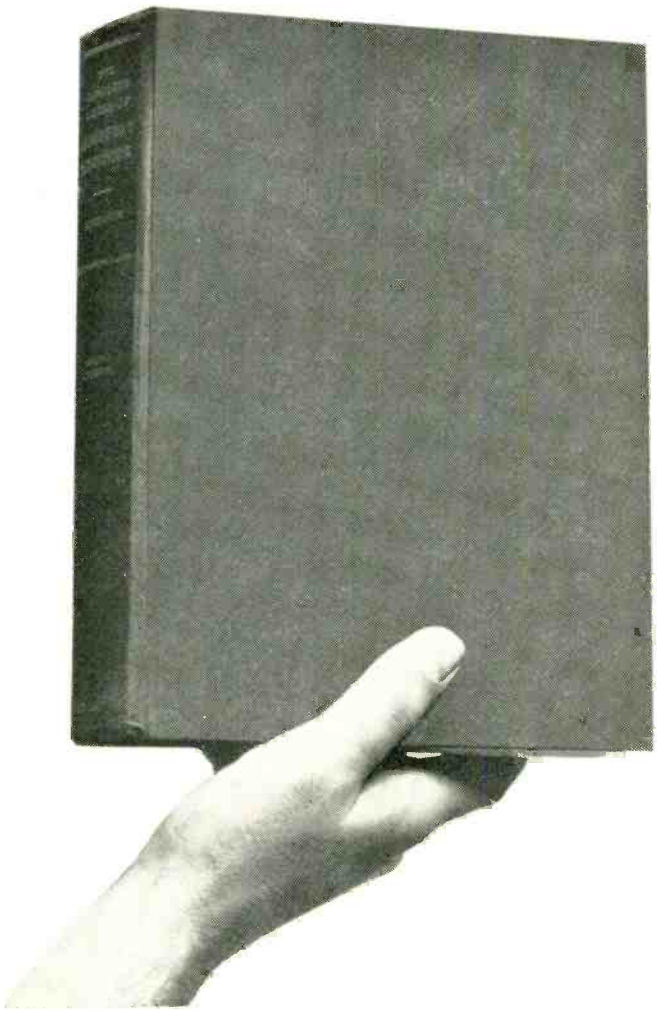

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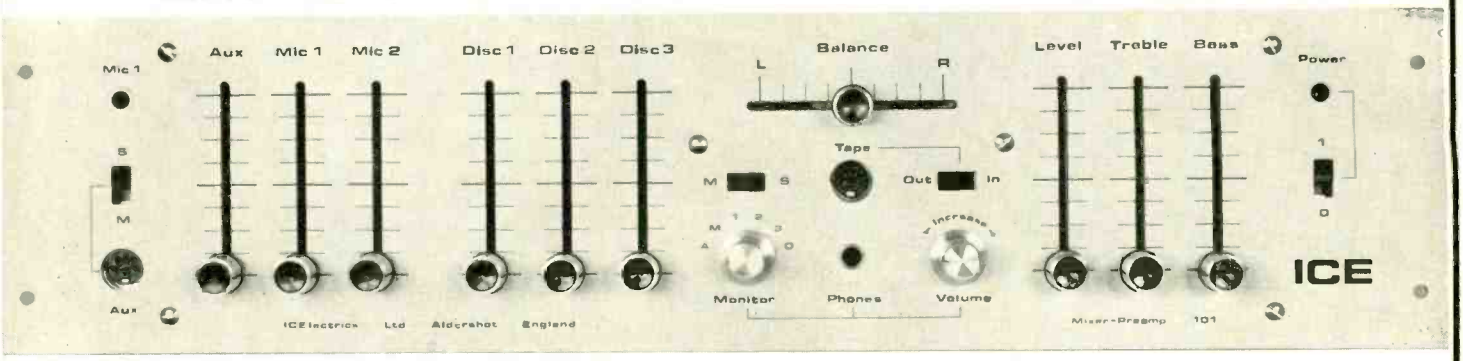

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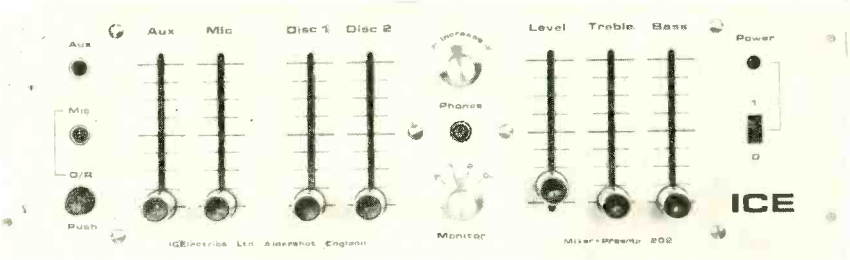

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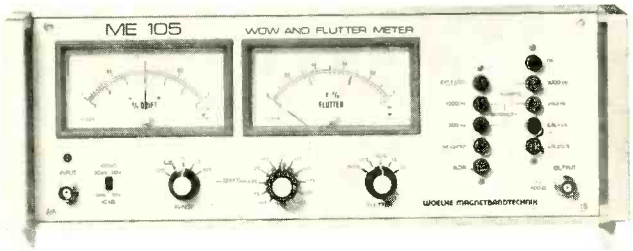

Illustrated is the ME 105, the very latest type of Wow and Flutter Meters manufactured by Woelke Magnetbandtechnik, Munich, Germany, and distributed exclusively by us in the U.K. Anyone concerned with the most accurate measurement of drift (down to plus/minus 0.1%) and wow and flutter (down to plus/minus 0.03%) will be interested in the ME 105. Fuller, final details on application.

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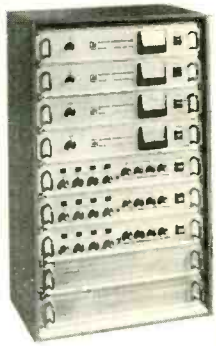

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Nippon Columbia develop pcm audio recorder

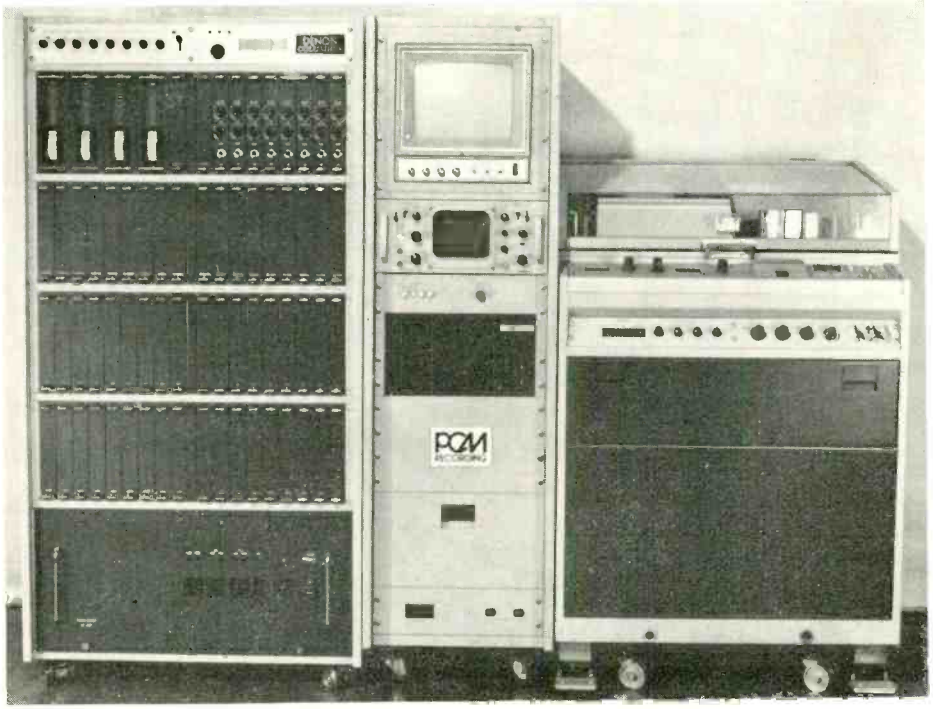
OF THE MANY techniques that may be applied to disc production—half-speed cutting, 'non-distortion' cutting, direct cutting, Dolby *A* noise reduction, metal master pressing, 45 rpm playback —there is one that is outstanding in the number of problems it removes. That is the use of pulse code modulation for studio master tape recordings. At one fell swoop, ghosting, duplication loss, wow and flutter, modulation distortion and crosstalk are reduced to insignificant proportions, at the same time having a flat frequency response of zero to 20 kHz, harmonic distortion of around 0.1 per cent and a dynamic range of greater than 75 dB. A pcm recorder newly developed by Nippon Columbia also features eight audio channels, a head in advance of the main head to permit variable-pitch disc recording, and half-speed operation.

Digital techniques are attractive because of their ability to overcome linearity problems in conventional tape recorders, to remove speed variations by synchronisation techniques, and because of their potential freedom from noise. The reasons for using pcm are thus a little different from those of the BBC in applying pcm to sound distribution systems but the principles are similar, with the difference in detail that a television-like signal is recorded on video tape. In the BBC links, audio signals are first sampled at a 32 kHz rate, and then amplitude quantised.

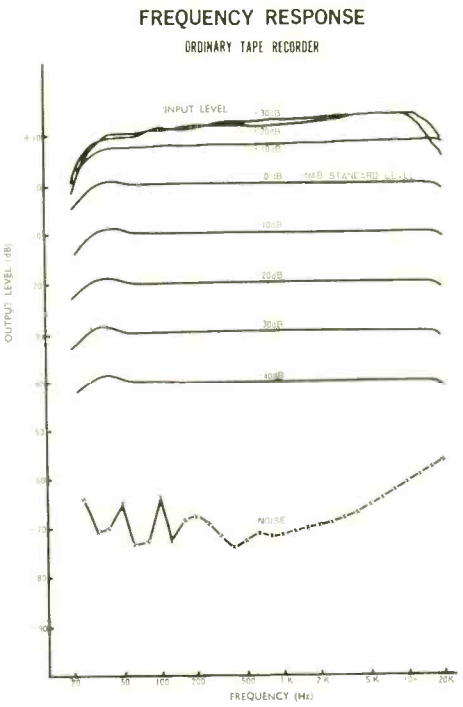
To achieve the noise immunity of pcm, each quanta is then coded in a 13 bit binary code. An additional bit is added for checking purposes and, when multiplied by 13 channels with 14 further bits added for switching and synchronising data, makes a total of 196 bits per sample; a rate of 32 kHz then gives a bandwidth of 6.336 Mb/s. To get this sort of information rate recorded requires a wideband recorder such as a vtr.

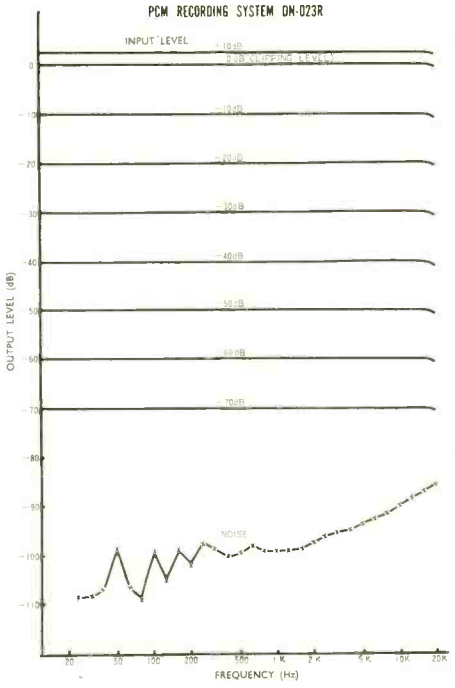
This is just what is done with the Nippon Columbia *DN0023R* recorder, developed in conjunction with NHK (the Japanese broadcasting organisation) research laboratories. Eight audio channels are sampled at 47.25 kHz (three times the horizontal sync signal of the video recorder), quantised and then converted to a 13-bit linear code (having the potential of 2^{13} levels of quantisation). Two check bits are added for error detection and phase shift detection and, when multiplied by eight, results in 120 bits per sample. Synchronising signals are carried on the front and back porches of the horizontal sync pulses.

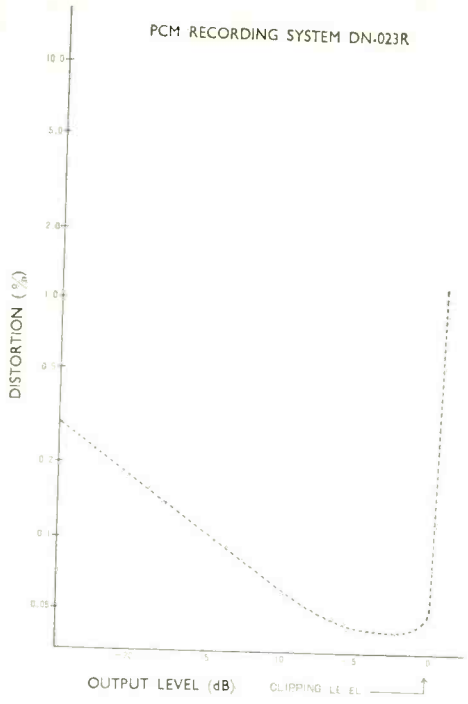
On playback the signals are routed into eight channels, error detected and checked for dropouts. If a sample is missing, the preceding and following signals are added and averaged. In the case of four-channel use, the input signals are duplicated and on playback the two samples of the same information are compared with each other and only the correct signal transmitted. The reproduced signals are converted to audio by a digital to analogue converter and then passed through a low-pass filter to remove the 47.25 kHz sampling frequency.



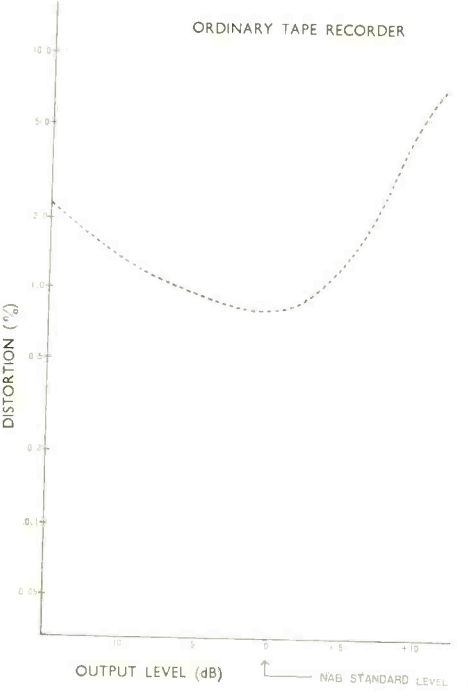
Comparative performance of analogue and digital magnetic recorders







DISTORTION CHARACTERISTICS (1 KHz)



Electronic music chips

THE FIRST two in a planned series of electronic music micro-circuits are now available from General Instrument Microelectronics, 57/61 Mortimer Street, London W1N 7TD. Conventional electronic organs have hitherto consisted of 12 separate basic frequency generators, each requiring occasional tuning. Circuit *AY-1-0212* eliminates all 12 and offers drift-free intervals from a quartz crystal locked master tone. Price is £5.35 (one off) or £4 (100 off). A complementary six-stage binary divider is also available as a means of producing lower octaves. Designated *AY-1-6721/6*, this costs £1.65 (one) or £1.10 (100+).

Agents: Semicomps Ltd, Wembley, Middlesex.

Assisted resonance at York University

THE FIRST commercial installation of an active assisted resonance system received its public inauguration recently at a concert in the Central Hall of York University. Devised by Mr Peter Parkin of the Building Research Station, the system employs microphones and loudspeakers located in the hall walls and ceiling. Sounds detected by the microphones are delayed and then reproduced into the auditorium. This has the effect of increasing the reverberation time of a hall which might otherwise seem unpleasantly dry. The original equipment developed by Mr Parkin is in regular use at the Festival Hall on London's South Bank. Marketing of the system is being handled by Acoustical Investigation & Research Ltd under licence from the National Research Development Corporation. Typical installations are expected to vary from £30,000 to £60,000 depending on hall size.

Manufacturers: AIRO Ltd, 26/28 Bedford Row, London WC1R 4HS.

Capital Radio appoint Head of Drama

THE APPOINTMENT of Mr Roger Snowdon as Head of Drama was announced in August by Capital Radio Ltd. Formerly a freelance producer, writer and actor, Mr Snowdon has hitherto worked mainly for BBC Radio and was involved in such programmes as *Morning Story*, *Book at Bedtime* and *Housewives' Choice*. His position with Capital was originally to be filled by Gabrielle Beaumont who was subsequently unable to take on the assignment. Capital Radio are due to commence 539m am broadcasting on October 16 at 05.00.

Internavex

THIS ANNUAL conference and exhibition has always been at two levels, programme production and technical, and this year the former was by far the most prominent. In current jargon, it was a mainly 'software' show, with comparatively few pieces of new equipment. Industrial, commercial and educational purchasers of equipment shown at previous Navex exhibitions had clearly been getting down to serious use of tape/slide, audio cassette, and television machinery in order to produce new material for teaching at all levels. Schools, colleges and universities were given space to demonstrate their teaching methods and Millfield school, for example, had a most comprehensive television system based on low cost 12.5 mm vtrs for both off-air recording and original programme making. The Scottish Film Council, The Welsh National Language Unit, Macmillan Publishers, Longmans and very many smaller organisations were using filmstrips, 8 mm loops and tape slide techniques for their programmes. Although film of one sort or another was clearly a very important medium, there seemed to be very little standardisation of formats. The Ontario Educational Communications Authority has the most impressive library of educa-

34 ▶

tional television programmes in the world, with 7,000 titles in stock and new programmes being produced at the rate of 1,000 per year. A Sony U-Matic NTSC standard cassette player and a sample few dozen recordings on free access allowed visitors to dip into their catalogue.

One of the few technical innovations was Hitachi's unheralded showing of a new video disc tv analyser. Up to 15 frames of CCIR monochrome television could be stored and replayed in the way commonly seen in broadcast 'action replay' of sports events.

RD Systems of Canada exhibited the Dan Gibson EPM parabolic microphone system which, using a transparent plastic dish of less than 1m diameter, did not seem to be very directional at medium and low frequencies though it did have a neat built-in agc amplifier and headphone monitor point which would make the device useful for conference recording.

The Teldec video disc was conspicuous by its absence and visitors who had hoped to see the new upgraded version with playing time increased to ten minutes were disappointed; although ready for press release, Teldec have chosen the Berlin Radio Fair for unveiling the new equipment which they hope to bring on to the market by early next year.

Marantz to market Dolby B tuner

AN FM RADIO tuner-amplifier equipped to receive Dolby B encoded broadcasts is to be marketed in Britain from November. Costing approximately £250 + VAT, the *4230* incorporates a phase-locked stereo decoder and a pseudo-quadraphonic bridging circuit.
Agents: Pyser-Britex (Swift) Ltd, Fircroft Way, Edenbridge, Kent.

Naim audio monitor for Capital Radio

NAIM AUDIO Ltd have received a substantial order from Capital Radio for their *NAM 802* loudspeaker. This incorporates a single channel version of their *NAP 160* power amplifier, both of which were introduced at this year's APRS Exhibition. The loudspeaker was specified for use in Capital Radio's studios and control rooms by their consultants, David Whittle Associates. KEF *LS 5/1AC* will be employed in the music production and quality monitoring areas where the required programme level is considered greater.

Cadac move

NEW ADDRESS for Cadac (London) Ltd. The company are now operating from Lea Industrial Estate, Batford, Harpenden, Hertfordshire. Telephone 05-827 64698.

Video distribution amplifier

A LOW COST video distribution amplifier has been announced by EIL. Available in five and ten output forms, it is designed to handle monochrome or colour signals for a variety of industrial and commercial cctv applications. The units are fully self-contained and respective prices are £38 and £58.
Manufacturers: Electrocraft Instruments Ltd, Liss Mill, Mill Road, Liss, Hampshire.

After repeatedly selling their demonstration mixers, Audio Applications have produced a BM104 they hope nobody will want to buy. Is this the only 2/4 desk in existence?

Variband equaliser

UP TO 15 dB boost or cut at any frequency in the audio spectrum may be obtained from the *Variband* equaliser now being produced by Multi-Track. Each unit comprises three sections which may be tuned to separate frequencies with slopes from 2 to 16 dB per octave. Typical applications include tuning to the pitch of cymbals, phasing and emphasising hidden instruments. Price is specified as under $350 per channel (£140 nominal).
Manufacturers: Multi-Track Audio Recording Systems, PO Box 3187, Hollywood, California 90028, USA.

Bias octet for Decca

EIGHT *BE1000* tape machines have been purchased from Bias Electronics by Decca Records. They are being used to re-equip the editing rooms at Decca's Broadhurst Gardens studios. Tony Steinman (Decca) and Tony Costello (Bias) are pictured during the installation of a *BE1000*.

Ferrograph 4a manual

AN OPERATOR'S manual for the Ferrograph *4a* is being sought by British Caledonian Airways for use in their Gatwick training school. Any reader able to assist is asked to contact E. R. Anderson, BCA, Flight Operations Training Centre, Beehive Building, Gatwick Airport, Horley, Surrey.

Lasers and light

A COURSE OF ten weekly tutorials at The City University will commence on Wednesday January 16, 18.30 to 20.00. Topics to be covered will include the theory of laser action, the design and construction of lasers, and laser applications in holographic storage and communications. The lectures will be supported by demonstrations and no prior knowledge will be assumed. Fee is £1.20.
Further data: Adult Education Courses, Room A343, The City University, St John Street, EC1V 4PB.

Polyaudio

'SOUND STUDIOS and Recording' and 'Broadcast Sound Reproduction' are the titles of two courses commencing on October 25 at the North London Polytechnic. The studio course is scheduled for Thursday afternoons, 14.30 to 16.30, ending with an examination in June 1974. Fee is £10.50. 'Broadcast Sound Reproduction' commences on the same date, 18.30 to 20.30, concluding on January 31. Fee is £6.50.
Further data: Department of Electronic and Communications Engineering, Polytechnic of North London, Holloway Road, N7 8DB.

Video conference

A CONFERENCE on Video and Data recording held at Birmingham University this July was organised by the IERE in association with the IEE, the IEEE, the RTS and SMPTE. It was their first conference on these topics since the International Conference on Magnetic Recording of July 1964 and looking through the proceedings of that meeting showed just how much that had been predicted there has since come to pass.

This year's conference was also truly international, with 13 of the 40 or so papers coming from abroad. The area covered was exceptionally wide and varied from the practical application of low cost vtr and broadcast video head maintenance, to magnetic bubble and holographic recording techniques, which could be equally relevant in another nine years time.

K. Sadashige of RCA started the conference with a survey of the refinements and techniques which his company are applying to their latest 50 mm quadraplex vtrs. There were no breakthroughs but the reductions in noise and moire patterning allowed the multigeneration copies resulting from editing to remain within broadcast tolerances. Also, the improvements in head and capstan servo systems now made reliable operation at half the linear tape speed possible.

The BBC, apart from being important customers for tape equipment, have always used their research and development capacity to improve on commercially manufactured products. In their first paper, S. M. Edwardson from Kingswood Warren showed that the timing accuracy from the best electronically corrected vtrs was satisfactory on colour monitors and on perfectly aligned domestic televisions but was insufficient for sets whose decoders were at the edge of the permitted tolerances. As a solution to this problem, Edwardson then described an extremely accurate digital corrector which could well replace the expensive analogue systems currently in use. A low level 5.5 MHz pilot signal was added to the record signal and used on playback to vary the length of a digital delay line. Final accuracy was an impressive ± 1 ns and the system could well find applications in helical scan recorders.

The second paper from the BBC, by Messrs Kershaw, Kitson and Taylor, covered Videotape Editing from operational requirements to the BBC's solutions of the many problems involved. The basic 'labelling' is done with the SMPTE proposed 80 bit address code applied to each television frame and recorded on the vtr cue track. This code gives programme time in hours, minutes and seconds, as well as a frame number and other information chosen by the user. The playback equipment is capable of reaching the code over a range of tape speeds which includes creeping and fast winding. Low cost helical vtrs for pre edit viewing, and synchronised audio recorders for sound editing, were also described.

In another paper by Frank Goldman, Christopher Laid and Roy Vitty from the BBC Television Centre, the work done to raise the standards of quadruplex video head assemblies from the major manufacturers was described. The need to maintain standards was made clear when the authors revealed that, of the 50 head assemblies returned to the manufacturers every month, 15 per cent are unused and 50 per cent are retired early for manufacturing faults. The remainder wear out in between 100 and 500 hours. At a cost of approximately £400 per service, the expense incurred in maintaining their standards is high. Each of the 45 quadruplex vtrs in use by the BBC is checked for head condition before each working day and members of the team have developed a test tape which uses saturated colour bars to give a quick off screen indication of head condition.

The interests of audio, video and other forms of data storage converge in the digital recording area and, although no manufacturer is likely to invest millions in developing a digital audio system, the spin-offs from efforts to digitise television recording and techniques to increase the storage density of other data recorders could well result in a sound recorder with zero wow and flutter, a 100 dB dynamic range and no modulation noise. The many papers on digital recording, while being of little short-term interest to STUDIO SOUND readers, certainly pointed the way to this.

Digital recording of television signals as they stand requires a binary rate of 10^8 bits/s, which is only marginally possible with the best present-day techniques. J. P. Chambers of the BBC Research Department described a practical version of their coarse/fine digital coding system (British Patent 1,298,015) which halves the digital information rate without degrading horizontal definition. Off-screen colour slides showed processed pictures which were indistinguishable from the original.

Probably the most impressive theoretical paper came from J. C. Mallinson of Ampex, and discussed the signal-to-noise and density limitations of magnetic recording. The paper was a model of clarity and apparent simplicity and showed that the particular nature of the recording medium was a more important limitation than the choice between gamma ferric oxide, cobalt or otherwise doped, and chromium dioxide. Taking examples from practical versions of audio, video and digital recorders, Mallinson claimed that these newer oxide formulations can do no more than reduce the 3 or 4 dB discrepancy which exists between theory and current practice. Mallinson's formulae were elegantly generalised to include both digital and analogue recording and showed that, in the analogue situation, the tape transfer function was linearised by only recording the signal on one-third of the available particles. The paper concluded that digital recording on particulate media was possible but no reductions in tape consumption were likely in the near future.

Rapid duplication of video tapes is of particular interest to the non-broadcast videotape industry and papers by Dr Smgaya of Mitsubishi and Dr J. Roos of Philips Eindhoven showed the state of the art. Both anhysteretic (field transfer) and thermal printing methods were discussed in great detail by Smgaya, who had clearly done extensive research and development. In a later private interview he disclosed details of a rapid printer which will copy a 30-minute 12.5 mm EIAJ/1 tape cartridge in two minutes 40s and should soon be commercially available. Philips have found that the temperature of 120°C necessary for thermal printing causes unacceptable shrinkage of the 17 μm tape used in their vcr so they have opted for the field transfer method but cool the tape to about –80°C to raise the coercivity of cobalt doped masters to the point where printing on to high coercivity slave tapes is possible.

Process Peripherals Ltd, Thatcham, Berkshire, discussed the problems of video recording on magnetic discs and described some interesting picture storage systems using analogue and digital techniques. Their products are welcome in an area which so far is only covered by very expensive broadcast equipment.

In one of the best-received lectures of the conference, Dr Evans of NPL described a low cost programmed videotape system for auto. mated medical history taking. The lecture interested this reporter because it used the Ikegami *TVR-321* 12.5 mm vtr reviewed in last month's STUDIO SOUND in exactly the way suggested there.

The conference proceedings have much useful information for the serious student of the subject and most of the 37 papers are sufficiently self-contained to be clear to those who did not attend.

Proceedings of the Conference on Video and Data Recording are published by the IERE and available from them at £8. IERE, 8/9 Bedford Square, London WC1B 3RG. **R.S.**

LETTERS

Microphone placement

Dear Sir, It is undoubtedly true that, as you remark in your preamble to Michael Thorne's article, few exponents of close microphone placement are prepared to commit themselves on the subject in print. How unfortunate, therefore, that your exponent should prove himself so unworthy of his task. To criticise the article in detail would take more space than you could allow me but I would like to make one or two general comments.

Firstly, controversy between the 'hoary categories of "close" and "traditional" ' is only possible when discussing music with which either technique will produce a recognisable result, ie. melody, harmonies, rhythm and reverberation in reasonable proportions. This music must necessarily be internally balanced, otherwise the traditional overall crossed pair will not work.

Close mic balance techniques in popular music and more recently in avant-garde (e.g. Stockhausen) began evolving when composers and arrangers started scoring, for reasons both artistic and financial, in such a way that the desired result could not be heard by the unaided ear in studio or concert hall; that is, they began to rely on 'artificial' means of achieving the results they required. With such a score, there can be no discussion as to the relative merits of a Blumlein technique or a close multimic pan-pot balance; the distant crossed pair is a non-starter as soon as a solo alto flute holds the tune backed by eight open brass, or an eight-two-and-two string section is required to sound like the RPO with a heavy rhythm backing.

Mr Thorne's introduction seems a most curious compound of occasional gleams of sanity (I like his phrase "'free air" sound' and heartily agree with his comments about coyness and secretive evasions) in a generally confusing fog of irrelevant nonsense (is 'a distorted correct view of the acceptable sound' the same as 'a distorted acceptable view of the correct sound'?).

The sections on specific instruments could be useful, if the style were not more suited to a popular Sunday newspaper than to a professional publication, but it soon becomes evident that Mr Thorne is often writing beyond the limits of his knowledge and experience (how on earth did that dreadful howler about a cor anglais being an 'angled horn' slip through?) and has little sympathy in many musicians and their instruments.

Articles about microphone technique are only useful if they either stick to general unchallengeable principles or offer specific detailed solutions to specific problems (with the inevitable one man's meat proviso). Mr Thorne does neither. He has obviously never (1) achieved a successful piano balance, (2) discovered where the sound comes out of a harp, (3) balanced vibes in a live group (the vibraphone presents a totally different separation problem to glock and xylo) (4) recorded a professional vocalist, (5) come to terms with string players (no wonder they are bad-tempered, they just heard a playback!), (6) found out how to record a flute. Oh, the list is almost endless. The article can only be a source of amusement and/or dismay to professional balance engineers worthy of the name and, worse, totally misleading to would-be initiates to the art, those very people whom Mr Thorne purports to aid.

Yours faithfully, J. L. Andrews, Operations Executive, EMI Broadcast Programmes Ltd, 135 Blyth Road, Hayes, Middlesex.

Michael Thorne comments:

The absence of any coherent or detailed argument makes Mr Andrews's letter difficult to answer. However, hopefully placing pomposity aside, I'll take each section in turn.

A dogmatic recording could be made in any adjustable situation, using any technique one wished. Some might not sound so good. As mentioned in the article, one does not lay down pedantic rules but decides in a given situation as to the technique/s required. Flexibility is all and if it sounds right . . .

In Mr Andrews's example, a crossed pair is *not* a non-starter if reinforced with a spot on the flute and if the set-up is intelligent. And anyway, an eight-two-two string section will never sound like the RPO first time round, God bless them.

Mr Andrews has misunderstood my small philosophies; the distortion is aesthetic, not electrical, and my comments pertain to the conditioning process by which one judges a particular sound to be acceptable (or correct).

Having been subjected to similar amounts of textbook and 'popular Sunday newspaper' material I think I prefer the latter. One tries to be human some of the time. I'm sorry Mr Andrews doesn't like my jokes, though. Investing audio balancing with the pseudo-rigour that plagues such other generalised sciences as economics and sociology would do little but breed pseudo-academics. If I had written on 'general unchallengeable principles', I would have had to fill all five pages with bad jokes; specific solutions to specific problems are by their nature not widely applicable. It is an insult and an arrogance towards the reader to assume him incapable of adapting to a field situation. Nobody has ever been creative and obeyed all the rules.

Two irrelevant academic points, for which I apologise: Stockhausen has never written specifically for the record medium, although he has frequently used tape for origination; the first was *Etude* (1952, predating the 'popular music' of Mr Andrews). Until a few years ago the cor anglais was always mistranslated, due to confusion of the original French. Old textbooks, of course, remain wrong.

The final abuse is unanswerable, except with similar fruitless rude noises. Mr Andrews obviously disagrees strongly with many points. Perhaps one day we will hear his constructive arguments and realise the folly of our ways. Yours faithfully, Michael Thorne, 82 Riverview Gardens, London SW13.

