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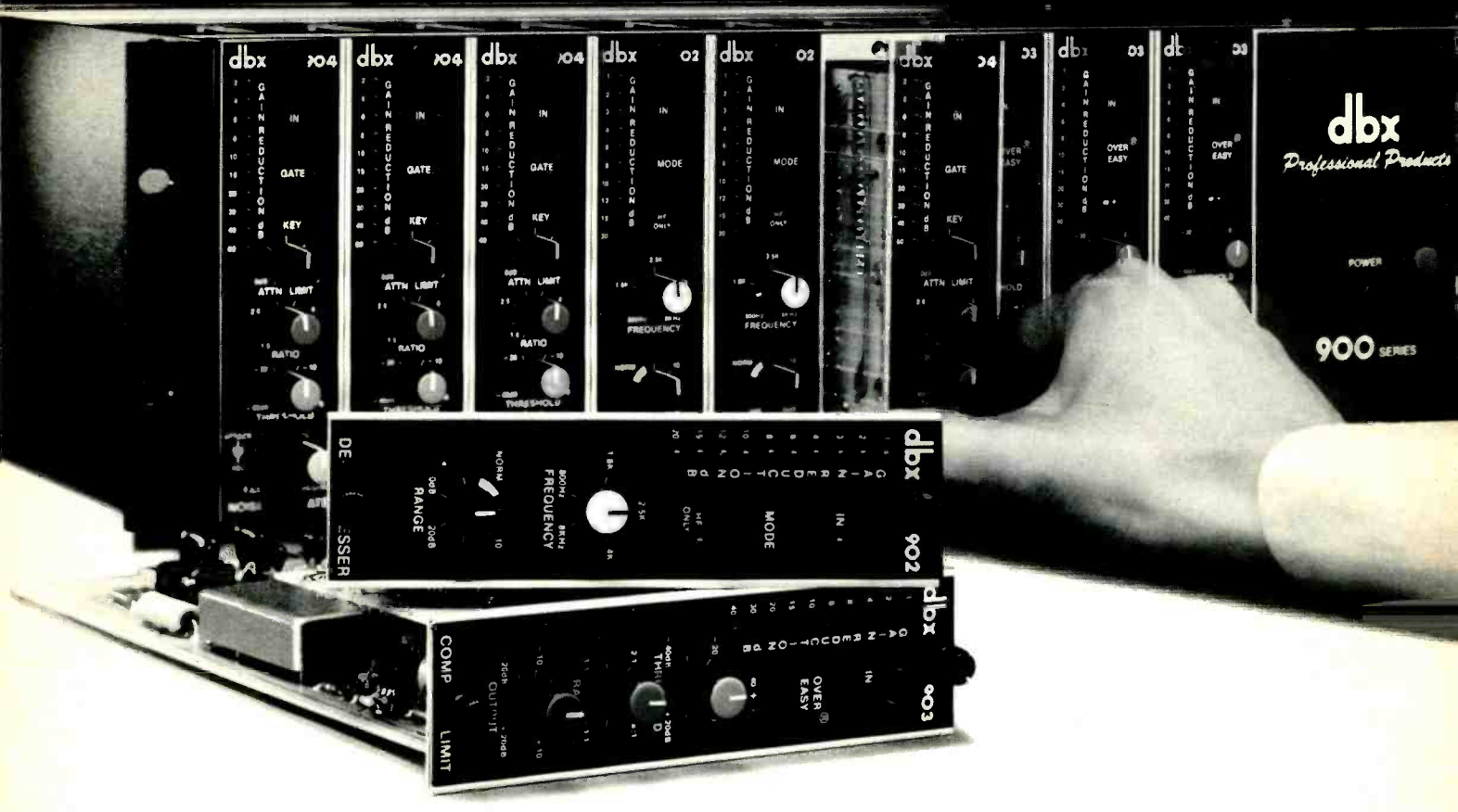

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EDITORIAL

Education and the state of the nursery

About this time of year, every year, the steady stream of letters received by UK recording studios turns into full flood as scores of hopeful future recording engineers about to leave schools and colleges try to realise their ambitions. Many of these applicants are of course quite unsuited to any form of studio activity and will not get any further than having their letter opened and 'put on file'. There is another equally hopeless type of writer who immediately offers to sweep floors and make the tea for no payment whatsoever, in some cases even offering to pay for the privilege of being allowed within the studio walls. The other letters will generally fall into categories such as out of work musicians, wayward history graduates and misguided individuals who have some very strange ideas about studio work. Of course amongst these letters there is one from someone who has all the potential to become an excellent engineer but will he actually get his chance?

This process of selection (natural?) by letter has provided the British recording industry with most of its engineers since the profession became sought after. The idea was that the successful applicant would be started at the very bottom and learn his trade the hard way by watching others for a few years. To ensure that those who made it to engineer were the right people for the job, some of the larger studios were actually able to keep the new recruits out of the control room for up to two years by giving them the responsibility for supplying tea and coffee, the cleanliness of the floors, cataloguing in the tape library and the eventual quantum leap to tape copying. While this was almost certainly excessive, anyone less than fanatically keen would have already left under the additional pressures of long hours and poor pay. Although it is easy to make light of this situation as I have done, it does seem very strange that an industry which considers itself professional, as it undoubtedly is, should rely on such a random method of selection for its future members.

A certain number of letters also find themselves on *Studio Sound* desks—usually from those who have tried the selection process, have written their 85 letters, received their 15 replies and all to no avail. The question is without fail — where can I study so that I will become a more desirable asset for a studio? What can you say as an honest answer to this question?

To the vast majority of the British recording industry, the concept of training is somewhat incomprehensible and unnecessary.

There are however developing situations that quite clearly suggest that the life of our tried and trusted selection/survival-of-the-most-suited/training-by-apprenticeship method of producing engineers may be quite unsuited in many ways for the recording industry of the very near future. The demands that will be placed on the engineer will go far beyond the present valued attributes. Stamina, the ability to relate to all kinds of people, PR, a musical ear, the ability to balance music, the developed sense of mic technique will be needed but it does appear that equipment appearing in studios will require a positive understanding of background principles if full and proper use is to be made of it. The areas that engineers will have to become familiar with will include more complex automation systems, digital and computer control synths and their detailed interfacing and control of studio equipment, far more advanced signal processors, particularly those in the field of psychoacoustics and artificial reverbs, esoteric mics and their techniques, digital recording, and finally the very real improvement in operating techniques that will have to occur if standards set by domestic systems using digital source material, are to be met.

All these changes are almost upon us and will undoubtedly increase the demands on the engineer. The trainee will have more to learn and have higher standards to attain at a time when the economics of the industry may dictate that he has less time to achieve this as a studio employee.

This returns us to the question of training and the letters on our desk. What do we say? The truth appears to be that in the UK at present there are pitifully few opportunities to study sound engineering and these will be quite unsuitable for the majority of our enquiries. The Tonmeister degree course at the University of Surrey offers a very high standard of widely based training but with an annual student intake in single figures or so, the competition is very hot and the entrance requirements often far in excess of those quoted in letters on our desk. The Polytechnic of North London also runs courses that offer a solid grounding although this again may not be suitable for our letter writers owing to course numbers or entrance requirements. Some private individuals have set themselves up to run short courses as have some studios although such courses vary from very good to rather less than. Even so a week's course cannot achieve a great deal from basics. And there is the criticism from within the industry that the higher powered courses just turn out chiefs rather than indians.

Unfortunately, for the majority of our enquirers we can offer very little help as to where they might be able to study something relevant. It is perhaps of little comfort when we add that even if you found a suitable course and qualified, it could lead only to a marginal improvement in your job chances in a largely education resistant industry.

There are a number of signs however from within the industry that things may be coming to a head. Consider the facts that (a) many studios are now operating without tape-ops, juniors, seconds as various automation systems have replaced their more manual functions; (b) the type of music that many younger engineers are being asked to record with only one musician at a time is perhaps not the ideal training; and finally (c) as already mentioned increasing demands and more advanced equipment will create extreme pressures to learn. It may be that these are signs that the traditional system is breaking down. Some studios will readily admit that they now have to look for a higher standard of potential engineer perhaps with some form of qualification to indicate an aptitude to deal with future needs.

Variety of engineering practice is very important for the health of the UK recording industry and if all studios recruited from graduates with all the theoretical experience but rather less hands-on experience, this would be far more dangerous than the present situation. The ideal must be a mixed staffing system for a cross fertilisation of ideas with 'traditionally trained' engineers.

The British recording industry at the present moment is resistant to trained entrants and training, at a time when this might be exactly what the industry needs. The braking effect of these opposed attitudes is preventing the nursery wheel from rolling in a manner to provide engineers equipped for a future industry and we may, if the situation surrounding training—in formal training and practical terms—is not resolved and improved soon, the British recording industry may slip from its current respected status. **Keith Spencer-Allen**

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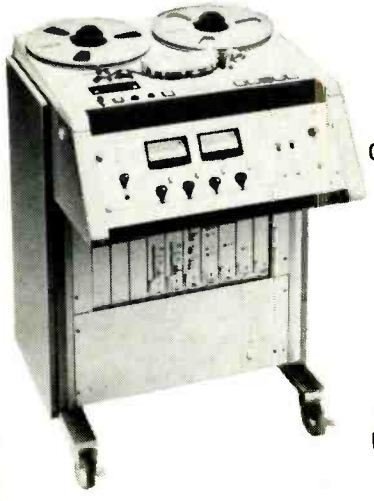

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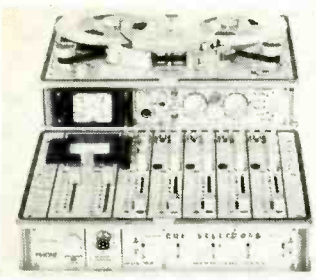

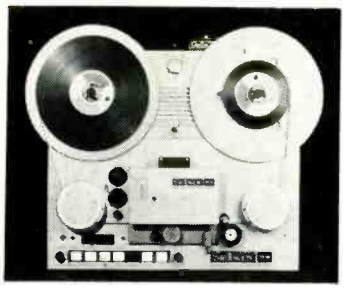

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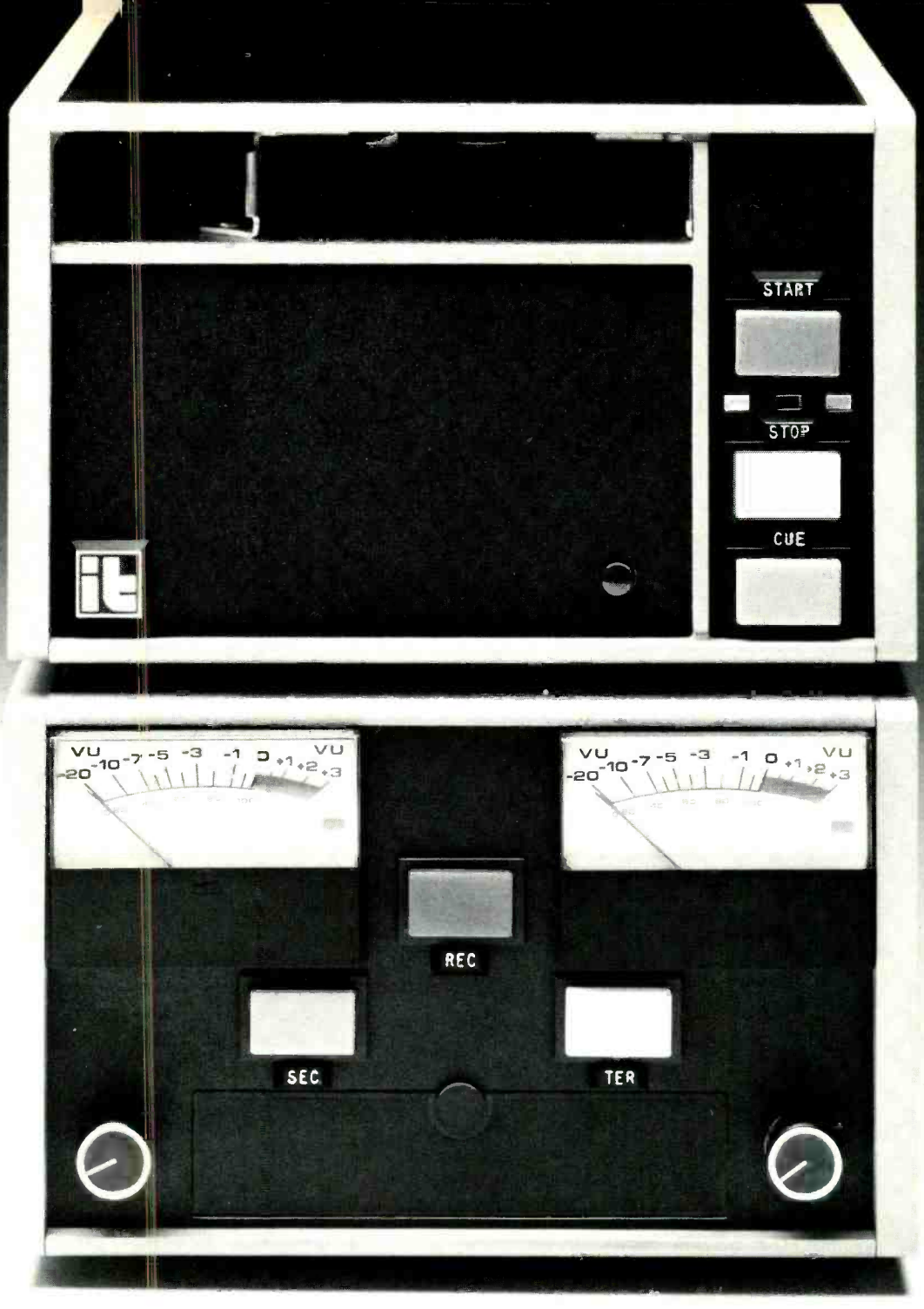

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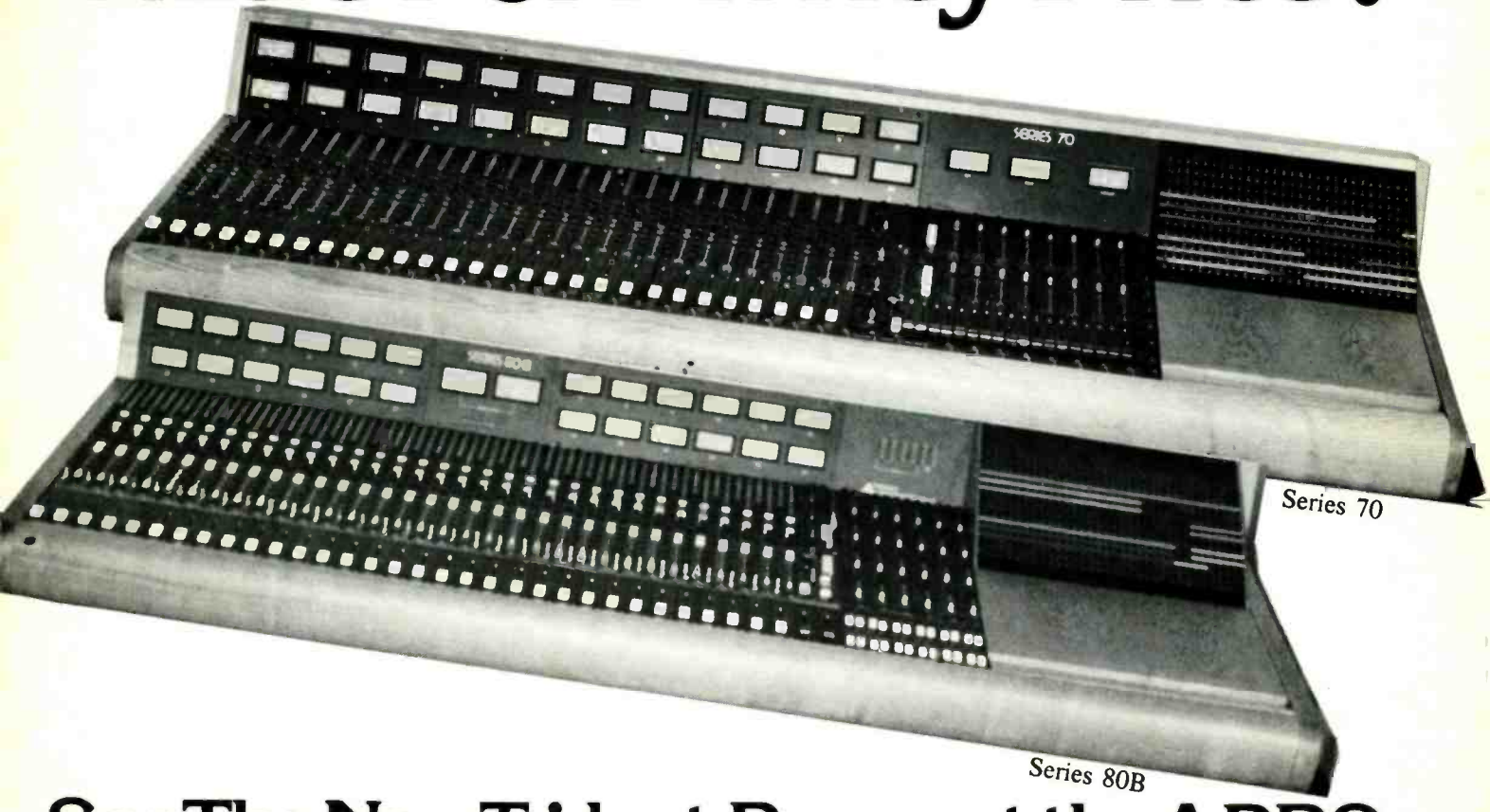