Stellavox SP7

Dear Sir, As a Stellavox *SP7* tape recorder owner of a few months, I have of course read intently every test report and any mention of Monsieur Georges Quellet's fascinating products under his 'Stellavox' flag. I have noted that sometimes the gentlemen who painstakingly prepare the test reports on recorders of this kind tend to treat them as purely fixed or transportable machines so, for those who also wish to operate their recorders slung over their shoulders, I hope that I may take up a little space to document my own (independent?) experiences as a 'practical user'. Incidentally, Mr Hugh Ford's review of the pilot version of the *SP7* seemed far more pertinent to the machine's intended applications, even if he was more critical than an earlier reviewer; I certainly agree with some of the points he makes.

Briefly: operating the Stellavox as a portable gives a natural position of hanging the recorder over one's right side with all the connecting cables coming forwards; the meters are then all clearly visible and the operational controls are to hand. This can be maintained, by me at least, for several hours at a time owing to the light weight of the machine. Retakes or checking of takes are easy as the *SP7* can (very quickly) rewind the tape while still in its carry case: the main function switch selects 'rewind' and the pinch wheel mechanism opens itself magically, or so it looks, and closes itself again when the play or record position is selected. This feature I find absolutely essential in my work, as well as the ability to take NAB spools when working as a portable, as well as a mobile, studio. The ABR accessory permits large spool operation but, no matter how large a tape loop is thrown on a start-up, my machine and two others of which I know are never affected; indeed, someone accidentally brushing against the take-up spool for a couple of seconds or so never seems to have the slightest effect upon the recording.

While I am praising and defending the Stellavox, I should like to mention my puzzlement on reading Mr Ford's comment that 'replay amplifier noise levels are good but are let down by noise from the record amplifier system . . .', the point here being that record and replay amplifiers are both *SPA* and *SOA*

38 ▶

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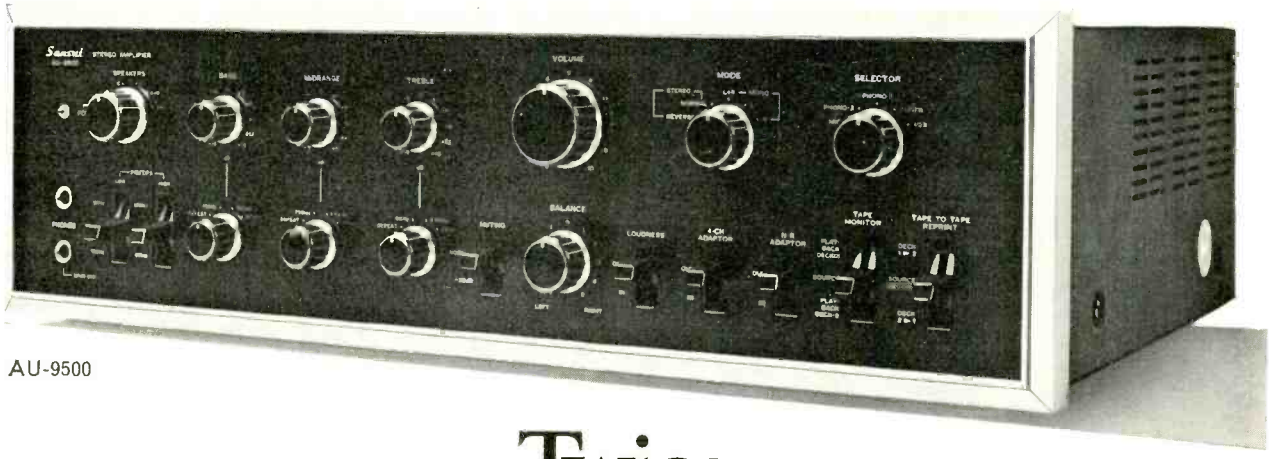

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So we made a brilliant tuner to match.

Our AU-9500 amplifier really can do an amazing number of things.
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This outstanding result is obtained by employing an all-stage direct-coupled OCL pure complementary parallel push-pull circuitry.

The TU-9500 is the other half of this talented partnership. It delivers a spectacular high input capacity of 130 dB that guarantees clean, distortion-free reception even in FM-congested urban areas. Now a whole world of outstanding FM reception can be yours.

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PATENTS

THE FOLLOWING list of Complete Specifications Accepted is quoted from the weekly *Official Journal (Patents)*. Copies of specifications may be purchased from The Patent Office, Orpington, Kent BR5 3RD.

July 4
1326474 Fernseh GmbH.
Method and arrangement for increasing the vertical resolution of a colour television image.
1326654 Baker, J., and others.
Magnetic tape reproducing apparatus.
1326700 Ricoh, KK.
Magnetic tape recorders.
1326706 Post Office.
Broad band flat frequency response circuits.
1326912 Philips Electronic & Associated Industries Ltd.
Musical scale tone-generator.
1327133 Daini Seikosha, KK, and Seikosha, KK.
Memory liquid crystal material.
1327214 Eminent, NV.
Electronic circuit arrangement for imitating a percussion musical instrument.
1327229 Motorola Inc.
Deck or tape recording/reproducing apparatus.

July 11
1327484 Matsushita Electric Industrial Co Ltd.
Manufacture of magnetic heads.
1327571 Minnesota Mining and Manufacturing Co.
Magnetic tape cartridge.
1327654 Franz-Vertriebs GmbH.
Reverberation apparatus.
1327689 International Standard Electric Corporation.
Field sequential laser scan for night colour television.
1327692 Hobrough Ltd.
Slope limiter apparatus.
1327881 Novar Corporation.
Coaxial tape cartridge.
1328014 Debell, L., and Price, D. D.
Method for recording predetermined information duration within preset record length.
1329146 Western Electric Co Ltd.
System for encoding video signals.
1329278 Bofors, AB.
Infra-red television camera.
1329305 Canon KK.
Magnetic record reproducing device.

July 18
1328056 Wandel & Goltermann.
Decade frequency generator.
1328077 Ampex Corporation.
Dual loop equalisation for a frequency modulated signal system.
1328095 British Broadcasting Corporation.
Detection of induction pulse cancellation errors.
1328141/2 Scheiber, P.
Audio systems.
1328183 Sony Corporation.
Magnetic recording and reproducing apparatus.
1328212 Blaupunkt-Werke GmbH.
Method and arrangement for the location of video heads on a head carrier.
1328254 Canon KK.
Mode switching system for magnetic recording-reproducing apparatus.
1328411/2 Sony Corporation.
Colour television camera.

July 25
1329146 Western Electric Co Inc.
System for encoding video signals.
1329151 Babcock & Wilcox Ltd.
Method of and apparatus for use in recording ultrasonic probe characteristics.
1329267 Matsushita Electric Industrial Co Ltd.
Cassette type magnetic recording and reproducing apparatus.
1329305 Canon KK.
Magnetic record reproducing device.

LETTERS

modules and are thus identical and interchangeable.

However, back on the practical user aspect of portables, one final experience I can remember: I have now developed the habit of placing my machine on any of its six sides and this has come in very useful. Unfortunately, at the '72 APRS exhibition, I was looking at the back of a rival Swiss recorder and nearly dumped the much heavier weight of that machine on to its own protruding delicate meter and plastic controls. I dread to think what the bill for replacing that lot might have been if I had not just stopped myself in time! Luckily the stand staff missed what happened but I shrank away from that stand hurriedly.

Yours faithfully, John M. Ward, 3 Northway, Tape Recorders, Audio and Video Equipment, Morden, Surrey.

Hugh Ford comments: Firstly I should like to thank Mr Ward for his compliments: I do try to criticise equipment from a user's point of view and I do *not* assume that users are engineers!

While Mr Ward is at pains to point out that the 'loop slinging' acrobatics of the *ABR* adaptor have little effect upon the recording being made at the time, it is likely that the tape may well be damaged and consequently be unsatisfactory for re-use. Also, the winding tension with the *ABR* adaptor is very low and, should the tape be subsequently wound on a mains powered machine, severe tape damage in the form of 'clinching' is almost inevitable. Furthermore, should tape be stored for any length of time under such a low winding tension this will produce a veritable tape manufacturer's nightmare.

Regarding the noise introduced by the record process, reference to my review will show that the bulk-erased tape noise was increased by 5 dB(A) at 19 cm/s or 6.5 dB(A) at 38 cm/s at minimum record gain, which I attributed to either bias oscillator distortion or record amplifier noise. While Mr Ward is quite correct in stating that the record and replay amplifier modules are identical, the module gain is controlled by external components to the module which will equally effect the noise performance. As I do not attempt to do the manufacturer's de-bugging when reviewing equipment, I still do not know if the noise is from the record amplifier or from the oscillator.

Finally, I too very much look forward to trying the new Stellavox recorders. The *SP7* had superb mechanical design and, if the electronics of the new models have been improved to match equally good mechanics, they will be superb machines.

Airmail subscriptions
IN RESPONSE to requests from overseas readers, STUDIO SOUND is now available by airmail subscription. Rates are £16.20 or equivalent in Zone C (Australasia, China and Japan), £13.56 in Zone B (North and South America), or £10.92 in Zone A (Africa and the Near East). Paid and controlled subscriptions in Europe and the USSR are automatically airmailed.

Just how good is the Philips 'Electronic'?

That Philips make Hi-Fi of the highest quality as well as good domestic audio equipment is most clearly demonstrated by the new GA212 'electronic' record deck.

This shows technological innovation of a high order, resulting in genuinely better standards of record reproduction.

Its two speeds (33⅓, 45 rpm) can be adjusted precisely, using the built-in stroboscopic rings and fine-speed controls, and are accurately maintained by a tacho generator that keeps wow and flutter to less than 0.1%.

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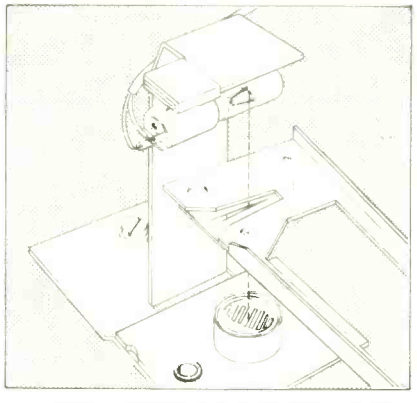
Autostop at the end of a record is not effected by mechanical means, but electronically. When the rate of interception of a light-beam striking a photo-sensitive cadmium sulphide cell exceeds a certain value, a bi-stable multivibrator is triggered, cutting off the motor supply voltage. Hence 'thumping' and groove jumping cannot occur. The pick-up can be lowered precisely into any groove, even close to the run-out, without premature switch-off.



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BOOK REVIEWS

SOUND WITH VISION: SOUND TECHNIQUES FOR TELEVISION AND FILM by EGM Alkin. Published by arrangement with the BBC. Price £6. **Publishers:** Butterworths Publishers Ltd., 88 Kingsway, London WC2.

THIS IS A large and very interesting book. The author has had considerable experience in broadcasting, first in sound and, since 1952, in television. Written specifically for those engaged in broadcasting (where a seven-man sound team is not uncommon), its information is nonetheless useful to all users of cctv equipment, right down to the simplest single camera and vtr.

The 16 chapters are divided into four sections: Fundamentals, Microphone Techniques, Technical Facilities and Sound Operational Practice.

Part one gives a short and perceptive evaluation of sound's importance and its relationship to vision, a compressed introduction to the properties of sound and the principles of level meters, together with interesting advice on dynamic levelling (particularly important in television with its limited dynamic range). A short section on studio acoustics is followed by an introduction to microphone fundamentals, with particular emphasis on the highly directional types often needed for tv work.

The second part gives general advice on the use of microphones in different broadcast tv situations, in and out of shot, on booms and fishing rods etc, and shows how the BBC treat the problems of audience participation discussions.

Tv sound, with its peculiar subservience to vision and its need to survive playback through undersized speakers placed at right angles to the listener, requires a great deal of electronic treatment. This means in practice that reliance must often be placed upon limiters, compressors, noise gates, and response selection amplifiers. Part three of the book devotes three chapters to these problems, together with coverage of the other sections of the sound programme chain, including mixers, talkback, foldback, and cable routing.

The last section covers studio operational practice. When the cctv user reads of the sheer scale of sound operations in broadcasting, he may feel that this part will have nothing to offer the non-broadcast user. But this definitely is not the case; exposure to different techniques for talks, drama, comedy and music is useful to everyone involved.

Glyn Alkins's concern with music is shown in the last chapter which is the longest of the book. It gives detailed advice on recording everything from a soloist to grand opera and here the book's value goes beyond the needs of tv sound; this section could usefully be reprinted in paperback form for the benefit of all sound engineers.

The area covered is so large that much of the information is of necessity general and for this reason it seems a pity that more references are not given. Appendices on the Haas effect, Post Office jacks, and sound in syncs, could usefully have been supplemented by a bibliography. **R.S.**

RADIO AND ELECTRONIC LABORATORY HANDBOOK by M. G. Scroggie. Eighth edition (1971). 614 pages, hardback. Price £4.75. Publishers: Iliffe Books Ltd, Dorset House, Stamford Street, London SE1.

DESPITE THE title, the aim and appeal of this book go far beyond what springs to mind with the term 'radio and electronic laboratory'. It is likely that most readers will have come across Mr Scroggie's work in one form or another, either through his other books or through his articles in technical journals under his own name or 'Cathode Ray', an alias for some observations in *Wireless World*. It is always easy to read Scroggie. He is never condescending or obscure and, despite the vastness of his subject, manages to cover an almost unbelievable amount of ground.

The first edition of the *Radio Laboratory Handbook* was published in 1938. Between then and the latest edition it has been substantially revised and enlarged and reset in what is now a rather clearer format. SI units are now used throughout, with explanation and addenda where necessary. It follows the general style of the earlier editions and, although there have been some inevitable prunings, a great deal has been added. Despite the substantial size of the book, not every topic can be considered in depth and there are accordingly a large number of references made to other literature covering particular subjects in detail, which is extremely useful. The book is well illustrated with some 369 diagrams and half-tones.

The book contains chapters on the general principles of measurement and laboratory practice, together with guidelines on the construction and purchase of test equipment by those with limited funds, caveats and guides to the interpretation of results, seven chapters on basic equipment and methods of measurement, and a substantial and invaluable reference section of tables, formulae, standards, codes, symbols and so on. The new material includes sections on microelectronics and integrated circuitry, operational and dc amplifiers, and digital meters. It deliberately excludes microwaves, which the author felt were a vast subject better documented elsewhere. While many of the circuits given are illustrative only, a significant number are set out in suitable detail for construction, a reflection of the author's realistic attitude to budgets and to the needs of amateurs.

In any particular field there must obviously be gaps, though these tend to be plugged by the references to other literature. For instance, I looked hopefully for material on the testing and standardisation of microphones and was disappointed, although loudspeakers and pickups are dealt with briefly. On the other hand I have found a great deal of useful fringe information in reading through this book for review, which I might otherwise not have thought of looking for, and have not noticed any serious gaps. In a book of this kind that reaches its eighth edition, one would hope there would not be! Any criticism I have would be very minor, such as the unfortunate interpolation of five pages of tables of standard discs and tapes between the paragraph on resistor colour coding and the corresponding table of codes and values, and the omission of the coil and two resistor values from a grid dip oscillator circuit otherwise inviting construction. But generally the presentation is to a refreshingly high standard.

You will have gathered that I am enthusiastic about and impressed by this book. I am. Highly recommended as a reference work.

J.H.F.

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Chromatic intervals from a single frequency

R. M. YOUNGSON

POLYPHONIC ELECTRONIC musical instruments employ either a free-phase system, in which each note is derived from a separate oscillator, or a frequency-division system in which octavely-related tones are produced by repeated division by binary stages. Problems of frequency stability and of the high cost of independent oscillatores have led to the virtual abandonment of the free-phase system, except for specialised purposes, and the great majority of modern polyphonic instruments use the divider system. The trend has been encouraged, in recent years, by the availability of medium-scale integration integrated-circuit dividers so that, today, no manufacturer or amateur constructor would consider producing binary dividers from discrete components.

A single musical octave consits of twelve notes at semitone intervals, nominally C, C♯, D, D♯, E, F, F♯, G, G♯, A, A♯ and B. Such an octave of pitches, set at a suitably high audio frequency, provides the means whereby, with normal binary division, all the necessary tones for a chromatic fully polyphonic musical instrument may be obtained. The conventional divider system therefore consists of a series of twelve master oscillators, each carefully tuned to a frequency corresponding to the pitch of its appropriate note in the tempered chromatic scale, and each followed by a chain of successive divide-by-two stages. **Fig. 1** indicates the system in outline and **fig. 2** shows how typical TTL ics (*SN7493*) can be connected to give eight octaves of tones from a master oscillator. Six or seven binary stages are sufficient for normal musical purposes but, as one is likely to be using ics each containing a four-bit binary counter, it is convenient to use eight stages. It might be mentioned, in passing, that a substantial musical instrument may be constructed using only four binary stages per master oscillator (i.e. only 12 ics altogether) but in this case it would probably be found necessary to use the master oscillators for the top octave of tones.

Problems with master oscillators

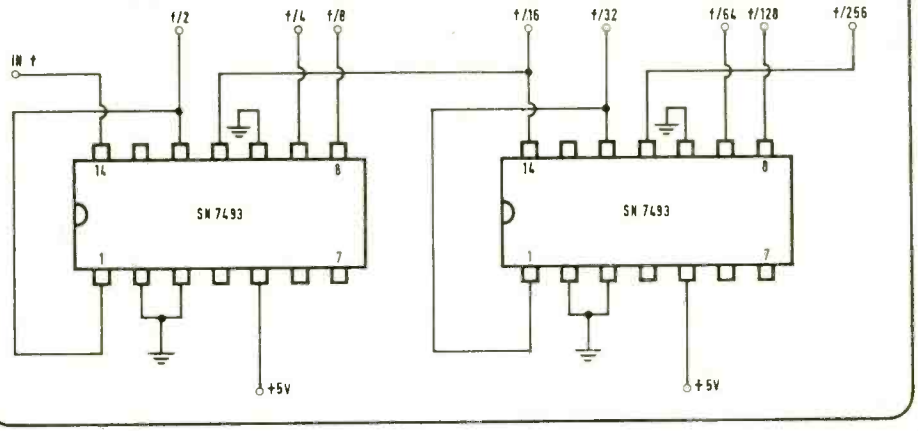
For many years now, divider musical instruments, notably electronic organs, have been designed on these principles and the system has not been fundamentally altered by the substitution of ic dividers for the original discrete component bistables. The master oscillator system has always, however, had a number of conspicuous disadvantages and shortcomings and these have promoted a search for an alternative system. The necessity to achieve a high standard of frequency stability (of the order of 1 part per 1,000, long-term) in the master oscillators has led to the use of LC circuits with ferrite pot-core inductors and high-quality capacitors, both of which are expensive and relatively bulky. Such oscillators produce a sinewave output which is inherently unsuitable for triggering bistables and requires wave-shaping by Schmitt trigger or other means. A further disadvantage is the fact that the 12 oscillators must be tuned before the instrument can be used. This may be no great problem to a manufacturer using digital frequency meters but can lead to difficulties for others less well equipped. In spite of the claims of advertisers, electronic organs *do* go out of tune and thereby occasion much user dissatisfaction.

Derivation of the equal-tempered chromatic octave from a single frequency

Happily the necessity for a bank of master oscillators has now been overcome. In future, few instruments of any pretentions to quality will employ them. The principle behind the method to be described was, as in the case of many ideas only now being realised in practice, evolved in the thermionic valve era but was then impracticable. Even using transistors the cost would have been prohibitive but, with the advent of medium-scale and large-scale integration, these objections disappeared.

The idea is to generate a very stable high-frequency squarewave train (typically, but not necessarily, by a quartz crystal oscillator). Then, by means of 12 separate chains of frequency dividers, each chain being designed to divide by a carefully calculated integer, the necessary twelve frequencies for the top chromatic octave of the instrument are derived from the single master waveform. The stability of the tuning is equal to the frequency stability of the master oscillator and even a simple ic crystal oscillator (such as that described below) can confer a standard of stability far more than adequate for all musical purposes. As an alternative to a crystal oscillator one may choose to employ an oscillator whose frequency is deliberately made controllable. If this is done, the pitch of the whole musical instrument may be varied at will and changes of pitch will in no way affect the exactitude of the relative tuning

FIG. 2 8-OCTAVE DIVIDER (NOTE: IC s ARE VIEWED FROM ABOVE)



Problems with master oscillators

References

'Generation of Musical Intervals by a Digital Method'. Philips Technical Review, Vol. 26 Nos 4 to 6 (1965).

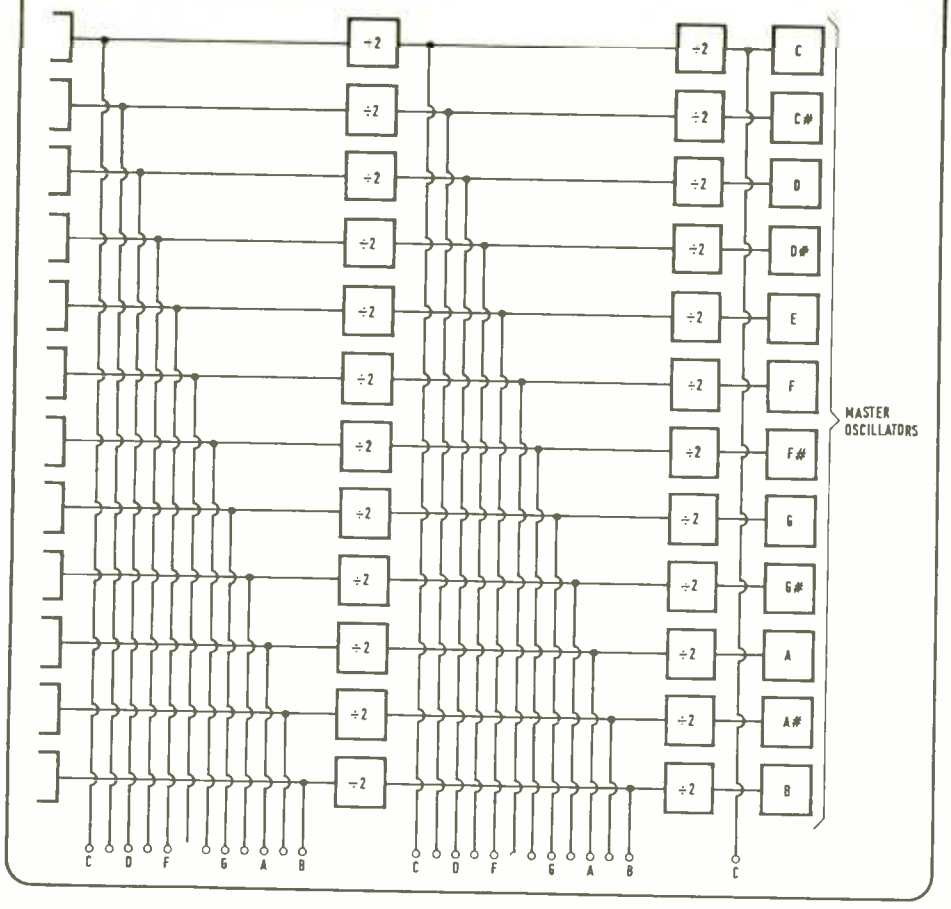
Stapelfeldt, R. Approximating the Frequencies of the Musical Scale with Digital Counter Circuits. *J. Acoust. Soc. Amer.* 46:478 (1969).

Cotton, R. B. Tempered Scale Generation from a Single Frequency Source. *J. Audio Eng. Soc.* 20:376 (1972).

Burhans, R. TTL Circuits for Monophonic Devices. *J. Audio Eng. Soc.* 20:829 (1972).

Designing with TTL Integrated Circuits. Texas Instruments Inc. Mc Graw-Hill Book Company, New York (1971).

FIG. 1 CONVENTIONAL DIVIDER SYSTEM



of the notes in each octave. Such a facility may be of great value in certain circumstances as, for instance, when the instrument is used to accompany a singer. The frequency stability of even the most carefully designed variable-frequency oscillator is, of course, necessarily less than that of a fixed-frequency crystal oscillator.

In order to achieve a sufficiently close approximation to the equal-tempered scale (i.e. an octave divided into 12 exactly equal intervals) it is necessary to select a fairly high master oscillator frequency. There is, in fact an infinite number of sets of division integers which may be used, and the higher the master oscillator frequency the closer may be the approximation to the exact equal-tempered scale. As the master oscillator frequency is increased so also will the size of the division integers increase. Computer studies designed to select the best compromises between accuracy and economy in the number of binary division stages used have shown that, for normal musical purposes, an adequate standard of relative tuning accuracy may be achieved with a set of division integers of which the largest is 232 and the smallest 123. Seven binary stages can be made to divide by any integer up to 128 and eight stages can be arranged to divide by any number up to 256.

It is therefore convenient to use eight-bit binary counters, each of the 12 being programmed to divide by the appropriate integer, as shown in **Table 1**. For the convenience of those wishing to achieve even higher accuracy, the table also includes sets of integers for 9, 10, 11 and 12 bit counters. After each division integer is shown in parenthesis the percentage deviation above or below the true equal-tempered frequency. Unless one is proposing to engage in research work, it is unnecessary to go to the trouble and expense of using more than eight stages of division.

Programmable dividers

The designers of MSI TTL ics have presented us with a remarkably simple means of achieving division by the desired integers. The fully programmable *SN74193* is a synchronous up/down counter with features tailor-made for our immediate purpose. The ic has four 'data input' connections and these are the programming inputs. Essentially the ic, properly connected, will divide by the decimal number equivalent to the binary number applied to these four data inputs. Thus, if to the data inputs A, B, C and D we connect, respectively, a logic 1, 0, 1 and 1, the ic will divide by 13 (note that the 'A' input is the *least* significant bit). The matter is even further simplified by the fact that, in practice, data inputs requiring logical 1 may be left unconnected and all that is necessary is to connect to ground those pins which require a logical 0.

Fig. 3 shows the wiring diagram of two *SN74193* arranged for an eight-bit programme. In this application we use the "count down" mode and this is determined simply by applying the master oscillator frequency (clock) to the 'count down' pin, the 'count up' connection being kept high (5V). Note that the two sets of data inputs now run consecutively, the A^1, B^1, C^1 and D^1 of the second ic being, respectively, the 2^4, 2^5, 2^6 and 2^7 inputs. For convenience, **Table 2** shows the binary values for the twelve sets of data inputs for an eight-bit programme.

The wiring diagram is implemented in a manner suitable for use with 2.54 mm matrix Veroboard. The vertical lines illustrated represent the Vero copper strips on the under side of the board and the horizontal lines are the wired connections above the board. The ics are shown in the normal manner as viewed from *above*. Twelve pairs of *74193*, with all connecting wiring, can easily be accommodated

44 ▶

TABLE 2. Binary coding for 8 bit programmable dividers

Notation	Divisor	Data Inputs A	B	C	D	A′	B′	C′	D′
B	116	0	0	1	0	1	1	1	0
A♯	123	1	1	0	1	1	1	1	0
A	130	0	1	0	0	0	0	0	1
G♯	138	0	1	0	1	0	0	0	1
G	146	0	1	0	0	1	0	0	1
F♯	155	1	1	0	1	1	0	0	1
F	164	0	0	1	0	0	1	0	1
E	174	0	1	1	1	0	1	0	1
D♯	184	0	0	0	1	1	1	0	1
D	195	1	1	0	0	0	0	1	1
C♯	207	1	1	1	1	0	0	1	1
C	219	1	1	0	1	1	0	1	1

TABLE 1. Optimum divisors to generate a tempered scale, using 8 bit, 9 bit, 10 bit, 11 bit and 12 bit binary counters.

Notation	Divisors 8 bit	9 bit	10 bit	11 bit	12 bit
B	116(0.00)	—	508(+.03)	—	1951(+.004)
A♯	123(—.09)	239(—.03)	538(+.01)	989(0.00)	2067(—.003)
A	130(+.15)	253(+.05)	570(+.01)	1048(—.01)	2190(—.007)
G♯	138(—.04)	268(+.07)	604(—.01)	1110(+.01)	2320(+.003)
G	146(+.10)	284(+.04)	640(—.02)	1176(+.01)	2458(+.001)
F♯	155(—.11)	301(+.01)	678(—.01)	1246(+.01)	2604(+.007)
F	164(+.03)	319(—.02)	718(+.03)	1320(+.02)	2759(+.001)
E	174(—.12)	338(—.03)	761(—.01)	1399(—.02)	2923(+.003)
D♯	184(+.07)	358(—.01)	806(+.02)	1482(—.01)	3097(—.003)
D	195(+.04)	379(+.07)	854(+.01)	1570(0.00)	3281(+.002)
C♯	207(—.15)	402(—.05)	905(—.01)	1663(+.02)	3476(+.005)
C	219(—.01)	426(—.07)	959(—.03)	1762(+.02)	3683(—.004)
B	—	451(0.00)	—	1867(0.00)	—

CHROMATIC INTERVALS

on a single 432×64 mm sheet of Veroboard and still leave room at one end for the master oscillator. Remember that data input '1's can be left disconnected. Data '0's should be connected to ground. A convenient arrangement is to use one of the outer strips running the full length of the board as the ground bus and two others at the other edge as Vcc (+5V) and clock inputs, respectively.

Master oscillator

Fig. 4 shows the circuit of a very simple but effective crystal oscillator using a single *SN7400* quad NAND gate. This circuit oscillated cheerfully up to 13 MHz, the highest frequency tried. Because we have to feed 12 dividers, we must bear in mind the question of 'fan-out' and to be safe the output stage has been doubled up so that each output gate need feed six only dividers. This is well within the fan-out limitations of the *7400*. Each of the four gates in the ic has two inputs and each gate has these two inputs tied together thus turning the four gates into four inverters. Two of these are used in a multi-vibrator mode, the frequency being determined by the quartz crystal, and the other two as buffers to square the output and increase fan-out. Fig. 5 shows the wiring diagram for the oscillator.

Master oscillator frequency

The calculation of the frequency for the master oscillator is a matter of multiplying the required frequency of one of the pitches of the desired octave by the division integer given. As was indicated, the selection of integers by the computer was made on the basis of the best compromise between accuracy and the economy of a reasonably small division integer (and consequently a reasonable number of binary stages). In making this selection, the choice of the best master oscillator frequency was not limited to those which are integral multiples of 440 Hz (the standard musical note 'A' and the only integer in the scale). In fact, in the series given, notably better accuracy for an eight-bit counter is achieved by taking as a master frequency an integral multiple of 'B' 493.8333 Hz. giving a nominal master oscillator frequency of 57,290.4280 Hz. In this case the error for the 'A'=440 Hz is +1.5 parts per 1,000. C♯ has an error of −1.5 parts per 1,000 and all the others are a good deal better. If a master frequency of a binary multiple of 57,200 Hz is used, with the same division ratios, the 'A' has zero error but C♯ has −3 parts per 1,000 and A♯ −2.4 parts per 1,000. It should be emphasised that these errors are related to the *absolute* values of the frequencies of the standard equal-tempered scale based on 'A'=440 Hz. The correctness of the relative tuning of notes is quite unaffected by changes in the master oscillator frequency and, if absolute pitch is unimportant, any convenient crystal which may be to hand can be used. Crystals for communications purposes are readily available in a comprehensive range of frequencies. It is a simple matter, if necessary, to divide the output of a high-frequency crystal oscillator, using a single *SN74193* programmable divider, so as to reach the desired master oscillator frequency. In this event, *SN7400* buffers should also be used to increase the fan-out of the additional divider stage.

For the convenience of those wishing to take the matter further (and to justify the cost of a pocket calculator) I have included as **Table 3** a list of the frequencies of the standard chromatic scale, correct to four decimal places. The lower-frequency 'C' in this table is 'Middle C' on the piano or organ at eight foot pitch. When calculating the frequencies needed for the top octave of a polyphonic instrument (i.e. those derived from the set of 12 programmable dividers) it is, of course, necessary to multiply the frequencies in this table by either four, eight or 16, depending on the upper extent of the range of the instrument. In the same way, when calculating the master oscillator frequency, it is necessary first to multiply the frequency of the highest pitch in the table by the chosen binary factor and then to multiply the product by the appropriate divisor integer. It follows that a suitable crystal frequency for a wide-range instrument, using an eight-bit binary counter will be: 49.8833×16×116= 916,647.4048 Hz. A crystal of 910,000.00 Hz will give an 'A' of 437.5 Hz which is only 2.5 Hz below standard pitch.