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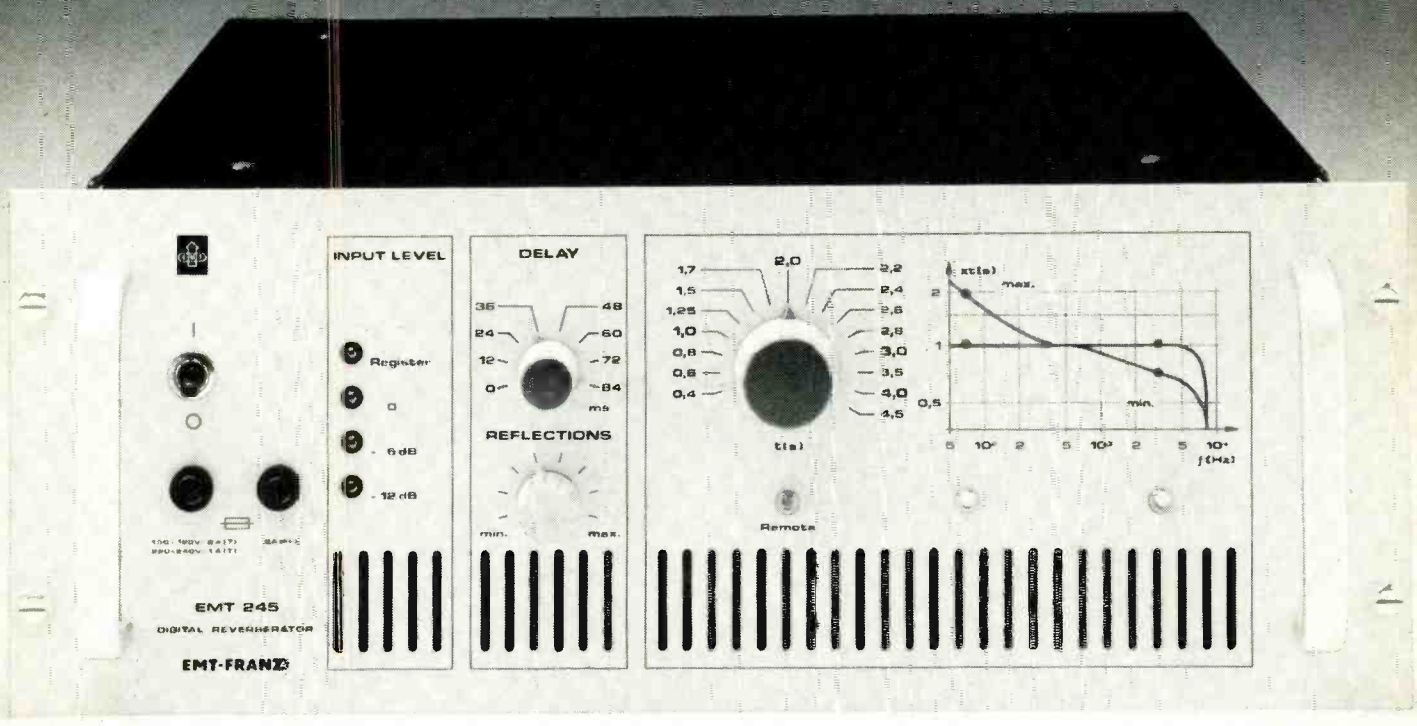

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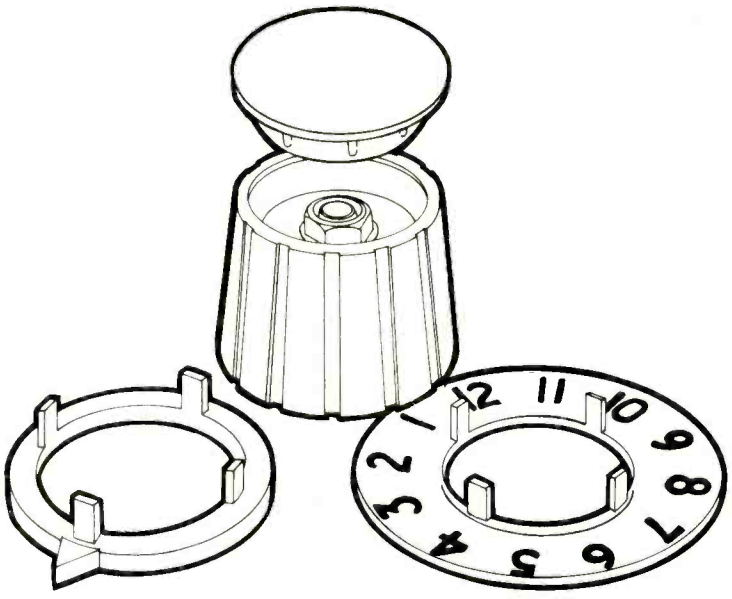

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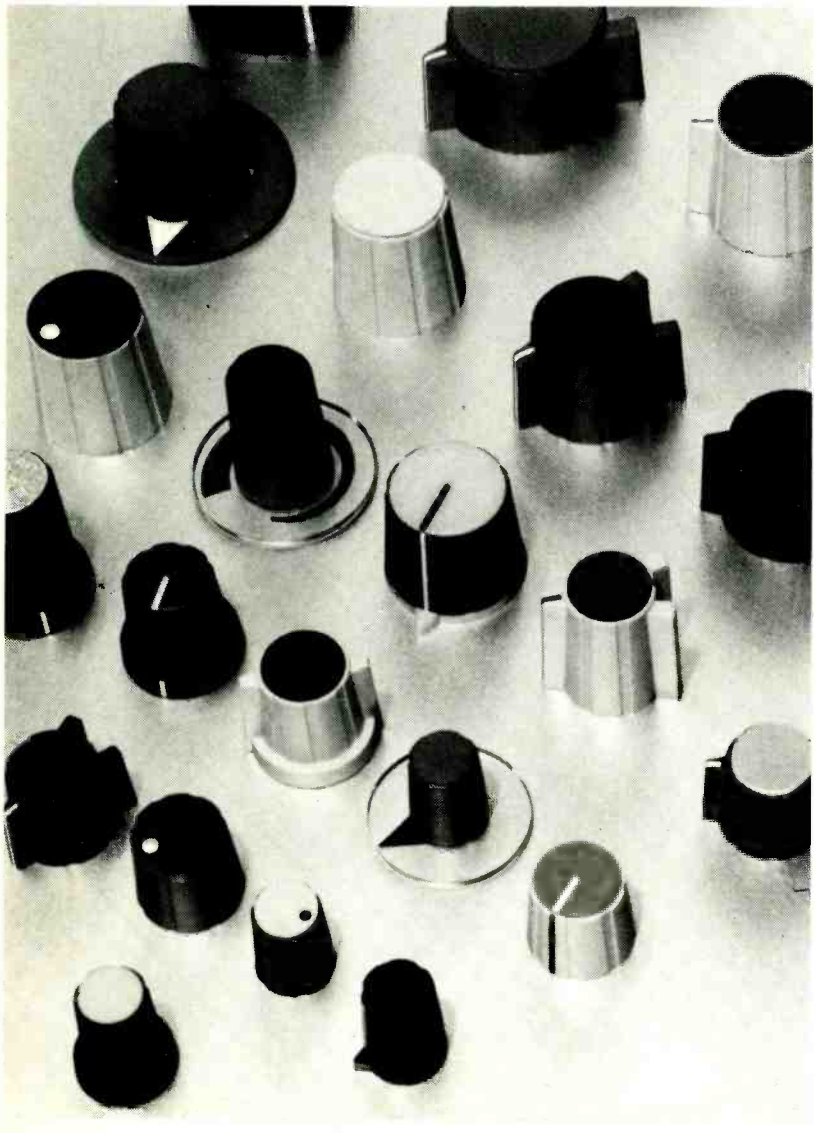

A knob is a knob is a knob? Not to Sifam. It took us quite some time to combine the best features of styling, function, handling and easy assembly. Once it was evident that our efforts were appreciated by knob twiddlers who care about such things, we kept extending the range. Now there are three knob colours, six different sizes from 10mm to 38mm, short knobs, long knobs, short knobs with one or two wings, short and long knobs with three wings, all with or without line or lines, all in matt-finish Nylon with brass fixings. Then there are plug-in caps in eight colours, with or without spot or line, pointers in six colours, eleven figure dials (or to your spec.) and stators.

Considering how complex we can make all this seem, the Sifam Collet Knobs and Accessories catalogue is a masterpiece of clarity. It covers all the technical considerations too. Send for your copy and see.

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With the new A810, Studer makes a quantum leap forward in audio recorder technology. Quite simply, it re-states the art of analogue recording.

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There's more. Electronic alignment of audio parameters (bias, level and EQ) is accomplished via digital pad networks. (Trimpots have been eliminated). After entering alignments into the A810's memory, you simply push a button to re-align when switching tape formulations. The machine even lines itself up every time it is switched on.

The A810 offers time-coincident SMPTE code on a centre track between stereo audio channels. Audio/code crosstalk rejection is better than 90 dB, while an internal digital delay automatically compensates for the time offset at all speeds. Code and audio always come out together.

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Practical, versatile and easy to operate, the new Melkuist Mastermix generation of automation systems reflect the Melkuist design philosophy of extending the power and performance of the engineers art.

The microprocessor based storage unit reproduces fader movements and mutes within single frame accuracy and features integral high density disk storage and a multi-standard SMPTE time code reader/generator system.

Melkuist Mastermix utilise the very latest developments in semi-conductor and floppy disk technology to provide high performance at low cost.

Complementary front-end modules have been custom-engineered for the full range of VCA fader types currently used in mixing consoles: not only the processor-based grouping systems of Harrison (Series 4), and MCI, but also the Melkuist and Fadex.

Designed by musicians for musicians, Melkuist Mastermix works quietly in the background, leaving the engineer free to concentrate on the mix.

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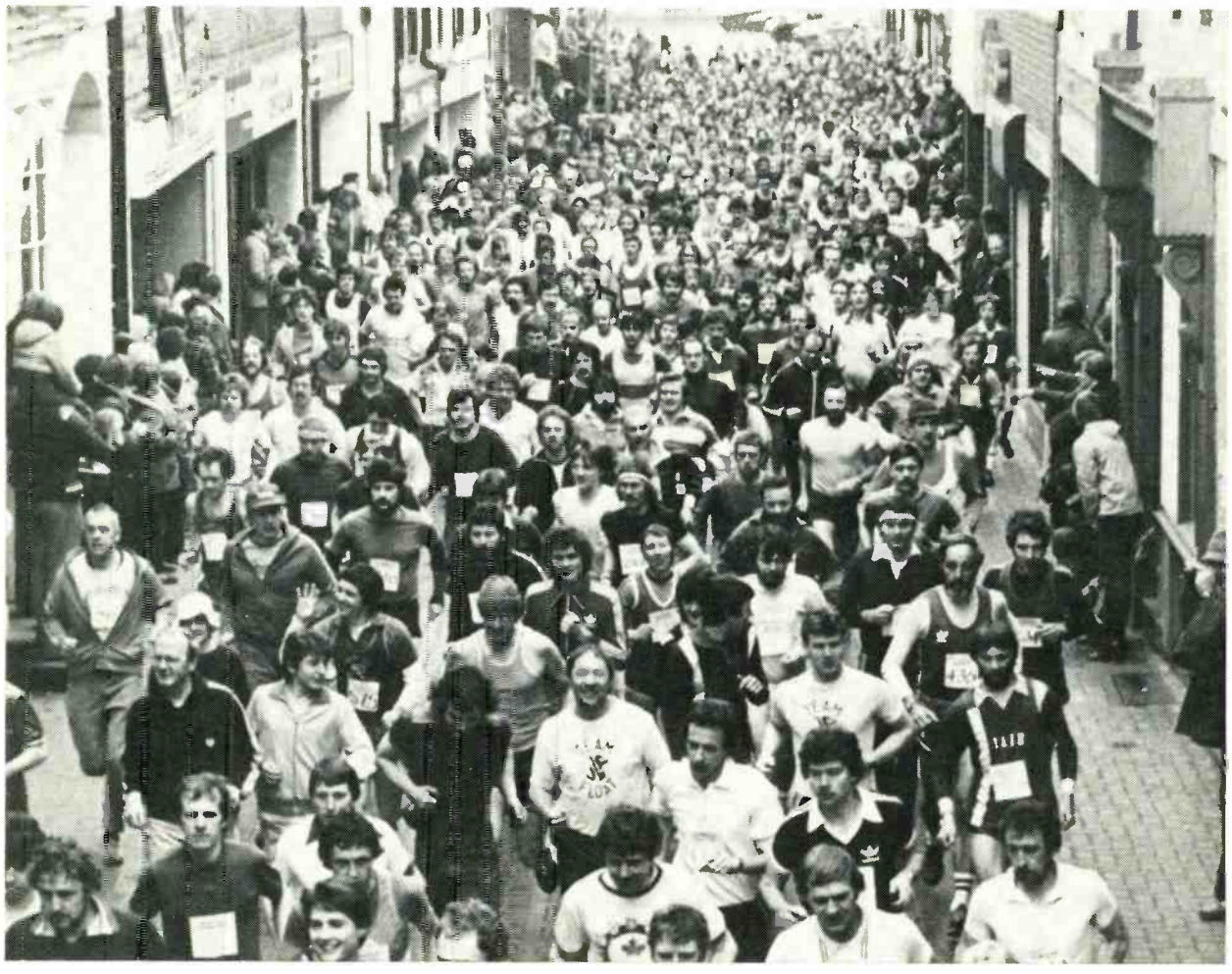

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The low impedance unit for transparent, distortion-free recording as well as on-the-air or live performances. Each of the four inputs is adjustable from 20dB to 60dB of gain.