FIG. 3 WIRING DIAGRAM FOR 8-BIT PROGRAMMABLE DIVIDER (NOTE: ICs ARE VIEWED FROM ABOVE)

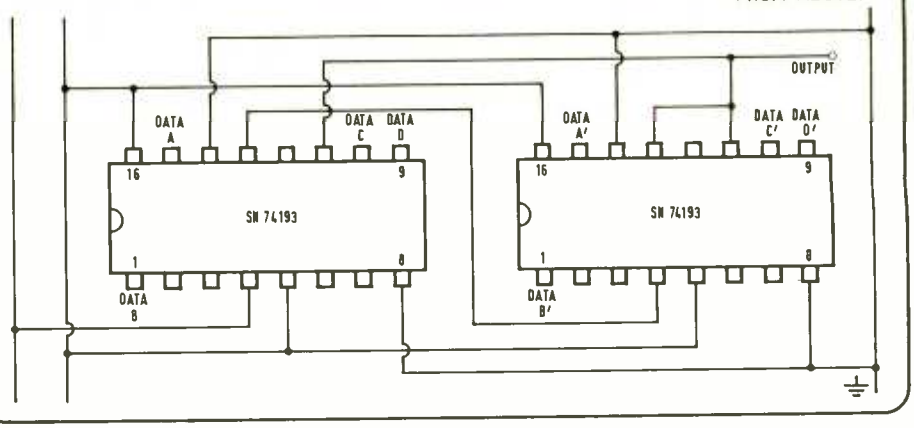


TABLE 3. The tempered musical scale, standard pitch (A—440 Hz)

C	523.2511
B	493.8833
A♯	466.1638
A	440.0000
G♯	415.3047
G	391.9954
F♯	369.9944
F	349.2282
E	329.6275
D♯	311.1270
D	293.6648
C♯	277.1826
C	261.6256

FIG. 4 MASTER OSCILLATOR

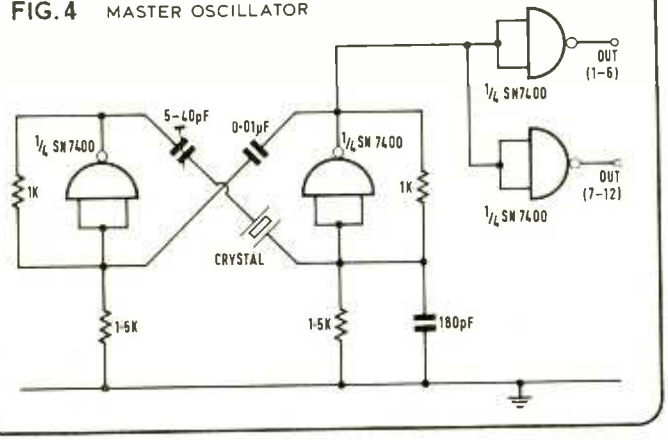
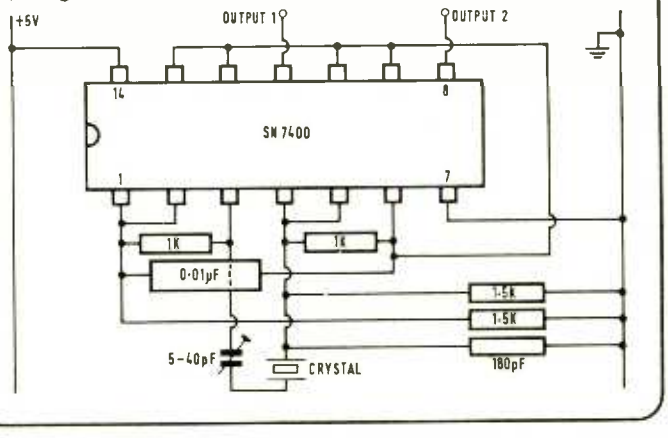
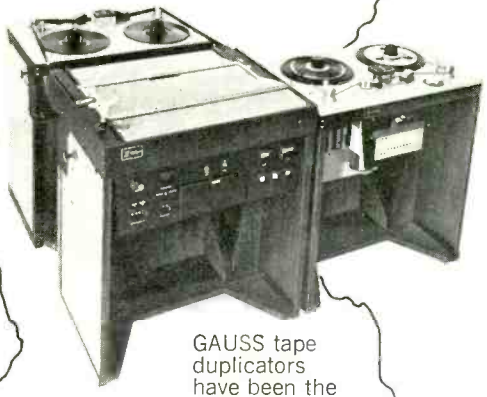


FIG. 5 OSCILLATOR WIRING DIAGRAM



we're here



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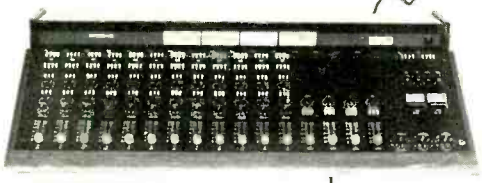

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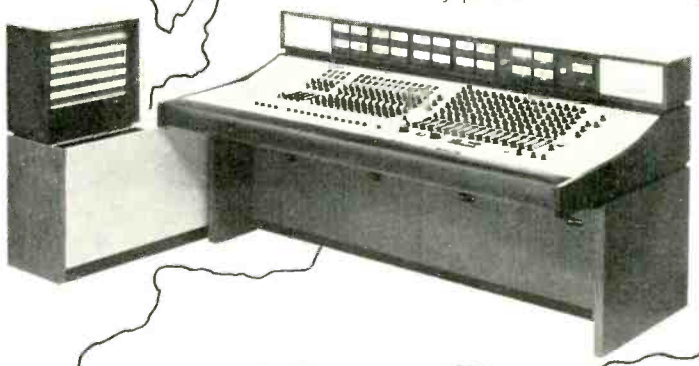

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Starting young

ADRIAN HOPE

looks at the present state of music teaching in the London area. The picture is encouraging, increased attention being given to performing and composition.

OVER THE past months I have had the pleasure of interviewing quite a few people who are one way or another doing interesting things with tape—sometimes recording their own material and sometimes canning other people's sounds. In each case the people concerned have been enthusiastic, almost obsessive, about tape and its potential. Although they have all been doing entirely different things and have learned their trade in different ways, they have all had one thing in common. Each of them was self-taught.

Characteristically, in the USA there are now signs of potted courses hopefully intended to convert laymen into skilled sound recordists, more or less overnight and doubtless for a great deal of money. In this country there are more rational approaches like the Surrey University Tonmeister course but, however valuable this may be to the handful who get into it, it is round the back of the moon for anyone who hasn't been programmed to pass A Level Physics and Music, the basic entry requirements. Tonmeister or no Tonmeister, I would bet that sweeping the studio floor and making the tea will be the starting point for most of those engineers and producers who eventually get to the top of the tree.

But isn't there room for guidance in the basic principles much earlier on? And by basic principles I don't mean the parrot recitation of Ohm's law or the colour code for resistors, although both have their place. What I am talking about is a basic groundwork on the kind of thing that can be done with tape beyond simple off-air pop snatching.

What set me thinking along the lines of a much earlier start were memories of a brief period teaching, several years ago. My most distinct and vivid recollection is of children by the dozen literally marking time, bored out of their skulls and getting into some pretty nasty habits while waiting impatiently for their release from school as dictated by the school leaving age requirements. And recently the authorities have raised the minimum leaving age from 15 to 16.

I also have some extraordinary memories of how music appreciation and similar classes were handled at the school where I was teaching. The music teachers were 'legitimate' in every sense of the word and viewed anything modern from as great a distance as possible. They had worked out complicated systems of keeping the children under something approaching control for short periods of time while they played them four- or five-minute snatches of the 'classics'. Not surprisingly, neither teachers nor children gained much from the experience. The only time the majority of the children showed any sign of enthusiasm was when they were allowed to join in the creation of anything resembling music. For instance, a percussion band. But the potential of a percussion band is limited.

Quite recently it dawned on me that, with relatively primitive recording equipment, school children could not only participate in musical creation but might also get a taste of what playing with tape holds in store for anyone interested. Not surprisingly, the idea isn't original. The ILEA and plenty of other people thought of it long ago but you could say without fear of contradiction that the idea is not yet really off the ground.

The question of future prospects in this direction seemed to lie in the attitude of the ILEA music department. So I had lunch with Mr Hamish Preston, an ILEA Inspector of Music, based at their Music Centre in Ebury Bridge, SW1. Much came to light. Preston, although obviously a man with a conventional musical background, is very open-minded and even enthusiastic on the question of letting children make creative use of recording equipment in ILEA schools. I suggested to him that the average music teacher has the wrong background for the job he is doing. The usual background of conventional music college, or university degree in music, often left no real interest in the 'music of the people' (as Edward Lee calls it in his study of British popular music). This tended to create a barrier between the majority of children and their teachers. Preston put it more mildly:

'The classical background of most music teachers does nothing to help them in the situation which faces them in most schools, where there is a need to develop music beyond classical confines'.

The ILEA are now starting to recruit music teachers whose practical skill and urge to communicate in areas of music, not necessarily classical, is a more important consideration than academic qualifications.

'What we would like to get away from is the circumstance where every music teacher concentrates on getting the children to finish their notes on Beethoven before discussing the Beatles lp that one of the children has brought along to play.'

But how is all this relevant to the use of tape in schools? Quite simply, it is a question of removing the barriers of prejudice against anything other than the classics and routine teaching methods. As Lennon and McCartney songs, and instruments like the guitar, become 'acceptable' so the use of tape in a creative way should fit into the 1970s.

Preston compared the state of music teaching with the revolution in art and drama teaching that started in the 1930s. He referred me to Herbert Read's book *Education through Art* and recalled the slow breakaway from compelling children to learn technique before allowing them to draw as they wanted.

Preston also instanced some of the difficulties inherent in letting children work with tape. He referred me to another book (*Sound and Silence*) by John Paynter and Peter Aston), which deals with the techniques of letting children make their own music, and also showed me the book *Experimental Music in Schools* by Brian Dennis which specifically explains how children can go about using simple tape recorders to get unusual effects.

Theories

All these theoretical ideas break down in practice where the average class is likely to have at least 30 pupils per teacher and where by definition it is impossible to have several musical groups working and recording in different parts of the same small room. There is also the difficulty that, although most schools have the basic equipment already available, the average teacher, even if enthusiastic about using it, is probably not sufficiently experienced. This problem may eventually be solved because courses are available and are being run.

The main point to remember at all times though is that, speaking generally, few schools

are without a couple of basic tape recorders. In practice most schools will have them already plus, in some cases, video equipment.

So we are left with the interesting situation where ILEA upper echelons are certainly not going to discourage any music teacher who wishes to try something out along these lines. This is important to remember because education is replete with buck-passing. If, as I hope, any reader with children is sufficiently interested in the idea to find out what is going on at their local school and press for something along these lines, it is essential that he know his facts. Those facts are quite clearly that, if a school in the London area wants its children to stop listening to *Peter and the Wolf* for the 500th time and concentrate instead on putting their own productions on tape, nobody in the ILEA is going to stop them.

ILEA support

That the ILEA's Music Department is serious about all this is proved by their practical support for what Graehme Dudley is doing. Dudley is the music director of the Cockpit Theatre, which comes under the ILEA aegis, and is pushing more than anyone to encourage developments in the electronic area. After seeing Preston I spoke to Dudley.

'We're using the tape recorder as a basic medium, along with other instruments and other electronics, as a means of enlivening music. We do a lot of musique concrete and I guess that my attitude towards this is that it's failed largely because it was too concerned with a reel of tape as the finished product that the audience had to sit down and listen to. And that's theatrically dead. What we try to do is use taped material simultaneously with a musical ensemble. Or we use techniques such as the one where we bypass the erase head so that the recorder will be simultaneously recording and playing back with a time lag. There are probably lots of other people doing it, better and with better equipment, but we're actually letting the children get their hands on the hardware. But it's not often a schoolteacher will realise that a tape recorder can be used as a musical instrument in this way. We've been round schools performing this kind of music. We take in two Revox or two Ferrographs and perform with them, then we leave them over for the pupils to have a go, coming back another time to work with them. The result of all this is that there are quite a few little music studios springing up in the schools that we've visited.

'There are plenty of good tape recorders available in schools. The ILEA have a panel that approves the purchase of tape recorders by schools and in fact schools can get hold of a Ferrograph 7 for themselves this way.

'Pat Brennan, a teacher at Hampstead Comprehensive School, came on a couple of courses at the Cockpit with a few of the children from that school and they were very keen on the idea. She has a very good relationship with her students and she's pushed the ILEA. They recently purchased a Ferrograph for her. Actually it's a combined purchase between the science and the music departments, and that's incidentally the way I've always tried to help schools push for equipment because the ILEA are very science conscious. They now have a Ferrograph, an oscilloscope and a *Synthi A;* that's the EMS *VCS 3* revamped into a carrying case.'

I asked Dudley for a brief run-down on the equipment at the Cockpit.

'We have two *VCS 3* and probably a third coming, two Revox, two Ferrographs, two reverberation units, various Shure microphones. That's it so far, apart from routine equipment like speakers. At the moment we are building a mixer which will link everything together, whereas so far it's all been down to plugging and unplugging.

'We use tape recorders plus just about any kind of live music we can produce. Our own instruments are trombone, piano, violin, cello and French horn, but we also use anything we can get our hands on. Like xylophone, vibraphone, electronic organ and percussion.'

What sort of material did Dudley play to schools?

'We start with an introduction. Typically a couple of sounds—a penny dropping or someone lighting a match. Then we speed it up, slow it down, reverse it—anything you can think of—and end up with a piece of tape collage based on just those sounds. The next step may be to try and incorporate a tape delay with a live performance, using the tape loop as an ostinato bass or a basic figure to tie the group together while we improvise. Or we might use a ring modulator, putting tape through the *VCS 3*, processing it, rerecording it and reprocessing it.

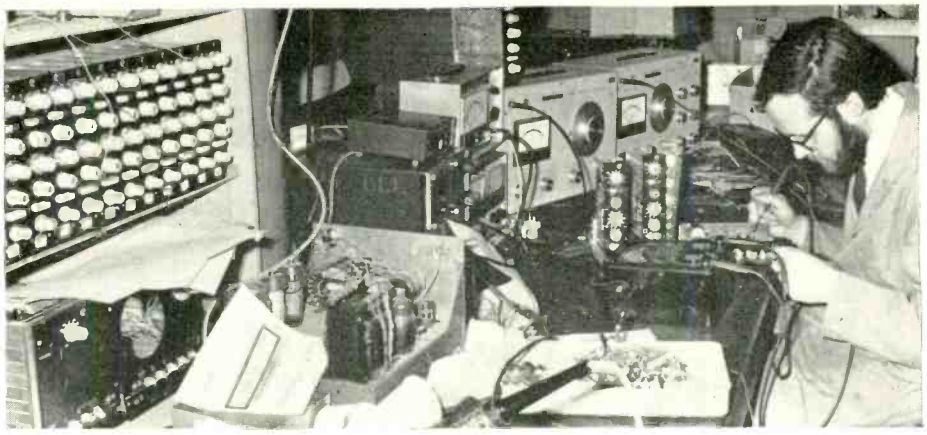
'One of the main objects of the exercise is to stimulate interest. This is the kind of thing I was pushing for when I was first appointed to the Cockpit. The theatre had been built with two music rooms and it was originally envisaged that these little rooms would be used for recorders or percussion bands. I couldn't see the need for devoting them to recorder playing and I suggested to Peter Fletcher of ILEA Music Centre that he might like to have the first electronic music studio run by the ILEA at the Cockpit. He was sympathetic and, because I didn't know much about electronic music myself, I studied with Tristram Cary at the Royal College. More or less by myself, I picked it up and worked out a list of the kind of electronic equipment we would need at the Cockpit if we were going to satisfy minimum requirements for young aspiring composers and also have stuff that would be tough and flexible enough to let the kids get their hands on.

'The teacher can come to the Cockpit to learn how to do what we're performing. In fact we find it's now working in a sort of loop. We originally intended that we would get the schoolchildren to come to the Cockpit but this proved difficult to organise with the schools because of timetabling. We're now running courses for teachers who have been won over by our visits to schools and who wanted to get on with the work but felt they needed instruction.

'Curiously, we're not allowed to go into primary and junior schools yet.

'Before that decision was taken, a letter was sent round a number of schools in the North London area inviting applications for the Cockpit group to come and perform. I think there were something like 20 applications from secondary schools and 170 from primary and junior schools. I hope they will eventually revise the ruling.'

Mixer module test bay.



Microphone power unit assembly department.

Calrec revisited

TREVOR ATTEWELL

Photographs by DAVID HOPWOOD

Many studios have tried their hands at manufacturing or importing industrial durables but few have diversified as widely as Calder Recording. The author returns to survey the scene three years after his original visit.

LIKE THE racing tipster who lets everyone know promptly when one of his selections comes up (and keeps mighty quiet for the other 99 per cent of the time), I can't resist quoting from an earlier article (December 1970): '. . . the company seem likely to gain an increasing share of this . . . market'. The company in question were Calder Recordings Ltd, now Calrec Audio Ltd, a change of name designed to avoid confusion between the original company name and the trademark of their products.

During almost three years since that article, their share of the market has indeed increased steadily. Last year it became obvious that they had outgrown their original building (why else would they have been wiring up a large mixer in the stair well behind the front door?) and they were very lucky to be able to obtain larger premises, almost within a stone's throw, into which they moved in December 1972.

Anyone who has tried moving a complete factory and keeping production going at the same time will know that there are some trifling difficulties, like snatching a couple of hours of sleep once in a while, and will not be surprised to learn that much remains to be done. Particularly the cosmetics of decorating and renovating frontages. It's all a matter of priorities, of course, and a realistic approach to priorities is undoubtedly one of the reasons for the firm's success.

The building provides nearly 1,700 m² on three floors. On the ground floor is the main machine shop with all the normal facilities for producing anything from prototype printed circuit boards to heavy mechanical items, including microphone parts and windgags.

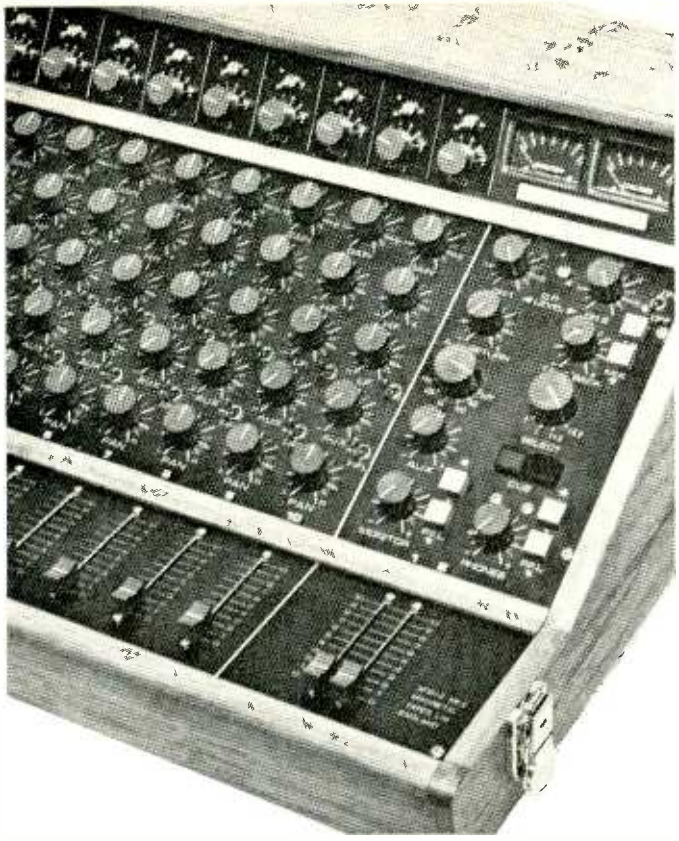
Also on this floor is an anechoic room which, when completed (the wedges are still to be fitted) will be one of the largest in the north of England. This is completely isolated from the surrounding fabric of the building. It will be possible to work from a sectioned wire floor supported above the bottom wedges if required but, in normal use, the floor will be removed and low-profile supports used to support test items. This should reduce reflections which have caused trouble in many installations.

In addition, the anechoic room is situated directly under the 12m test duct built on the first floor, the centre of the room being under the test position in the duct. By removing a rectangular plug from the floor of the duct it will be possible to lower a microphone on test automatically, first into the duct for test up to 200 Hz, and then into the room below for tests at higher frequencies. Until this feature is complete, the original miniature anechoic room is still doing yeoman service.

The ground floor will also house a large studio and control room on which construction has just started. Calrec still believe firmly that equipment cannot be designed without operational feedback from practical use. The studio will also allow potential customers to assess the characteristics of microphones and desks under strictly working conditions. Normal recording continues. This generally involves local musical societies, and often produces a final output of 500 (sometimes 1,000) discs.

At about this stage of the tour, Howard

50 ▶



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Smith suggested that I ought to hear an interesting recent recording. Agreeing readily, I was inwardly anticipating a decent bit of Monteverdi—or, maybe, a few rugby songs—when the peace was rudely shattered by the ear-splitting racket of a pneumatic drill, so loud and so realistic that it was a second or two before it dawned on me that this was a recording in question. Howard stopped the noise for long enough to point out that the microphones used were Calrec *1050*, without acoustic or electrical pads, placed less than 1m from the unmuffled drill. I could hear no trace of overload—a most impressive performance. The hearing loss, they tell me, is only temporary.

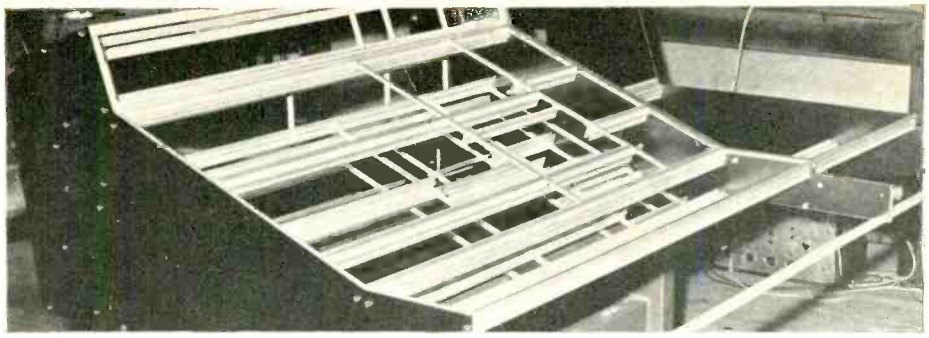
Microphones are made on the first floor, apart from machining, and there is a clean room for capsule assembly which has further reduced the already low reject rate. Calrec microphones have been gaining ground steadily and the demand is now considerable. The firm are about half-way through a programme aimed at trebling microphone production, which has risen by about 600 per cent over the past three years. The main sales have been to recording studios and local radio stations and many units have been exported. Calrec now have agents in Europe, North America, Canada, Australia, South Africa and India, and will shortly have one in New Zealand. Some microphones have even been exported to Japan, a happy reversal of the usual trend.

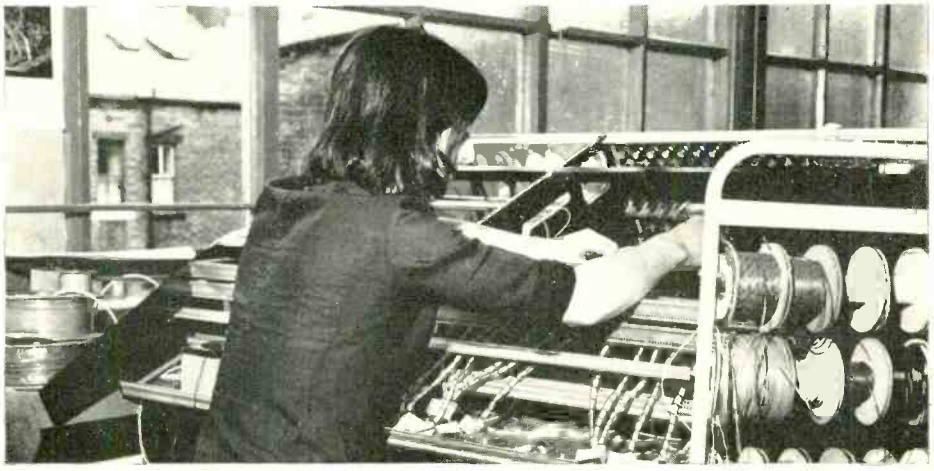
In addition to the original *600* series (now virtually ex-stock, and comprising four basic types each with a choice of DIN or Cannon connectors) and the *1000* series (four types), they have introduced a new *700* series, powered by a single internal cell and giving 300 hours operation from one *HP7* or more than 1,000 hours from one mercury battery. The power is switched on, mechanically, only while the microphone is plugged to its connector. A new and extremely rugged capsule mounting is used and this feature will also be introduced into the *1000* series. Simple, cheap adaptors will provide compatibility between old and new mountings if required. There are four versions of the *700* series amplifier, namely balanced or unbalanced outputs on either DIN or Cannon connectors, and any *1000* capsule can also be used. I tried swopping capsules and found this both quick and TA-proof; cross-threading is virtually impossible, and the job could be done one-handed in the dark, which some cynics claim is the usual requirement!

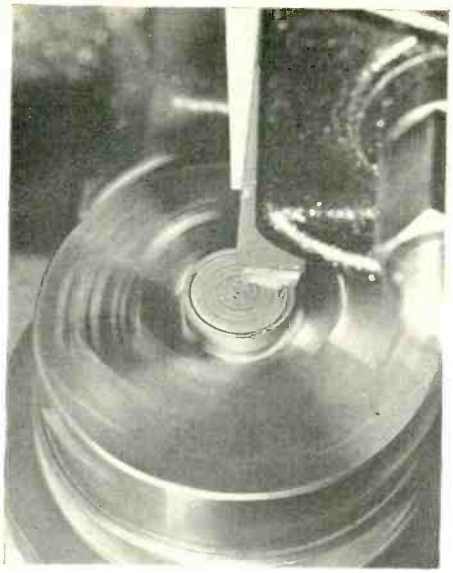
An additional variant in the *700* series is the *756*, a bass roll-off cardioid with a built-in spherical mesh shield. Coming shortly, I was told, is the *CB1100* preamplifier, which can be phantom powered, taking the same low current, at any voltage from 7.5 to 50V. This will accept any *700* or *1000* series capsule. Various extension tubes bring the total number of possible combinations of the system up to 144.

In addition to the clean room, the first floor provides most of the bench facilities for assembly and wiring of microphone amplifiers and power units and also of the mixer and control desks for which there is an ever-increasing demand.

Recent customers have included York University (equipment additional to that

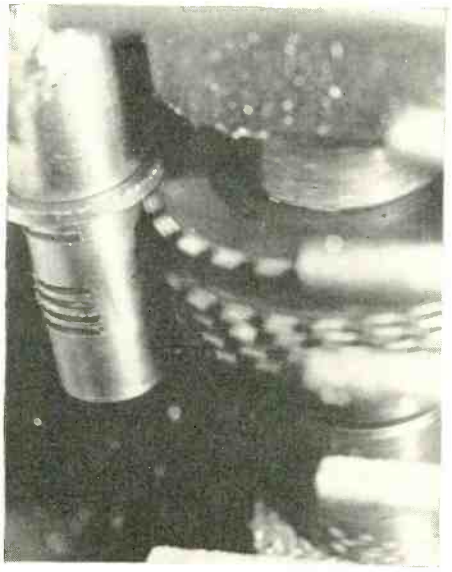






Top left: K Series main frame.
High left: K series modules under assembly.
Bottom left: Wing mirror mixer main frame.

Top right: Gapping a capsule.
Bottom right: Milling a capsule holder.



already installed in the Lyons Concert Hall), Blaze Advertising (India), the Wakefield Theatre Club (an extensive system for the international artists who perform there), Anglia and ATV (submixers), and Yorkshire TV (ob desk). Other important customers are the BBC for whom Calrec are making control desks; this year's Proms are all being relayed via a Calrec desk at the Albert Hall. These control desks are designed specifically for broadcast use and are of unit construction to allow ob use if required. A basic system involves an eight input unit, a four group plus two echo returns unit, and an output monitoring unit equipped with two twin ppms, usually reading a/b and m/s respectively but switchable as necessary. Five further eight input units can be added, powered by the group and monitoring unit, making 48 channels in all, and still more channels can be had by using extra group or monitoring units for powering.

The BBC and commercial concerns use up to 80 channels for (typically) band shows, and demand a minimum of 50 even for outside broadcast. To cope with this proliferation, Calrec are making premixers, each little bigger than one of the monitoring units mentioned above, containing six sets of six channels, and each set functioning separately if desired. Calder point out that, when all else fails, you can push their desk into the studio and record on it direct, since all their desks have capacitor talkback mics! This conjures up a nightmarish picture of 80-odd musicians each playing into a separate desk, with their music jammed under the routing knobs.

I noticed, too, that all Calrec desks have engraved legends—an increasingly rare luxury these days. Many of the standard modules are potted, and printed circuit switches are mounted directly on the mother board to cut down wiring—these features should improve reliability. Sizes, meanwhile, are shrinking. The Audio & Design *F760* complimiter is fitted in a module 210 x 45 mm x 166 deep, while two Dolby *CAT 22* cards (equivalent to two *361*) occupy 90 x 210 mm.

Three offices (plus the usual one), a test laboratory, a small drawing office, and a small canteen with an apparently endless supply of drirks (hot, free and non-alcoholic) complete the first floor.

The top floor is still empty, ignoring some inedible left-overs from the biscuit makers who used to live there. With the continuing expansion it is anticipated that all the lighter manufacture, such as microphone parts and mixer modules, will eventually be concentrated on this floor.

The staff now number 20 and is rising steadily. The company are still run in the same enthusiastic spirit by the same five directors, the only new titled appointment being that of George Waddington as works manager. He is a qualified industrial designer and his hand can be seen in improvements both in the appearance and the mode of construction of various items.

Calrec Audio sensibly refuse to bite off more than they can properly chew at any one time but this certainly does not inhibit them from looking well ahead, planning future improvements and looking into new ideas. For the future, I see no need to modify my original forecast, quoted at the beginning—on the contrary, I'm now giving it as a nap!

Equalisations and test tapes

J. M. BOWSHER*

The trouble with audio standards is that there are so many, not least in the field of tape equalisation. J. M. Bowsher explains the origin of the present profusion and the characteristics required to convert one standard to another.

DESPITE ANGUS McKenzie's excellent article in STUDIO SOUND a couple of years ago[1], it appears that some engineers are still getting confused over what is meant by a time constant and how they are to line up their machines when only an inappropriate test-tape is to hand. This article gives a short explanation of why various equalisations are necessary and an exposition of what to do in practical cases when a machine originally lined up for one standard has to be used to play a tape recorded to another standard.

For a professional in a large organisation the problem is in fact very simple because over the years only two equalisations and two speeds have survived for programme exchange. However, an amateur or small professional studio could meet anything and will have to try and work something out independently: hence this article.

Equalisation is necessary because it is not possible to carry out the recording and reproduction processes in a manner which is independent of the frequency of the signal. While there are some effects which can be traced directly to the frequency of the incoming signal (resonances in the heads, eddy current losses, etc), the more important and larger effects are directly attributable to the relationships between the wavelength of the signal as recorded on the tape and various dimensions of the tape transport such as the reproducing head gap length, the reproducing head length, the reproducing head width, and the tape thickness. It is much more convenient to talk of the wavelength in a general discussion but the actual values do not come readily to mind. **Table 1** shows wavelengths for some of the frequencies to be found on a test tape at the standard tape speeds.

Typical coating thicknesses are about 12 μm for a professional tape and about 5 μm for a cassette tape. Track widths are typically 6.25 mm for full track mono, 2 mm for two tracks on 6.25 mm tape or multitrack on wider tape, and 0.6 mm for stereo on cassette tape. Typical reproduce head gaps are 3 μm for professional machines and 1 to 2 μm for cassette players. It will be noticed that all these figures are comparable to a wavelength somewhere in **Table 1** and so a reproduction correction will inevitably be necessary in at least one region of the wavelength range covered in an audio recording.

Many papers have been written on what happens in the recording process; let us just take it for granted that, if one measures the short-circuit flux on a tape (this is what actually produces the signal for reproduction), one finds that for constant alternating current to the record head the short circuit flux for a typical fairly modern tape is 2 dB down for a wavelength of about 125 μm, 7 dB down for a wavelength of 63 μm, and 35 dB down for a wavelength of 8 μm. We can refer to **Table 1** to put these wavelengths into frequencies for any tape speed. If we had an ideal head to reproduce the recorded flux, we would get a frequency response curve for the whole record-reproduce process of the same shape as that giving the variation of short-circuit flux, assuming that the reproduce amplifier integrates the signal from the reproduce head to compensate for the fact that it responds to the rate of change of flux. The reason for the rapid fall-off towards short wavelengths lies primarily in the way the reproducing head gathers the flux from the increasingly thick (in terms of wavelength) tape coating.