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Gain Brain II

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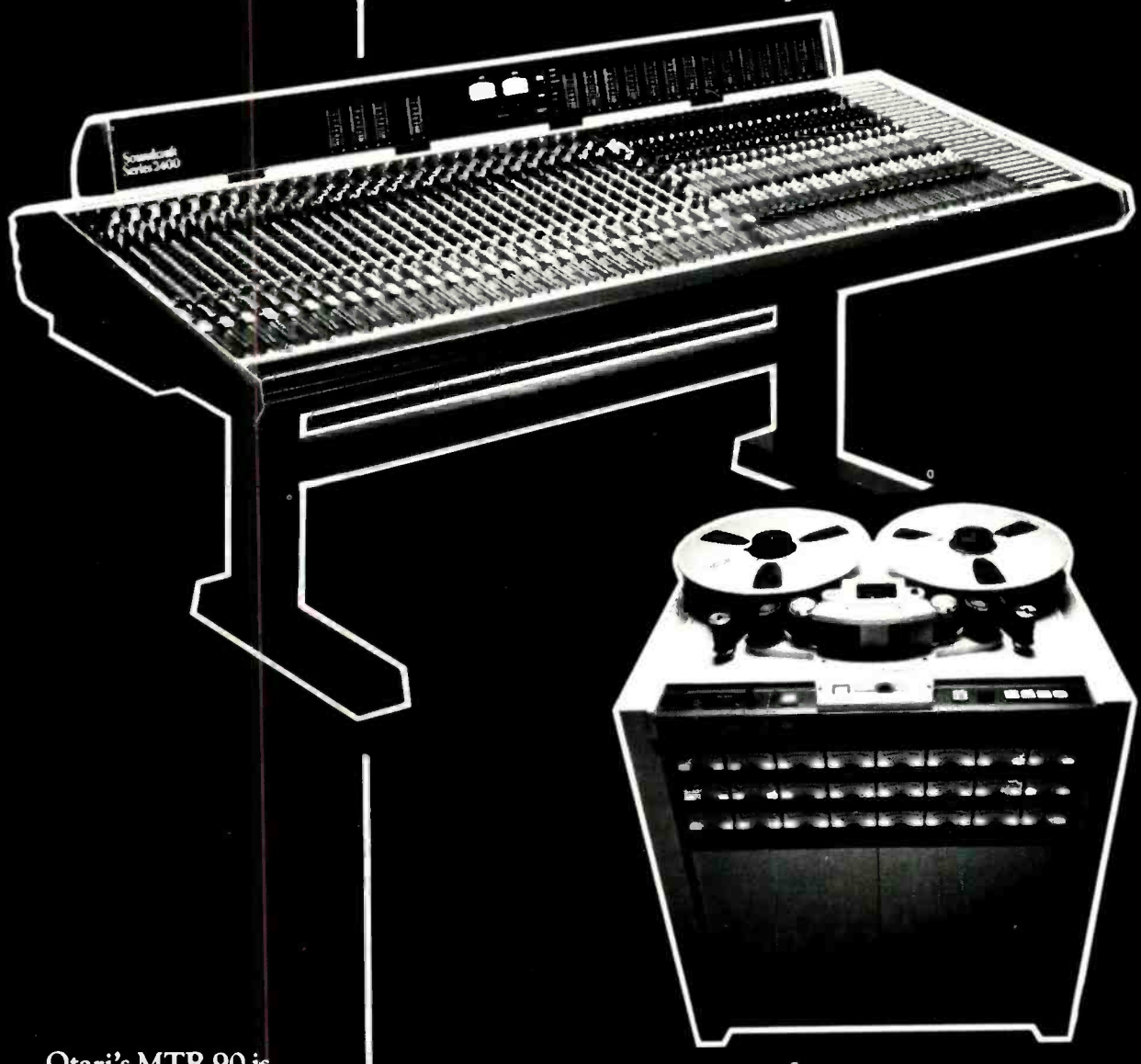
The Challengers & the Workhorse



Otari's MTR 90 is specified as the New Workhorse throughout the real world of twenty four track studios. And Soundcraft's 2400 Challenger consoles are first choice when the widest range of facilities and highest quality of performance must be within budget.

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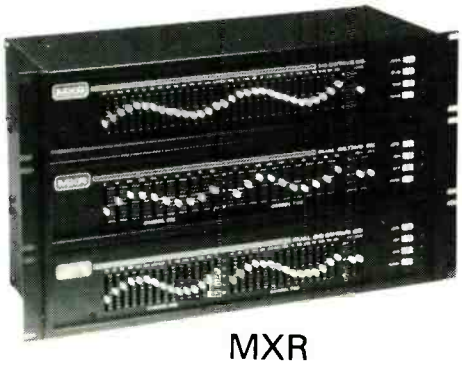

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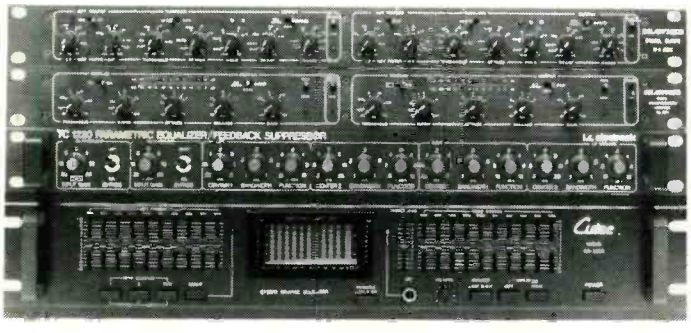

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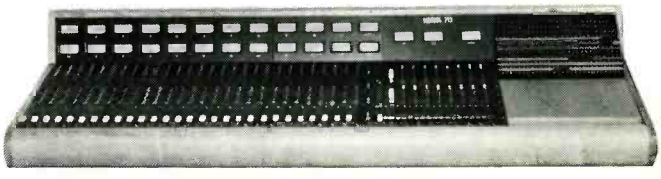
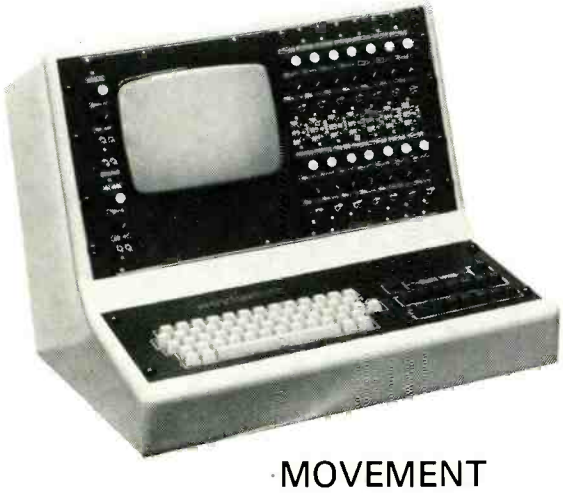


TRIDENT



MOVEMENT

AKG

These are just a few of the famous names to be seen, heard, and played at Don Larking's 'Over The Road Show' at Kensington Town Hall, June 22–24, 10 a.m. 'til late. Bring along your own tape and try out all this exciting equipment.

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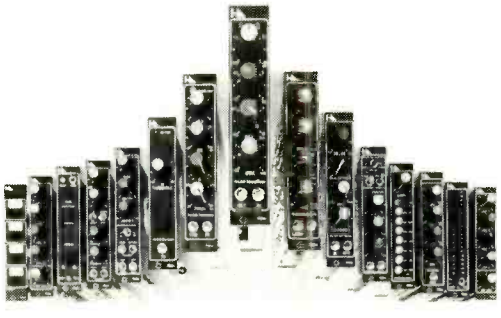
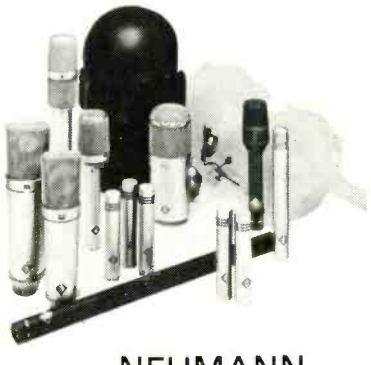


REBIS



NEUMANN

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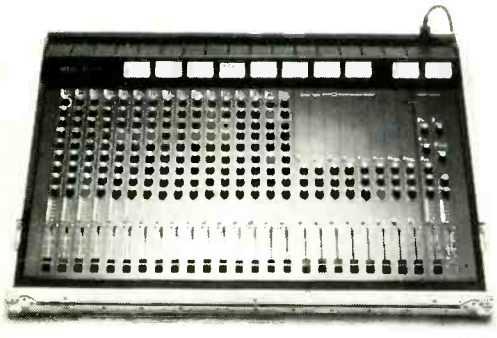
Off the road by popular demand

When the SECK 1682 was introduced, it caused a sensation. For the first time time the price of eight buss mixing and monitoring dropped below the thousand pound mark. Contained in a compact flight case, were all the facilities neccessary for complex PA applications or eight track monitoring and mixing.

Extensive facilities like sweep equalisers, triple auxiliaries, long throw faders and talkback. Here at last was the opportunity for eight track owners on a budget, to have all the features of studio consoles costing several times the price.



The success of the 1682 on the road for PA and for recording, resulted in an enviable reputation for both quality and reliability. So much so in fact, that several manufacturers imitated this formula for success. But copying concepts, often results in misinterpretations, and it's these small errors that results in products, that dont quite make it.

In fact, the competition simply stimulated the market further, and resulted in ever greater sales of SECK to clients who would not compromise with the competition. So we carried on with a full order book, throughout 1982. And it's only now, that we can truly say that we have a mixer that's designed specifically for studios

We have stripped off the road case, and introduced an elegant wedge profile for the studio industry. Internally, it's still as robust, and from the outside it looks like continuing it's success for a long time to come.

Inputs	16 and 24 channel versions
	electronically balanced mike in
	unbalanced line in
Routing	to 8 buss and/or stereo
Line return	routable in stereo
Outputs	8 buss into stereo plus
	two pre, one post auxiliary
Equaliser	high, low and sweep mid
Faders	carbon, 90mm throw
Connectors	XLR, mic in, line out
	all others ¼ inch jacks
Meters	10, VU type plus channel LED's
PFL	Automatic selection on channels,
	monitors and auxiliaries
Talkback	Routing and level to Aux one
Monitoring	full stereo mix, aux send
Tape Return	stereo tape to monitors
Headphone	mix buss monitoring

SECK DEALERS IN BRITAIN

Don Larking Audio Sales, 29 Guildford Street, LUTON, Beds., □ Audio Services, udio House, High Lane Villge, Nr. STOCKPORT, Cheshire □ Carlsboro Sound Ltd., 182-184 Chesterfield, MANSFIELD, Notts,. □ Future Music, 10 Baddow Road, CHELMSFORD, Essex □ Michael Stevens & Partners, The Homesdale Cente, 216/218 Homesdale Road, BROMLEY, Kent. □ REW Professional Audio, 114 Charing Cross Road, LONDON WC2 □ Side Street Music, 11 Lochrin Place, EDINBURGH, Scotland □ Turnkey, Brent View Road, LONDON NW9 7EL

Both versions of the SECK 1682 are available from the listed, authorised dealers.

Take the opportunity to discover this remarkable console for yourself and see how it's suited for both fixed and mobile, PA and recording applications.

Write now for a free copy of the twelve page manual.

bandive ltd

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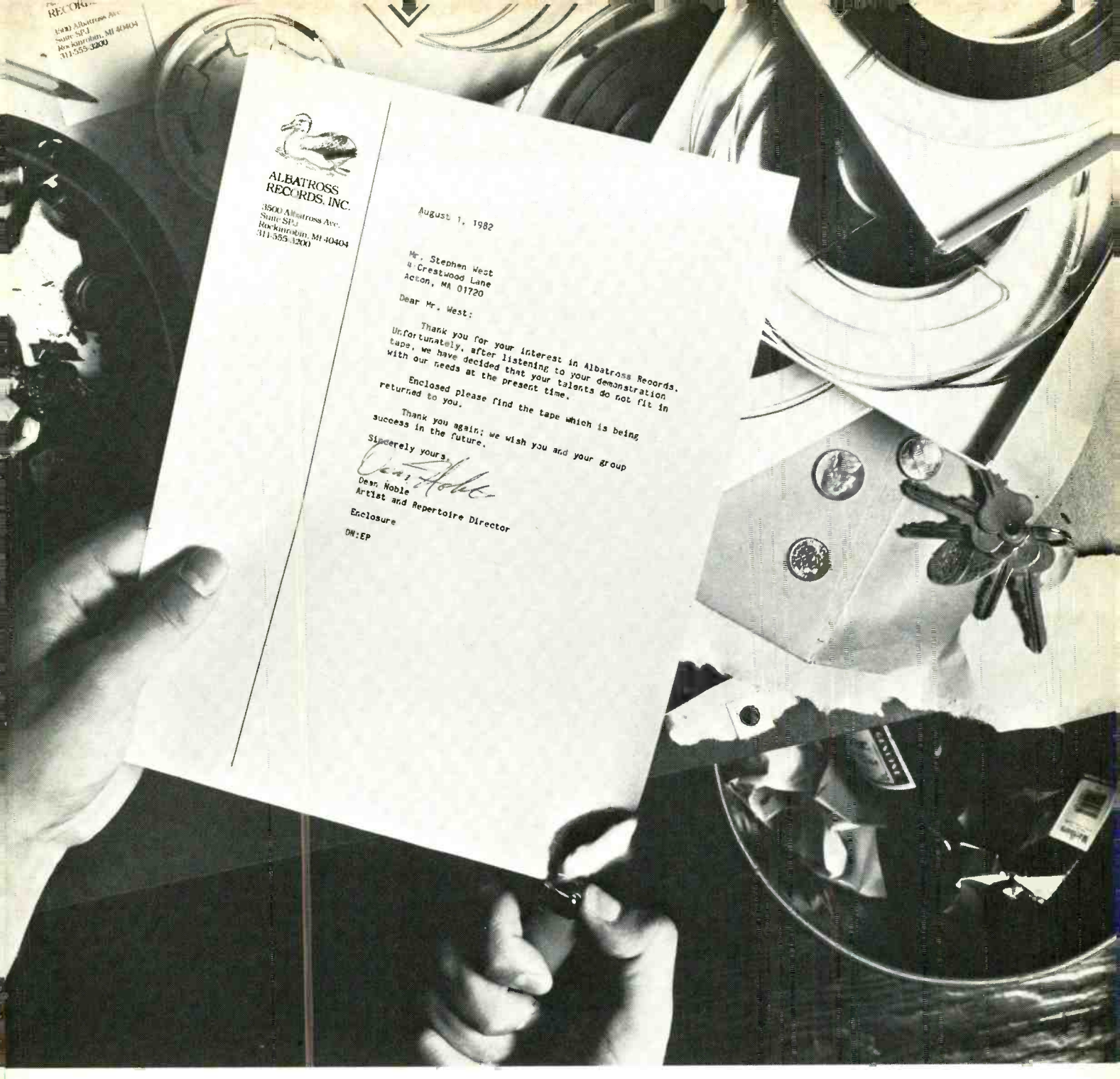

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Few things in this world are as irritating as a polite rejection letter.

But maybe one of these days someone will like your demo tape. And instead of a form letter, you'll get a phone call.

At dbx, we know it's the quality of your music that will make you successful. But we can't help thinking that the quality of your tape recording will play a part, too. After all, how will they know how good you sound if the tape doesn't really capture your sound?

So we have a suggestion: dbx tape noise reduction.

For a modest investment, you can add a dbx professional component to your tape system and start sending in demos that sound like the real thing.

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Now of course, we can't guarantee that this will make you a hit.

But it will sure make you sound like one.

Visit your authorized dbx professional dealer for a look at our full line of equipment. Or call or write dbx, Incorporated, Professional Products Division, 71 Chapel Street, Box 100C, Newton, MA 02195 U.S.A.
Tel. (617) 964-3210.
Telex: 92-2522.

dbx® Professional Signal Processing

diary

Ambisonic moves—and Prince hears Periphony

The British Technology Group—a merger between two government bodies, the National Enterprise Board and the National Research Development Corporation (the latter being the sponsors of Ambisonic surround-sound)—recently moved to new headquarters at 101 Newington Causeway, London SE1, and the new building was officially opened by Prince Charles on March 2nd. During his visit, the Prince listened to a demonstration of Ambisonic full-sphere surround-sound, replayed via Celestion *SL6* loudspeakers driven by Meridian amplifiers, these being part of a system at BTG headquarters which can be used to demonstrate Ambisonics to visitors. The system also incorporates a Walker *CJ55* turntable with SME arm and Goldring cartridge, and a NEAL multi-channel cassette recorder. We hear that Prince Charles was highly impressed by the system. He is seen here in the centre of the 8-speaker Periphonic array, with John Wright of the Ambisonic Technology Centre, and D R Easson, the co-ordinator of the BTG's sponsorship of Ambisonics, to his right.

The Ambisonic Technology Centre has been recently set up to co-ordinate information and practical applications of Ambisonics in both the professional and consumer environments, replacing the Ambisonic Advisory Service. Current projects include the production of studio mixdown equipment in modular form which may be used to encode a mix, or a number of individual channels localised Ambisonically, into B-Format, facilitating the production of multi-track-derived material of mass appeal. As most *Studio Sound* readers will know, Ambisonics—unlike current 'enhanced binaural' techniques which have gained coverage in the Press recently—allows the recreation of a full 3-dimentional soundfield on loudspeakers which may be produced from either a multi-capsule microphone or from conventional multi-track sources. Ambisonics is also completely mono- and stereo-compatible.

A range of equipment for Ambisonic mixdown from multi-track sources will soon be available for evaluation, and studios or broadcasters interested in the possibilities offered by Ambisonics should contact the Ambisonic Technology Centre, 16 North Street, Reading RG1 7DA, Berkshire, England, telephone (0734) 597083, telex 848722. Extensive information packages are available, including reprints of articles published in *Studio Sound* and *Broadcast Sound* in recent months. A local recording studio is being fitted with Ambisonic mixdown equipment over the coming months as equipment becomes available, and potential users of the system will be able to visit the facility for demonstrations and hands-on experience of Ambisonics involving both multitrack and soundfield mic-derived sources.

Noisegates Product Guide

In the February 1983 Product Guide on Noisegates, we inadvertently omitted the Aphex *CX-1* Compressor-Expander. The *CX-1* features 'over-easy' or levelling amplifier characteristics, and 'tube type' overload performance, having, in its compression mode, a release time from 50 ms to 2.5 s and a threshold variable between −40 and +20 bBV.

In the expansion mode, the unit offers expansion depth control from 0 to 50 dB maximum gating, the expansion attack time being variable from 1 μs to 2.5 s. The threshold setting in this mode is variable from −75 to −10 dBV.

The *CX-1* offers internal metering via a 10-segment LED bar display which can indicate compression gain reduction, expansion gain reduction, C + X gain reduction or output level. An optional VU meter may be connected to terminals for traditional metering.

The *CX-1*, along with other Aphex products, is available from Aphex Systems Ltd, 7801 Melrose Avenue, Los Angeles, CA 90046, Tel: (213) 655 1411, or Aphex offices worldwide. In the UK, Germany and Austria, Aphex products are available from AKG Acoustics.

We apologise to Aphex and their agents for this omission.

Product Guides

In two issues' time, we will be modifying the Product Guide section of *Studio Sound*. The present system has run for over 12 months, and it is now possible to cover the specific areas we discuss in each issue in a slightly more compact form, which will allow us more features space.

The re-styled Product Reference section will cover the same subjects as before: manufacturers please note that these subjects, their issues, and the relevant copy dates are published in our brochure. The manufacturer and distributor contact information will remain in its present form, but specific products will be detailed only where they did not appear in the listings when the subject was last covered. New products will, of course, continue to be written-up in the New Products section as soon as we hear about them and this data will be summarised in the appropriate Product Reference when it appears. This restyling takes advantage of the fact that the majority of readers use *Studio Sound* as a reference source for product information, and will highlight new products more effectively. This means that a new product will be mentioned, on average, twice in the year: once as a New Product when it first appears, and again in the appropriate Product Reference section.

Correction

In connection with the studio monitor product guide published in the April issue, Meyer Sound Laboratories have informed us that they are no longer affiliated in any way with ACD Electronics SA and their entry is therefore incorrect. We apologise for any inconvenience that this error may have caused.

The entry for Meyer should have detailed the *833* monitor which was previewed at the Eindhoven AES. This is a two-way monitor system with external control electronics. The system is internally optimised with regard to crossover frequencies and speaker protection allowing the user to select his preferred amplifier.

In the near future we will be publishing an interview with John Meyer which will, amongst other points, cover the *833* monitor philosophy and the ideas behind its development.

Agencies

Connectronics Corporation has been appointed USA distributor for the Accessit range of audio signal processing units manufactured by Bandive Ltd.

Address changes

- Brooke Siren Systems have moved to 213 Sydney Road, Muswell Hill, London N10. Phone and telex numbers remain as before.
- Mitsubishi Electric Sales America Inc have relocated and their new address is 799 North Bierman Circle, Mount Prospect, Illinois 60056. Phone: (312) 298-9223. Telex: 27-0636.
- Technical Projects has moved to new premises in Windsor. The full address will now be Rampart House, 63 Victoria Street, Windsor, Berkshire SL4 1EH. Tel: 07535 58154. Telex: 849988 ENERGY. On the staff side Sam Wise is now managing director and Tony Crockett has been appointed product applications engineer.
- Soundcraft Inc has moved to larger premises and increased its support staff substantially. The new address is Soundcraft Electronics, 1517 20th Street, Santa Monica, CA 90404.

Forthcoming Exhibitions and Conferences

May 10 to 12
CABLE 83, London, UK.
May 28 to June 2
International Television Symposium, Montreux, Switzerland.
June 22 to 24
APRS Exhibition, London, UK.
June 27 to July 1
BSKTS 83, London, UK.
August 28 to 31
NAB Radio Programming Conference, San Francisco, USA.
September 13 to 15
CAST 83, Birmingham, UK.

BSI Recording standards

The British Standards Institution has just published the first three parts of a comprehensive new standard entitled BS 6288 *Magnetic Tape sound recording and reproducing systems*. This multi-part standard is being introduced to implement the current revision of IEC Publication 94, each BS part being identical to the corresponding IEC part.

Part 1 covers specifications, measurement methods and tolerances for non-perforated blank and pre-recorded tape; Part 2 deals with calibration tape specs; and Part 3 lists and defines parameters, conditions and measurements applying to recording equipment using magnetic tape. Further Parts will include reel-to-reel system specs, mechanical and electrical magnetic tape properties, and a magnetic tape cartridge for professional use.

Copies may be obtained from the **BSI Sales Department, 101 Pentonville Road, London N1 9ND.** ■

Sony's PCM F1 Digital Audio Processor represents the world's first affordable digital recording system.

Simply connect the PCM F1 to any video cassette recorder and you will immediately benefit from Sony's advanced technical achievement: dynamic range of over 90dB, frequency response 10Hz–20,000Hz ± 0.5dB, harmonic distortion less than 0.005%, and immeasurable wow and flutter.

Ideally used with the SL F1 Betamax the system is not only very portable, but also offers: non-degradable copying, additional track for time code etc, and up to three and a quarter hours (on Betamax) recording/playback time reducing tape costs to an all-time low.

Digital is an affordable reality now. Why not get involved sooner than later?

Call us and find out: HHB Hire and Sales, Unit F, New Crescent Works, Nicoll Road, London NW10 9AX. Telephone: 01-961 3295. Telex: 923393.

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Digital at the price of a Revox.

*Sony PCM F1 £915.00+VAT *Revox PR99 £1100.00+VAT

new products

New FX for Micmix range

New additions to the Micmix range of effects and reverb units, unveiled at Anaheim, include a modular signal processing system and a new reverb unit, the *XL-404*.

The *MC-F* is a card cage for mini-rack cards, and is fully compatible with the dbx *900* series. A range of modules will be introduced to fit the frame, such modules also being dbx-*900*-compatible. The rack will accept up to 5 modules in a 19 in wide frame with integral PSU. Two modules have been introduced to complement the system: the *MC-101* is a card version of the *Dynafex* decode-only NR system (see review, August 1982) offering a single channel of noise reduction, while the *MC-201* is a decay control/noise reduction module. The latter is designed to give up to 30 dB of noise reduction plus the ability to vary the decay time of any reverberation system. The unit is designed to interface in the return channel of a console and can be used to shorten the decay without unwanted tonal alteration. Operation is simple, as there are only two controls: in/out and decay time.

This proprietary circuit is also used in the new *XL-404 Plate Synthesizer* to alter the decay of a reverb system tailored to reproduce the high density, instant diffusion characteristics of a reverberation plate. In addition, the unit offers effects a plate cannot provide, notably two discrete channels which may be used in stereo or independent mono plus summed mono operation. Four-band EQ is provided on each channel and other features include a mix control, LED signal level display, and convenient front-panel I/O which is normalled to the rear panel connections.

Micmix Audio Products Inc, 2995 Ladybird Lane, Dallas, Texas 75220. Tel. (214) 352-3811.

UK: Scenic Sounds Equipment Ltd, 97-99 Dean Street, London W1V 5RA. Phone: 01-734 2812.

Orban Programmable EQ

The new Orban *Programmable Parametric Equalizer*, announced at the Anaheim AES, will be available from spring 1983. It features fully adjustable frequency, bandwidth, boost/cut, HPF and LPF plus gain, with LED displays to indicate settings. Thirty-two non-volatile memories are included for EQ storage and recall, all controls being set to the recalled values instantaneously. An external pulse source can supply the command to advance the register and recall a setting from memory.

The unit is a two-channel device which can be stereo-linked for accurate tracking, and a pair of front-panel switches allows each channel to be adjusted independently or in tandem. An *IEEE 488* interface is provided for computer control, and up to 28 channels can be ganged and controlled simultaneously. The audio path is similar in design to the *622B* parametric.

Orban Associates Inc, 645 Bryant Street, San Francisco, California 94107. Phone: (415) 957-1067. Telex: 171480.

UK: Scenic Sounds Equipment, 97-99 Dean Street, London W1V 5RA. Phone 01-734 2812-5. Telex: 27939.

Audio Technology LED display

As a new addition to their *510* series of displays, Audio Technology have announced the model *511*, available in horizontal or vertical format, with rack panels for one, two or eight displays.

The *511* uses linear phase peak detectors and will accept both line level and power level inputs. The mode can be selected from the front panel switch and the level calibrations then correspond to dBm or dBW as selected. In use, the highest LED illuminated is held while the LED below continues to function as normal. The hold time for the peak LED is set by turning the front panel mode selector switch.

Audio Technology, 1169 Tower Road, Schaumburg, Illinois 60195. Phone: (312) 885-0066.

Whirlwind additions

Whirlwind Music Inc has recently introduced three new product series —additions to the *Medusa* line of multi-wiring systems; a new range of transformers; and a new DI box.

The upgrades to the *Medusa* range comprise updates to existing systems, none of which add to the overall cost. The *Medusa 19* (16 in, 3 out) is replaced by the *20* (16/4); the *15* (12/3) becomes the *16* (12/4), and the *27* (24/3) becomes the *30* (24/6).

The new transformers are for impedance matching. The *TRSP-1* and *TRSP-2* are designed to split a single mic signal into two or three separate outputs. They feature an exceptionally flat response and can handle up to 6 V at the input stage with very low distortion. The *TRHL-M* and *TRHL* transformers are designed for high to low impedance matching applications and feature the same low distortion and flat response. The former is packaged in a mu-metal screening can and offers an extended frequency response. All the transformers include electrostatic interwinding screens and are available in bulk or as part of other Whirlwind products.

The *Director* DI box features the *TRHL-M* transformer and is able to handle instrument, line and speaker signals while providing a clean low impedance feed. A ground lift and HPF are included. The frequency response is quoted as flat from 20 Hz to 32 kHz and the unit can handle 6 V inputs before saturation. The unit is housed in a black aluminium casing and features impact-resistant switches.

Whirlwind Music Inc, 100 Boxart Street, PO Box 1075, Rochester NY 14603. Phone: (716) 663-8820.

UK: Atlantex Music Ltd, Wallace Way, Hitchin, Herts SG4 0SE. Phone: 0462 31511.

Electro-Voice barrier plate

Electro-Voice have made an accessory for use with the miniature *CO94*, *CO90* and *CO90P* mics so that they may be used for 'barrier miking'. The Model *370* Barrier Adapter Plate is a glass reinforced polycarbonate square plate of 2½ in square and ¼ in thick, being finished in non-reflecting black. The mic is held in a spring-like clip on the top surface in a slight recess so that the mic is in the optimum position to receive direct and reflected sound waves in phase. The *370* may also be permanently mounted using the holes in the surface.

The concept of 'barrier miking' is very similar to that being expounded by most other manufacturers of mics at the present time but Electro-Voice claim that if you already own one of the suitable mics mentioned, this is probably the cheapest way to start experimenting.

Electro-Voice Inc, 600 Cecil Street, Buchanan, MI 49107. Phone: (616) 695-6831.

UK: Shuttlesound Ltd, 200 New Kings Road, Fulham, London SW6. Phone: 01-736 0907/8/9.

IBM PC for Diskmix

Sound Workshop Professional Audio Products Inc of Hauppauge, NY, have announced that the *Diskmix* automation storage/editing system now includes the IBM *1550* personal computer as its control keyboard. The original *Diskmix* concept called for a host computer that would talk to the existing automation system in the console, while an existing personal computer was to be used for the engineer to communicate with the system. Original prototypes utilised the Commodore *VIC* PC for the latter, this being replaced later on by the NEC computer. The IBM was also investigated at the time, but they were not sufficiently easily available.

Now that the IBM is in plentiful supply, it has been incorporated in the system for a number of reasons. Above all, the *1550* is technically sophisticated and reliable, and has an excellent keyboard. It is small enough to sit on the console or in the engineer's lap. The PC supplies the prime link between the engineer and the system (besides the console controls) and its suitability for the task is thus highly critical.

In addition, the IBM PC has a massive amount of industry support. When the automation system is not in use, the PC is freed for a multitude of useful studio-related tasks and there is plentiful software available for such applications as word processing, invoicing, accounting and other purposes.

Sound Workshop Professional Audio Products Inc, 1324 Motor Parkway, Hauppauge, NY 11787. Phone: (516) 582-6210. ■

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Ralph Denyer

Part 2

SKY

IN Part 1 of this feature I outlined the basic design and concept of the Hill Audio *M3* speaker cabinet which forms the basis of the Sky system which can now be examined in more detail. Essentially, it is an all-in-one unit housing bass, mid-range and high frequency speakers. Measuring 53 × 45 × 21 in and weighing in at 350 lb, the *M3* has three ATC bass drivers positioned in a central vertical array with a flared horn directly above and between the two mid-range units which are angled inwards slightly.

Part of the motivation behind using 12 in bass drivers arises from the desire to get the fundamental response of the cabinet as low as possible. If they had used a 15 in or even 18 in driver—as do most companies in the concert sound business—the size of the cabinet would have had to be considerably bigger in order to achieve the same fundamental response, which relates directly to the cone area to cabinet volume ratio.

Malcolm: "The advantage of having a cabinet with a low fundamental resonance is that you don't have to boost the very low frequencies electronically, because they are there naturally. The fundamental of the *M3* is something like 19 Hz. In fact you have a situation where quite often you have to roll off the very low frequencies, especially if you are using a very large system. As you stack more and more cabinets up, the fundamental drops lower and lower.

"So if you've got about 40 of those cabinets you have to electronically roll the system off at 40 Hz, otherwise it shakes the walls and becomes fairly uncontrollable.

"Also, the 12 in unit gives a very nice clean tight bass section because the cone doesn't flex like a 15 in unit, so there are no additional colourations there. Further, the speaker is not under excessive pressure because the cabinet is relatively large as well as being heavily ported. The driver is free to respond. The end result is a deep, tight, uncoloured bass sound.