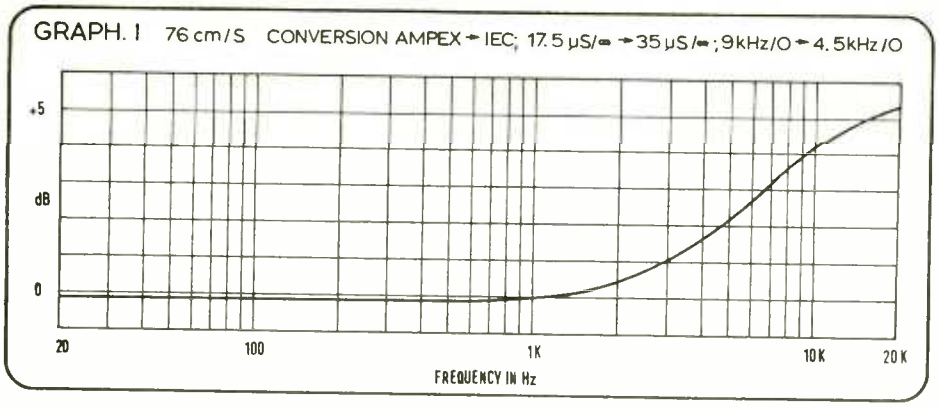
(Incidentally, although the 'ideal head' appears in several international and national standards it is not defined consistently and we have to rely on intuition to decide what it is.[3]) A response falling rapidly at short wavelengths is of no use on a tape recorder so some form of equalisation is essential. Unfortunately the curve described above is not a simple shape—in particular it cannot be represented by responses such as may be obtained with frequency proportional resistance/capacitance equalisers. McKnight shows, however, that the unequalised flux frequency response may be represented by *two* frequency proportional equalisers with transition frequencies (the frequencies where the responses have changed by 3 dB) in the ratio 4:1 for this example. Moreover, if the tape speed is halved, only one of the equalisers need be readjusted and the fit to the necessary curve is still very good. (Remember that, when the tape speed is changed, the frequency corresponding to a given wavelength is also changed so the equalisers *have* to be readjusted in some way.) For example if a transition frequency of 3,150 Hz is used in the reproduce amplifier equaliser, it is found that extremely close fits to the inverse of the short circuit flux/frequency curve are obtained if the record amplifier equaliser has a transition frequency of 12.5 kHz for a tape speed of 38 cm/s and 2.8 kHz for a tape speed of 19 cm/s. This is how the NAB specification arose[4]; it enables one to have the same reproduce amplifier for a two-speed tape machine.

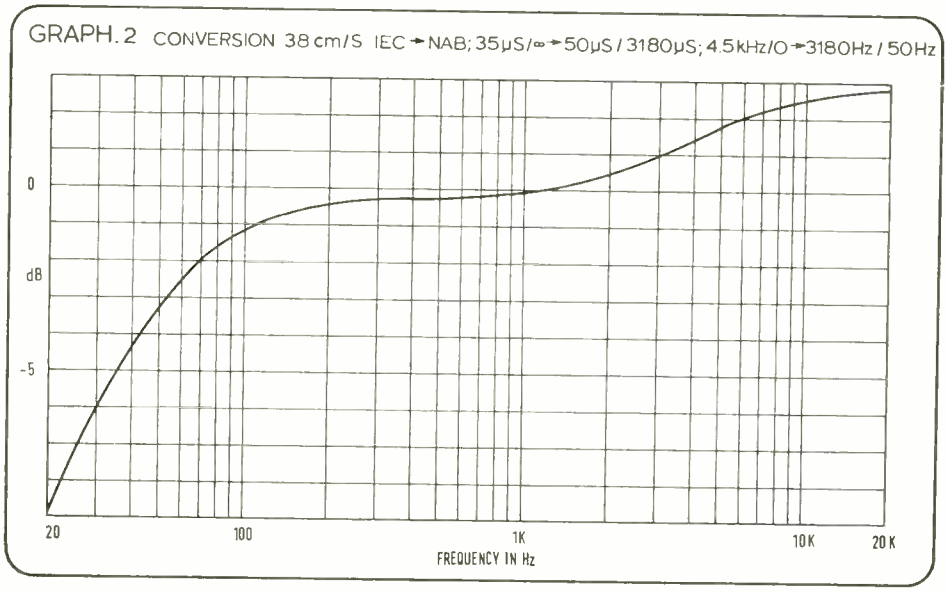
It is very important to realise that so far we have been concerned with compensating for the 'frequency response' of the recording process; we have not discussed at all the problems of improving the signal-to-noise ratio of the whole record-reproduce process or the problem of achieving a constant risk of overload for all frequencies or of correcting for

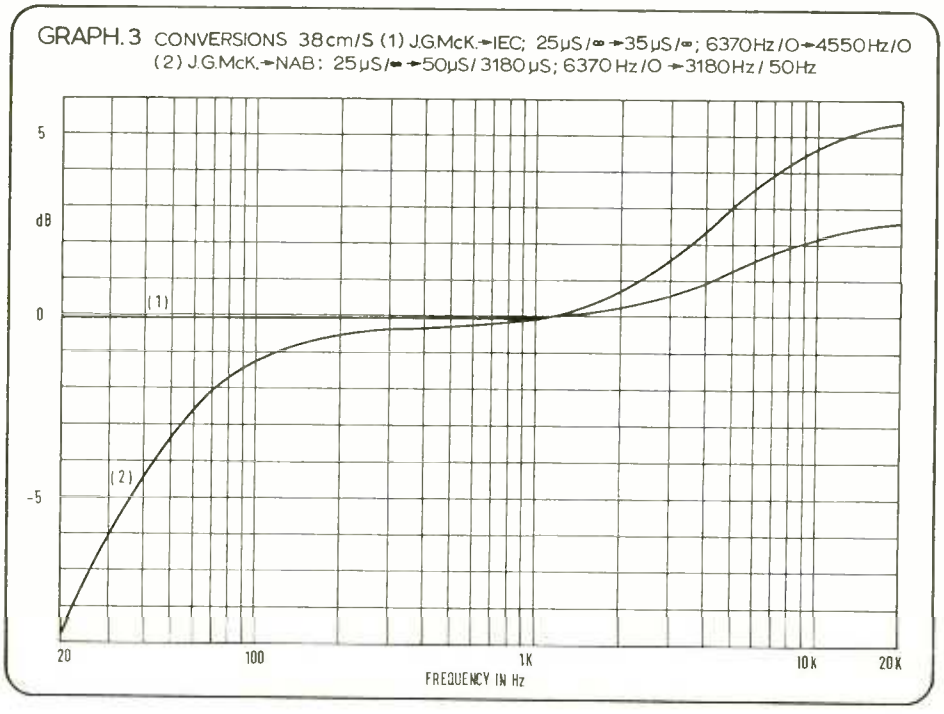
TABLE 1

Frequency (Hz) / Tape speed (cm/s)	31.5	333	400	1k	10k	18k
76	24.2 mm	2.29 mm	1.19 mm	762 μm	76.2 μm	42.3 μm
38	12.1 mm	1.14 mm	953 μm	381 μm	38.1 μm	21.2 μm
19	6.03 mm	571 μm	475 μm	190 μm	19.0 μm	10.5 μm
9.5	3.02 mm	285 μm	238 μm	95 mm	9.5 μm	5.27 μm
4.75	1.51 mm	143 μm	119 μm	47.5 μm	4.75 μm	2.64 μm

*University of Surrey







reproduction deficiencies. Despite a revealing article by Cramer,[5] most of the standardising organizations seem to work by a mixture of 'cut and try' and intuition in specifying the equalisers to be used. Essentially the philosophy seems to be to arrange the record equaliser so that a reasonable signal level as a function of frequency may be recorded on the tape, and the reproduce amplifier is then adjusted to complete the compensation for record losses, to compensate for the 'noise reducing' components of record equalisation and also to complete compensation for the reproducing losses.[6] Roughly speaking, the equalisations arrived at about 15 to 20 years ago turn out to be pretty satisfactory compromises between the conflicting requirements of, principally, signal-to-noise ratio and overload margin.

So far in this discussion, time constants have not been mentioned at all. Perhaps the first thing to dispose of is the hoary schoolboy howler that the time constant is the transient response of the tape machine. J. McKnight reports this tale,[7] I have heard it myself, and it is a warning to all of us not to use an unnecessarily complex idea when a simple one will do. In this article we refer to 'transition frequencies' and use them in what seems to be a natural manner. However in audio recording, for some very obscure reason, the convention has grown up of doing part of the circuit designer's work for him and calculating the RC product of the simple equaliser having the desired transition frequency. If f is that transition frequency, then the RC product of the simple equaliser is given by $1/2\pi f$. Since this product has the dimensions of time, it may be called the time constant of the equaliser. Why this curious convention has grown up and persisted is perhaps a matter for another paper.

Up to now there is an implication that only one equaliser will be used in each of the record and reproduce amplifiers. There is no fundamental reason why this should be so (for example the NAB standards imply the use of two equalisers in each). If we know (following Cramer) that the spectrum of the signal most likely to be recorded is low in some frequency region, for example the bass end, we can arrange equalisers so that the record signal is passed through a bass lift equaliser with a fairly low transition frequency (e.g. 50 Hz), and the reproduce amplifier has an inverse equaliser (bass cut) with the same transition frequency. In this way we have improved the signal-to-noise ratio at low frequencies at the expense of the dynamic range. For speech and conventional music there is very little power at low frequencies and so this idea works. But for organs, drums and electronic music the loss of dynamic range may be serious.

In general, NAB and amateur standards call for bass equalisers and European industrial standards manage without them. Standards, though, are usually behind the times because tapes are continuously improved to have better distortion or signal-to-noise ratio at given signal levels and so really require new equalisations to perform optimally at all frequencies. A further difficulty is found nowadays in multi-track work where one cannot make assumptions about the average spectrum to be recorded on any track since at one and the same time one track may be recording very high levels at bass frequencies and the next one very high levels at

54 ▶

EQUALISATIONS AND TEST TAPES

extreme high frequencies. It is quite impossible to have different equalisations on each track so standardising organisations have to err on the side of very adequate overload margins at all frequencies rather than press for the ultimate in signal-to-noise ratio.

So far the story has been (in principle!) fairly straightforward. There is an implication at least that the standard specified may be attained in practice without too much difficulty and that there is some point to a discussion of the relative merits of various transition frequencies for various tape speeds. When we come to the practice, though, we find that things are by no means as clear cut and test tapes purporting to allow one to set up a reproduce channel with a transition frequency at, say, 2,270 Hz (IEC standard for 19 cm/s), may in fact show a range of transition frequencies not only from tape to tape but also within one tape since the curve actually recorded does not follow the curve corresponding to the frequency response of a simple RC equaliser.[8] With this state of affairs there is not so much point in worrying about the precise differences between various equalisations as might appear from a reading of the standards. The literature indicates that test tapes made by BASF are likely to be closer to the intent of the standards than those made by other manufacturers, but the author has no personal evidence on this point. Let us, nevertheless, move on to calculate some of these differences so that a small studio will have the necessary conversions to hand. At this point we shall also bow to the entrenched convention about time constants (with some reluctance) and set out in **Table 2**

TABLE 2

Transition frequency (Hz)	Time constant (μs)
50	3180
100	1590
1140	140
1330	120
1590	100
1770	90
2270	70
3180	50
4550	35
6370	25
9100	17.5

the relationships between transition frequencies and time constants. (N.B. There are one or two misprints in Angus McKenzie's article.[1]) It is a fairly simple matter to work out from first principles the frequency response of a single RC equaliser of given time constant but the IEC have standardised the formula[9] as:

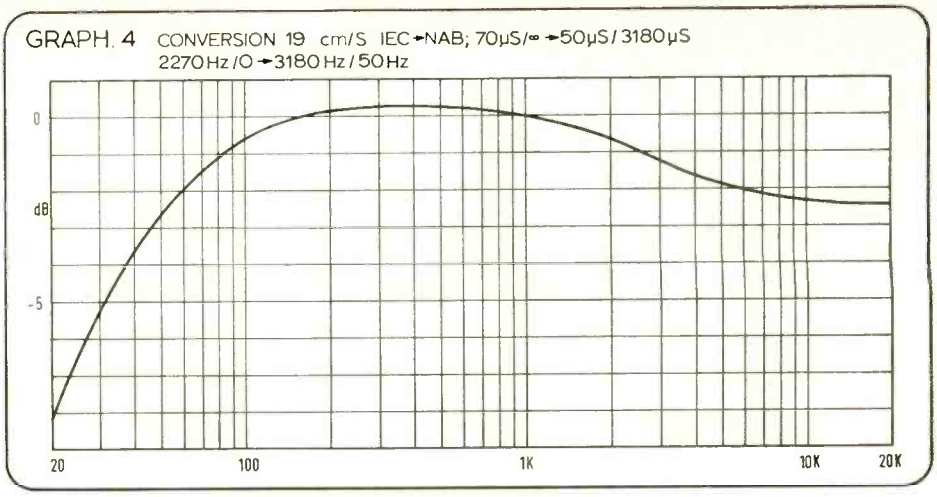
$$N(dB) = 10\lg\left(1+\frac{1}{4\pi^2 f^2 t_2^2}\right) - 10\lg(1+4\pi^2 f^2 t_1^2)$$

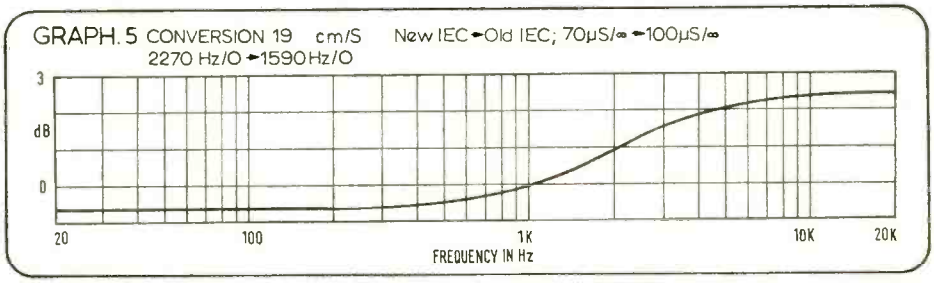
where f is the frequency in Hz,

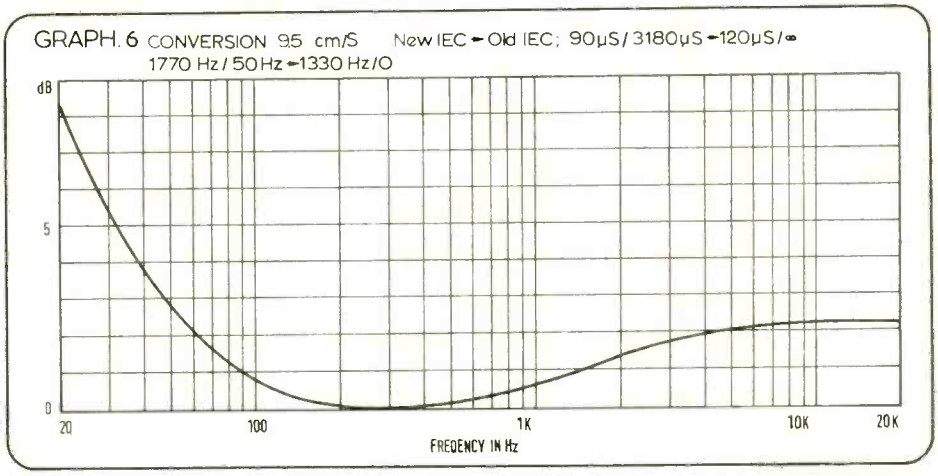
t_1 in *seconds* is the time constant of the treble equaliser,

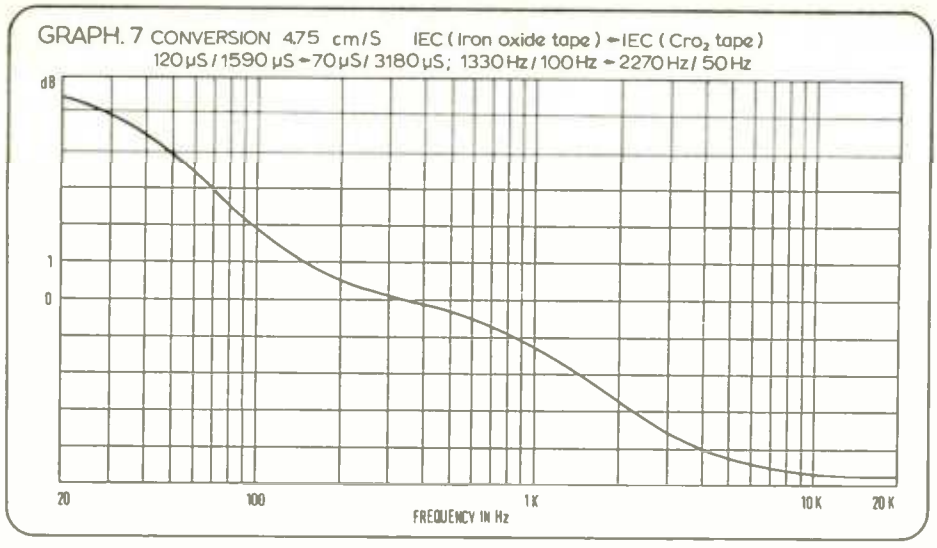
t_2 in *seconds* is the time constant of the bass equaliser.

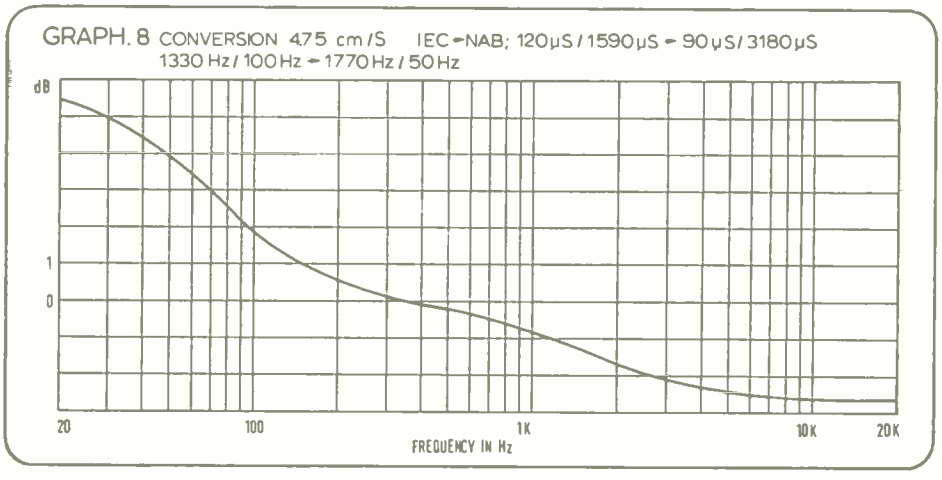
Thus, to work out the difference between two equalisations, all we have to do is to calculate N for one pair of values of t_1 and t_2, do it again for the other pair, and take the difference. This is excessively tedious without a computer or programmable calculator so the author here presents graphs for most of the cases likely to be met. A certain convention has to be set up or one can get very confused about the signs of the corrections. We assume that the studio has a particular test tape (A) but wishes to align the machine to a different standard (B) because a programme tape has arrived from outside recorded to standard (B). We shall call this a conversion A—>B and a *positive* correction for any frequency means that the reproduce level on the machine playing test tape (A) must be *increased* by the amount shown. This is the convention adopted by the major tape manufacturers. It is, perhaps, fair to note that many of them do supply conversion tables, usually to enable one to use a new test tape to line up a machine to the older standard appropriate to that speed. A word of warning is also necessary here—the author has found that there are quite a few errors in the conversion tables supplied by EMI (which they admit) and the best advice is to ignore any EMI conversion tables published before the date of this article. If a reverse conversion is required (i.e. B—>A) all that has to be done is to use the appropriate A—>B graph and change all the signs from positive to negative and vice versa.











Graph 1 Applies to 76 cm/s and is the conversion Ampex—>IEC

Graph 2 Applies to 38 cm/s and is the conversion IEC—>NAB

Graph 3 Applies to 38 cm/s and shows the two conversions from the proposed new standard for studio mastering[10]—>IEC and—>NAB.

Graph 4 Applies to 19 cm/s and is the conversion IEC—>NAB. This is the same as the conversion DIN studio—>DIN household and is particularly convenient for smaller studios who frequently have to line up machines set for the DIN (H) equalization.

Graph 5 Also applies to 19 cm/s and is the conversion New IEC(70 μs)—>Old IEC(100 μs).

Graphs 1 to 5 inclusive are normalised so that the correction is zero at 1 kHz, this being the frequency which is used to set the reproduce level initially.

Graph 6 Applies to 95 cm/s and is the conversion New IEC (90 μs/3,180 μs)—>Old IEC (120 μs). This graph has been normalised to 400 Hz as this is the frequency used on EMI test tape *SRT19* to set levels. Fortunately the correction is also zero at 333 Hz, the frequency used for level setting on DIN calibrated tape 9.

Graph 7 Applies to 4.75 cm/s and is the conversion IEC (cassettes)—>Proposed IEC for CrO_2 tape. This conversion illustrates dramatically the large amount of bass pre-emphasis used in the 'iron oxide tape' equalisation for cassette recorders.

Graph 8 Also applies to 4.75 cm/s and is the conversion IEC—>NAB.

Graphs 7 and 8 are normalised at 333 Hz.

Many more graphs could be drawn but the author believes that this selection will be the most useful. The EIA test tape *SP 1015* is not included in the conversion graphs because it seems unlikely that any reader of this journal would use it. However, if any reader does need a conversion graph for it or a 'special' relating two esoteric equalisations the writer will be happy to supply one provided that the equalisations are described by no more than two time constants. This eliminates, I am afraid, such oddities as the Ampex Master Equalisation and the old *ARD* German broadcasting standard. These equalisations were realised in practice by resonant circuits and cannot be described very simply in mathematical terms. I have made several enquiries about them and have not found any need for conversion graphs.

A final complication remains to be considered: fringing. All internationally agreed standards and most national ones call for the test tape to be magnetised across its full width; if one uses a reproduce head which is narrower than the test tape (e.g. a twin track head) it responds to the flux on the tape outside its own width to an extent which depends primarily on the ratio of the head width to the wavelength of the recorded flux. This ratio is normally very large but for lower frequencies it becomes smaller and may even go less than one. See **Table 1**; for a reproduce head width of 2 mm, the head width to wavelength ratio is less than one for frequencies below about 200 Hz at 38 cm/s. For values of the ratio less than about two, the extra flux passing through the head is significant and leads to a frequency-dependent increase in the signal from the reproduce amplifier which may in practice easily be as much as 5 dB.[11] Unfortunately the general formula to fit all cases is very difficult to apply as one needs to know not only the head width but also the position of the head relative to the edge of the tape, the amount of screening between tracks, and even the length of the head. There are therefore no fringing corrections given in this article. A very rough guide[12] may be given, though, for the particular case of twin tracks on 6.25 mm tape. Given an IEC test tape (38 cm/s) with no low frequency bass lift, if it is played on a twin track machine and no fringing correction is made it will be found that the reproduce amplifier will have a bass cut corresponding almost exactly to that required for NAB alignment (50 Hz transition frequency).

A final note: since one cannot rely on a test tape to close limits, it is not worthwhile going to a great deal of trouble to adjust a machine to precisely the response shown in the graphs; a precision of 0.5 dB is entirely adequate.

References

1. A. McKenzie: *Studio Sound* June 286 (1971). 'Understanding Time Constants'.
2. J. G. McKnight: *Journal Society Motion Picture and Television Engineers 87* 457 (1969). 'Flux and flux-frequency measurements and standardization in magnetic recording.'
3. J. G. McKnight: Ibid p. 470.
4. R. K. Morrison: *Journal Audio Engineering Society 15* 158, (1967) "Reproducer test tapes: evolution and manufacture.'
5. B. G. Cramer: *IEEE Transactions on Audio AU-14*, 3 (1966), 'Optimum linear filtering of analog signals in noisy channels'.
6. R. Bufford et M. Calmet: International Conference on Magnetic Recording, London 1964. 'Etude des normes de l'enregistrement sonore'.
7. J. G. McKnight: Ibid p. 466.
8. F. J. Kolb and D. L. Carr: *Journal Society Motion Picture and Television Engineers 80*, 1 (1971). 'Frequency response for 16 mm magnetic sound: a survey of test films'.
9. International Electrotechnical Commission: Publication 94 (1968) Magnetic tape recording and reproducing systems.
10. J. G. McKnight and T. Kendall: AES Preprint 1973 'Proposed equalisation for 38 cm/s studio master recording on high-output, low noise tapes'.
11. J. G. McKnight: *Journal Audio Engineering Society 20*, 100 (1972), 'The fringing response of magnetic reproducers at long wavelengths'.
12. F. J. Kolb and D. L. Carr: Ibid p. 5.

Survey: Industrial tape recorders

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MM1100

Eight, 16 and 24 channel models. Constant tape tension with 27 and 36 cm reels. Capstan servo affording stable tape motion in 0.5s. at 38 cm/s. Identical playback in both sel-sync system and normal reproduce. Mounted on large castors. Detachable controls for remote operation.

The *MM1100* is available in eight, 16 and 24 track models, and it accepts 27 cm and 36 cm reels. In performance, it equals the specifications of the Ampex *MM1000* and the eight track Ampex *AG4408*.

Capstan servo

The capstan servo stabilises tape motion in 0.5s at 38 cm/s and keeps constant speed through operation. The capstan servo isolates the capstan motor from power line frequency fluctuations by using its own crystal oscillator as a reference. The capstan is actually the shaft of a printed-circuit dc motor: this feature eliminates belts and pulleys.

Tape tension servo

The tape tension servo is activated by the tape. The result is improved tape to head contact.

Sel-sync

The record head and the switching circuitry are designed to produce a playback response in the sel sync system equal in every respect to normal reproduce performance.

Flutter: 38 cm/s below 0.08% rms, 19 cm/s below 0.1% rms, 9.5 cm/s below 0.15% rms.

Percentage of total flutter is measured by the methods of American Standard Association 257.1 1954, in a band 0.5 to 200 Hz, while reproducing an Ampex flutter test tape (flutter on test tape less than 0.03%).

Playback output: +8 dBm into 600 ohms re-strappable for +4 dBm output, balanced or unbalanced. Clip level not less than +28 dBm.

Distortion: second harmonic distortion of a 500 Hz signal recorded at peak record level is less than 0.4%.

Record input: 100k unbalanced bridging with dummy plug supplied or 20k balanced bridging with plug-in transformer supplied with each electronics. −17 dBm to produce recommended operating level.

AG440B

Specifications

Tape speeds: 19 and 38 cm/s or 9.5 and 19 cm/s.

Signal-to-noise ratio at 38 cm/s:
66 dB (full track).
63 dB (two track).
60 dB (four track).

Peak record level to unweighted noise (30 Hz to 18 kHz). Includes bias, erase and playback amplifier noise using Ampex *404* series tape or equivalent.

Frequency response Overall: 38 cm/s ±2 dB 30 Hz to 18 kHz, 19 cm/s ±2 dB 40 Hz to 15 kHz, 9.5 ±2 dB 50 Hz to 7.5 kHz.

Electronic adjustments: accessible from front equalisation; reproduce calibration; bias adjustment; bias calibration; erase adjust. Sel-sync level and bias trap adjustment on rear of chassis.

Start/Stop: Start tape at full speed in less than 0.5s. Stop at 38 cm/s tape moves less than 50 mm after pressing stop button.

Playback timing accuracy: ±0.2% (±3.6s in 30 minutes recording time).

Mounting configurations: portable, unmounted, console (electronics above transport).

Tape width: standard 6.25 mm (one or two channels) or 12.5 mm (four channel).

Reel size: standard up to 27 cm reels, adjustable up to 29 cm reels.

Equalisation: all standard models supplied with NAB equalisation. CCIR curves available on special order.

Edit control: edit button stops take-up reel, permitting tape to move in play mode without winding on reel. Button also releases brakes in stop mode for easier threading.

Rewind time: approximately one minute for 730m NAB reel; 30s for 365m EIA reels.

Amplifiers: separate record, reproduce and bias amplifiers plug-in from front of module. Input or output may be monitored during recording.

Bias and erase frequency: 150 kHz.

Power requirements: standard models are 117V 50 or 60 Hz. Units with multiple tapped power input transformers are available on special order. Single channel requires 2.3A; two channel requires 2.5A; four channel requires 2.9A. All machines are supplied with three wire grounding power cord.

Dimensions: single channel console 103 x 62 x 70 cm. Add 9 cm height per additional channel Standard 48.3 cm wide panels with commercial notching for rack mounting. Transport requires 40 cm of rack space.

AG500

Remote control of all functions, four position head assembly. Two speed transport (19, 38 cm/s or 9.5 and 19 cm/s). Full or half track mono, half or quarter track stereo. Portable case or rack mount. System-matched accessory units.

Overall frequency response: 30 Hz to 18 kHz ±2 dB at 38 cm/s. 30 Hz to 15 kHz ±2 dB, 4 dB at 19 cm/s. 40 Hz to 8 kHz ±2 dB, −4 dB at 9.5 cm/s.

Signal-to-noise ratio: (peak record level to unweighted noise: includes bias, erase and playback amplifier noise). 55 dB at 38 cm/s and 9.5 cm/s (half track or two track). 60 dB at 38 and 19 cm/s (full track 60 cps). 57 dB at 38 and 19 cm/s (full track 50 cps). 55 dB at 9.5 cm/s (full track). 50 dB at 9.5 cm/s (half track and quarter track).

Wow and flutter: less than 0.15% rms at 38 cm/s. 0.18% rms at 19 cm/s. 0.25% rms at 9.5 cm/s.

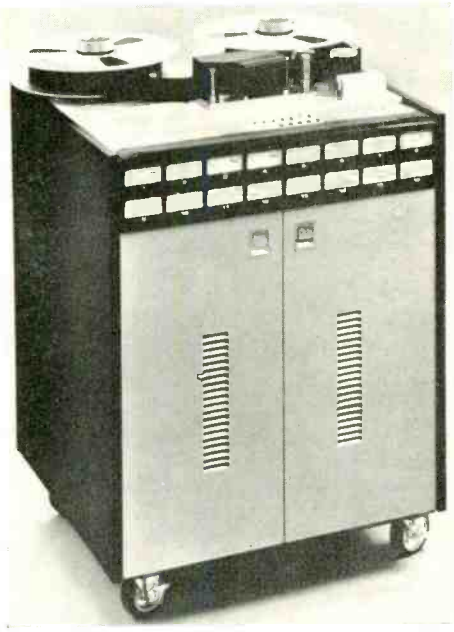
Timing accuracy: ±0.25% at 38 and 19 cm/s ±0.40% at 9.5 cm/s.

Output: +4 dBm into 600 ohm balanced load. Cannon XL connectors. Single headphone jack provided.

Inputs: two inputs per channel, 100k ohms unbalanced. Will accept input signal levels as low as −18 dBm for normal operating level.

Power required: 117V ac 60 cycles, 1.50A 230V ac—50 cycles 0.75A. Three wire grounded power cable supplied.

Rack space: transport (22.2 x 48.3 cm).



Electronics: 8.9 x 48.3 cm. Minimum space required 15.2 cm behind panels.
Portable units: mounted in rugged Samsonite cases. Both one and two channel cases have sliding rear panel for access to connectors and adjustments on rear of machine. Cases are designed so machines can be operated vertically or horizontally with cables connected.
Dimensions: one channel portable 508 x 234 x 364 mm (includes feet and handle). Two channel portable 508 x 234 x 461 mm (includes feet and handle).
Weight: 23.6 kg.

AG600B Portable audio recorder
Rugged, time-proven construction. Two switch-selectable speeds. Automatically switched equalisation, solid-state electronics. Compact portable and rack-mount versions, stereo and mono versions. Three digit tape counter, accessory speaker/amplifier and mixer
Specifications
Speeds: 19 and 9.5 cm/s.
Frequency response: 19 cm/s ±2 dB from 60 Hz to 10 kHz, ±2 —4 dB from 40 Hz to 15 kHz. 9.5 cm/s ±2 dB from 50 Hz to 7 kHz, +2 dB from 40 Hz to 8 kHz.
Signal to noise: 19 cm/s full track 57 dB, half track 55 dB. 9.5 cm/s full track 52 dB, half track 50 dB.
Crosstalk rejection: better than 40 dB mid-frequency.
Wow and flutter: (measured by ASA standards) 19 cm/s less than 0.17%, 9.5 cm/s less than 0.25%.
Timing accuracy: 19 cm/s ±0.2% (±3.6s in a 30 minute recording), 9.5 cm/s ±0.4% (±7.2s in a 30 minute recording).
Fast forward or rewind time: 19 cm/s mode: 365m reel: 90s. 9.5 cm/s mode: 365m reel: 180s.
Speeds: 38 and 19 cm/s.
Inputs: Two inputs with individual gain control on each. Low impedance mike input, 150 μV required for programme record level 30 to 250 ohm nominal impedance. Line input (100k ohm unbalanced), —10 dBm required for programme record level. (May be used as microphone input with accessory plug-in microphone preamplifier).
Outputs: two outputs for each channel. +4 dBm into 600 ohm. Balanced or unbalanced load. Headphone monitor jack (on front panel) monitor selector permits monitoring either input source or tape playback, with recording.
Equalisation: for 117V, 60 Hz models: 9.5 cm/s 120 us, 19 cm/s NAB. For 115/230V, 50 Hz models: 9.5 cm/s, 120 us, 19 cm/s NAB or CCIR.
Power requirements: for 117V operation 0.5A. For 230V operation 0.3A.
Dimensions: (in portable case) single channel: 375 x 330 x 222 mm.
Dual Channel: 496 x 330 x 222 mm.
Weight: single channel: 12.7 kg. dual channel: 19 kg.

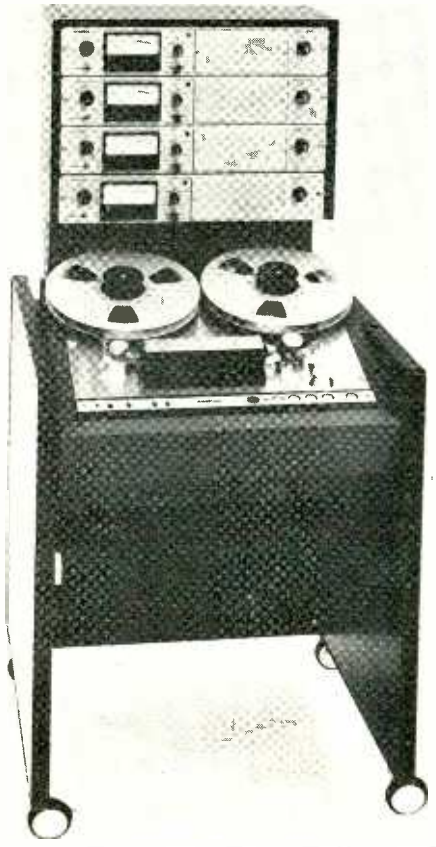
BIAS
Bias Electronics Ltd, Unit 8, Coombe Trading Estate, 112/120 Coombe Lane, London SW20 0BA
Phone: 01-947 3121
BE1000
6.25 mm range
Range of models includes mono full track, stereo, and twin track in rack mounting, transportable or console form.
Features include: precision case tape deck; plug in headblock; electronic servo tape tension system; three motors; variable speed spooling; counter driven by tape reading minutes; plug in modules on fibre glass circuit boards; bias gain and eq adjustments on module front panel; switchable NAB/CCIR.
Tape speeds: 19 and 38 cm/s standard.
9.5 and 19 cm/s to order.
38 and 76 cm/s to order.
Prices of 6.25 mm machines: from £546 for stereo.
Logging machines
Based upon the *BE1000* a range of logging machines for continuous monitoring of broadcasts, etc, are now available. With tape speeds 2.375 and 4.75 and recording up to four tracks on 6.25 mm tape. Full details on request.

BE2000
The *BE2000* series are 12.5 mm format machines for four track recording. Three models are available. The *BE2000 RRT* is a four track 12.5 mm record/replay transportable intended for four track on quadraphonic mastering or copying. The *BE2000 RRTC* is a four track 12.5 mm console record/replay machine. The *BE2000 RRSC* is a four track 12.5 mm console record/replay machine with track selection, sync and VU meters. The specification of the four track machines is the same as that of the *BE1000*.
Additional information
Sync response: 40 Hz to 12 kHz ±3 dB.
Crosstalk at 1 kHz: better than —40 dB.
Click-free drop in.
Ernest Turner VU meters switched line in/out.

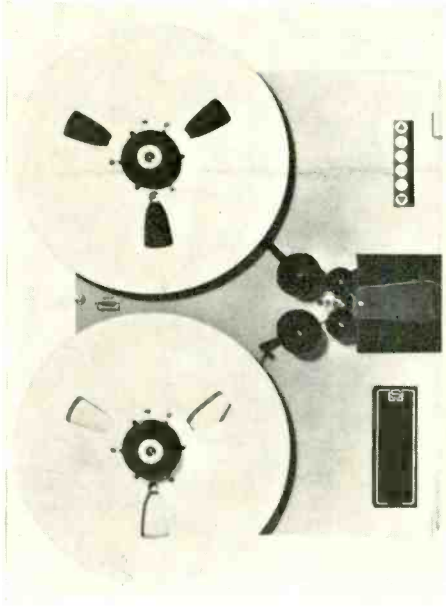
KLARK
Klark-Teknik Ltd, MOS Industrial Site, Summerfield, Kidderminster, Worcestershire.
Phone: 0562 64027
Teknik 2000
Teknik 2000 range of tape recorders for studio and laboratory applications available October 1973.
Tape widths: 0.25 mm—50 mm.
Tracks: stereo (0.25) to 24 track (50 mm).
Logic control.
Full remote facilities.
Dc variable speed capstan.
Wow and flutter: 0.04% at 38 cm/s.
Dual capstans.
S/n ratio: 64 dB.
Designed for those who want custom built systems or special applications at no extra cost.
Prices: on application.

LEEVERS-RICH
Leevers-Rich Equipment Ltd, 319 Trinity Road, Wandsworth, London SW18 1YQ.
Phone: 01 874 9054
E200
Heavy duty two-speed recorder available in full track and stereo forms, rack or console mounted. Track format to BS 1568: 1970.
Tape speeds: 73-38, 38-19 or 19-9.5 cm/s. (Specifications relates to 38 cm/s).
Wow and flutter: 0.06%.
Stability: ±0.2% end to end.
Start time: 90 ms to rated flutter.
Spool capacity: 29 cm European, 27 cm NAB, 21 cm cine.
Frequency response: 40 Hz to 18 kHz ±2 dB.
Signal to noise: (full track) 62 dB.
Metering: VU standard. ppm to order.
Price: £770 (full track), £950 (stereo) excluding mounts.
Lowline version
Lowline professional tape recorder console—desk high for armchair operation—full monitoring selection—professional faders—plenty of room for editing.
A desk-high, sloping top professional tape recorder was introduced by Leevers-Rich at the APRS exhibition in London on June 22, 1973.
This departure from the usual 'kitchen stove' design concept makes it possible to integrate mastering and broadcast machines with other desk-high equipment, such as sound mixing desks, in studio control rooms.

High left to right:
Ampex *MM1100* and *AG-600B*,
Amity eight track,
and Ampex *AG440B*.



INDUSTRIAL TAPE RECORDERS



High left to right:
Klark Teknik *2000*, Cetec 6.25 mm transport, and Leevers-Rich *E200*.

The new arrangement makes it possible to edit for example, with the operator seated and with a good view of the deck and all controls easily to hand.
Known as the *E200* Lowline, the new equipment is available with any of their standard *E200* 6.25 mm tape decks (full track, half track, twin track or stereo). Features include a control panel offering a selection of audio and headphone monitoring with VU or ppm metering, and fully professional faders by Penny and Giles.
The electronics are modular with plug-in sub-assemblies. Performance is to the same specification as all the other Leevers-Rich machines and, like other *E200* machines, it has interchangeable sub-assemblies and can be used away from major repair facilities.
No pre-set controls are visible so levels cannot be accidentally altered. A pencil tray is provided.
The deck hinges upwards on the horizontal plane for access and the electronics are mounted in the pedestal and swing out for servicing.
The console is of heavy gauge steel in matt black with teak side panels and upholstered trim. It is mounted on ball castors. Dimensions: (wdh) 584 x 711 x 787 mm.

Film recorders
Range of magnetic recorders suitable for COMMAG duplicating and all SEPMAG applications. Available in 8, Super 8, 16, 17.5 and 35 mm. Specification relates to model *F35*.
Film gauge: 35 mm edge stripe or fully coated.
Film speed: 24 or 25 f/s convertible (sprocket change)
Frequency response: 40 Hz to 15 kHz ±2 dB.
Noise level: 57 dB.
Wow and flutter: 0.05%.
Dimensions: 700 x 540 x 1560 mm.
Weight: 100 kg.
Price: (single *F4RCR* recorder/reproducer): £1,400.

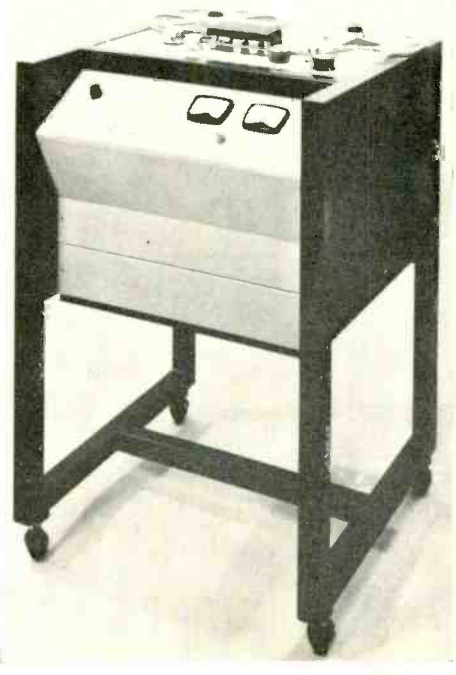
SCULLY
Manufacturers: Scully Recording Instruments Company (division of Dictaphone), 480 Bunnell Street, Bridgeport, Connecticut 06607.
Agents: Scully Metrotech, 14 Broadway, London, SW1.
Phone: 01-222 5483

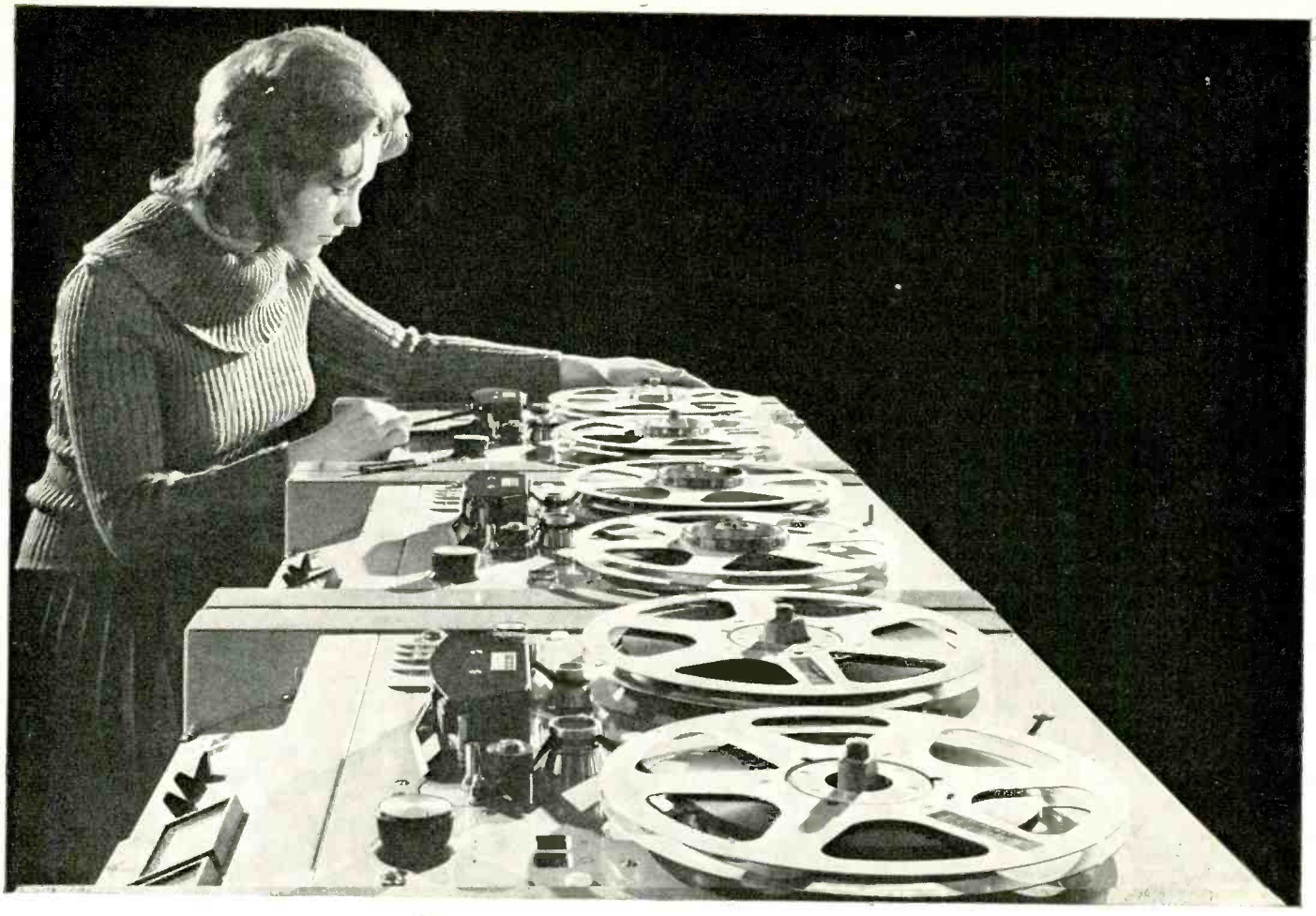
100
Tape speed: single speed 38 cm/s (76 cm/s on special request).
Multi-channel configurations: 16 track on 50 mm tape, 12 or eight track on 25 mm tape.
Mounting: custom floor console mount.
Tape transport controls: start, stop (and cue), fast forward, fast rewind, automatic tape lifter defeat.
Reel size: up to 28 cm.
Start time: play speed in 0.1s.
Timing accuracy: 99.9%.
Rewind time: approximately 75s (730m) reel.
Wow and flutter: 0.06% rms, 0.5 to 200 Hz, unweighted (per ASA 257.1).
Frequency response: ±2 dB, 35 Hz to 15 kHz.
Signal to noise ratio: reference +10 dBm using 3M 206 or equal: 16 track (50 mm) 63 dB, unweighted (30 Hz to 20 kHz bandpass).
Electronic controls: record-sync mode selector, input and output level, record and sync playback high frequency equalisation and master bias level.
Equalisation: NAB, 50 µs +3180; CCIR, 35 µs.
Bias and erase oscillator frequency: 100 kHz.
Sync playback output: +4 dBm from balance or floating unbalanced line of 15 to infinite ohms impedance.
Input impedance: 10k ohms.
Output impedance: less than 100 ohms.
Remote controls: all except power on-off.
Power requirements: 115V ac, 50 or 60 Hz, 1k W.

270
Specifications
Head configurations: monophonic half or full track stereo two or quarter track.
Tape speed: 9.5 and 19 cm/s or 19 and 38 cm/s.
Tape width: 6.25 mm.
Reel size: up to 36 cm.
Start time: play speed in 0.1s.
Rewind time: approximately 105s. (1460 m reel).
Timing accuracy: better than 99.7% for 30 minute tape.
Power requirements: 117V ac, 60 Hz 275W (50 Hz optional).
Transport controls: play, fast direction, change, stop, speed selector.
Control system: all relays and solenoids 24V dc plug-in relays.
Frequency response: mono and two track ±2 db 50 Hz to 15 kHz at 38 cm/s. Quarter track stereo, ±4 dB 50 Hz to 100 Hz above 100 Hz response same as mono and two track.
Signal to noise ratio: mono full track: 65 dB minimum at 19 cm/s and 38 cm/s. Stereo two track; 60 dB minimum at 19 and 38 cm/s. Stereo quarter track; 58 dB minimum at 19 and 38 cm/s 54 dB minimum at 9.5 cm/s.
Wow and flutter: 9.5 cm/s 0.2% rms or better; 19 cm/s 0.1% rms or better; 38 cm/s .08% rms or better.
Distortion: less than 0.5% total harmonic distortion at +18 dBm.
Equalisation: front panel switch.
Output: +18 dBm from 600 ohm balanced line (normally supplied +4 dBm = 0 VU).
Tape tension: continuous adjustable electrical control system.
Weight: 45 kg.
Dimensions: 483 x 621 x 222 mm.

284
Configurations: Eight or 12 channel on 25 mm tape.
Tape speed: 19 and 38 cm/s or 38 and 76 cm/s.
Mounting: suitable for rack mounting, portable cases or custom floor console.
Power requirements: 115V ac 50 to 60 Hz 325W.
Tape transport controls: power on/off, record, rewind, fast forward, stop, start, speed equalisation change, edit, individual reel tension switches.
Reel size: up to 28 cm.
Start time: play speed in 0.1s.
Timing accuracy: 99.9%.
Rewind time: approximately 75s (730m NAB reel).
Frequency response: ±2 dB 50 Hz to 15 kHz at 76 cm/s, ±2 dB 35 Hz to 15 kHz at 38 cm/s. —3 dB +2 dB, 50 Hz to 15 kHz at 19 cm/s.
Signal to noise ratio: reference +10 dBm using 3M 202 or equal, 63 dB.
Wow and flutter: (all components between 0.5—250 Hz) 76 cm/s 0.6% rms or better; 38 cm/s. 08% rms or better, 19 cm/s 0.1% rms or better. Electronic alignment controls: visible controls: record level, function switch, monitoring and meter switch, playback level, line termination switch.
Maintenance controls: (located under dress strip): noise balance, playback equalisation, record equalisation for high and low speeds, linearity test push-button, linearity control, record-calibrate, reference set, bias adjust, bias calibrate, bias tuning.
Distortion: (playback amplifier) less than 0.5%

60 ▶





for the professional

contact **Derek Owen** at 01-874 9054 or
Telex 923455

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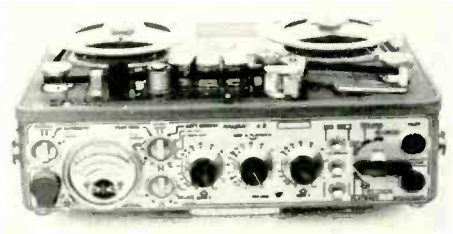
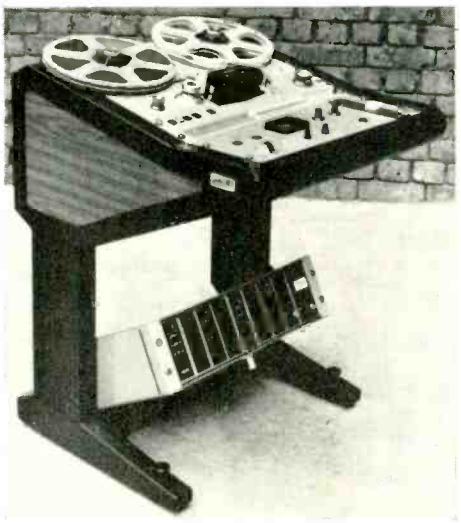
INDUSTRIAL TAPE RECORDERS





High left to bottom right:
Nagra 4, two versions
of the LR *E200*, and 24 track MCI.

total harmonic distortion at +18 dBm.
Equalisation: NAB curve equalisation standard; CCIR equalisation available on special order. Capstan speed switch selects appropriate selection.
Bias frequency: 180 kHz.
Erase frequency: 60 kHz.
Output: +4 or +8 dBm from 600 ohm balance line. (Machines are factory prepared with +4 dBm = 0 VU).
Input: bridging (600 ohm balanced or unbalanced line) microphone, low impedance (150 to 250 ohms).
Input impedance: 10k ohms (line).
Remote transport controls: record, rewind, fast forward, stop, play tape lifter defeat.
Remote amplifier controls: record, safe and sync for all tracks; master ready and safe.

280B
Frequency response: (3M 206 or equivalent tape used as reference) 38 cm/s ±2 dB 30 Hz to 18 kHz.
Signal-to-noise ratio: (Using 3M 206 tape or equivalent). Peak record level to NAB weighted noise. (NAB equalisation 500 nWb/m).
Two track stereo at 38 cm/s:

Full track	half track	two track	four track
6.25 mm	6.25 mm	6.25 mm	12.5 mm
72 dB	69 dB	69 dB	69 dB

Wow and flutter: unweighted rms flutter of recording and reproducing system 38 cm/s 0.08% or better, 19 cm/s 0.1% or better, 9.5 cm/s 0.2% or better.
Distortion: 500 Hz 3rd harmonic (500 nWb/m): less than 3% standard operating level. (250 nWb/m less than 5%).
Head and track configuration: full track mono (6.25 mm) half track mono (12.5 mm), two track stereo (6.25 mm), four track (12.5 mm).
Timing accuracy: within ±0.2% at all speeds.
Start and stop time: 6.25 mm tape less than 0.5s at 38 cm/s tape moves less than 3.75 cm/s after depressing stop. At wind speed tape stops in less than 4s.
Wind time: less than 60s for 730m NAB reel, 6.25 mm tape.
Reel sizes: to 30 cm CCIR.
Inputs: floating bridging 10k ohms minimum level 200 mV.
Output: 600 ohms, 24 dBm (output impedance 60 ohms).
Power requirements: 105-125V 60 Hz (50 Hz optional extra).
Tape widths: 6.25 and 12.5 mm.
Tape speeds (two) equalisation switches automatically with speed 9.5 and 19 cm/s or 19 and 38 cm/s.
Motors
Capstan: direct drive hysteresis synchronous. Reel: induction torque motor (2).
Brakes: dynamic plus disc.
Alignment controls: equalisation controls: two record, four play, bias level, record calibration; sync calibration; play calibration.
Bias and erase frequency: 160 kHz.
Erase efficiency: greater than 75 dB.
Remote control: fast (forward-rewind) start/stop; record and atl defeat (fast forward or rewind button).
Accessories
Remote control. Extra manuals: (in addition to manual provided with recorder).
Dimensions: hwd 127 x 632 x 725 cm.

STUDER

Manufacturer: Studer Franz AG, CG 5430, Wet ingen, Switzerland.
Agents: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Hertfordshire.
Phone: 953 0091

A80
Model options
The standard models have speeds of 19 and 38 cm/s. Track configurations available include 6.25 mm full track; 6.25 mm stereo with full track erase head and track separation of 0.75 mm; 6.25 mm two channel with track separation of 2 mm and a two track erase head; 12.5 mm four channel; 25 mm four channel; 25 mm eight channel and 50 mm 16 channel. All the units are supplied in a metal console and the four, eight and 16 track machines can be converted to 12.5, 25 and 50 mm tape operation by exchangeable head assemblies and tape guides. Multichannel models using 12.5 to 50 mm tape.
Tape speeds: 38 and 19 cm/s ±0.2%.
Reel type: up to 27 cm NAB hub.
Tape slip: 0.1% or less.
Wow and flutter: 38 cm/s.
Measured with EMT 420 DIN 45507, peak value unweighted: 0.1% or less.
Wow and flutter: 19 cm/s.
Measured with EMT 420 DIN 45507, peak value unweighted: 0.15% or less.
Line inputs: balanced and floating. Input impedance 8k ohms.
Minimum input levels: —14 dBm to produce recommended operating level (200 nWb/m).
Maximum input level: +22 dBm.
Line outputs: balanced and floating. Output impedance 30 ohms or less (minimum load impedance 200 ohms).
Maximum undistorted output level: +24 dBm.
Sync outputs: same specifications as line outputs.
Frequency response overall: 38 cm/s 30 Hz to 18 kHz ±2 dB, 60 Hz to 15 kHz ±1 dB. 19 cm/s 30 Hz to 15 kHz +2 dB, 60 Hz to 12 kHz ±1 dB.
Record reproduce
Record sync
Crosstalk rejection: 40 dB or more, 60 Hz to 15 kHz.
Bias frequency: 240 kHz.
Erase frequency: 80 kHz.
Power requirements: Mains: 100V to 120V or 200V to 240V +10% 50 Hz or 60 Hz.
Power consumption (tape transport and amplifiers): 6.25 mm 320 VA, 12.5 mm 400 VA, 25 mm 450 VA, 50 mm 800 VA.
6.25 mm versions.
Tape speeds: 38 and 19 cm/s ±0.2% (adjustable).
Reel type: DIN, NAB, Cine up to 300 mm reels.
Wow and flutter: 38 cm/s.
Measured with EMT 420, DIN 45507, peak value, unweighted: 0.08% or less.
Wow and flutter: 19 cm/s.
Measured with EMT 420, DIN 45507 peak valuer, unweighted: 0.12% or less.
Minimum line input level: -8 dBm.
For other parameters, see multi-channel spec.

A80R Broadcast master recorder
This machine is available in chassis form or supplied with a VU meter control panel, or on the normal wheeled trolley with line-up facilities below. There are six tape formats: full track 6.25 mm mono; same with pilot tone; stereo 6.25 mm tape width with 0.75 or 2 mm track separation; same with 0.75

62 ▶

PLUGS & LEADS

PLUGS

Pack 107 5 pin Din	22p
Pack 108 3 pin Din	20p
Pack 135 ¼" Jack	27p
Pack 130 4" Jack Stereo	50p
Pack 103 Loudspeaker Plug	17p
Pack 100 Phono Plug	7p
Pack 230 3 pin Socket	25p
Pack 236 5 pin Socket	33p
Pack 234 Loudspeaker Socket	33p

READY MADE LEADS

3 pin to 3 pin Din	70p
3 pin to open end	55p
5 pin to 5 pin Din	90p
5 pin to open end	70p
5 pin to 4 phono plugs	100p
Speaker lead Din to spade 12ft.	40p
Extension lead Din plug to socket 12ft.	70p

All leads approx. 6ft. in length

DIAMOND STYLI

8TA; 9TA; 9TAHC; GP91; ST4; ST9; EV26, GC8. All at 80p each.
Double Diamond £1·25
Diamond suitable for Orbit NM22; G800; M3D £2.25 each.

CARTRIDGES

Goldring G800	£6·00
Orbit NM22	£4·00
Shure 75/6	£6·00
Sonotone 9TAHC (Dia)	£2·00
Sonotone 8T4A (Dia)	£1·50
Ronnette 105 (Dia)	£1·25

All prices include VAT and postage

RECORD CARE

Cecil Watts Dust Bug	£1·20
Parastatic Disc Preener	45p
Antistatic Fluid	20p
Dust Bug Spares (Brush and Roller)	15p

CASSETTE TAPES

Audio-Magnetics C60

Qty.	3	6	10	20
Price	£1·00	£1·90	£3·20	£6·30

Cassette Caddy £1·20
Cassette Head Cleaner 35p

Zonal Ilford Tape

5" Standard 600ft.	25p
5¾" Standard 900ft.	50p
7" (Plain boxed) 1200ft.	60p
7" (Westminster Boxed) 1800ft.	£1·25
7" Reel of Leader Tape (Blue or green)	75p

HEADPHONES

Sennheiser HD414	£10·60
AKG K50	£6·50
Beyer DT48S	£35·00

MICROPHONES

AKG D109	£11·50
AKG D202E1	£39·50
AKG D190C	£17·00
AKG D190E	£18·20
AKG D224	£50·00
Sennheiser MD211N	£45·00
Sennheiser MD413N	£27·00
Sony ECM5	£85·00
Audio RMS7F Radio Mike	£210·00

SPEAKERS

E.M.I. 350 Kit 8 ohms	£8·20
E.M.I. 450 Kit 8 ohms	£4·50

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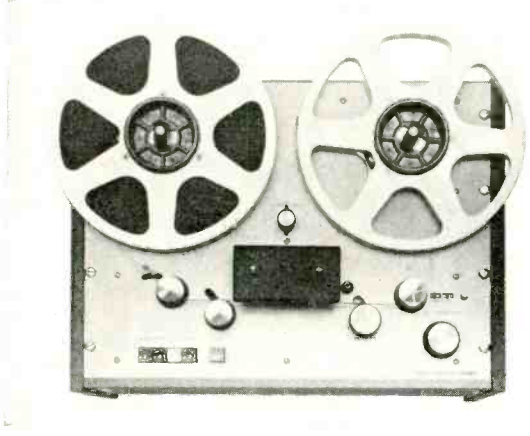

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STUDER A80/R

F.W.O. Bauch Limited
49 Theobald Street
Boreham Wood, Herts
Tel: 01-953 0091

INDUSTRIAL AUDIO RECORDERS

High to low: Perfectone *LP6A11*, Otari *MX7000* and Philips *Pro 12*.

mm separation and mono stereo switch; and same with 2 mm track separation and individual track selection.

A80/R

(parameters not listed below, as *A80* multi-channel specification where applicable).

Tape speeds: 38 and 19 cm/s ±0.2% (adjustable).
Reel type: DIN, NAB, Cine up to 300 mm reels.
Rewind time: approximately 120s for 1000m reel.
Stopping time: 3s or less from fast winding mode.
Operational tape tension: 70 to 100 p during play and fast winding mode.
Tape tension maxima: 500 p at start, stop and change of wind direction.
Minimum input level: 0 dBm.
Equalisation: plug-in pcbs for equalisation CCIR or NAB.
Signal-to-noise ratio record-reproduce (rms): as 6.25 mm version of *A80*.
Distortion at 1 kHz: as 6.25 mm version of A80.
Bias frequency: 150 kHz.
Erase frequency: 150 kHz.
Dimensions (wdh): 700 x 600 x 780 mm (seated). 700 x 600 x 840 mm (mobile). 700 x 600 x 900 mm (standing).

B62

The *B62* is available in the same tape formats as the *A80/R*.

Reel type: cine (adapter for NAB and DIN) up to 27 cm reels.
Wow and flutter: 38 cm/s.
Measured with EMT *420* DIN 45507, peak value, weighted, 0.05% or less, unweighted: 0.10% or less.
Starting time: 0.5s or less, to reach 0.2% flutter, peak value, weighted.
Tape timer: ±0.5% timing and repeated timing accuracy. Indicating minutes and seconds, real time indication for 38 cm/s (19 cm/s on request).
Rewind time: maximum 120s for 730m reel.
Operational tape tension: 70 ±10p during play.
Minimum input level: 0 dBm.
Equalisation: plug-in prints for equalisation CCIR or NAB.
Signal-to-noise ratio record-reproduce (rms): as 6.25 mm version of *A80*.
Distortion at 1kHz: as 6.25 mm version of *A80*.
Crosstalk rejection, stereo: 40 dB or more, 60 Hz to 12 kHz.
Erasure efficiency: 75 dB or more at 1 kHz.
Bias frequency: 150 kHz.
Erase frequency: 150 kHz.

OTARI

Manufacturers: Otari Electric Co, Suginami-ku, Tokyo, 167 Japan.
Agents: Industrial Tape Applications, 105 High Street, Eton, Windsor, Berkshire.
Phone: 95 52663

MX7000

The Otari *MX7000* are available in six track formats, all 6.25 mm tape width: full track mono; half track mono; two track stereo; four track two channel stereo; three track stereo and four track quadraphonic stereo.
Tape width: 6.25 mm.
Reel capacity: up to 27 cm NAB reels.
Tape speed: 9.5, 19 and 38 cm/s three speeds.
Heads: four
Tape speed deviation: less than ±0.2%.
Wow and flutter: 9.5 cm/s less than 0.08%, 19 cm/s less than 0.06%, 38 cm/s less than 0.04%.
Capstan: single capstan three speed hysteresis synchronous motor.
Reel motor: high quality of torque motors two pieces.
Input signal: line input −20 dB unbalanced 50k ohms (600 ohms). Balanced available with optional transformer mic input −55 dB unbalanced 10k ohms (600 ohms balanced available with optional transformers) both cannon connectors.
Output signal: line output: +4 dB (0 VU) balanced 600 ohms. Monitor output: −3 dB unbalanced 10k ohms. Both Cannon connectors.
Reproduce frequency characteristics: 38 cm/s 30 Hz to 20 kHz ±2 dB.
VU meter for watching record input, reproduce output, bias current. Record safe switch record and reproduce high compensation, frequency characteristics circuits. Test oscillators. Record and reproduce frequency characteristics: 38 cm/s 30 Hz to 20 kHz ±2 dB.
Signal to noise ratio: greater than 65 dB from peak level.
Synchronous reproduce: greater than 50 dB (from peak level).
Crosstalk: greater than 50 dB at 1 kHz.
Distortion: less than 1% at standard level.
Bias frequency: 150 kHz.
Test oscillator signal: 700 Hz and 10 kHz.
Operation buttons: play, stop, fast forward, rewind, record and cue buttons. Reel torque change-over, speed change-over and power switches.
Power supply: single phase ac 100 to 117 to 220 to 230V 50 Hz or 60 Hz.
Cabinet: Wooden.
Both horizontal and vertical styles are available by changing installation of electronics and deck. A stand will be installed as optional accessory in case of horizontal style.
Dimensions: (whd) 66 x 112 x 58 cm.
Weight: 53 kg.