"The 12 in speakers are driving a compression chamber of relatively low compression compared to normal PA designs. Then there's a horn-loaded port either side of the bass speakers. This means that there is so little pressure within the cabinet that you are not wasting energy on vibrating wood. In most typical units with high compression, you waste a lot of energy trying to shake the cabinet apart. Not only do you waste energy, that effect of the cabinet vibrating also colours the sound.

"Approaching it from the studio monitor point of view as we do, you've got a very solid freely-moving cabinet design. We have taken that type of approach and developed the way it's done—especially the drive units—to stop it falling apart, which is what normally happens if you try to use studio monitors for PA applications."

I asked Malcolm about the question of phase interference.

"The phasing of the mid-range has really been *the* topic in sound circles over the past couple of years. For the first decade of the sound industry's activities, creating 'bottom end', as they call it, was the important thing. Shifting air, which is what we concentrated on with our 12 in bass unit.

"Then recently, mid-range colouration has been the problem, mainly due to phasing distortion and various people have had different attitudes to it. One common direction—used by our competitors—was creating phasing throats to put in front of the speakers to correct for phase, which was a worthwhile improvement. However, it didn't help when you had lots of units together. And the throat itself adds its own colouration although the phase is more maintained.

"We put the mid-range speakers at an angle that we calculated was the best compromise as far as phase was concerned. But the main thing that we did as far as mid-range is concerned was to investigate into what was the absolute highest quality, most accurate driver we could find and *that* is the crucial element."

That unit is a special version of the Tannoy 10 in dual concentric speaker used in Tannoy *Buckingham* studio monitors. It was the most accurate they were able to find and the most powerful to boot. They tried several mid-range units designed for studio monitors which they found to be accurate but unable to take the kind of continual pounding and rough treatment which is commonplace with a rock act on the road.

Malcolm: "Fortunately the Tannoy—mainly due to the company having extremely high standards of quality control anyway—and the use of ferro-fluid round the coil, has proved very reliable even with acts like AC/DC and Saxon."

Normally, the Tannoy has a crossover between the cone and dual concentric tweeter, as would be expected. For their concert system applications, Hill Audio have a crossover from the cone of the Tannoy into the separate flared horn and then back into the tweeter of the dual concentric.

Malcolm: "This gives a lot more SPL at critical frequencies for PA which are in the 2 to 5 kHz area. Normally if you have a horn handling a couple of octaves of the high frequency, as you go up in frequency, the sound tends to beam. In other words it becomes very directional. Now the nice thing about the design of using the dual concentric Tannoys with the units *at an angle* is that as you go up in frequency, the horn itself becomes quite directional, *but* as this happens, the tweeters at either side come in. So in fact, you get quite a nice dispersion up to 20 kHz. That's rather a fluke advantage of following the Tannoy dual concentric routing in that way. "So as you move off the axis of the actual horn, you move into the axis of the tweeters."

Accepting that the different units have varying natural acoustic roll-off the actual mid points of crossover are: 250 Hz from the ATC bass driver to the Tannoy mid cone, 1.5 kHz from the Tannoy mid cone to the custom high frequency horn, and 7 kHz from the horn into the Tannoy dual concentric's tweeter.

The horn in the *M3* cabinets used by Sky is a Hill designed fibreglass dispersive unit on a 1 in throat made

Ralph Denyer

LIVE

Ralph Denyer

by Renkus-Heinz. It is coated with a hard smooth reflective polyurethane finish to minimise ringing. (A matt finish would reduce the ringing but at the same time absorb high frequencies.) Normally for vocal bands, the *M3* has a similar flared horn on a 2 in Renkus-Heinz throat.

On the subject of transient response Malcolm continued: "We work very hard to get all the speaker units to have a very good transient response commensurate with the frequency at which they are operating, which is one of the reasons why we have those 12 in bass drivers instead of 15 in or 18 in. The idea is that as well as reproducing the steady state frequency response, the system is not limited by lack of transient response at a particular frequency.

"We tend to have smaller, higher transient response units, working at lower frequencies than other people. So we've got the 10 in mid-range instead of 12 in, then the tweeters at the top. We make sure that all the units have a transient response capable of handling the requirements within their frequency range."

Another part of Malcolm's policy with regard to equipment design is that his systems should produce the most 'transparent sound' possible, and he works very hard towards ensuring that they add the least sound colouration. He went on to explain how he considers acceptance of a narrow frequency bandwidth to represent too much of a compromise, as well as his aims with regard to faithful amplified reproduction of sound in the concert environment.

"Most, shall we say, rock 'n' roll systems are designed to work between 60 Hz and 5 to 6 kHz and that's where most people leave it. But we're working towards 20 Hz to 20 kHz. We've only got to 25 Hz to 15 kHz at the moment but that is still a full two octaves wider than most other concert systems. Between half and a full octave on top and a good octave or so below."

Accepting that the average person has the capability to hear frequencies up to somewhere in the 17 kHz range, and that some instruments produce harmonics (aka upper partial tones) up to and sometimes beyond 15 kHz, systems with a relatively narrow frequency bandwidth must in effect colour sound.

Malcolm: "So we try for minimal distortion, minimal colouration, full bandwidth, and apply that to whatever the music is, the development work then being on making the technology reliable."

Malcolm holds the opinion that far too little attention is paid to overall dynamic range and the transient response of concert sound systems. He feels that these factors should be given similar attention to that paid to achieving high sound pressure levels, good frequency response and reaching low distortion figures. An important feature of his sound systems is the absence of any overall compression or limiting devices to protect the system itself.

"There are no actual limiters as such on the system. Everything is designed with a lot of headroom. Most systems—as some attempt at safeguard or reliability—have some form of overall limiting. We design everything to have a lot of headroom so that we avoid the usual problems of a system with an overall compressor-limiter.

"What happens—especially with a loud act—when you get near the maximum capability of the system, is that the limiter is having a lot of effect so you lose all your dynamic range. A band is playing away and they come crashing in with a chord but it's not doing much because it's held back. Even at rated output our systems have still got 12 dB of dynamic headroom. So if you drive an *M3* cabinet at 1,000 W and then hit it with a peak, it will respond up to 12 dB beyond that. So you can drive it full out, hit the snare drum and still have a dynamic impact rather than being lost in the compression."

As well as protecting a system from overload damage, limiting and compression are often also used to prevent the unpleasant audible and damaging effect of an amplifier going into clip. Malcolm claims that his amplifiers are designed so that they do not clip.

"Obviously, the sound gets progressively distorted," he said, "but there's no obvious clip point at which there's mass disaster. If you've got dynamic headroom *in the amplifier* you don't need a compressor to stop the amplifier making a nasty noise. And then all the drive units are built to take large excursions beyond their nominal power rating for short periods. So the whole system—all the way through—can be run around its full power level and still have dynamic headroom."

It would be unfair and misleading to use Sky as a typical amplified band because they do play at decidedly lower levels than most users of Hill Audio systems. But at the Hammersmith Odeon dates they only used a total of six, one tri-amplifier/one cabinet 1,000 W module units, to achieve a full sound.

Certainly they also achieved a full sound throughout the three-week tour, on a couple of occasions they only used two 1,000 W module units and to good effect. (It should be pointed out that two Tannoy studio monitors that were set up at the back of the Hammersmith Odeon were only used for experimental effects well below the level of the main system.)

Malcolm went on to explain how the system operated when Sky used only 1,000 W each side.

"At the extreme peaks they were just going beyond the nominal rating, even with Sky you can do that perfectly cleanly and you can't hear that it has gone over the top. If the system had standard amplifiers, Andrew would have had to operate the system at a lower level because he wouldn't dare let it go into the area where the (clip) distortion would have come in. Or, he would have had to put a compressor on there and lose his dynamic range.

"It's very noticeable with Sky actually. Halfway through a number they gradually die away then BANG, they come straight back in at a high level and you get a dramatic effect. I've calculated that they actually work to about a 70 dB dynamic range, so they'd make life very difficult with a conventional sound system."

The 70 dB figure tied in with the fact that John Williams had told me that he likes the group to aim for similar dynamics to a classical orchestra, which would be in that region.

Malcolm continued: "Although rock bands have got louder and louder—obviously a lot louder than a classical orchestra—they've tended to lose the dynamic range. So they're not really achieving anything apart from ruining people's ears. So what we try to do, and have done by approaching it in this way, is to keep some element of dynamic range."

Malcolm feels that even very loud rock acts who do not employ the same dynamic range as Sky can benefit from using his approach to system design. He says that AC/DC work with around a 30 dB dynamic range —basically varying between loud and extremely loud—but with his system their peaks and cresendos are discernible as such.

Malcolm: "I went to see the Rolling Stones with a ShowCo system last year, and it was so compressed that in fact it got *quieter* on the cresendos. So when they hit a loud chord, the whole system shut, it was actually quieter. The system was in compression all the time, they had it set so that the limiting was too far advanced and it was over emphasising the limit. But even if they had tuned it better, it would still have been reducing the dynamic range to hardly anything. I use that as an example of a typical system and the point was particularly noticeable on that occasion."

The Monitors

The monitor cabinets are custom-built by Hill Audio to meet Sky's specific requirements. John and Kevin's each have two Tannoy 10 in dual concentric speakers as fitted to Tannoy *Little Red* studio monitors with a specially adjusted crossover between the cone and central tweeter. The cabinet is ported.

The larger units used by other members of the band each have two ATC 12 in speakers, as fitted to the *M3* cabinets, plus one 10 in Tannoy. Accordingly, there is a 3-way crossover and once again, the cabinets are ported.

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SKY LIVE

Gary Nielsen is Sky's monitor sound engineer and enjoys a close relationship with the band and the resulting exchange of ideas.

Gary: "This is the first tour on which I've been 100% happy with the equipment.

"The monitor desk is really still at the prototype stage but it's good and with a few more refinements which I've mentioned to Malcolm, it's going to be great."

How does Sky's somewhat individual approach make his job different from the occasions when he works with other bands?

"It's different in as much as with the acoustic and electric instruments, and the varying levels required, I can't leave anything on when it's not being used. Consequently, in a piece like *Love Duets* I'm switching things on and off continuously. While we were in Australia, I worked out that there are 321 cues in a Sky concert. People laugh and say: 'How can there be that many?'

"But if you think about it, I've got six independent mixes, so therefore divide 321 by six and the figure is believable.

"It's really a case of having to concentrate. You certainly can't leave things like Tristan's vibes or marimba mics on because they obviously pick up everything. During a soundcheck, I can even hear Steve and Pete talking through the *C-Ducer* strips on the piano. I can hear people talking through the *C-Ducer* strip on Herbie's double bass."

System operation

What is the ideal sound level for a Sky concert? That apparently innocuous little question is guaranteed to garner different answers from members of the band and the sound crew. Certainly, a percentage of the group's followers—and there are quite a few—don't like the music to be as loud as is generally accepted at most rock concerts.

Andrew feels that they are mainly the people who will complain to members of the band or the crew after a concert if they think something has been too loud. Sometimes it turns out that they've been sitting close to a 2,000 W array of speakers.

Andrew thinks that perhaps the band are sometimes a little too sympathetic to the complainants whom he refers to as "music centre listening people" at the expense of the vast majority of the group's following.

He thinks that 90% of the audience are 'true fans' and as such would prefer much more of a rock concert sound level, at least during the music's dynamic peaks. For them—as well as himself—he'd like to "... give it a bit more welly". Of the nights when the audience is up on its feet and yelling for more, he's convinced that wouldn't be the case if he didn't surreptitiously ease up the volume. And then he feels frustrated when he goes backstage after the show to find the band happy with their performance and the audience reaction but telling him the sound was too loud.

Andrew: "I know in my heart of hearts that any quieter and those people would have just sat there, clapped and gone home".

Andrew's fierce personal loyalty for Sky doesn't colour his judgement on this point, though perhaps he may at times temper his expressed opinions. Also it should be pointed out that this is the only major point of disagreement with regard to performance resulting in a 'Them and Me' division of opinion.

If it were not for the relatively low monitor sound level on stage, the situation would arise far less often, as the band would not hear as much of the sound coming from the main system. Andrew points out that both Herbie and John actually start to play quieter if the level of sound they hear on stage coming from the main system makes them feel that the sound in the house is too high, or if they see someone in the front of the audience close to a speaker array putting their fingers in their ears.

Final words from Andrew on the subject: "And so I have to mix in that situation, not one where I can achieve the optimum sound. Try to make it all full without being loud, so you try to use all the frequencies to achieve that full sound.

"In fact on this last tour I've used a bit more volume and a bit more punch, there's been comeback from fanmail saying how good it sounded as opposed to the last tour. That kind of reassures me but with the band—it's still a case of 'It's a bit loud'."

Andrew makes great efforts to minimise problems relating to the acoustics in different venues. His vast experience with a whole range of acts is of course a major plus factor. Also, Sky tend to play more-or-less the same halls each time they tour, with the odd exception here and there. As a general guide, he finds that most British concert halls seem to accentuate bass and low-mid with 160 to 200 Hz in particular.

Each afternoon prior to a concert, the sound check begins when Herbie arrives. He does an individual check and tune up on his instruments—double bass, bass guitar and tuba—and the others do likewise before they run through a few numbers together.

In terms of getting the best possible group sound, Andrew finds that the major compromises have to be made on the acoustic instruments. The solo or semi-solo features present far fewer problems. Add together magnificent sounding harmonically rich acoustic instruments such as the piano, guitar and double bass with the electric instruments, all shifting large volumes of air and without careful EQ work, the result would of course be instant mush. But with Sky, the acoustic instruments often provide the main thrust of their music. As the EQ is tweeked to provide a good balance, gradually harmonics are removed from the sound of the acoustic instruments more than the electric or electronic variety. The result is that the acoustic instruments begin to sound artificial and lose their character. As John Williams had said earlier: "You end up taking out the frequencies that make a guitar sound like a guitar."

And this is only talking very generally about all the instruments. Take them individually and you have to consider individual tonal centres, particular to different parts of the register of one instrument, as Andrew pointed out: "We've only just got to the stage where if Steve plays a bottom C on the piano, it actually sounds like a bottom C and not a middle C with a little bit of rumbling underneath."

The piano—a Steinway grand hired for each gig—is amplified via two 8 in *C-Ducer* strips and one AKG *451* microphone. All go to active stage boxes. Andrew generally finds that he must reduce the bass and low-mid to avoid feedback when the group are playing together and to this end there is a White graphic equaliser on the bottom end.

Andrew: "With the *C-Ducer*, we can get more bass on the piano using phase cancellation switches on the desk to reduce feedback problems, but you never actually use all of the bottom end".

When the whole band is playing fairly loudly together there is a certain amount of slight of ear involved. Andrew: "If you hear the top end and bottom of the piano, then what goes on in between you can almost imagine to be there."

When the piano is featured and the rest of the band are quieter, Andrew can bring up the mid-range, mainly with the microphone. He has found this to be the best way of making the instrument sound full and natural during the times when it is featured. If there is too much low-mid or mid when they are all playing together, the piano tends to make the sound far too muddy.

He uses similar techniques with the harpsichord but it is only fitted with one *C-Ducer*.

"In the louder parts, if you really analysed it, there would be relatively little audible middle."

When Herbie's double bass is featured Andrew explained: "If I want to lift the double bass in a certain section of a number, I tend to use the EQ rather than volume, to give it a little bit of cut and additional very low bottom . . . bringing that out instead of bringing the fader up.

"I've never really analysed it as such, but I'm doing this kind of thing all the time. It's funny really, electric instruments seem to work well with the ear. An electric bass guitar will still sound bassy if it's amplified quietly but acoustic instruments seem to lose the body of their sound."

As with all the instruments fitted with *C-Ducer* strips, Andrew and Pete Sullivan—the keyboards technician with Sky—have spent many hours experimenting and finding the optimum positions for the devices. They regard this point as very important as placement can affect the performance considerably.

The keyboards

On the British tour, keyboards player Steve Gray used a Steinway grand piano, a William DeBlaise double manual harpsichord, a Yamaha *GS1* synthesiser, a Roland *JP8* polyphonic synthesiser, an Oberheim *OBXA* polyphonic synthesiser, a Korg *CX3* organ, a Yamaha *CS01/BC1* monophonic *Gob* synthesiser, all looked after by Pete Sullivan.