TELEFUNKEN

Manufacturer: AEG Telefunken, 775 Konstanz, Bucklestrasse, 1-5, West Germany.
Agents: Hayden Laboratories, Hayden House, 17 Chesham Road, Amersham, Bucks.
Phone: 024-03 5511

M15

Dual speed (38-19 cm/s) recorder with electronically commutated dc capstan motor. Available in A or B wind forms with full track, stereo or two-track head format.
Speed deviation: ±0.1%.
Wow and flutter: ±0.05% (DIN 45507 peak weighted).
Slip: 0.2%.
Spooling tension: 100 gm, peaking to 750 gm.
Tape time counter: 0.2% accurate 4s addition after tape end.
Frequency response: 40 Hz to 60 Hz ±1.5 dB, 60 Hz to 15 kHz ±1 dB.
Signal-to-noise ratio: 55 dB (full track).
Distortion: 1%.
Chassis dimensions (hwd): 308 x 645 x 525 mm.
Weight: 53 kg.
Price: on application.

M12

Supersedes the *M28*. It is a 6.25 mm machine available in 38 and 19 cm/s or 19 and 9.5 cm/s speeds and in three track configurations: full track with or without pilot-tone; stereo with or without mixer; and two track with or without mixer. It accepts NAB spools.
Specification
Wow and flutter: 0.08% max. at 38 cm/s; 0.1% max. at 19 cm/s; 0.2% max. at 9.5 cm/s.
Frequency response: ±1.5 dB from 30 Hz to 16 kHz at 38 cm/s.
Signal to noise ratio (38 cm/s peak to peak weighted): full track 58 dB; stereo 58 dB; two track 55 dB.
Price: on application.

REVOX

Manufacturer: Willi Studer, CH 8105 Regensdurf, Zurich, Switzerland.
Agent: C. E. Hammond, Lamb House, Church Street, London W4 2PB.
Phone: 01-995 4551

Revox H77

Transportable stereo recorder with direct drive 38-19 cm/s servo controlled capstan system.
Bias frequency: 120 kHz.
Signal-to-noise ratio: 60 dB.
Total harmonic distortion: 2%.

64 ▶

NUMBER 1!

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SPECTRA SONICS

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INDUSTRIAL AUDIO RECORDERS

Frequency response: 30 Hz to 20 kHz ±1.5 dB.
Crosstalk: 45 dB.
Wow and flutter: 0.04% p-p.
Note: The VHS77 is a very high speed version of the Revox HS77 and is available with speeds of 76 and 38 cm/s. It has a sel-sync facility and sells at £298. This version is only available from ITA, 105 High Street, Eton, Windsor, Berkshire. Phone: 95 52663.

PERFECTONE

Manufacturers: Produits Perfectone, 250-Bienne, Switzerland.
Phone: 0323 09 34
Agents: Evershed Power Optics, 214 Harlequin Avenue, Brentford, Middlesex.
Phone: 01-560 6151

LP6A11

Transistorised 6.25 mm auto-reporter tape recorder with pilot tone. Produced to allow synchronised transfer on to perforated 16 or 35 mm film.
One playback pre-amplifier.
Two correcting filters for bass and high notes with compensating level amplifier.
Accentuations and attenuations by 4 symmetrical positions to 0 dB, to max. +12 dB and −18 dB to 30 Hz for bass and 10 kHz for high notes.
One presence filter at 2.8 kHz allowing accentuation through 3 positions of +2, +4 and +6 dB.
One high filter with cutting frequencies of 65, 100 and 150 Hz giving an attenuation of 6 dB to the selected frequencies.
One continuous attenuator with a graduated output in 10 position giving a max. level of +12 dB for a tape modulated at 100%.
One symmetrical 600 ohms output.
One synchronised pre-amplifier with a low filter at 150 Hz. Accentuation of the frequencies from 100 to 50 Hz.
Filters for the correction of tonalty and level reducer mounted on the control panel on the front part of the platen.
Amplifying elements of the modulation channels and synchronisation clipped in on printed circuits, easily accessible.
Supply from 12 1.5V torch batteries or 12V accumulators, i.e. a total of 18 or 14V. The batteries are housed inside tubular magazines on each side of the platen.
Autonomous functioning: 12 hours on batteries, 8 hours per charge on Ni-Cad accumulators.
Capstan driven by electric motor at strictly constant speed.

Fast re-winding with the help of an auxiliary motor.
Maximum diameter of the spools: 12.8 cm.
Characteristics of frequency and stability of running speed maintained within the professional tolerances of −20°C to +50°C.
Tape speed: 19 cm/s.
Speed variation due to fluctuations in the battery voltage of 10 to 18V less than 0.2%.
Speed variation between the beginning and the end of the spool less than 0.3%.
Wow and flutter: less than ±0.2%.
Modulation output level: maximum +12 dB to 100%.
Synchronisation output level (without charge): 3 to 3.5V.
Signal to noise ratio: more than 62 dB.

High to low: Studio recorders by Philips and Stellavox *SP7*

Playback distortion at +18 dB: less than 0.6%.
Dimensions: 340 x 370 x 115 mm.
Weight: without batteries 7 kg, with batteries 8.1 kg.

KUDELSKI

Manufacturer: Kudelski S. A. Ch 1033 Cheseaux/Lausanne, Switzerland.
Agents: Hayden Laboratories Ltd, Hayden House, 17 Chesham Road, Amersham, Buckinghamshire.
Phone: 023 03 5511

NAGRA 4

Lightweight (6.4 kg) battery portable three-speed (38 to 19 to 9.5 cm/s) recorder available in single and dual channel forms.
Specification relates to single channel model *4D*.
Erase track width: 6.25 mm (8 mm head).
Record track width: 6.25 mm (6.4 mm head).
Play track width: 6 mm.
Record head gap: 7 µm.
Play head gap: 3 µm.
Bias frequency: 120 kHz.
Signal to noise ratio: −73 dB (ASA A weighted).
Total harmonic distortion: 0.8%.
Frequency response: 30 Hz to 20 kHz ±1.5 db (30 Hz to 35 kHz ±1.5 dB to special order).
Tape flux at peak recording level: 510 nWb/m.
Spool capacity: 18 cm (cine) 27 cm NAB with outriders.
Level meter: ppm characteristic, dB calibrated.
Price: £560.

STELLAVOX

Manufacturer: Georges Quellet, 2068 Hauterive/Ne, Switzerland.
Agents: A.V. Distributors Ltd, 26 Park Road, Baker Street, London NW1 4SH.
Phone: 01 935 8161

Stellavox SP7

Stereo battery recorder taking 13 cm spools, extending to 27 cm capacity with accessory outriders. Tachometer capstan servo system. Mono and pilot versions available.
Tape speeds: 76, 38, 19 and 9.5 cm/s.
Wow and flutter: ±0.12%.
Tape slip: 0.1%.
Frequency response: 30 Hz to 15 kHz ±2 dB.
Signal-to-noise ratio: 65 db (ASA 'A' weighted, full track).
Distortion: 2%.
Weight: 3.5 kg.
Dimensions: 80 x 215 x 300 mm.
Price: £525.

TANDBERG

Manufacturers: Tandbergs Radiofabrik A/S Oslo 8, Norway.
Agents: Farnell-Tandberg Ltd, Farnell House, 81 Kirkstall Road, Leeds LS31 HR.
Phone: Leeds (0532) 35111

Tandberg 11-1P

Three speed (19 to 9.5 to 4.75 cm/s) battery tape recorder with film sync facility. Single audio channel Mechanical mode selection. Tachometer speed control. Limiter may be switched into all inputs.
Spool capacity: 18 cm.
Wow and flutter: 0.1%.
Frequency response: 40 Hz to 16 kHz ±2 dB.
Signal to noise ratio: 59 dB (DIN 45511 weighted).
Distortion: 3%.
Erase/bias frequency: 85.5 kHz.

UHER

Manufacturers: Uher Werke Munchen, 8 Munchen 71, Postfach 71 10 20, West Germany.
Agents: Bosch Ltd, PO Box 166 Rhodes Way, Watford WD2 4LB, Herts.
Phone: 92 44233

1200 report synchro

Full track single speed (19 cm/s) battery recorder designed for pilot tone film sync. Hanging magnetic

78 ▶

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STELLAVOX SP7

By Angus McKenzie

MANUFACTURERS' SPECIFICATION (19 cm/s stereo).
Weight: 3.1 kg (excluding tape and batteries).
Dimensions: 8 x 21.5 x 27 cm.
Maximum reel diameter: 13 cm (26.5 cm with extension accessories).
Speed stability at 20°C: 0.1 per cent.
Tape slip: 0.1 per cent.
Wow and flutter: (DIN peak weighted): better than ±0.1 per cent at 38 cm/s; ±0.12 per cent at 19 cm/s.
Starting time: approximately 100 ms.
Rewind: approximately 4 m/s.
Forward wind: approximately 1 m/s.
Power supply: 12V to 20V dc, 120 mA.
Frequency response of amplifiers: 20 Hz to 20 kHz ±1 dB.
Frequency response overall: 30 Hz to 15 kHz ±2 dB.
Total distortion at 1 kHz, 500 pWb/mm: 2 per cent.
Erasure at 1 kHz (500 pWb/mm): 70 dB.
Signal-to-noise (weighted ASA 'A' filter): 60 dB (stereo) relative to 500 pWb/mm; 65 dB full-track.
Crosstalk overall: 40 dB.
Modulation indicator: Double modulometer.
Stereo compressor rise-time: less than 10 m/s, input 1 to 40 mV (distortion approximately 0.3 per cent).
Loudspeaker diameter: 88 mm.
Inputs: *Microphones one and two:* 0.2 to 75 mV symmetrical. *Automatic:* 1 to 40 mV. *Mixer one and two:* 1.55 V at 820 kΩ. *Diode one and two:* 440 mV adjustable with potentiometer. *Pilot:* 1 to 1.5V (impedance greater than 10 kΩ. *Clapper:* positive pulse.
Outputs: *Phone I and II (output):* 1.55V (max 2.8V) asymmetrical. *Phone one and two:* 1.55V at 5 ohms to 2kΩ. *Diode one and two:* 440 mV at 470 ohms. *Pilot* (with sxq): 1V to 1.5V.
Manufacturer: Stellavox Georges Quellet Eng.-EPZ, CH-2068 Hauterive, Switzerland.
UK Agents: A. V. Distributors Ltd, 26 Park Road, London NW1.
Prices: Machine less heads and accessories: £687.50.
Equipment as reviewed including two head blocks, power supply, nickel-cadmium accumulators, reel extension for NAB reels, and quartz generator: £1,206.35.

IT is very easy when making a field trial of a machine such as the Stellavox to be rather overcome by its general excellent performance for its size, and therefore one must consider all the practical aspects of performance—electronic, mechanical and ergonomic—when writing a report. I would first like to draw attention to Hugh Ford's technical report, published in January STUDIO SOUND, since many but by no means all the points he raised bear a direct relationship to the performance under normal operational conditions.

From an ergonomic point of view I found the joke batteries very annoying since it was not initially possible to close the battery compartment lid completely. This meant that the batteries could fall out at any inconvenient moment! After considerable frustration it was discovered that some of the accumulator type batteries were oversize and, when these were replaced, no more trouble was experienced.

I took the machine with me on holiday and had the opportunity of recording under some very difficult conditions. The machine was used in a bar attached to a restaurant where a friend of mine performed throughout the evening on a Lowry organ. It was necessary to share a table with some members of the public who found the open, attached lid of the machine rather monopolised the space. As a result of this Stellavox have now made a detachable lid assembly.

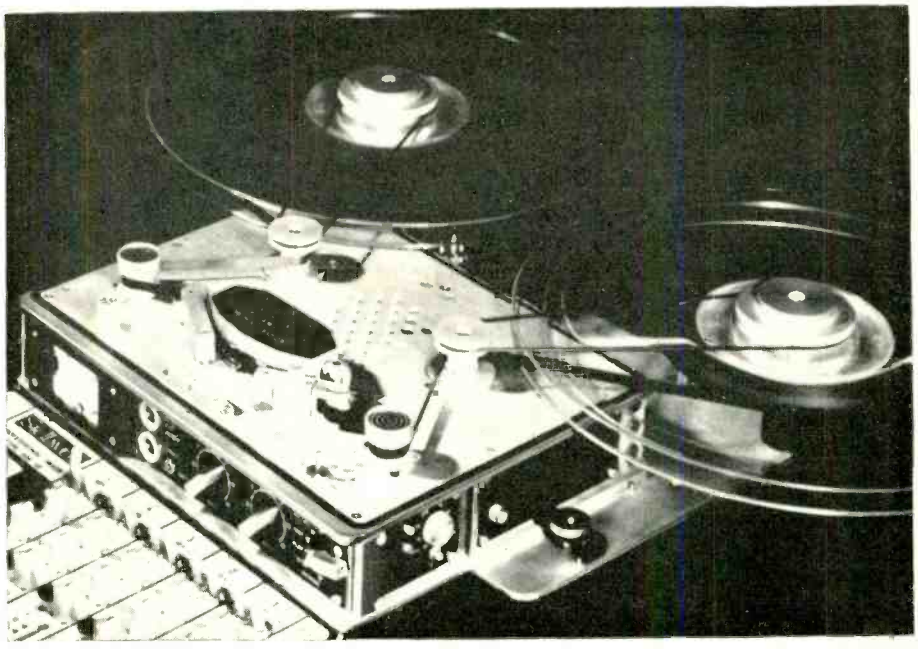
The NAB adaptors allow NAB spools to be used, but were found very cumbersome, and the forward tension, although steady, was so low that the tape on the take-up spool became spongy and almost impossible to rewind. However, provided the user has considerable patience, NAB spools can be used for recording of long continuous duration if the spools are to be rewound on a mains machine. As it stands, the machine will accept up to 13 cm spools. I was particularly impressed with the very fine wow and flutter performance, both on recordings of the Lowry organ and also under difficult conditions when recording old fairground organs in a museum near Bodmin. For the latter recordings the machine was hand-held and, despite this, no wow and flutter was heard when the tapes, recorded at 38 cm/s, were replayed on a studio machine.

The machine is very quiet in operation, and can be used fairly close to the microphones. It also performs satisfactorily when carried about, at reasonable angles, during recording. Provided that the manufacturer's instructions are carefully followed the machine is very simple to operate, and can be quickly threaded up.

The machine was supposed to have been set up for the DIN recording standard and biased for Scotch *207* tape. All the recordings made lacked a considerable amount of top when replayed on studio equipment, although they sounded satisfactory when replayed on the machine itself. On investigation it was found that the replay response was too toppy, in fact slightly more so than Mr Ford's review indicated, so that approximately 4 dB too little top was recorded at 10 kHz. It must therefore be assumed that the test tape used for setting up originally at the factory must have had the high frequencies partially erased. Mr Woolford, acting for the British agents, agreed with my findings and, after the replay and record responses had been accurately reset, the performance was very satisfactory.

When I first started using the machine, an extraneous low pitched tone was audible when tapes recorded on the Stellavox were replayed on studio equipment, though this tone was not audible on the machine's own playback. I was not aware at first of the existence of a pilot

68 ▶



The 3M M79 Professional Recorder

The 3M M79 professional recorder is 27″ wide, 24″ max. deep and around 4′ tall. It's the most compact professional recorder you can buy. But the M79 gives you a lot more – or less (depending on how you look at it) – than just mere space saving. Look at this.
Less hum – because of DC power throughout. Less noise – Normal SNR 64 db. Sync SNR 64 db. Less weight – the M79 weighs under 300 lb for 24 track. Less reeling time – it spools at 500 i.p.s. Fewer boards – because of unified channel electronics. No goofs – interlocked record logic and bias/erase integrity. No loops – mode-to-mode transport logic and dynamic breaking. No clutter – the Isoloop deck and modular design see to that. No service problems – London-based service department.
The M79 also gives you the best servo around, 3 set speeds, built-in variable speed, CCIR/NAB/AES equalisation.

Accessories There are also several useful accessories. Like the 3M synchroniser/reader for synchronising audio recorded material to video recorded material. And the compact 'Selectake' unit which automatically locates a pre-selected tape position. There are three M79 models (24, 16 and 8 track). All the basic units are the same size and have been designed so that the 8 and 16 track models can be expanded when required.

E. R. Haworth, Magnetic Products, 3M United Kingdom Ltd., 3M House, Wigmore Street, London, W1A 1ET.

3M

3M, Isoloop and Selectake are trademarks 3M 2120

SP7 FIELD TRIAL

tone for synchronous film recordings. Therefore for playing back tapes made on this machine a wide guard band replay head should be used on studio replay equipment to obtain the best signal-to-noise ratio. For stereo recording when the pilot tone system is not going to be used I would advise a narrow guard band record head which will give a better signal-to-noise ratio when the tapes are replayed on narrow guard band heads.

Mr Ford commented on the machine's lack of margin of record drive current, particularly for high output tapes. In practice this becomes very obvious since speech recordings made at a level which a mains operated machine would accommodate caused very noticeable clipping on the Stellavox. By recording at a slightly lower level, however, the machine's performance in this respect was excellent. In particular the overall recorded sound was very clean due to the predistortion technique employed. The automatic gain control was set at slightly too high a level such that when limiting was applied distortion was noticeable on the tape. A reduction of gain of only 2 dB or so after limiting would probably have cured this trouble.

The machine was supplied with a pair of Sennheiser *HD414* headphones. These perform excellently with the machine, but I would have preferred a headphone volume control. The AB monitoring facility was very useful, and very little audible difference was noticed, provided that record amplifier clipping was avoided. The modulometers were found to be very accurate, with a fast rise time, giving a peak program meter characteristic. However, I would have preferred a slower fall back time as this would allow peaks to be more easily noted.

The machine is equipped with some very useful input and output facilities. In particular it is useful to be able to plug AB powered capacitor microphones such as the Schoeps *CMT46* straight in. For preference, however, I much prefer normal low voltage phantom powered mics such as AKG *451*. Stellavox tell me that a modification is available to allow such phantom powering. Moving coil and ribbon mics can be used, in which case the dc powering is switched from the microphone sockets. Under such conditions, however, the input impedance is far too low, and can cause problems. In these circumstances the noise level is not good enough, but Stellavox can supply preamplifiers having 20 dB gain which take their ht through the microphone input sockets which must therefore be switched to capacitor mic input. Sufficient gain would thus be available for all circumstances, although this accessory has not, as yet, been tested.

I found it particularly tiresome that each headblock could only be used at one speed—not only is it expensive to purchase a headblock for each speed required, but the extra weight and the changeover time become significant. I consider that each headblock should be capable of operating at at least two speeds. Both the record and replay equalisation, and biasing, are set by fixed resistors and capacitors in the headblock, and this gives exceptional stability of performance in the field. I am not quite happy, however, with the record equalisation being done in the record head feed itself, since this is better done by feedback before the record head driver stage. The existing form of equalisation is partly to blame for the inadequate clipping margins, since considerable attenuation of low frequencies becomes necessary in order to boost high frequencies passively. Perhaps in a later model the manufacturers could alter all this.

The replay time constant when corrected tended to show a rise in extreme top due to the head not being sufficiently resistively damped. Decreasing the value of the damping resistor corrected this. By carefully adjusting the damping resistor and the time constant components, it should easily be possible to gain a very flat response at all speeds when using the appropriate headblock.

The power supply for recharging the accumulators can also be used for working the machine off mains. The supply runs at a very high temperature and under some circumstances—when recharging overnight, for example—can build up so much heat that, in a confined space, it could become unsafe. I consider that this must be attended to as a matter of urgency. I also found the hum level produced from the power supply when mains operating the machine to be quite intolerable, particularly on playback, and therefore it should only be used in this mode for checking.

Notwithstanding the faults mentioned, I wish to make it abundantly clear that the machine has been very reliable and easy to use. Its weight makes it eminently suitable for recording under difficult conditions as the entire equipment necessary for recording stereophonically can be carried in one hand over long distances without strain. It is capable of making recordings to a standard comparable with that of recordings made on mains-operated studio machines. I have had to be critical o some elements of performance, however, for the Stellavox is rather expensive. Its cost would be more than justified if the manufacturers could attend to the various points raised and, in this respect, like Mr Ford, I would like to pay tribute to the considerable help given by the importers, both in accepting the criticisms and in assuring me that they will be seriously heeded. Such helpfulness weighs heavily in considering the purchase of professional equipment.

Agents' preliminary comments:
The microphone input impedance is 3.85k ohms; current machines have phantom and AB powering as standard. A new cool running, hum-free, power supply is now available. At 38/cm s, external powering improves the take-up tension with NAB or 30 cm spools. R.J.W.
(Detailed comments in letter next month.)

PHILIPS PRO 36

by Arthur Garratt

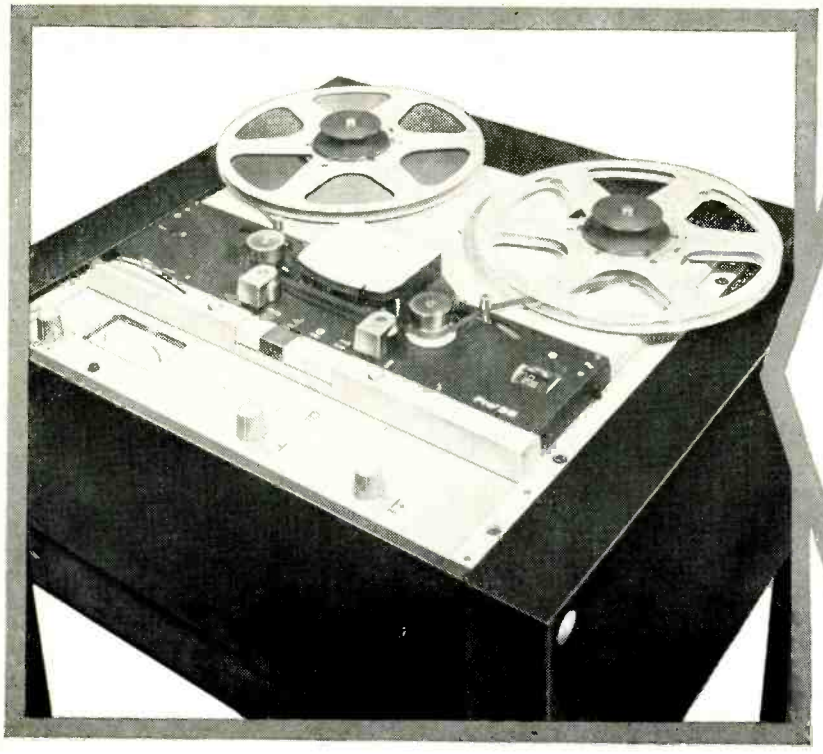
MANUFACTURERS' SPECIFICATION (38 cm/s IEC equalisation)
Tape speeds: 38, 19 and 9.5 cm/s ±0.2%
Tape width: 6.25 mm.
Format: full or half track mono, mono+pilot, stereo or two channel (specification relates to two x 2.75 mm stereo).
Slip: 0.1% (matt back tape).
Tension: 60 to 125g for 1 km tape.
Heads: Up to four (ferrite).
Wow and flutter: 0.1% peak (0.04% peak weighted to DIN 45507).
Overall distortion: 1.5% at 510 pWb/mm.
Noise: —62 dB ref 510 pWb/mm.
Price: £1,100 basic. Review model £1,400 basic.
AGENTS: Pye TVT Ltd, PO Box 41, Coldhams Lane, Cambridge, CB1 3JU.

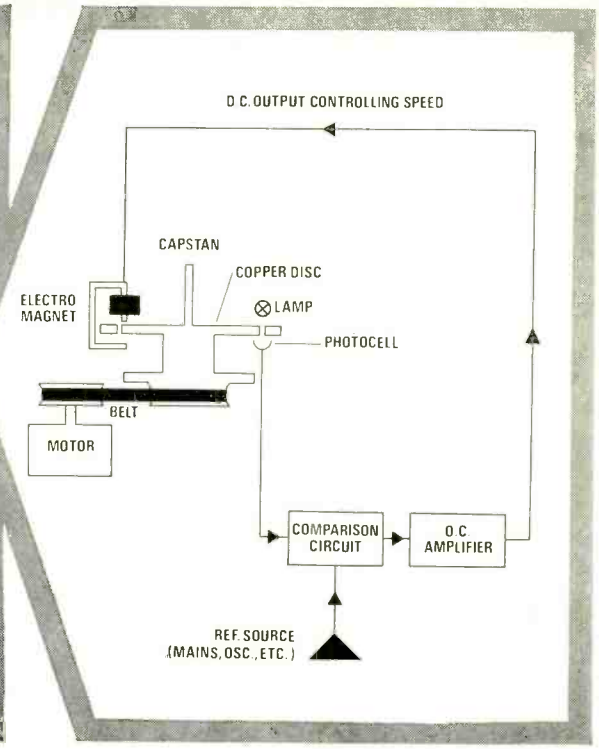
HAVING HEARD a lot about the Philips *PRO36*, I was delighted to be offered one for a field trial. I collected the machine late one night from Cambridge and took it home to put it through its paces and to give it a few months' tough treatment. In fact, apart from the test runs I shall describe, I used it continuously for the arduous role of a broadcaster's hack machine. This way I could find out its foibles and weaknesses as well as its sterling qualities.

The first thing that strikes one about the *PRO36* is how euphemistic the word 'portable' is. The machine weighs 40 kg and, just to make it as awkward as possible, the handles (one on each side) are not in line with the centre of mass. The result is that the machine tries to rotate as you carry it, needing a minimum of three hands. In fact I rather think this was a console machine until someone said 'We must have a portable version too'. I am not saying this only on account of the weight; there are two other factors involved.

The first is the way the input and output lines, including the mains feed, are arranged. These all run into sockets *underneath* the machine (see **fig. 1**). This is fine for a permanent set-up but rather a nuisance for a temporary one as it means that you have to turn the machine on its side or back to change the plugs. The other point about portability is this: the machine is complete in the sense that it has both microphone and line inputs but it has no facility allowing you to hear before tape. This is extraordinarily inconvenient. If you feed in from a separate mixer you will have this facility on the mixer but this is supposed to be a complete portable machine and it would not cost much to fit an ab switch.

70 ▶





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- Servo-controlled capstan speed
- Facilities for synchronization with other equipment
- Three motors – three speeds and up to four heads
- Solenoid operated pinch roller, brakes and cue facility.

CHARACTERISTICS

Three motor tape drive. Mains frequency: 50 and 60 Hz. Three tape speeds 3¾, 7½ and 15 in/s, electrically switchable. CCIR plates 300 mm diameter with 100 mm hubs (acc. to DIN standard). NAB reels 10½-inch diameter. Cine reels 7-inch diameter. Wow and flutter peak value 0.04% at 15 in/s. Tape slip less than 0.1%. Signal-to-noise ratio 62 dB. Optimum bias setting separate for each speed and each track. NAB or CCIR equalisation by switchable correction networks. Tape speed selection automatically switches equalisation and all corresponding preset controls by semiconductor switching. Monitoring by VU meters. Remote operation on all functions. Plug-in head assembly with pre-amplifier. Digital tape coupled time counter reading minutes and seconds.

Pye TVT Ltd

Pye TVT Ltd., Coldhams Lane, Cambridge CB1 3JU
Tel: Cambridge (0223) 45115. Telex: 81103

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Please tell me all about Philips' Pro' 36 studio tape recorder.

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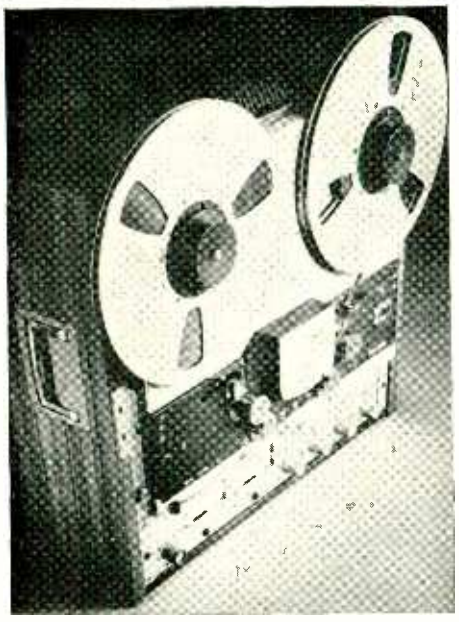
S4

PRO 36 FIELD TRIAL



The *PRO36* stereo portable is fitted into a well-made wooden case with an effective, if somewhat tatty, plastic cover. It takes both cine and NAB spools. A small point here, the cine spool hub diameters are at the top end of the tolerance range (measured diameter 7.874 mm) and some cine spools, notably EMI, are exceedingly tight and difficult to remove. Hublock spools just do not work. They jam on and a screwdriver is needed to get them off. There is a tension switch with two positions, one for large and the other for small spools. Variable speed spooling is controlled by a quadrant pot and works extremely well. Normally the tape does not touch the heads during winding but there is a switch controlling the right-hand pinch wheel which moves part way forwards to push the tape against the replay head for cueing.

Incidentally, there is a curious system called 'dubbing': by pressing another switch the left-hand pinch wheel can be retracted during recording. The tape then does not make contact with either the erase head or the record head until the pinch wheel is pushed in by hand, producing a fade-out of anything on the tape and a fade-in from the recorder input. This is a facility which I did not use, except to prove it works, but I presume there are people who might find it of value.

There are no pressure pads and editing is very simple. I soon learned a trick. If the machine is set at pause, one can run tape normally by pushing the right-hand pinch wheel forward by hand—very useful when one wants to listen to a part of the tape one is proposing to cut. There is an excellent feature for editors. Pushing the right-hand tape guide pin fully to the right operates a switch which breaks the feed to the take-up spool motor so tape can be played out without the take-up spool racing round and pulling the tape out of the editing block. I would like to see every studio recorder fitted with a similar device.

The main controls are of a piano-key type and are simplicity itself. There are four: wind, record, stop and play. To record, you have to push both record and play simultaneously so it is difficult to switch to record accidentally. A slot in the head assembly allows tape to be cut *in situ*. I never used this and could not see any positive advantage to be gained from it. All the main functions can be selected remotely using a control unit available as an extra.

The capstan speed is controlled in an elegant fashion. The motor driving the capstan, which is large and heavy enough to provide a flywheel action, runs faster than required under free conditions. Part of the capstan assembly is a large copper disc with a series of holes drilled coaxially. The speed of the disc is sensed by a lamp projecting a beam of light through the holes on to a photocell (see **fig. 2**). The output from the photocell, which is of course in the form of pulses at a repetition rate dependent on the speed of the disc, is fed into a comparator. Here the rate is compared with either mains frequency or a local oscillator. The difference signal is amplified and its output controls an eddy-current brake operating on the copper disc. In this way the copper disc, and the capstan, run at a speed determined precisely by either mains or a local oscillator. In operation an indicator lamp lights when synchronisation is effected.

As you can see, this is a very elegant system though it uses over 30 transistors in its control circuit. The results are excellent, the specified weighted wow and flutter figure at 38 cm/s is 0.04 per cent and it has the very useful facility of being able to run at any speed from a simple oscillator. It has one disadvantage, a long delay on switching speeds before the machine synchronises at the new speed. This can be in the order of 20s. This is partly offset, however, by a superbly accurate time counter which is correct to within 1s over 30 minutes at 19 cm/s, quite the most precise counter I have ever used. It is, I must say, fiddling to zero and I prefer the type that just needs one push of a button.

The amplifier unit, which is in front of the deck when the machine is in its normal horizontal position, has separate record and play gain controls for the microphone amplifier. Another four-position switch controls the two VU meters. There are two positions for recording: 'line up' which is operating level and 'music' when 0 VU corresponds to −10 dB. There are similar positions for playback. The VU meters, as VU meters go, are quite satisfactory. Personally I subscribe to the school of thought which regards VU meters as things sent to try us and I wish fervently that Philips would offer ppms as an alternative.

I feel that an industrial machine selling at a high price should have something rather better as gain controls than ordinary log pots fitted with rather nasty knobs and no proper calibrations. Not only is it impossible to note a setting, change it and return to the original with any accuracy, but the playback gain knobs rotate so easily that it is only too simple to turn one inadvertently when editing and find the gain has gone up 10 dB on restarting!

When I collected the machine it was completely out of adjustment. Obviously Philips do not deliver new machines in this condition; mine had been on show at an exhibition and someone had obviously been trying out his screwdriver on the presets. I was not displeased with this as it gave me a chance to use the instruction book and do the job 'for real'. First of all the azimuth of the heads was out. This adjustment is very simple indeed and a model to many other tape recorder manufacturers. The head assembly contains the three heads (four if you have the pilot tone model for film sync recording) and preamplifiers for the two playback channels, each with 22 dB gain. The plastic lid can easily be prised off and the azimuth of record and playback heads adjusted using a small screwdriver (see **fig. 3**). Full marks for this, it's quick and simple.

Something of a criticism for the next stage, the equalisation and bias adjustment. The criticism is lack of accessibility. You start by loosening two screws which operate an incredibly complicated mechanism to free the amplifier unit. This unit, now free apart from a screened umbilical, has to be lifted slightly and pulled forward (**fig. 4**). It needs space in front of the record to lay it down on so the recorder must be slid back, if possible, or another table of the right height brought up to support the amplifier. Now this all seems rather silly to me and is an example of how little designers are really in touch with users. All that's required is a simple hinge system so that the amplifier can be freed and then rocked forward to get at the adjustments, like some of the Leevers-Rich studio machines.

Having said this I must point out that, when you do get the amplifier into a suitable position, the adjustments are extremely well laid out and properly labelled. Along what is now the top of the amplifier unit are the equalisers. Each recording channel has the following adjustments for each separate speed: treble boost modulation; bias. The bias pots are in fact on the main recorder unit and can be seen to the left of the capstan and disc assembly. Each replay channel also has a treble equaliser for each speed. In addition, and this is a feature I commend to all manufacturers of tape recorders, there is a switch on the record amplifiers and another on the replay amplifiers so that each can be switched independently to either IEC or NAB characteristics. Full marks to Philips for this whole arrangement which makes setting up and adjusting as simple as possible.

The next job was to do replay frequency

Tape: EMI *SRT 17* (38 cm/s), record/replay

Frequency	Upper track	Lower track	Upper track	Lower track
20 kHz	—1 dB	—1½ dB	0	0
18	—1	—1½	0	0
16	—½	—½	0	0
14	0	—½	0	0
12	0	0	0	0
10	0	0	0	0
8	0	0	0	0
6	0	0	—½	—½
4	0	0	—½	—½
2	0	0	0	0
1	0	0	0	0
500 Hz	0	0	0	0
250	+½	+½	+1	+1
125	—1½	—1	0	0
60	—1	—1	0	0
40	—3½	—2½	—4	—4
30	—8	—7	—8	—7

Tape: Ampex *01 31321 01* (19 cm/s), record/replay.

Frequency	Upper track	Lower track	Upper track	Lower track
12 kHz	+½ dB	+½ dB	+1 dB	+1 dB
10	+½	0	+2	+2
7.5	+½	0	+2	+1½
5	−½	−½	+½	+½
2.5	0	0	+½	+½
1	0	0	0	0
500 Hz	+½	+½	+½	+½
250	+½	+½	+½	+½
100	0	0	0	+½
50	−3½	−3	−1	−1

runs. I did these at 19 and 38 cm/s, the former being a NAB tape and the 38 cm/s an IEC (which is identical to NAB at this speed).

The slight treble lift at 19 cm/s was probably due to my record equaliser adjustments being slightly out.

These figures are excellent except for the fall in bass response. This is in line with the specification which quotes for both speeds ±1 dB at 63 Hz and ±2 dB at 40 Hz. The bass fall occurs on replay; it is flat down to 40 Hz on recording as I confirmed by recording a tape and playing back on another machine. It is certainly not a method of saving money on smoothing as mains hum from the machine was undetectable.

Next I measured the signal-to-noise ratio. As the figure obtained depends so much on the test procedure, I will outline this briefly. I used a low distortion oscillator feeding into the line input and recorded 1 kHz tone at 0 VU level on Zonal *100* tape. I then recorded in the same way but with the oscillator switched off. I did not measure the output at the same time as a small and quite insignificant amount of bias breakthrough made the readings meaningless. Instead I ran the tape back and carried out measurements in the replay mode.

The actual determinations were made using an attenuator between the *PRO36* and a vvm. Results were on specification with a figure of 58 dB. With no tape laced, the signal to noise figure rose to 60 dB. One can legitimately add 3 dB to both these figures because one may argue that peak modulation is +3 VU instead of 0 VU, the level I used. So with Zonal *100* tape at 19 cm/s and tone at 1 kHz, the unweighted signal to noise ratio was 61 dB—an excellent figure. I tried as a matter of interest to see if passing the replay signal through a sharp bandpass filter falling off at 12 dB per octave and set at 22 kHz to 54 Hz as the −3 dB points would improve the signal-to-noise figure. It did not.

Next I tested for 19 cm/s distortion. Modulating at 320 pWb/mm, the distortion measured on a Sugden SI 452 gave the very satisfactory figures of 1% at 100 Hz, 1 kHz and 10 kHz. I carried out two more tests. To check the erase, I recorded 1 kHz tone at +3 VU and then ran it through in the record mode. No trace of the tone remained so the erase is better than 61dB and is perfect from a practical point of view. The final measurement was of crosstalk. Recording 1 kHz at 0 VU gave a crosstalk figure of 42 dB from lower to upper track. This is exactly on specification.

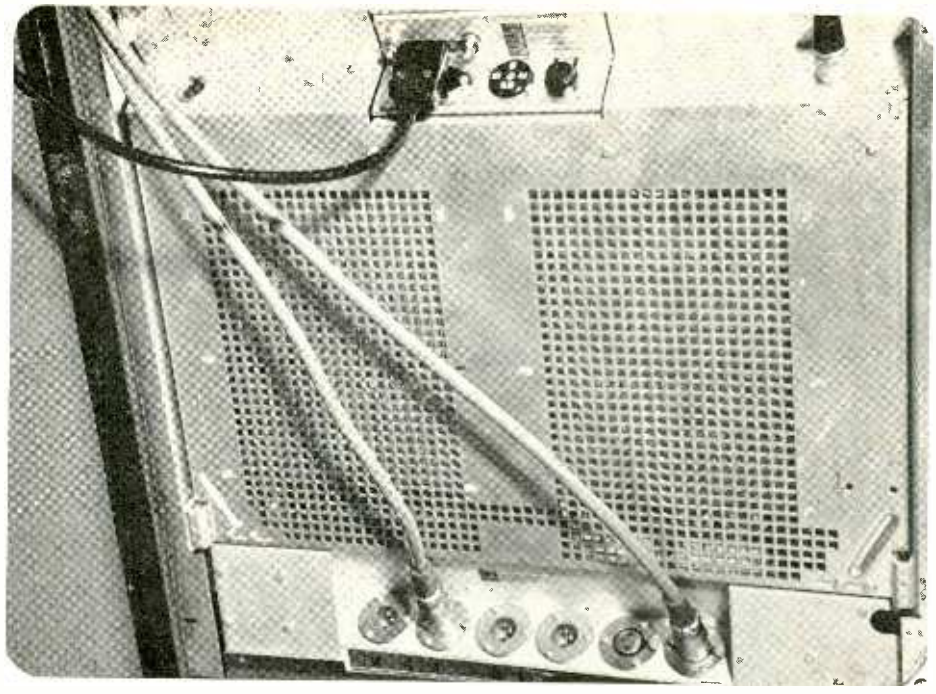


FIG. 1: The *PRO36* viewed from below. At the bottom are the four inputs (two line and two microphone) and two outputs. At the top is the mains input, mains voltage selector and fuse. Top left is the remote control socket and top right the external sync plug. This is removed and a feed line substituted when the machine is operated with pilot tone. (*Photo: Marvin Garratt*)

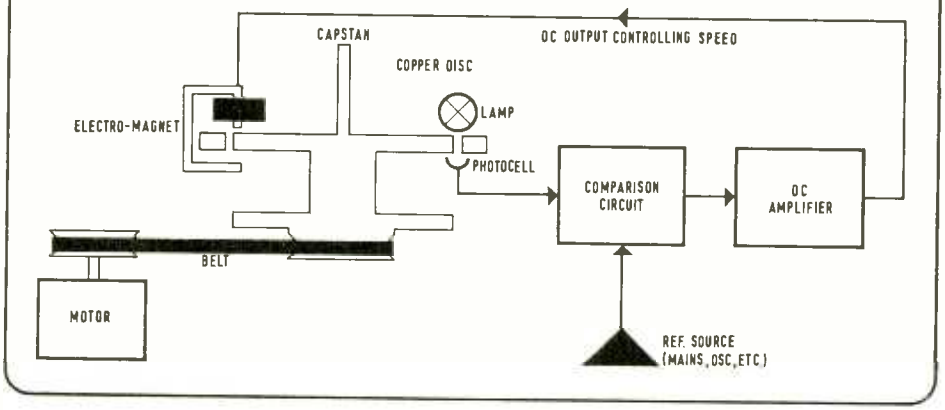
So the test figures were excellent, putting the *PRO36* right up in the front rank of studio machines. I was pleased to see that my results lined up almost exactly with the published specifications which are obviously totally realistic. My only slight criticism is that the replay bass response could stretch a little further, particularly for music tapes.

I really put the machine through its paces during the four months I had it, editing on it several hours a day and using it for recording, copying and playing in. I felt that for the money such a machine should have an editing block fitted. I used my favourite EMI block which fitted fairly well just under the *PRO36* lettering but could not find a decent place to put editing tape. I wonder why designers do not have closer liaison with users. Anyone doing a lot of editing would like features which no machine I have ever seen provides completely. For example, marks along the front every 19 cm so that an editor can measure a short length cut out. Every editor has a rule of thumb such as 'one width of the machine is three seconds'; why not a simple and very cheap system of marks and take the guesswork out of it? Locations for editing tape, razor blade and yellow pencil: how useful they would be.

Having got that off my chest, I would say

72 ▶

FIG. 2 PHILIPS PRO 36 CAPSTAN SERVO



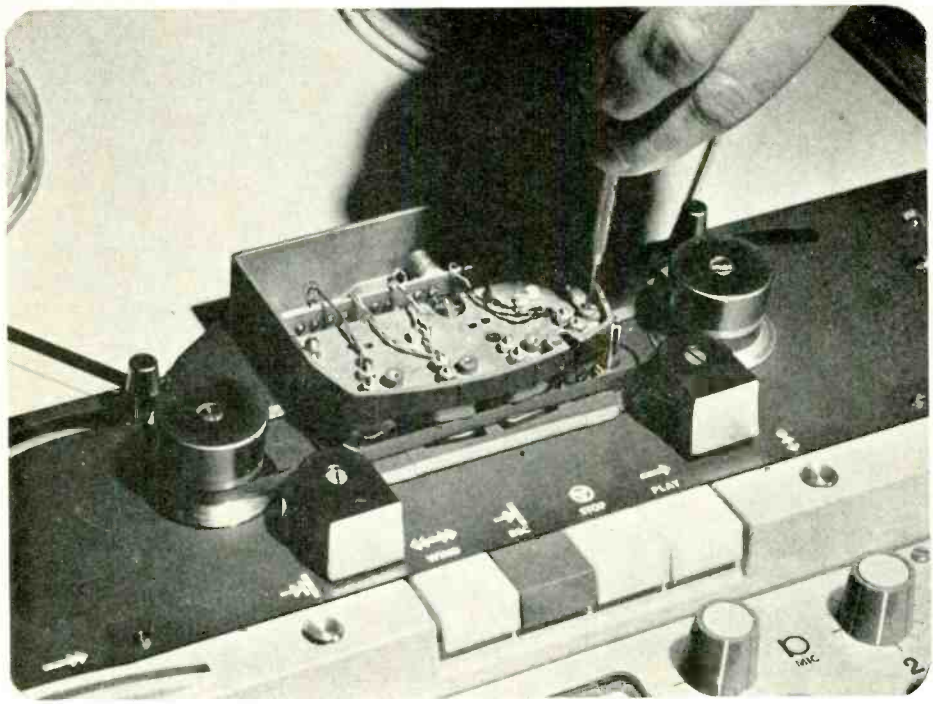
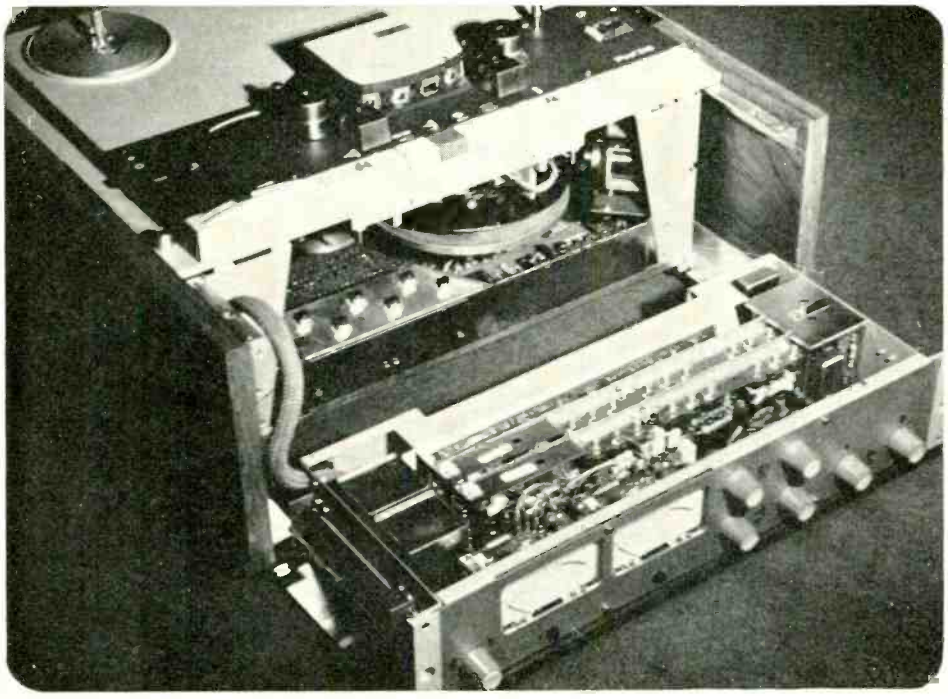


FIG. 3: The head assembly with the cover removed to adjust the head azimuth. Note the slot between the two right hand heads so that the tape can be cut. The third head from the left is a dummy which can be replaced by a pilot tone head for synchronisation with film or perforated tape. Each head is mounted in a Mu-metal screen.

FIG. 4: The amplifier unit removed for adjustment. On the top of the amplifier can be seen the record and replay equalisers and the NAB/IEC switches. In the main body of the machine are the six bias pots and above them the copper disc which operates the capstan speed control. (*Photos: Marvin Garratt*)



that the *PRO36* is easily the best machine I have ever used for editing, a sentiment shared by several BBC friends who tried it out. Unlike many machines, the motors cut off at the end of winding and certain disasters I have ever seen in august places just cannot happen. I mentioned the excellent system for cutting out the takeup spool motor and the only real shambles I had was when I switched rapidly from fast wind through stop to play: this is a guaranteed tape-breaker and I feel that a delay could be put in to prevent idiots from doing it. Incidentally, another thing not recommended is to wind double or treble play tape on 7 cm spools! But I suppose Philips could very justifiably say that this is not what studio machines are made for. Everything else I asked the machine to do it did in an exemplary fashion.

I used the microphone amplifiers and found the results very good. They will accept either 50 or 200 ohm microphones, but a bit of dismantling to change a soldered link is required to change from one to the other. With a dummy source of 60 ohms connected to the microphone input, the noise at full gain was too low to measure. The sensitivity is then 250 μV; not enough for a low output ribbon microphone like a Reslo.

One fault developed while I had the machine. This was a failure of the left-hand pinch wheel to swing in, caused by a 6 BA screw having fallen out of the pinch wheel solenoid. I never found the offending screw so I fitted another and this was a somewhat traumatic experience without dismantling the machine. Everything else worked perfectly and it would seem that it is a very robust recorder capable of standing up to very hard work without complaint. It is very quiet in operation, apart from the solenoids which are clearly audible in operation. There are no electrical clicks when the machine is stopped and started so it can be used to play in with complete confidence.

All in all, I found it a delightful machine to use. It has faults as I have pointed out and some of these could be corrected very easily. To give an example of how the designers worked, there are no microswitches. Instead the controls are operated by lamps and light-dependent resistors. This probably accounts for its complete electrical quietness. I thought that it would be possible for a scrap of tape to get into the machine through one of the numerous holes in the deck and block out one of the lamps responsible for the switching but I must say that nothing like this happened to me so it may not be a legitimate fear. It is certainly a machine I would take anywhere to do any stereo recording with complete confidence, and that's what you pay for.

Agents' comment:

1. Pretape monitoring is provided by means of the VU meters.
2. Preset screwdriver-slot input circuit potentiometers are fitted on request.
3. All *PRO36* recorders now being supplied in the UK are modified to prevent the effects reported.
4. The machine tested was the stereo version which has a full-track erase head fitted. A twin-track version is also available with split erase heads. These may be fitted to other configurations on request.

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TEAC A3340

By Hugh Ford

MANUFACTURERS SPECIFICATION
(38 cm/s 3M 207)

Heads: Three (record, playback and erase). Four-track, four-channel, stereo or mono, in line (with selsync switch).
Tape width: 6.25 mm.
Reel size: 27 cm.
Tape speeds: 38 and 19 cm/s standard.
Tape slip: 0.17%
Motors: Three. One dual speed hysteresis synchronous capstan motor. Two eddy current induction reel motors.
Wow and flutter: 0.04% at 38 cm/s (weighted rms).
Frequency response: 35 Hz to 22 kHz ±1.5 dB.
Equalisation: NAB.
Signal-to-noise tatio: 57 dB (64 dB ASA weighted)
Harmonic distortion: 0.8% at 1 kHz normal operating level (Ampex).
Crosstalk: 60 dB at 1 kHz.
Stereo channel separation: 50 dB at 1 kHz.
Inputs: *Microphone:* 0.25 mV at 600 to 10K ohms. *Line:* 100 mV at 100k ohms.
Outputs: *Line:* 0 dB; 0.77V for load impedance of 10k ohms or more. *Headphones:* 8 to 600 ohms.
Input and output configurations: Jack sockets.
Power requirements: 100/117/200/220/240V ac, 50/60 Hz. 150W.
Dimensions: 584 x 457 x 229 mm.
Weight: 28 kg.
Price: £492.
Agents: Industrial Tape Applications, 105 High Street, Eton, Windsor, Berkshire.

THE INDUSTRIAL version of the TEAC *A3340* differs from the domestic version in two respects: it has an improved frequency response and an improved signal-to-noise ratio. Both machines are genuine four track stacked-segment recorders with facilities for synchronous playback of any one or more tracks of the record head for playback. The *A3340* is in fact one of the very few 6.25 mm machines with anything like industrial facilities and it is probably fair to compare it with the Revox category of recorders which cost about the same, track for track.

From the point of view of styling, the machine is based on the typical black and chrome Japanese domestic but, as this review will show, the styling should not discourage one from giving this machine serious consideration as a four track studio recorder. The mechanical construction of the tape transport is fairly substantial and there are none of the horrible bits of bent tin which are commonly associated with the cheaper type of recorder. However, in spite of the capstan and the two reel brakes being operated by individual solenoids, no remote control facility is fitted.

In comparison with the mechanics, the standard of construction of the electronics is perhaps a little disappointing. While the great majority of the electronic components are mounted on printed boards, the boards themselves are of domestic quality, and they are wired in as opposed to plugged. This can make faultfinding extremely tedious, specially as the boards are not printed with component references.

The complete machine is mounted in a strong mahogany case which is equipped with two sensible lifting handles that make the machine easy to transport. However, no cover is provided for the front of the machine which could be damaged in transit. The line inputs and outputs are in the form of unbalanced jack sockets located at the rear of the machine which also houses the mains input, mains fuse, and voltage selector etc.

At first sight the front of the machine strikes one as a horrific collection of knobs but in fact the controls are sensibly grouped and the functions are easy to select once one is used to the machine.

Movement of the tape is controlled by three microswitch pushbuttons and a three-position lever, the former actuates forward, stop and rewind, while the latter provides the functions fast, pause and play. In addition to these there is a high/low speed switch which also deals with equalisation, and a large/small spool switch which changes the winding tension. With the exception of a slight tendency to sling a loop at the take-up reel on start, the behaviour of the tape transport was excellent, even during the fixed speed fast winding functions. Tape handling was in fact so good that it is unnecessary to pass through the stop position when going between functions. There was however one interlock fault which meant that, if one went rapidly from play to fast wind through the pause position, the machine went into the fast forward mode. While this did not in any way damage the tape, it could be an irritation.

The following worst case wow and flutter figures, taken from the beginning, middle and end of an NAB reel (there being little difference within the reel) show that the wow and flutter performance is very good but that the absolute tape speed could be more accurate:

Nominal speed (cm/s)	Error (%)	Wow and flutter (DIN weighted)	Wow and flutter (RMS unweighted)
38	—0.8	.045%	.03%
19	—1.0	.15%	.08%

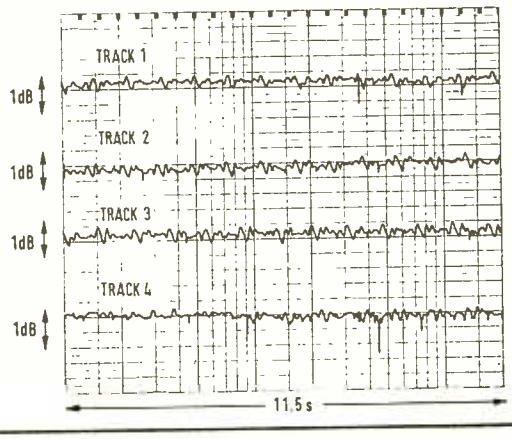
Fig. 1 also demonstrates that the head to tape contact is very good on all four tracks, the figure being obtained by recording and replaying at 10 kHz tone at 38 cm/s and plotting the resulting output with the B & K level recorder set to a very high pen speed. The resulting variations are undoubtedly partly due to tape defects, so good are the results.

76 ▶

FIG. 1

TEAC A 3346
10kHz REC/PLAY
UNIFORMITY AT 38 cm/S

PEN: 1m/S
PAPER: 10 mm/S



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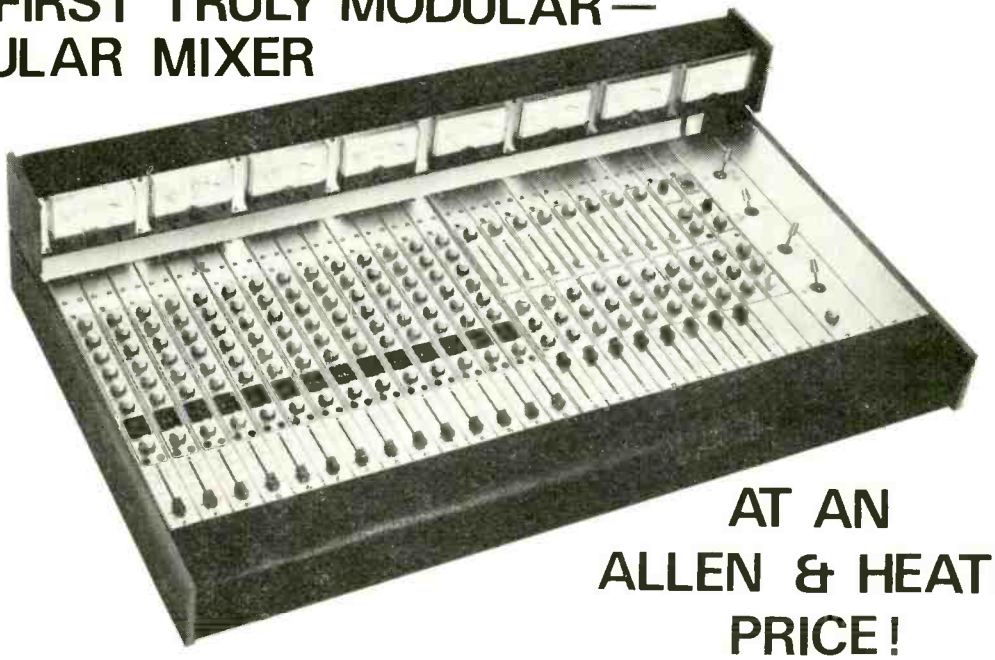

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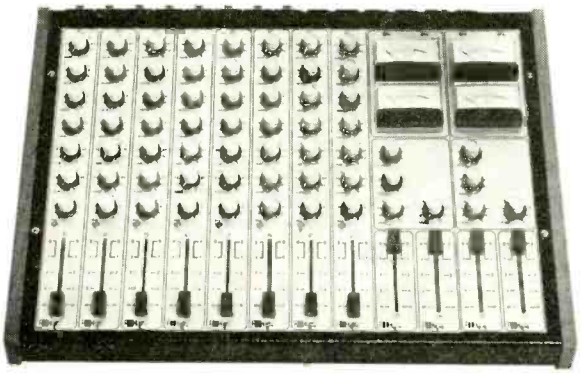

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During this test it was noted that friction noise (scrape flutter) was a problem, which is not surprising when one finds that there are no rotating guides in the tape path. Finally, two other potential defects in the tape transport: bent NAB spools cannot be used because the spool flanges run very close to the cabinet (perhaps this is a blessing in disguise!), and the spool turntable height is set for metal NAB spools so central tape winding will not occur with plastic spools.

Now to the electronics. Each of the four channels is provided with an after/before switch that also switches the four level meters which on playback are located after the four playback level controls. Playback is also controlled by four sync switches which are located on the head assembly and connect the playback amplifiers to either the playback head or the record head when sync playback is required. A monitoring output for headphones is also provided, with an associated switch which connects the headphones to either the front channels, the rear channels or to the sum of front and rear channels.

As usual, my initial investigation into the playback performance was checking azimuth, which was found to be exact (the adjustment being on the sound four screw principle) with extremely small phase jitter between the outer tracks in the order of ±5 μs at 38 cm/s tape speed. Replay frequency response at 38 cm/s to the NAB 50 μs and 3,180 μs characteristic was within ±1 dB from 31.5 Hz to 18 kHz on all four tracks. At a tape speed of 19 cm/s, it was within ±1.5 dB over the same frequency range with the exception of track Three which was 3.5 dB down at 18 kHz—a matter of correcting the replay equalisation.

The maximum output level when replaying a reference level of 320 pWb/mm at 1 kHz was +3 dBm from channels One and Three +4.5 dBm on channel Two and +3 dBm on channel Four from a source impedance of just over 1k ohms. As is so common with Japanese machines, this output impedance is too high for loading with 600 ohm lines and a little more available output would be desirable.

Referred to the above reference level, the machine amplifier noise was extremely low in spite of the wide bandwidth of the replay amplifiers, and the level of mains hum at better than –66 dB was good.

Reference level to machine replay noise

Channel	Unweighted	Weighted
1	—60 dB	—70.7 dB(A)
2	—61.5 dB	—71.5 dB(A)
3	—59.5 dB	—70.5 dB(A)
4	—60 dB	—69.2 dB(A)

FIG. 2

TEAC A 3340
REC / PLAY FREQUENCY RESPONSE AT 38 cm/S CHANNELS 1 AND 2 ALTERNATED

PEN : 100 mm / S PAPER : 3 mm / S

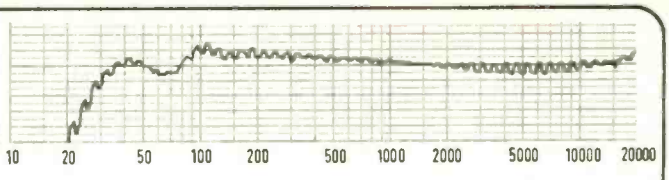


FIG. 3

TEAC A 3340
EXTENDED REC / PLAY FREQUENCY RESPONSE AT 38 cm/S CHANNELS 1 AND 2 ALTERNATED

PEN : 100 mm / S
PAPER : 3 mm / S

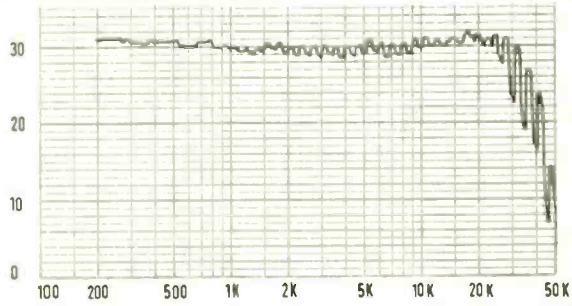
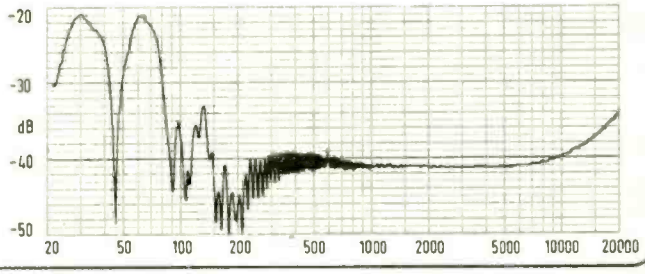


FIG. 4

TEAC A 3340
CROSSTALK
CHANNEL 1 RECORDED
CHANNEL 2 PLAYED

PEN : 100 mm / S
PAPER 3 mm / S



On the upper end, the replay amplifiers can handle +10 dB on reference level which is a perfectly adequate margin for all current tape materials.

Overall, with the exception of one maladjusted replay equalisation, the performance of the replay section is really excellent when used in the normal replay mode. In the sync mode there is naturally a considerable degradation in performance both in signal-to-noise ratio and frequency response, but both are quite adequate for the purpose for which the sync mode is intended.

On the record side, the machine has provision for the use of high and low bias tapes and it was very pleasing to note that various tape types were recommended for each of the switch settings. As the industrial user will no doubt always use the best tapes available, the measurements were taken with Scotch low noise tape, the performance being briefly checked with low bias tape and found to be satisfactory.

Two inputs are provided for each track, the relative input levels being controlled by four sets of concentric potentiometers; a design feature of which I do not approve.

Not only are the potentiometers rather difficult to set but it is all too easy to disturb one setting when adjusting another level, also it was found that manipulation of the microphone input potentiometer upset the line input level by 1 dB. The line input, fed by jack sockets at the rear of the machine, had a sensitivity of 90 mV for recording reference level of 320 pWb/mm at 1 kHz with an input clipping level in excess of 12V and an input impedance of 150k ohms: all very sensible. Also the microphone input, which is a further unbalanced input fed by jack sockets on the front of the machine, had a sensible sensitivity of 240 μV for recording reference level, an overload limit of some 50 mV before the onset of clipping, and a relatively high impedance of 37k ohms.