Steve: "We've got a lot of keyboards. I use them—to a certain extent—because Kevin and I are the ones who give the band an orchestral sound. John, Tris and Herbie tend to play one main instrument most of the time. So any changes of colour come from Kevin's assortment of guitars and pedals and my assortment of synths. I always come back to the piano because I am a piano player. I started lessons when I was ten, so everything revolves around the piano. For Francis Monkman—who was in the band before me—it all revolved around the harpsichord."

One interesting feature of the setup is the use of a keyboard interface on the piano and harpsichord. When either instrument is played, the keys trigger one or sometimes two synths to play unison figures.

Steve: "I inherited the interface from Francis. He used to interface the harpsichord (and a clavinet) with synths and I thought it would be fantastic if we did it with the piano."

The live album is a double, featuring material previously released on studio albums as well as new material. What were the aspects of

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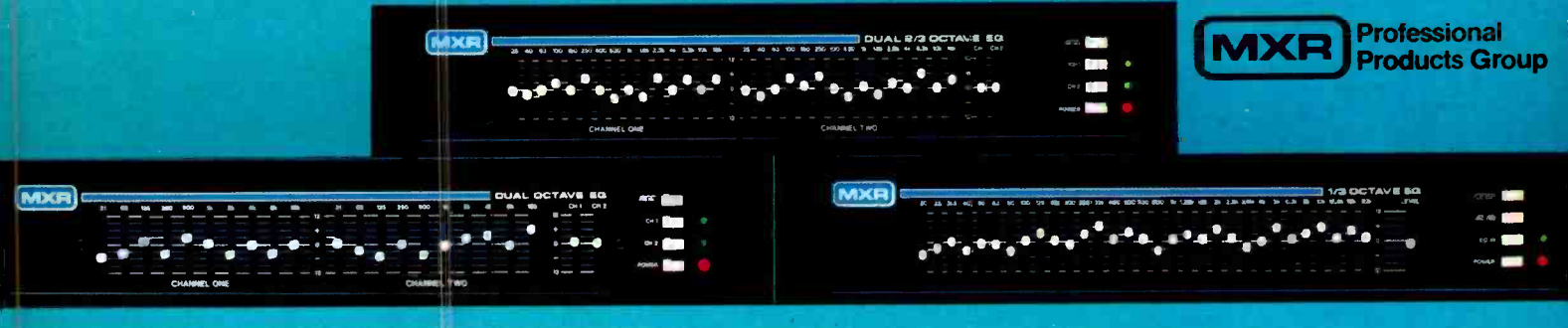

MXR Professional Products Group

SKY LIVE

recording live that had most interested Steve?

"Quite simply, the acoustics. As far as I am concerned, Studio 3 at Abbey Road—where we have recorded all our studio work in the past—is as good a studio as you will get.

"But for Sky it will *never* be as good as recording live. I think we *might* have made a policy decision to record *everything* live even though we may not present it in a live format."

During the recording of the live album, Sky found that they were able to capture qualities which had previously alluded them in the studio. The general feeling within the band is that way because of the relatively high sound level moving large volumes of air in a spacious interior. So although they may record in concert halls, they may not necessarily have audience tracks. When the experiment started in Australia, Steve wasn't so sure that it was going to work, as he explained.

"Personally, I didn't go and listen to the playbacks. I did one day but it was so horrible listening to it in a cramped mobile, there just wasn't the space for all of us to listen. At the time, I thought we'd made a terrible mistake. When we got back to Abbey Road and heard it I thought 'Blimey, this is fantastic'.

"But it's as simple as that, just a big volume of air being moved around at fairly high levels creates a bloom or beauty of sound on the acoustic instruments. I don't know if you could get that in a studio.

The other guitar

Kevin Peek was a well-known session guitarist on the London scene before the formation of Sky. Nowadays, he lives in his native country, Australia, and commutes to far flung corners of the globe to team up with Sky.

The guitars he plays with Sky are a Fender *Stratocaster Anniversary* model, two Gibson *L5S* models. His acoustic guitars (with piezo transducers built in) are an Ovation *Folklore* and an Ovation *Classical*. The effects he uses on the solid electrics are one Electro Harmonix *Big Muff*, one MXR *Dyna-Comp*, one Ernie Ball foot volume control, one Boss *KM04* Micro Mixer. His RSD *Studiomaster* and Roland *Jazz Chorus* amplifiers are, as previously stated, muted and positioned under the drum riser in order to keep the on-stage sound level relatively low.

Kevin's electric playing with Sky is very controlled. With the amps muted and hidden away he cannot use feedback or feedback-assisted sustain, techniques that a great many guitarists rely on. So how is it done?

Kevin: "It's done differently in different numbers. Sometimes with the compressor, sometimes with the fuzz, and also with a combination of both. Sometimes it's done with a straight guitar sound. The Gibson *L5S* sustains beautifully by itself.

And what are Kevin's feelings about Sky recording in halls with a mobile? "The majority of the guys would like to do the next and possibly other future albums recording in a live context. Not recording with an audience even. What they really like and have grown very fond of with this first live album is the ambience that being in a hall gives to a lot of instruments, particularly things like the harpsichord and John's guitar. We've never been able to quite get that with all the artificial reverbs and everything in the studio. I'm still a bit of a studio buff, I like being in the studio. With everything we do, we take a majority vote and the majority of the guys want to record in a hall with natural ambience as much as is possible in the future.

Going back to *Sky Five Live* for a moment, there is only one thing wrong with recording a lot of dates on a tour. You end up with a lot of reels of tape. At the end of the Australian tour, Sky came home with 117 reels of multitrack master tapes. Was the editing a big job?

Kevin: "Yeah, I ducked out of it, I stayed in Australia. Our engineers and co-producers did virtually all of that, thank goodness."

The bass

It is hard to say if Herbie Flowers is best known among his peers as a humorist, individualist or musician but as a result of being all three, he's a legend on the British session recording scene. The famous 6-note tuba riff that can be heard at the beginning of vintage 'Hancock's Half-hour' programmes is played by Herbie on the very instrument he features in his 'novelty' number with Sky, though it is now covered in sound-triggered LEDs, blows soap bubbles and is amplified by a radio microphone.

So what is important to Herbie in terms of sound quality with regard to his main instrument, the bass guitar?

"Really I don't mind, Ralph. Bass players are the cop-out merchants, there's no doubt about that. Universally, they're not really sure. If they've got a highfalutin point of view, it's bullshit. Because the bass, you actually feel it through the soles of your feet or through your tum. If there's too much treble on it, it inhibits you 'cos the fact that you can hear it very loud means you are not going to go for things that—if you can't hear it—you'll try for.

"As long as it sounds woolly and deep, you can play quite a few bad notes, so I think bass players aim for the low register.

But, on the other hand . . . the acoustic double bass is actually hard to amplify well. If you use a pickup, you're cheating, you're really playing a pogo stick 'cos you're not amplifying the organic sound element of the double bass, the *wood* in fact."

Herbie: "I think a double bass should sound as much like a tree as possible. If you put your ear to a tree in the wind, that's what a double bass should sound like. All the squeaks and all the rattles."

The quantum jump in terms of sound on the double bass was when they fitted, an 8 in *C-Ducer* strip, positioned just above the bridge at a slight angle. Gary pointed out that the monitor wedges had to be reinforced to handle the low frequencies.

Andrew and his team have in fact tried just about every type of pickup, transducer, microphone, contact mic and device ever made, in countless positions and combinations, to achieve the most natural acoustic sounds possible. They also tried all the different lengths of *C-Ducers* and settled for the 8 in model for piano, harpsichord and double bass because they considered them to have the widest frequency bandwidth as well as the smoothest response. During the stage performance of *Meheeco*, which includes his double bass feature, the sound is indeed truly 'noble' with all the distinctive tonal centres and characteristics of the instrument amplified beautifully.

The recording

Haydn Bendall and Tony Clark engineer and—with the band—co-produce Sky's records. They are staff engineers at Abbey Road Studios as well as producers of other acts. Tony and Haydn describe their working relationship as 'a sharing one' with neither taking on a specific role. As engineers, they knew all the musicians in Sky with the exception of John Williams. After hearing the group's demos they went into No 3 studio at Abbey Road and were soon caught up in the excitement.

Coming up to the present, on *Sky Five Live* how were the two weeks spent working on the initial recordings?

Haydn: "It was done as a demo recording really. They always do bits of the writing in the studio, more on some numbers than others. Previously we'd always recorded the albums in the studio, then the band would go out on the road and do a couple of tours and the music would evolve.

"They would find better ways of playing things and change the arrangements. This time, we spent two weeks in the studio really sorting out the writing and arrangements so that we could all become absolutely familiar with the material. So it was just like expensive demos really."

Business and contractual factors also came into play. The group were cutting things a bit fine inasmuch as they were committed to delivering an album by a certain time. If there had been problems recording out on the road which resulted in no album, the studio recordings gave a safety net.

When they arrived in Australia, Haydn and Tony found that the AAV Australia Pty Ltd mobile was not of the standard they would have expected in England but they say the Australian people with whom they worked more than made up for below par equipment with their enthusiasm and helpfulness. (The mobile was due to re-equip after the Sky recordings.)

Tony: "They were amazing people to work with. Whatever we asked for, they put together. I can't remember the name of the main mixer, but we had to have two more Yamaha mixers slung on the side of the thing. The people we were working with had their hearts in it, even though they knew the equipment wasn't the way it should be."

Tony regards Sky as a unique band. As such, he feels they should experiment and try different approaches, using the recording medium in ways to suit the group and not *vice versa*.

Tony: "There is talk of using an auditorium as a studio and that idea excites me. In Australia there were times when we did the rehearsal during the afternoon, and the control of the sound was really exciting because you didn't have an audience and therefore didn't have to hold back because of extraneous noises.

"I did make certain suggestions to the band. It would be great to record in No 1 studio (Abbey Road) and have them play using their own monitor system. Because they're musicians, they *know* their instruments and they *love* their instruments, but they don't *particularly* like hearing them through headphones. That is because they are a live, acoustic band. The approaches to recording will develop and I think must do so over the next few years. I think it will be really exciting if we can keep going, trying all these various ideas and experimenting.'

Haydn: "Although we are not set on how we are going to record the next album, I would say that we can be sure of two things. One, that it won't be a *live* album and two, that it won't be a *studio* album. I think we'll be trying to combine both atmospheres, and that will be very interesting." ■

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studiofile

Sarm Studios East, London

The original Sarm Studios are located just to the east of the City of London. Sarm bought the premises, previously known as the City of London Recording Studios, in 1973 and pioneered by installing a 24-track setup. During the studio's 10-year history under the Sarm banner, the equipment has been continually updated and upgraded to keep pace with clients' needs and technological developments.

The latest series of improvements have given the studio a 46-track capability, automation and a new acoustical treatment. With the company's acquisition of Basing Street Studios, the original studio has been designated Sarm East with Basing Street being logically renamed Sarm West.

Since opening, Sarm have attracted an illustrious clientele which includes Queen, Elton John, David Essex, Foreigner, Yes, Buggles, Fox, Monsoon, BeBop Deluxe and ABC.

The studio is run by the brother and sister team John and Jill Sinclair. John is based in America these days so Jill is very much at the helm. The latest studio update was completed at the end of last year supervised by Sarm's highly regarded chief recording engineer Julian 'Jules' Mendelsohn.

The control room, re-designed by Eddie Veale, has a floor area of approximately 172 ft^2 and is dominated by a Solid State Logic 40-input *4000E* console, fully computerised with *Total Recall*. Though the console's features are extensive, it is smaller than previous units Sarm have used. As a result, they now find they have much more room to work in in the control room—a commodity previously in short supply. Apart from general advantages, this accommodates the growing amount of synthesiser and keyboard players who want to record direct into the console playing in the control room. The room is carpeted, and has acoustic panels on the walls, while the ceiling and area around the main fixed monitors is covered in attractive natural finish softwood slatting. There is a sound trap immediately behind the engineer and producer's chairs.

The studio has 24 channels of Dolby noise reduction. Sound processing equipment includes *EMT 140* valve stereo plate, Lexicon *224* digital reverb, AMS digital delay with pitch transposer and lock-in facility, Eventide *Harmonizer*, Lexicon *Prime Time,* DeltaLab *DL 1* delay line, Bel stereo flanger, Marshall *Time Modulator,* Survival Projects and *Scamp* automatic panning units, Aengus graphic equalisers, Audio & Design *Vocal Stresser*, Audio & Design *Express Limiter, Scamp F300* noise gates/expanders, *Scamp* dual gate, *Scamp* de-essers, *Kepex II* noise gates, UREI *1176N* compressors and dbx *160* compressor/limiters. The control room also houses a Neal-Ferrograph *302* cassette machine as well as a Revox turntable with a Quad *33* preamp.

The standard double-glazed panel between control room and studio is quite large, allowing very good visual communication between the two. The tape machines are housed in a room adjacent to the control room with total remote operation. Two Studer *A80 VU MKII* 24-track tape recorders are linked with *TLS* tape lock for 46-track recording. There is an Ampex *ATR 100* ½ in stereo tape master recorder. Julian finds that the ½ in format gives a significant improvement in recording quality over ¼ in and says that clients do not have any problems finding a cutting room with ½ in facilities.

The main control room monitors are customised Eastlakes which Julian avidly points out: "Do *not* sound like Eastlakes anymore." Eddie Veale did the customising to allow for Julian's requirement that it be possible to monitor at high levels without the sound being too cutting. The bass units are Gauss, while the mid-range and top are JBL.

Additional monitor speakers include the obligatory reference Auratones along with a pair of Acoustic Research *AR 18* units and Tannoy *Little Reds*. The monitors are powered by H/H MOSFET *V800*, Crown/Amcron *DC 300A* and Quad *303/405* amplifiers. A White graphic equaliser is used on the monitor system but the adjustment to the frequency curve is only slight in order to provide true monitoring.

The studio decided to go for full automation in response to a growing demand from clients. Julian continued: "People were not coming in to mix because we didn't have automation."

That has combined with a requirement for a certain amount of 46-track recording time. Using 46-tracks, a stereo mix can be recorded on to two or more tracks on the slave tape leaving several tracks free for more overdubs.

Whereas some studios see automation and 46-track recording as ways of upping their rates and making more money, Sarm are finding ways of using the facilities to avoid unnecessary time-wasting to actually *save* money for their clients. There are many applications of both the automation and the 46-track capability which have been absorbed into standard recording procedures at Sarm, allowing minds to be directed towards more creative aspects of the actual music being recorded.

Julian is also firmly convinced that a 24-track tape which is constantly passed over the heads of the tape machine for a great many overdubs can become worn, resulting in degradation of the recording quality: "The incredible thing is when, after working on the slave tape for a couple of weeks or something, you come back to your master tape to do your bounce and your original backing tracks all sound so fresh, the highs and everything are still there. It doesn't cost that much because we only charge them the higher 46-track rate during the time when the tape machines are locked together, which we work out is around a third or quarter of the studio time. So they're only charged for it when they do the initial bounce and bounces back to the master. It's not that much more expensive — you buy an extra reel of tape and spend a couple of hours of your 8 hr session at the higher rate."

The main studio has an area of approximately 600 ft^2 and has been re-designed by Sean Davies to requirements worked out with Julian who jokingly describes the previous acoustics as being close to those of an anechoic chamber! Julian explained the new approach.

"The whole point of the exercise was to make the place more like a room than a recording studio, more like your front room, and I think we've succeeded.

"Separation was really bottom of the list. The idea was to make one instrument sound good in the room rather than having total separation between four instruments, because I think that most recording is done in bits, rather than all at the same time."

Semi-reflective wood covered surfaces dominate the room which is bright but not excessively so. This is partly due to the fact that one wall is in fact false and stands 18 in or so forward of the structural wall. Between 30 and 40 wideband absorbers hang between the two. And this is where they've been crafty and possibly totally original.