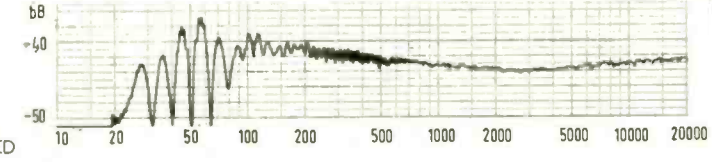
It is often said that all good things have to come to an end and the only serious shortcomings found in this machine were the four so-called VU meters. The response of these meters to tone bursts is far slower than a standard VU meter—a 300 ms tone burst producing a deflection of between 95 per cent

83 ▶

FIG. 5

TEAC A3340
CROSSTALK
CHANNEL 1
RECORDED
CHANNEL 3 PLAYED

PEN : 100 mm / S PAPER : 3 mm / S



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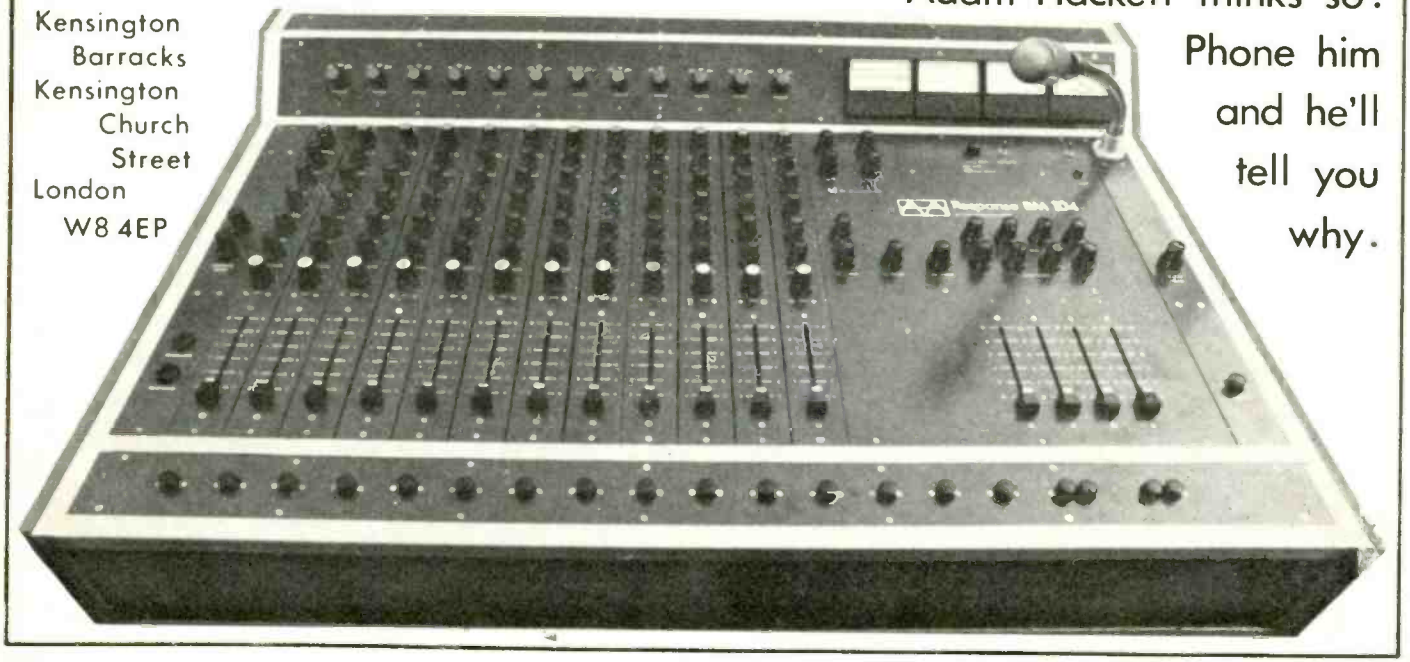

INDUSTRIAL TAPE RECORDERS

heads permit rapid adjustment from above. Mechanical mode selection. Switchable AGC.
Spool capacity: 13 cm.
Wow and flutter: ±0.07%.
Speed deviation: ±0.5%.
Frequency response: 60 Hz to 12.5 kHz ±1 dB.
Signal-to-noise: 56 dB.
Distortion: 2%.
Pilot attenuation: 58 dB.
Price: £271.50.

FERROGRAPH
The Ferrograph Company Ltd, Auriema House, 442 Bath Road, Cippenham, Slough, Bucks SL1 6BB.
Phone: 062 86 62511

Series 7
Three speed (38, 19, 9.5 or 19, 9.5, 4.75 cm/s) single or dual channel recorder available in full, half or quarter track format. Internal minitor loudspeakers and amplifiers. Variable speed search.
Equalisation: IEC.
Spool capacity: 21 cm.
Frequency response: 40 Hz to 20 kHz ±2 dB.
Signal-to-noise ratio: 9.5 cm/s, 55 dB at 2% distortion level.
Stereo crosstalk: 50 dB.
Wow and flutter: 0.08%.
Stability: ±0.5%.

Series P
Essentially as Series 7. Developed for use in broadcasting, specifically local radio.

MCI
Manufacturers: MCI, 1140 Flagler Drive, Ft. Lauderdale, Florida 33304.
Agents: Feldon Audio Ltd, 126 Great Portland Street, London W1N 5PH.
Phone: 580 4314

JH16
The *JH16* is designed for either 25 or 50 mm tape and with an optional set of heads and guides is quickly field convertible to either mode of operation. The system is available in eight or 16 track format and may be expanded to the full 16 tracks with the purchase of a conversion kit. All functions are fully remotable with a complete remote control supplied as standard equipment. An optional Digital Auto-Locator is available as an accessory, mounted in the remote box. Fool-proof control logic system, fully remotable function switching, and an optional automatic rewinder save time and allow the engineer to concentrate on programme material. Simplicity of design and accessibility of component systems reduce the possibility of failures and increase serviceability.
The *JH16* is housed in a steel cabinet with aluminium and walnut vinyl trim. The automatic rewinder and remote function controls are housed in a brushed, anodised aluminium case with a cradle for table top mounting.
Features of the *JH16*'s transport include automatic tape lifter, automatic dual head shield, constant tape tension, fully interlocked control logic, dynamic braking, rigid roller guides, unconditional failsafe braking, digital rewinder and tape logger, tilt access deck mounting. Features of the electronics include plug-in record, reproduce, bias and equaliser boards, built in remote overdub switching, automatic input/tape switching, balanced inputs and outputs, fully remoted function controls, remote control standard equipment, easy servicing, noiseless record in and out switching.
Tape speeds: 38 and 76 cm/s.
Long term speed stability (beginning to end of tape): Less than 10 Hz of 15 kHz. Recorded tone.
Wow and flutter: (38 and 76 cm/s): Weighted: less than 0.05% peak (DIN).
Unweighted: less than 0.15% peak (DIN).
Start time (To meet wow and flutter): 3s.
Reel sizes: 15 cm to 27 cm NAB hubs.
Rewind time (for 730 m reel): 55s.
Frequency response: (38 and 76 cm/s): reproduce −30 Hz to 16 kHz ±2 dB Cue −30 Hz to 16 kHz ±3 dB.
Signal to noise (unweighted): reproduce −64 dB below ±4 dBm. Cue −60 dB below ±4 dBm. Record and Erase less than 3 dB. (Increase over bulk erased tape.)
Input: level −20 dBm (minimum). Impedance −20k ohms (Nominal) balanced.
Output: level 0 VU +4 dBm. Impedance 600 ohm balanced. Line amp clipping +24 dBm.
Equalisation: NAB—automatically switched by deck speed switch.
Bias oscillator: frequency—120 kHz (located in deck).
IM Distortion: At standard rec level—3%.
Dimensions (wdh): Console: 840 x 750 x 1140 mm. Remote: 292 x 127 x 202 mm.
Weight: 184 kg.
Power: 117V ac, 8A, 60 Hz (50 Hz opt).
Temperature range: 5 to 45° C.

JH24
The *JH24*, 24 track Magnetic recording system, is a natural extension of the *JH16* system incorporating the same basic elements expanded into a larger format. The packaging of the *JH24* is identical to that of the *JH16* and the same modular design concepts have been employed throughout. The *JH24* design maintains both the economy and the serviceability of the *JH16*.
As with the *JH16* the *JH24* is readily convertible from 25 or 50 mm tape format with optional sets of heads and guides available. The system may be purchased in eight, 16 or 24 track configuration and expanded at any time with conversion kits. The 24 track remote box is identical to the 16 track version with an additional row of control push buttons. An optional auto-locator is also available as an accessory, mounted in the remote box.

JH100 servo-driven tape transport
Has dc capstan servo drive; crystal controlled tape speeds of 38 and 76 cm/s with 19 cm/s available; variable speed control on the front panel; external speed control facility; flutter typically 0.04 per cent at 38 cm/s DIN weighted; TTL deck logic; new auto-locator available which operates in both directions, real time readout and operation, and controlled approach speed with no overshoot.

PHILIPS
Pye TVT Ltd, PO Box 41, Coldhams Lane, Cambridge CB1 3JU.
Phone: 0223 45115

Pro 12
Portable 6.25 mm studio tape recorder. Two track ferroxcube heads for stereo and dual-track mono operation. Special version with full-track Ferroxcube heads and optional pilot tone head, tape speeds of 19 and 9.5 cm/s, tape speeds of 19 and 38 cm/s on special order, constant load tape drive, three inputs for each channel, built-in facilities for mixing two inputs, balanced microphone and line input and output transformers, dB switch for lining-up purposes, before and after tape monitoring, built-in monitor amplifier with loudspeaker, extra connection for stereo headset, cue and dubbing facilities incorporated suitable for 483 mm rack mounting.
Number of tracks: two; optional: full-track.
Number of heads: three; optional: pilot tone head (NAGRA system) according to DIN 15575, erasing frequency 120 kHz.
Reels: cine type, maximum 18cm, minimum 13cm.
Starting time: less than 0.3s to reach normal speed, less than 1s to reach normal wow and flutter level.
Fast forward and rewinding time: less than 75s for 540m.
Signal to noise ratio: 19 cm/s to DIN 45405 (overall). 19 cm/s −56 dB (weighted). 9.5 cm/s at −52 dB (weighted).
Total harmonic distortion: recording amplifier less than 0.5% (measured at a level of +6 dB above full modulation) playback amplifier less than 0.5% at a level of +6 dB.
Inputs: each of the two channels has the following inputs, selectable by means of a switch: microphone input with microphone transformer (balanced) for 0.2 mV at 50 ohms, 0.4 mV at 200 to 500 ohms (taps) line input transformers to obtain matching to 0.775V or 1.55V; source impedance: 600 ohms.
Outputs: each channel has line output transformers to obtain matching to 0.775V or 1.55V; impedance: 600 ohms, a stereo separate monitor output for direct connection to separate amplifiers nominal level (0 dB on VU meters) load 10,000 ohms.
Monitor amplifier: nominal output approximately 0.5W via built-in speaker; distortion 1%.
Dimensions: 520 x 340 x 240 mm.
Weight: 23 kg.
Price: £330.

Pro 36 Studio tape recorder
Three speeds (electrically switchable) servo-controlled capstan speed, brakes and pressure roller solenoid-operated, precision-mounted fixed heads making adjustable azimuth setting superfluous second generation long-life Ferroxcube heads, horizontal and vertical operation, all functions are push-button operated; semi-conductor switching, die-cast tape deck chassis, equipped with three motors.

Pilot version
The pilot tone version (Neo-pilot system) of the *Pro 36* allows for the recording and playback of a 50 Hz or 60 Hz pilot tone reference signal together with a mono full-track programme signal.
In addition to the pilot recording and playback facility, an automatic playback synchroniser is available as an accessory. With the aid of the synchroniser the playback of a pilot tone tape can be kept in perfect lip-synchronism with any other mains or non-mains powered equipment such as perfo-tape machines, film and tv-film projectors, video tape recorders/reproducers as long as they produce a reference signal.
Instead of an external pilot signal it may be taken from the mains, which position can be set for by a switch on the operating panel. A 'start marker' of 1s 1 kHz will automatically be added when switched for at the operating panel. The start marker condition is indicated by a signal lamp.
The *Pro 36* studio recorder can be supplied in the following versions: unmounted (chassis), portable and console.
The chassis type is suitable for deck as well as 483 mm rack mounting. A rack mounting set is available. For the console versions castors are available on request instead of the adjustable feet. The height of the console will not change by using adjustable feet or castors. In case the amplifier unit is mounted underneath the tape deck, the amplifier front panel will have level preset controls only.

Specification
General:
Tape speeds: 9.5, 19 and 38 cm/s.
Tape width: 6.25 mm.
Reel type: NAB, DIN Cine (dia 18 to 30 cm).
Starting time: maximum 1s for reaching nominal flutter figure.
Microphone input (symm; floating). **Source impedance:** 200 ohms (adaptable for 50 ohms). **Minimum input level:** 0.2 mv.
Line input (symm: floating). **Input impedance:** more than 10k ohms, **source impedance:** 200 to 600 ohms. **Nominal input level:** +6 dBm, **minimum input level:** −14 dBm.
Line output (symm. free from earth), **Output**

80 ▶

TM 50 MK2 SERIES AUDIO MIXERS

SIngle or multi-output mixers with up to 100 input channels made to professional standards and incorporating the following features:

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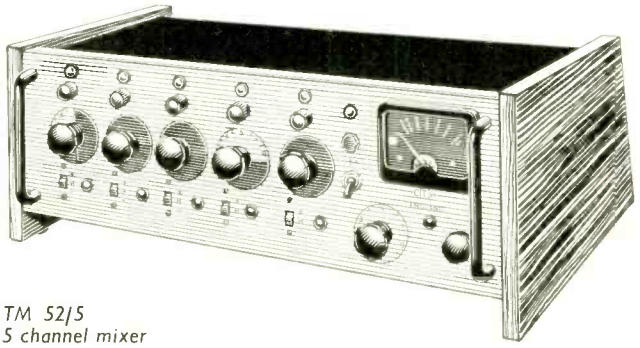
- ☐ Prefade listening
- ☐ 180° self-evident dials
- ☐ Back contacts
- ☐ 'Channel on' lamps
- ☐ Peak programme meter
- ☐ +12 dBm floating output
- ☐ 0-30-60 dB input attenuators
- ☐ 0-30 dB preset channel gain
- ☐ 30Hz-20kHz ±2 dB

OPTIONAL FEATURES INCLUDE:

- ☐ Tone controls
- ☐ Extra PPMs
- ☐ VU meters
- ☐ Disc and tape inputs
- ☐ Limiter/compressors
- ☐ Battery operation
- ☐ Portable field units
- ☐ Rack mounting units



TM 52/5
5 channel mixer

CTH also manufacture a range of modular mixing units, consoles, distribution amplifiers, studio disc player units, speaker amplifiers, cable drums and many other items of studio equipment.

CTH ELECTRONICS

Industrial Estate, Somersham Road, St. Ives, Huntingdonshire, PE17 4LE. Telephone: St. Ives 64388 (0480 64388)

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INDUSTRIAL TAPE RECORDERS

impedance: less than 50 ohms. **Load impedance:** 600 ohms (adaptable for 200 ohms). **Nominal output level:** +6 dBm, maximum output level: +18 dBm.
Wow and flutter: DIN 45507; peak value at 38 cm/s less than 0.04%, 19 cm/s less than 0.05%, 9.5 cm/s less than 0.08%.
Note: measured with flutter tape on DIN hub.
Distortion: (incl. tape) approximately 1.5%.
Signal-to-noise ratio (Overall):
Full-track, speed 38 cm/s: 62 dB (ref to 320 nWb/m) unweighted.
Stereo, 38 cm/s: 62 dB (ref. to 510 nWb/m) unweighted.
Wow and flutter: measured with MICOM, rms value 38 cm/s less than 0.03%.
Measured with flutter tape on NAB reel.
Distortion: (operating level and incl. tape) approximately 1.5%.
Signal-to-noise ratio (overall ref. to peak record level). Full track 38 cm/s: 64 dB unweighted.
Stereo 38 cm/s: 60 dB unweighted.
Price: £1,600.

Pro 51 master recorder
Ferroxcube heads, extensive new mechanical and electronic editing facilities, resulting in greater ease of operation and tape mounting. New electronic tape transport control resulting in reduction of wow and flutter, fully transistorised electronics, correction filters for both speeds, automatically selected and independently adjustable. Automatic end of tape switching, two tape speeds electrically switchable, precision minutes and seconds indicator, complete remote control on all operation modes. Plug-in head assembly, suitable for various types of tape, the bias current being continuously adjustable. Can be used with adaptor, for ccir hubs NAB and cine reels ,can be supplied for mains frequencies of 50 or 60 Hz and different mains voltages, entirely suitable for use in the tropics.
Versions
Pro 51 mono:
Full track, speeds 19 and 38 cm/s or 38 and 76 cm/s, console height 80 or 90 cm.

Pro 51 stero:
Two-track with full-track erase, speeds 19 and 38 cm/s or 38 and 76 cm/s console height 80 or 90 cm.
Wow and flutter, peak value, measured with BASF professional tape type *LGR*: 0.05% at 38 cm/s.
Tape width: 6.25 mm.
Starting time: 0.1s to reach nominal speed, 1s to reach a wow and flutter of 0.1%.
Fast winding of 1 km of tape: 120s.
Tape reel diameter: CCIR plates: 295 mm, NAB reels: 263 mm, Cine reels: 180 mm.
Tape deck dimensions: 618 x 440 mm.
Mounting depth: underneath tape deck, 264 mm.
Weight: 58 kg.
Recording amplifier
Source impedance: 200 ohms and 600 ohms.
Input impedance: (30 Hz to 15 kHz): 8 to 10k ohms.
Minimum input voltage for rated output: 0.5V.
Playback amplifier
Output impedance at 1 kHz: 100 ohms.
Load impedance: 600 ohms or 200 ohms.
Output voltage: +6 dBm (1.55V) maximum +20 dBm (7.75V).
Frequency response tolerances for CCIR and NAB: At 38 cm/s 40 Hz to 18 kHz.
Distortion at 1 kHz, a tape flux of 320 nWb/m and measured with BASF professional tape type *LGR*: less than 1.5%.
Background noise measured according to CCIR at 320 nWb/m tape flux, with filter according to DIN 45405 and equalisation according to IEC, and between 30 Hz to 20 kHz rms value: −62 dB at 38 cm/s.
Background noise when tape is modulated to 3% third harmonic distortion and equalisation according to NAB, with filter according to DIN 45405, 30 Hz to 20 kHz rms value: −66 dB at 38 cm/s,
Overall dimensions: 742 x 570 x 900 mm.
Weight: 100 kg.
Price: £3,950.

Pro 71A four-track 12.5 mm studio tape recorder
Newly designed second-generation ferrite heads, improved crosstalk damping, synchronous playback from record head position, overdubbing from sync channels, individual synchronous playback for each track: sync replay, modular plug-in solidstate electronics, level metering for each track. Tape speeds of 19 and 38 cm/s, electrically switched. Automatic selection and independent adjustment of correction filters for each tape speed. Equalisation switchable to CCIR or NAB.
Specification
Tape speeds: 19 and 38 cm/s.
Tape width: 12.5 mm.
Tape length: 1m on CCIR 100 mm hub 730m on NAB 27 cm reel
Tape reels: CCIR 100 mm hub and NAB 27 cm reel.
Fast winding (730m): approx 120s.
Starting time: (wow and flutter within twice the specified limits): 2s at 38 cm/s; typical values 1.6s.
Starting time (rated speed): approximately 1s, typical values 0.6s.
Wow and flutter (measured with EMT 420, weighted, peak value): maximum 0.05% at 38 cm/s, maximum 0.75% at 19 cm/s.
Input voltage (balanced input for 600 and 200 ohms lines): minimum 0.7V.
Input impedance: (30 Hz 15 kHz): more than 10k ohms.
Output voltage (balanced): nominal 0 dBm, maximum +18 dBm.
Output impedance (40 to 15 kHz): less than 50k ohms.
Load impedance: 600 or 200 ohms.
Distortion including tape distortion: less than 2%.
General
Power supply: 110, 220 and 240V (±10%), 50 or 60 Hz.
Power consumption: 400 VA.
Price: £6,750.

Pro 72 Four and eight track 25 mm studio tape recorders
Newly designed second generation ferrite heads, improved crosstalk damping, synchronous playback from record head position, overdubbing from sync channels, individual synchronous playback for each track; sync replay. Modular plug-in solid-state electronics, level metering for each track, tape speeds of 19 and 38 cm/s, electrically switched automatic selection and independent adjustment of correction filters for each tape speed.
Specifications
Tape speeds: 19 and 38 cm/s.
Tape width: 6.25 mm.
Tape lengths: maximum 732m.
Tape reels: CCIR 100 mm hub and NAB 27 cm. reel.
Playing time for 730m of tape: at 19 cm/s 62 minutes, at 38 cm/s 31 minutes.
Tape tension: approximately 200g.
Maximum slip between beginning and end of tape: 0.1% (Agfa PER 525).
Fast winding (732m): approx 120s.
Starting time: (wow and flutter within twice the specified limits): 2s at 38 cm/s typical values: 1.6s.
Starting time: (rated speed): approx 1s typical values 0.6s.
Wow and flutter (measured with EMT 420, weighted, peak value): maximum 0.5% at 38 cm/s.
Output impedance (40 Hz to 15 kHz): 50 ohms.
Load impedance: 600 ohms or 200 ohms.
Distortion including tape distortion: less than 2%.
Power supply: 110, 220 and 240 V, 50 or 60Hz.
Power consumption: 400 VA.
Price: £8,600.

Due to circumstances beyond our control, several late entries have been omitted from this survey. They will appear next month.

TELEX COPIER 1

By Hugh Ford

MANUFACTURERS' SPECIFICATION

Head configuration: Half track, two channel. Play only on left deck of master. Automatic erase and record on right deck of master and on both decks of slaves.
Copy speed: 76 cm/s.
Automatic rewind: 178 cm/s at end of copy mode.
Equalisation: RIAA and DIN Standard.
Signal-to-noise ratio: 45 dB
Crosstalk rejection: 45 dB or greater at 1 kHz.
Distortion: Typically below 1% thd at 7 dB below O level.
Wow and flutter: Contributes .25% or less to cassette copy as measured per ANSI Standard S4.3-1972.
Bias oscillator: 600 kHz.
Record level: Corresponds to playback flux level of 250 nWb/m at O level.
End of tape sensing: Automatic stop at end of tape in less than 1s.
Outputs: Copier one output accepts control cable for control of the copier Two and two oscillator sync jacks. Copier Two input accepts control cable from copier One. Copier Two output accepts control cable for operation of additional slave. Copier Two oscillator sync jacks accept standard 91 cm patch cord.
Electronics: All solid state amplifiers. Control circuits solid state integrated circuit.
Power requirements: 110V to 120V 60 Hz (220V 50 Hz and 120V 50 Hz optional).
Power consumption: 90W maximum, each unit, 270W maximum with master and two slave units.
Capstan: 3.2 mm diameter, hardened stainless steel.
Dimensions: 400 x 455 x 190 mm (width).
Weight: 14.5 kg.
Manufacturers: Telex Communications Division, 9600 Aldrich Avenue South, Minneapolis, Minnesota.
Agents Avcom Systems Ltd, Newton Works, Stanlake Mews, Stanlake Villas, London, W12.
Price: £523.

THE TELEX *Copier 1* compact cassette copier is a simple duplicator for producing a single copy at a time from half track master cassettes, but further add-on slave units can enable the copier to produce five simultaneous copies, when two slave units are added.

Standard facilities include the ability to copy either track One, track Two or both tracks simultaneously, and also automatic erasure of the slaves which removes the requirement of bulk erasure of previously used cassettes. Furthermore, the copier automatically copies the complete master, erases the complete length of the slaves, and then completely rewinds all cassettes without human intervention. Should the full cycle not be required, the cassettes can be rewound at any point.

While the copier takes up a fair amount of table top space, it is similar in size to many office duplicating machines and equally simple to operate as it has only three controls the function of which will be clear from the method of operation. The master and slave cassettes are placed in the machine, the former automatically switching on the mains supply. Rewind is then pressed, which rewinds both cassettes. The track selector switch is set to the required copying mode of either track One, track Two or tracks One and Two, and the copy button pressed. The remainder of the operation is automatic until the copier stops with the master and slave rewound. Both the rewind and copy buttons are in the form of illuminated pushbuttons which indicate the function in progress, and both cassette stations are equipped with indicator lights that show they are in action. Should an emergency stop be required for any reason, this can be achieved by pressing both pushbuttons at the same time.

In spite of this simplicity, there is one serious possibility for operator error: this is that there is no record interlock on the slave station so it is possible to erase a master cassette accidentally if it is placed in the incorrect station.

The copying speed of 76 cm/s means that a full C90 cassette can be copied in just under three minutes, to which must be added the rewind time of 70s to complete the operation. In spite of this high speed, the wind of the cassette was quite reasonable but I would not advise the use of any thinner tape than a C90.

The mechanical design of the copier was to a high standard but probably not up to a 24 hours per day workload. While it was noted that the cassette location was not particularly positive, no side effects were observed.

Accessibility to the entire unit was really good so that servicing should present little problem, particularly as the electronics are mounted on high quality plug-in printed boards and all leads are well equipped with plugs and sockets instead of soldered joints. From an electrical safety point of view, all the wiring is well enclosed and the copier is supplied with a three-core mains lead with the earth connected to all exposed metal parts. However, as was mentioned by the distributors, the rated mains voltage is 220V as opposed to the British mains standard of 240V. In continuous operation that leads to a fair degree of rise in temperature of the cassette stations, which could cause tape distortion if a master tape is in use for a prolonged period. This potential trouble can be overcome by feeding the copier from a suitable autotransformer.

In practice the operation of the copier was so good that I risked making copies of my very expensive calibration cassettes; one does not trust £40 or so worth of cassette to any old machine!

All tests were done with BASF low noise C90 cassettes, and the resulting errors in frequency response are in **TABLE 1** from which it is to be seen that the copier performance is very good. **Fig. 1** shows the errors in frequency response resulting from copying a high level recording which might cause the copier's recording amplifiers to saturate. There is however no indication of this possible fault.

As the copier works at a fixed record/replay level, it is desirable that the copies should be recorded at a slightly lower level than the master: in the case of channel One this was the case, the copy being 2 dB down on the master. In channel Two the reverse was the case, the copy being 1 dB up on the master. This is reflected in the distortion performance where channel One added 0.4 per cent third harmonic to a copy of the standard reference level of 250 nWb/m, and channel Two added

TABLE 1 Telex Copier 1 frequency response (playback from calibration cassette).

	Channel 1	Channel 2
30 Hz	—6	—6
40	—1	—1
60	0	—1
130	+1	+1
150	0	0
500	+1	0
1k	0	0
2k	0	+½
4k	+1	+2
6.5k	+2	+3
8k	+1	+2
10k	+1	—1

FIG. 1

TELEX CASSETTE COPIER 1

FREQUENCY RESPONSE AT HIGH LEVEL

PEN: 16 mm/S
PAPER: 3 mm/S

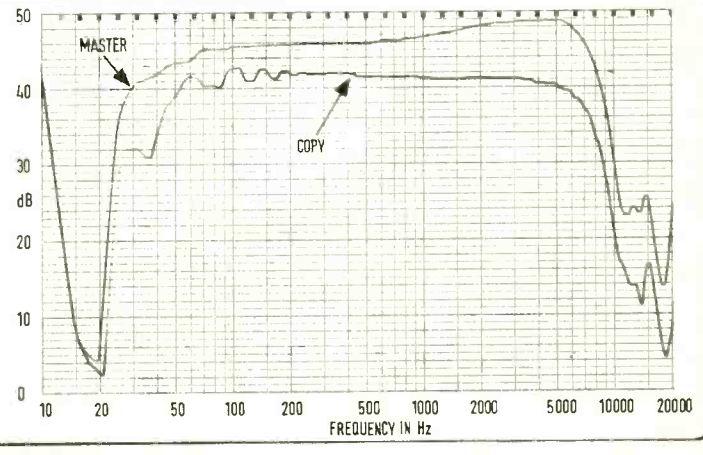
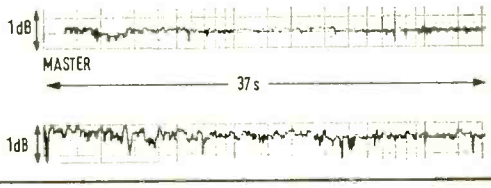


FIG. 2

TELEX CASSETTE COPIER 1

6.3 kHz OUTPUT UNIFORMITY
PEN: 250 mm/S
PAPER: 3 mm/S



1.8 per cent third harmonic. In any case the performance is very good and channel Two can be improved by minor internal adjustments. In this context it was noted that the maintenance manual advocates equal levels on the master and the copy, something with which I do not agree. A 2 dB margin considerably reduced distortion and loses little in signal-to-noise performance.

The noise performance of the copier was also good. The noise introduced to a bulk erased BASF low noise C90 cassette being only 3.5 dB(A) above bulk erase noise. Erasure of the slave cassette was also excellent, the erasure of a 333 Hz tone being greater than 71 dB.

Fig. 2 shows the degradation in uniformity of a 6.3 kHz tone when copies are replayed quarter track. While this performance leaves something to be desired, it is really pretty good for a cassette copier in this price range and I have seen far worse performance from fairly expensive cassette recorders.

Similarly, wow and flutter is a limitation at 0.27 per cent DIN peak weighted. Perfectly adequate for speech recordings but marginal for music. However the copier's error in tape speed was really excellent with the introduced speed error being only 0.1 per cent.

The final measurement of interest was the degree of crosstalk between tracks: this measured 50 dB at a frequency of 333 Hz which is 5 dB better than the manufacturers' 1 kHz specification but could be better still.

Summary

The brevity of this review is an indication of how well the Telex *Copier 1* performed. It is a very simple machine to use and, taken in the context of a desk-top cassette copier, its performance is more than adequate for routine copying of speech recordings—a common requirement which seems to cover the ground from sales blurbs to sermons.

So far as copying of music recordings goes, the only limitation is really wow and flutter which measured 0.27 per cent DIN weighted and the crosstalk performance. Both these parameters are better than many conventional cassette recorders, but hardly put the copies in the 'hi-fi' bracket.

Over £500 is a lot of money to pay for the facility of making copies of cassettes, but the production rate and performance of the Telex copier cannot be matched at this price by a bank of conventional recorders wired together. In conclusion, if good quality copies are wanted fast, the Telex *Copier 1* is a good buy.

A3340 REVIEW

and 88 per cent of the steady state condition, when the steady state condition should be overshot in the case of a VU meter. Furthermore, the response to a 100 ms burst of 1 kHz tone is only 50 per cent of the steady state condition. Just to cap this, it was found that 0 VU in the before condition corresponded to reference level of 320 pWb/mm—when in the case of a genuine VU meter it should be about 4 dB below reference level depending upon the type of tape being used. Readers be warned; this is far from the only machine which has meters labelled and looking like VU but which are nothing like the well-defined standard VU meter and are often quite useless as recording level indicators.

Having aired my views on this subject, I will now return to the better aspects of this machine. The record/replay frequency response with high bias tape was well within the specified ±2 dB from 30 Hz to 16 kHz at 19 cm/s, and in fact remained within these limits to above 20 kHz. **Fig. 2** shows that excellent results are also obtained at 38 cm/s while **fig. 3** shows that the high frequency response remains with the limits of ±1.5 dB right up to 30 kHz from where marked differences between channels appear, but a useful response extends to 35 or 40 kHz. This performance is quite remarkable and very little difference between channels was noted up to well clear of the audio spectrum. While frequency responses above 20 kHz are completely unnecessary for audio recording, this machine has potential for instrumentation work, such as vibration recording.

Figs 4 and **5** show the crosstalk performance between tracks One and Two and One and Three respectively. The crosstalk above 100 Hz is to a high standard of performance, as is the low frequency crosstalk between tracks One and Three. While the crosstalk at low frequencies between adjacent tracks on ¼-track machines is always somewhat poor, the beautiful theoretical humps peaking at 30 Hz and 60 Hz are a perfect example of fringing effects to a rather excessive degree. However, this defect does not particularly detract from the recorder's performance when it is used as a four track machine; it is only serious when stereo programmes are recorded in the conventional track format using all four available tracks.

From the point of view of distortion, the machine was capable of fully driving BASF *LGR* tape and gave a three per cent harmonic distortion point of +6.5 dB with respect to 320 pWb/mm at 38 cm/s with 3m *207* magnetic tape; so all is well in this department.

The recording process was found to increase bulk erase tape noise by 4 dB at both tape speeds, which indicates that the bias oscillator could well have less distortion. It was also found that recording introduced a hum level at 50 Hz some 58 dB below reference level of 320 pWb/mm, which is probably satisfactory for most purposes but could be bettered.

The line input gain did not have any effect upon recorded noise, as is the correct situation, and the effective noise level at the microphone input was 124.5 dBm(A), which is a good performance.

Summary

Unfortunately my acquaintance with the machine has not been long lived and this review was necessarily prepared in somewhat of a hurry so I have not mentioned the less significant aspects of the machine.

The only serious dislike I have for the machine are the ballistics and setting of the level indicators but such defects are all too common. Having regard for the price, this Teac *A3340* is undoubtably very good value and has many outstanding features. In particular, the overall performance of the replay electronics is exceptionally good.

While I have raised a number of other shortcomings in this review, it is the job of a reviewer to point out such matters, and one certainly does not expect to find a perfect machine at this sort of price level. It is a different matter when a machine costs several thousand pounds for four tracks.

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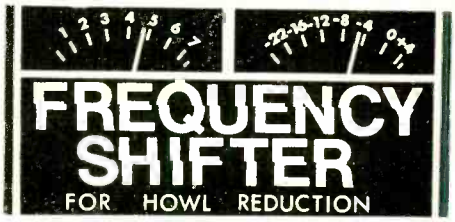

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