The wood panelling reflects higher frequencies while lower ones are picked up by the wideband absorbers and the building structure. However, there are four separate doors in the wall. As each one is opened, more higher frequencies are absorbed instead of being reflected. Thus, after a relatively low cost output, they have four degrees of control of the acoustical environment. The degree of control is quite surprising and easily detectable by means of a simple hand clapping test. This facility, in conjunction with the use of Audio Kinetic acoustic screens and carpet, allows plenty of manipulation of sound when varying degrees of reflectiveness or separation are required. Another pair of Veale customised Eastlake monitors are provided in the studio which also houses a magnificent Bosendorfer 9 ft 6 in *Imperial* grand piano with the flap covering the extra bass notes which, incidentally, Julian finds great for producing abstract sounds.

Microphones include AKG *C414, C451,* valve *C28*; Beyer, Calrec, Electro-Voice, Neumann including *U47, U67, U87*; Schoeps, Sennheiser, Shure, STC and RCA.

The copy room is quite separate from the studio though *all* facilities are routable to the control room. A Trident *Fleximix* 8/4 console is used for monitoring only. There are two Studer *A80 VU* ¼ in stereo mastering machines, Neal-Ferrograph *302* cassette machines, Tannoy *Little Red* or JBL *L100* monitors with Quad *405* amplifiers.

Off-street parking is provided a couple of minutes' walk away. Studio users can expect to be fed once a day, providing that they don't start ordering champagne and caviar or abusing the staff. Very nice, a good marriage of high technology and practical application. **Ralph Denyer**

Sarm Studios East, Osborn House, 9-13 Osborn Street, London E1. Tel: (01) 247 1311. Telex: Sarm G 297 314. ■

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business

BARRY FOX

Play Misty for me . . .

Recently I chanced on a patent application filed in Europe by an Andrew Boettner of California. It's an interesting idea intended to make life easier for singers who work in smokey nightclubs or studios with a dry atmosphere. The singer's microphone has a miniature humidifier clipped on to it. The humidifier is a cylinder, rather like another microphone, which contains a small bottle of compressed carbon dioxide gas. When the seal is punctured, the gas leaks through a control valve into a coiled chamber. This chamber is fed with distilled water from a reservoir through a wick. As the gas leaks out of the coiled chamber it picks up the water and produces a fog of moisture around the singer's head. This, the inventor claims, soothes the singer's vocal chords. You set the valve to control the rate of gas escape and so the size of the cloud. Under normal circumstances the mist is invisible, but apparently it shows up in front of strong backlighting to produce an eerie halo effect that could be dramatic on the stage. And I suppose you could fill the reservoir with booze instead of distilled water . . .

Tape tangles

Just fancy that! If the Liberal SDP alliance wins the next election, anyone buying magnetic tape in Britain can expect to pay more for it—even if it is for pre-recorded music. *Music and Video Week*, the trade paper which has loudly supported the record industry's call for a levy or tax on blank tape, invited Liberal leader David Steel to speak at the annual music industry awards held earlier this year. Steel obligingly said that Britain should take a lead in copyright reform, rather than wait for the rest of Europe, and put a levy on blank tape. This, he said, 'would be of immediate benefit' to the music industry. But Steel seemed as muddled as the existing copyright laws, which he described as 'a ghastly mess'. What the Liberal leader actually advocated was a tax on blank tape for video and music cassettes. So if the Liberals have their way, firms in the business of legitimately duplicating music cassettes will be forced to pay more for their blank tape!

Needless to say the music press, in reporting Steel's apparent pledge to put a tax on blank tape, glossed over the actual words that he used. So did he mean what he said? Or does he know so little about the music industry that he didn't realise the significance of what he was saying? Either way, Heaven help us from politicians who make pledges on subjects that they don't understand.

Space scramble

The BBC has now finally signed the contract with United Satellites (the consortium of British Telecom, British Aerospace and GEC) for two satellite channels to broadcast direct into British homes in 1986. The BBC is paying £12.2 million per channel, per year for seven years. To guarantee a seven-year service Uni Sat will be launching two satellite birds late in 1985, using either the European rocket Ariane, or the American space shuttle if Ariane continues to give technical problems. One flying bird will transmit the two DBS channels and the other will be used as a spare. A third bird, on the ground, will be ready for launch as a back-up.

The IBA isn't in on the act, because while the BBC were lobbying for permission to use DBS channels, the ITV companies were thinking only of Channel 4. Now it's no secret that they wish they had backed DBS, rather than Channel 4 which is proving to be uncomfortably like a hobby boat. You know, that's a hole in the water into which you pour money.

The ITV companies are now busy cooking up alternatives to DBS. One idea is to transmit scrambled programmes through the night which people with de-scrambler video recorders can tape and watch the next day. Of course you pay an extra licence fee for the special equipment. Another idea is for the IBA to lease the BBC's spare satellite, which will normally be sitting up in the sky doing nothing. The BBC gleefully notes that this means ITV will be renting transmitters from the BBC and have to go off the air without notice at any time the BBC needs to use its spare bird.

The really big row, however, is over audio standards. Following the Part Committee's recommendation, the British Government told the BBC that it has to use the IBA's new MAC transmission standard for the video signals. To cut a long story short MAC is quite different from Britain's existing TV system, PAL. MAC separates the black and white and colour information in time, rather than frequency.

The MAC standard has room in the waveform for up to eight channels of digital audio. But if you use all eight channels, you sacrifice bandwidth and dynamic range; you have to make do with 15 kHz and 14 bits companded to 13 bits. Some engineers in the BBC are now complaining that this is ridiculous. Who needs eight channels of sound for each TV channel, even if some of the channels are radio programmes and quite unrelated to the video signals? Surely it's better, they say, to opt for fewer sound channels and a 20 kHz, 16-bit linear format compatible with current digital audio standards. After all the new DBS standard won't become operative until 1986 and we will be stuck with it right through into the next century. So it doesn't make any sense to opt for something no better than existing FM radio quality.

The pressure for compromise audio comes from the Scandinavian countries. They need all eight channels to cope with the large number of languages in that part of Europe. A film or TV programme will be transmitted with a wide choice of soundtracks. But realistically, the way things are going, by 1986 most people in Europe will be speaking English anyway. This is the one area in which Britain has really scored an export success. We've shown so little interest in learning anyone else's language, that they've all had to learn to speak ours.

The first edit?

Do you want to hear what's almost certainly the first drop-in tape edit made in Britain? Well for £2.99 you can buy a copy of HMV concert classics *SX LP 30440*. It's Sir Thomas Beecham conducting the Royal Philharmonic Orchestra playing Delius's *Songs of Sunset* and Bantock's *Fifine at the Fair*. Although the record was issued in 1980, the Bantock piece was recorded at Abbey Road No 1 in 1949.

At that time EMI was still officially recording direct on to disc, but the musicians of the Philharmonic knew full well that EMI engineers had for a long while been secretly taping sessions with experimental equipment hidden away upstairs. Sir Thomas Beecham knew all about it because he had always been interested in new technology and it was he who co-operated with Alan Blumlein at Abbey Road on January 19, 1934 to make the first British stereo test recording of music. It was also Beecham who, on November 19, 1936, co-operated with BASF at Ludwigshafen, to make the world's first orchestral recording on tape.

So it's no surprise that Beecham was enthusiastic about the idea of tape and freedom of editing that it offered when EMI installed its first recorders after the war. Although EMI kept quiet about the tests, Beecham lectured his orchestra on the changes which tape would bring. It would mean an end to short takes, he told them. And it would mean a beginning to editing. To prove his point he sent the orchestra home after they had recorded the main part of *Fifine at the Fair*, asking only clarinetist Jack Brymer to stay on alone in the studio.

The Bantock piece has a clarinet cadenza in the middle. Beecham saw no point in the orchestra hanging around while Brymer recorded his solo. Afterwards, the EMI engineers spliced it into the middle of the main orchestral work. To be frank, the edits aren't that smooth. You can certainly hear them if you listen for them. But as an historical landmark it's fascinating. Unless of course someone thinks they know of an earlier drop-in edit made in a British studio. If so, let's hear about it.

Double time

Funny how times change. Classical musicians used to be the 'long hairs'. Then came the long hair rock era. Now pop stars go for velvet heads and one group has had to provide American tour promoters with a birth certificate for their crew-cut girl singer, to prove she is a girl.

Legit musicians are finding out how useful it can be to use pop-style backing tracks. Recently musicians on some sessions, for instance a string of Gilbert and Sullivan works, were paid twice over. One fee was for audio release and the other for video. The music, orchestral accompaniments for operatic vocalists is being used as backing playback for the featured singers who tape their songs live on a video set. When you are shooting a gaggle of opera singers on video, the last thing you want is a full orchestra cluttering up the studio floor. So the obvious answer is to use pre-recorded tapes. And there is no point in recording the same music twice, once for audio and once for video. So the musicians get a double fee for no extra work thanks to a technique originally developed for the pop world.

CD reveals master's imperfections

There's a lovely passage in a recent issue of the American hi-fi magazine *Stereo Review*, which should be engraved on every recording studio desk. David Ranada was reviewing some *Compact Disc* players. He had four discs to listen to, three from Polygram, one from CBS Sony. "In every case I could hear no sonic problems that stemmed from the *CD* system," he writes. "Compressed, equalised, raucous-sounding popular selections recorded on hissy multitrack analogue tape machines sounded compressed, equalised, raucous and hissy."

Suddenly, the record companies are being brought face to face with a gruesome reality. With *CD*, their customers are going to hear exactly what is on the master tape and, in some cases, they may very well not like what they hear. The inadequacies of analogue systems have gone a long way towards disguising the nasties that are now going to be stripped bare for all the world to hear. As one engineer put it, "It's like seeing Barbara Cartland in a bikini". ■

Tonmeister

THERE is to be a change at the top of the only formal training course in Britain for recording engineers.

David Pickett, the lecturer in recording techniques at Surrey University in Guildford, who has been running the *Tonmeister* course since 1979, is leaving in August to take up a position as associate professor in audio technology at the University of Indiana.

There is already a recording studies programme at the University but it is not run on the same lines as the degree course that Surrey offers. David says it is too early to say what changes, if any, he may make to the American course, but during his time at Surrey he has helped to develop the *Tonmeister* course and instituted a number of new ideas.

David Pickett is not a product of the academic world. He started out as an engineer in satellite communications and took a sandwich course degree in electronics. He then moved to Abbey Road studios to become a sound engineer, where he worked with everything from rock to classics while taking an external degree in music at Goldsmith's College.

His work with EMI took him to Italy to record Bellini's opera *Il Pirata*, before he began specialising in remastering old discs. Working with Alan Warner he took the snap, crackle and pop out of Laurel and Hardy's posthumous hit *On the Trail of the Lonesome Pine*, and helped Sam to play it again by cleaning up *As Time Goes By*. He not only worked with Warner on several LPs of compilations of old film soundtracks and radio shows, but at the other end of the scale he worked with Bill Leader in remastering a collection of folk songs recorded by Percy Grainger—some of them on cylinders—and transferred the Furtwängler version of *The Ring* from acetates on to LPs.

During this time David was also conducting and doing a little composing and had a fair reputation when he took over the *Tonmeister* course. Since 1979 he has steered the course through a difficult period: the industry has been contracting, money has been tight at the University, and the course has attracted criticism from the industry. Some say it offers too little—past graduates have complained that too much time was spent with theory and not enough in the real world of recording studios. Some say it offers too much—they believe the course is elitist, good only for producing studio managers but no good for producing engineers, who are the backbone of the industry.

And there is another group, the anti-academics, who believe that too much education is not good for engineers and that people who want to get into recording should push their way into a studio and get on with it, learning the job as they go along. And as a prime example of someone who made good without university they can point out David Pickett, living proof that a degree course is not necessary—for which David has a ready counter.

"Engineers in the studio don't have time to learn the fundamentals," he says, "and you haven't got time to teach them. Here we have an opportunity to teach them from square one. Basically, I am trying to teach them in four years what it took me 15 years to learn."

And for those who have other complaints about the way the course is run, David counters that it started from scratch only 10 years ago and is still developing.

"The problem is that there is still no recognised way of teaching it. There are a number of text books and each one is good in its own way, but there is no one basic book."

The *Tonmeister* degree was born in Germany, hence its name, but David describes the British approach as much more flexible than the German. There is also a course in the State Academy of Music in Warsaw, with which the University of Surrey has strong links. David visited it in 1980 and 1981 and is going back in May to lecture, and a Polish Tonmeister, Andrzej Miskiewicz, is now at Surrey, teaching and researching for a thesis. But despite this cultural exchange the British course remains unique.

In their four years at Surrey, the students spend two studying physics, music and recording techniques, the third working in industry and the fourth studying advanced music and science and preparing a research paper on a special aspect of recording which they have chosen. As part of the final assessment they have to present a portfolio of recordings they have made themselves.

There are only 31 students spread over the four years and competition for places is tough. This number also includes some outsiders who are taking other courses with incorporated tonmeister studies.

"In the past," says David, "there have been people, mainly from overseas, who have come and said: 'I'd like to take just part of the course'. The music department thought it would be a good idea to rationalise this and provide courses which did give some kind of a diploma, so we started three—one in conducting, one in musicology and one in tonmeister studies. We also have a year M Mus course, which we have revised to bring in a tonmeister option."

The main tonmeister course is intensive, requiring the students to have more than a love of all types of music and a strong interest in recording. They also need physics and maths to at least A level standard.

The theoretical work is tough, covering acoustics and electronics in depth. "Anyone without good maths would be lost after the first week," says David.

There are also lectures on music and recording techniques past and present. A visitor to the music department might find the students listening to and analysing classic recordings of classical music or vintage pieces of early jazz. Or they may have lectures from people like Bill Leader, who has done wonders recording folk artists, sometimes just with an old Revox; Peter Andery, the head of EMI's classical division; Adrian Revill, the head of the BBC Transcription Department; or Laurie Fincham, the technical manager of KEF loudspeakers.

There is also plenty of practical recording work for the students. The university is well equipped with the type of gear one would expect to find in a good recording studio. David feels it is important for the students to be able to work with basic equipment and also with the state-of-the-art technology. So 18 months ago the University spent £10,000 installing Sony digital recording equipment.

Computerised mixdown is well beyond the department's means at present and probably for many years, but David points out that in the long run the most important thing is for students to get a good grounding on the basic equipment. Digital equipment is good, he says, but in the end it all comes down to the skill of the engineer.

The department has a main studio and a control room which is constantly being refitted. At present the equipment includes three Neve mixers, Studer and Ampex recorders, AKG, Neumann and Schoeps microphones and a large selection of monitors. There is a smaller control room next door to the main studio and the department also has a mobile recording unit. The university's main hall is linked to the control rooms for recording concerts.

"We often have three students recording the same concert," says David, "one in the small control room and the others in the big control room, one working with headphones and the other using speakers. Then we can compare the recordings and the results not only from analogue and digital equipment but also the different microphone techniques used by the students. It means that sometimes we have a forest of microphones facing the orchestra."

There is no shortage of material for the tonmeisters to record. At Surrey they live in harmony with the other sections of the music department, the performers, conductors and composers. The tonmeisters have the opportunity to record at least one concert a week and if they want someone to play a piece interminably while they decide on the best microphone positions for recording a piano, harp or violin then they can always get a music student to do the job in return for a few drinks. The musicians benefit from being able to hear good quality recordings of their work.

The university has also formed a special relationship with the National Centre for Orchestral Studies at Goldsmith's College, which gives them another valuable source for classical recordings.

At the other end of the scale, local rock groups queue up for the chance of a recording session at the university studio.

Training ~ UK

John Eason

Two students are currently using the university facilities to produce a record for a local school for the disabled. This is proving valuable experience as they are supervising all stages from the recording to the pressing and have even helped design the record sleeve.

Tonmeister students are expected to have a good musical knowledge, to be familiar with at least one instrument, and to take an active part in the musical life of the University. "We don't think they should just be technicians," says David, "but people who can bridge both sides".

Finding students with the right qualifications, a good scientific background and a good musical foundation, would seem to be a problem. But 80 people applied for the 10 places available last year. Of these, says David, only a few were out-and-out timewasters. The rest were good which made deciding who got in a hard task.

"We only took 10 students," says David, "but there are only about 10 jobs going in the industry each year. We had to miss out on a few people who might have made good engineers and I'm sorry. But the entertainment business is tough and it's no good producing people with the skills if there aren't the places in the industry for them."

So if people come in with equally good qualifications, what is the deciding factor?

"We lay a lot of emphasis on personality. If you come into a studio you have all sorts of problems. You have to work with engineers and you've got to keep the artists happy to get the best out of them. You've got to be someone who can get on and work with diverse equipment. And you've got to be charming with your back to the wall. We can help people with problems in maths but the personality is formed by the time you're 18 and we can't change that."

If the personality and the qualifications are right the next phase is developing what David terms the 'golden ear', the ability to go into a studio, hear a piece of music and know how to get it down on tape the way it should sound.

To help train the 'golden ear', David has instituted a course called 'technical listening', based on work he saw at the State Academy in Poland.

"It's a way of teaching the tonmeisters to use their ears. There are so many different things to listen to in recording a piece of music. You can be listening to the composition itself, or the performance. But a sound engineer has to listen to the overall sound and recognise distortions as easily as a musician would recognise a wrong note. And if a recording doesn't sound right he has got to know why and how to correct it without wasting time. The engineer who wins out in the studio is the one who can get it right fast."

So David takes a good recording and uses a graphic equaliser to alter its frequency characteristics. The students then try to balance it out again.

To help them learn the technique, David employs a third-octave real time analyser which provides a visual image of the frequency response of the record. He has found this 'eye training' reinforces the 'ear training'.

David feels the technical listening course is one of the most important innovations as it gives the students an early insight into the problems of EQ and a chance to suffer and combat aural fatigue.

The students get an even bigger taste of the problems of the industry in their third year. One of the first problems is finding someone who will employ them for the industrial year. Previously, the University had tried to place the students with firms but the policy now is that they should first attempt to place themselves. This is on the theory that people are much more likely to take a student if he presents himself to them directly and shows that he is interested in coming to them. The theory seems to have paid off as this year six students have found themselves jobs.

One is working with a mobile recording unit in Leeds; another, a Dutch student, is with Sony in Holland; a third is with Angus McKenzie's tape consultancy in London; the fourth is with Audio Rents, a hiring service; and the other two are in studios.

David would like to see some sort of encouragement for employers to take a student for a year, perhaps even a Government subsidy.

"It would be nice if we could get a studio to take a new student each year on a rotating basis," he says, "but the scene is still very depressed".

The depressed state of the industry is a topic which must lie heavily on the minds of the students and their tutors. David has some harsh words for the industry he loves. He believes many of its troubles stem from a lack of foresight and imagination by British companies and instances the half-hearted way in which the *Compact Disc* is being marketed, an event he feels compares with the British reluctance to accept stereo at first. He is also opposed to those calling for a tax on blank tapes and refers to them as the Luddites of the industry.

"You can't stop progress and you can't be sure that the money will go back into the industry."

Rather than home taping, he feels that the decline in the manufacturing quality of records has helped to contribute to the decline in sales. [*Hear, hear!—Ed.*] He points to the number of badly pressed, warped and off-centre records which are appearing on the market at a time when all

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David Pickett (seated) talks to some of his students

John Eason

Tonmeister Training~UK

the problems of producing an analogue disc should have been ironed out.

"I have records which were made 20 years ago," he says, "and their quality is still better than some records produced today.

"It could be argued that if manufacturers want to promote *Compact Disc* they would not be doing themselves a favour in making analogue discs as good as they can. I should not be surprised if they begin to deteriorate."

But he does not believe that the analogue disc will disappear overnight in the face of competition from *Compact Disc* and cassettes as some have predicted.

"There's lots to be said for the analogue disc. It's cheap, easy to make and one good copy will run for thousands of pressings. And you can reckon that if the hundredth one sounds OK and the thousandth one is OK then all the ones in between will be all right. Cassettes are still dodgy. Each one can have a different problem. The fact that the hundredth and thousandth are OK says nothing about the ones in between.

"I believe that *CD* eventually will and should take over; it's an important step forward," says David. But at the same time he feels the record companies have not yet come to grips with the problems presented by digital techniques, especially the problem of miking, which he believes needs to be totally reassessed.

"What the companies have got to realise is that now the general public can hear in their own homes the same quality which was previously only available in the studio from the master tape. A lot of deficiencies which were covered up by the analogue disc will now be revealed."

But David also warns against regarding *CD* as the universal panacea for all the recording industry's ills. Companies cannot just push out the same old discs in a different packaging.

"Although hi-fi magazines put a lot of emphasis on quality there is very little indication that the general public buys for sound quality alone. Instead they want good music. Companies are now looking for a fast return on investment and there are too many records in the same repertoire coming out."

So the pressure is going to be on the record companies to provide good quality recordings and a good repertoire, and this will come not only from the general public.

"Traditionally this industry has always tried to work to the highest standards," says David. "Sound recording is a job that takes up your whole life, you have got to be really keen on it. People are working to their own personal standards all the time and you also have to satisfy the artists and they are getting very critical."

Despite his criticisms, David is optimistic about the industry's eventual recovery.

"It's not a grim future," he says, "it's just bad at the moment. We believe the industry is in the process of restructuring itself. If the industry is regrouping with new and more complicated equipment then the companies will find our students more attractive."

He also believes that Britain is still an attractive place to record.

"Our orchestras are very fast sight readers. They can walk into a studio and play a piece they've never seen before. Many orchestras abroad will not record a piece unless it is already in the repertoire, a system which also has its advantages. Our engineers are much more flexible than engineers anywhere else and our union rules are more flexible than the United States."

Testing the C-Ducer

John Eason

So when the bright new day does dawn for the recording industry the next generation of tonmeisters will be ready. In the meantime does David think that more could be done by the industry to help the engineers of the future?

"The main support we are looking for from the industry is for them to employ our students. We realise it is very difficult, the industry is facing a lean period. But we believe that as the equipment gets more complicated there will be a greater necessity for trained personnel. And experience indicates that those firms which have employed our students have been very pleased with them."

There has been some outside help. The Performing Rights Society has set up a scholarship in memory of John Lennon and last year its first award, a £2,000 grant, went to David Wilson, a science graduate from Edinburgh University whose strong interest in music has led him to Surrey to do post-graduate research in recording techniques. Each year the award will allow other graduates to study at the University.

The APRS has set up a fund to commemorate their former chairman, Jacques Levy. The money is being used by Surrey University in three ways. There is an annual award for compositions in electro-acoustic music which would not be possible without studio facilities.

Another prize has been set up for the tonmeister student who produces the best fourth-year research project. Last year's winner had experimented with binaural recording.

Says David: "He tried to record sounds using a dummy head. There had been previous work in this field but he decided it was not enough to have a representation of a head: it had to have real ears. So he modelled his own ears in plastic for the dummy."

Other student projects have covered such diverse subjects as the best way of miking up drums for recording, ways of checking the quality of magnetic tape and the best way of recording jazz in a studio without destroying the spontaneity of the music.

Thanks to the third part of the APRS fund all this research will be made available. Money is being provided for the publication of the projects and David and his colleagues are preparing the material.

Research is a field where David thinks that the industry and the students could work together to their mutual benefit. He would like to invite companies to bring their products to Surrey for testing which would give the students practical work and could help the firms involved. This sort of co-operation is quite common between other industries and science departments.

There has already been some co-operation from local firms. C-Tape Developments Ltd of Aldershot sent the department their *C-Ducer*, a type of transducer in the form of an adhesive strip. The students tested different types, short and long, on pianos and found that whereas the company had thought that a long strip would be best for pickup from a piano, two medium length *C-Ducers* gave a better result.

David feels that contact with all sections of the industry is important. "If they don't like our course they should come and tell us why: perhaps we can improve it." It is a tradition he is sure his successor will keep up.

"I just fine-tuned the course," he says, "my successor may well see things that I didn't and change it again".

But whatever happens he doesn't see the course changing too radically, despite the cries of those who see it as elitist and want to see a not-so-technical course brought in for engineers. He stresses that Surrey is a university that provides an education 'with a capital E' and the course should remain as high-grade as possible. But he welcomes the idea of other recording courses being set up at polytechnics. He was part of a 3-man team which went to Salford Polytechnic to discuss the possibility of setting up a course there for maintenance engineers. This course has not yet got off the ground but it could provide a useful complement to the *Tonmeister* course. ■

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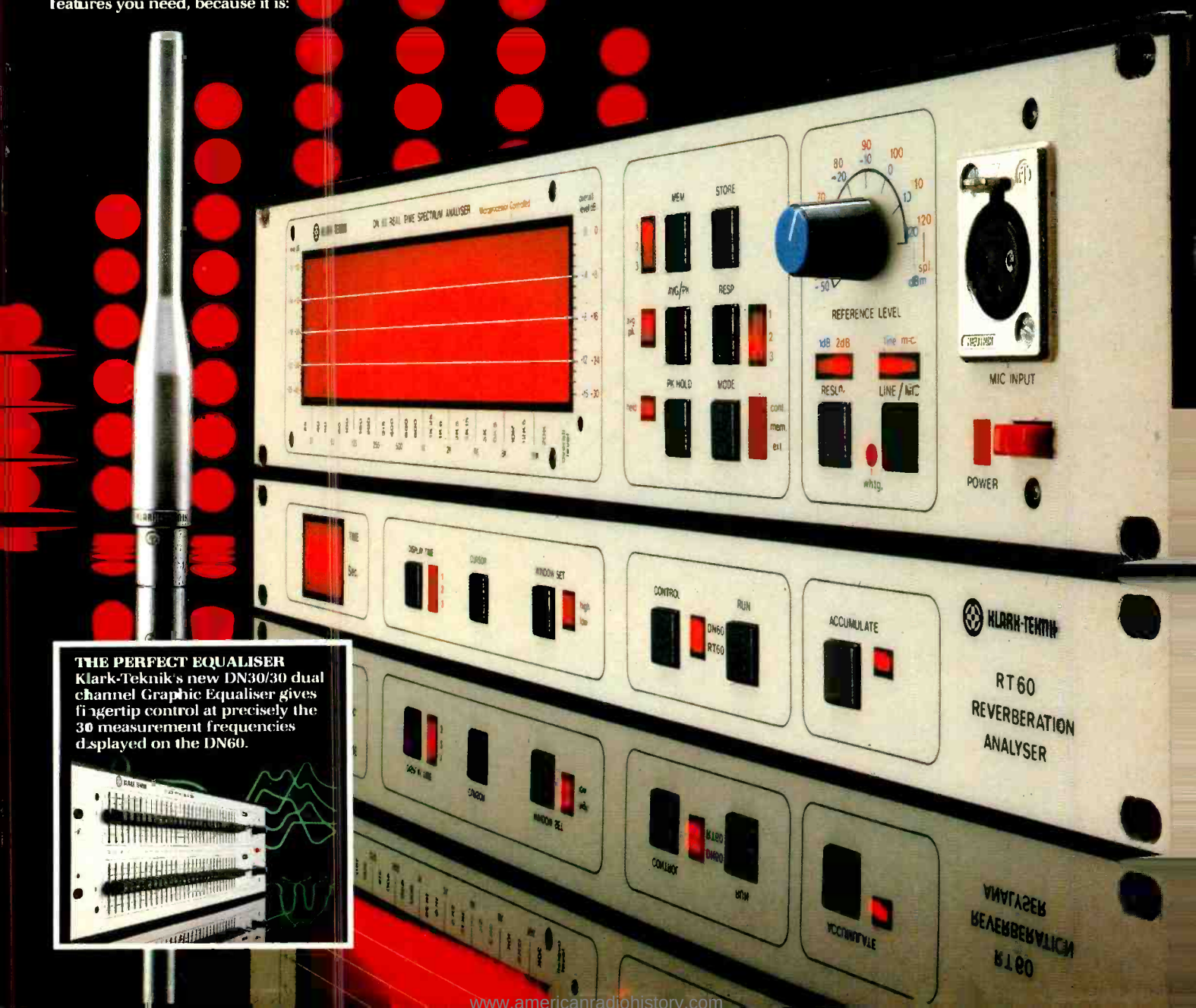

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Sacred

'Visual Music' is a difficult idea to define, yet it is becoming increasingly important, both artistically and commercially. All manner of visual and audio techniques can be combined in many ways to produce a unique interrelation of sound and vision. In a sense, the major problem is one of balance: sound is a very powerful medium, but moving pictures (be they video or film) can very easily 'take over'. The sound, or musical content, tends to be submerged by visual impact, to such a degree that the audio can be almost forgotten, both technically and artistically. The comment 'Nice video, shame about the song' is unfortunately so often true of promotional videos. The video artist often chooses to set his images to already-existing music rather than collaborating on a complete work.

There is, however, an international movement towards integrating these complementary areas which will one day become the same medium—despite the pundits who will say it has already happened. A very important part of this movement is represented by the Visual Music Alliance based in California. But there is also work going on in Europe.

In this article Chris Evans, an English composer working in West Germany, describes the production of two albums, *Stonehenge* and *Symbols of the Seven Sacred Sounds* (both released by WEA in West Germany) and the video techniques utilised for their performance in a number of planetariums.

THE album *Stonehenge* was recorded in West Germany towards the end of 1979 and released there in January 1980. The album represents a musical journey through my West Country home portraying famous places which relate to Stonehenge. The music is electronic rock although it features many acoustic instruments such as drums, electric and acoustic guitars, brass ensembles and vocals. The album has sold about 45,000 copies, mainly in German-speaking countries.

However, in January 1980 we were looking for a means of giving the album a push on its release. We had the idea of presenting *Stonehenge* in a planetarium, and Ludwig Rehberg—the video man—and I were able to persuade Erich Übelacker, director of Hamburg's planetarium, to provide the facilities one night for this purpose. It was a great success and since then we have done many concerts in Germany, not only in Hamburg but in Stuttgart and Nuremberg, too, also using the follow-up LP *Symbols of the Seven Sacred Sounds*, released in May 1981. Pre-recorded tape was used since it is acoustically impossible to do this kind of music live within the planetariums apart from the fact that complete darkness is required for projection.

Both albums featured the vocals of David Hanselmann. A third album *Empty Spaces* with other vocalists has been recorded but not yet released.

Music preparation

There were two points of departure: synthesisers and the lyrics—some of which came from classical literature, eg William Blake and Tennyson, and to a certain extent determined the composition. Only two of the numbers, *Stones of Avebury* and *Camelot*, were done from scratch, that is the basic playbacks were laid down in the studio in the normal way with the musicians. All others had electronic tracks prepared, not only sequencers but also other effects which for various reasons had to be done in advance. These prepared tracks were rhythmical and could provide the musicians with advance information as to the atmosphere of the numbers. Even after months of work in my home studio preparing and storing sounds and effects, we still required up to four days studio time before the musicians could join in. Some sequences which were too difficult to reproduce twice (normally using analogue equipment) were recorded at home using a *Revox* machine and later transferred to 24-track. All the LPs have been arranged in normal notation although many electronic sounds defy imagination as to how this should appear.

Stonehenge—technical details

Keyboards used were: ARP *2600*, PPG *Module System* and Sequencer, PPG *360 Wave*, EMS-Rehberg *2000 Vocoder* and EMS *Large Vocoder*, EMS-*AKS Synthi* and ARP Sequencer. Keyboards were the same for *Symbols*, apart from a PPG *Computer Sequencer* although I am now using a *Waveterm* system.

The introduction of *Sunrise* was done solely using the ARP *2600* with a technique I had learned with a Teac 4-track. I patched a string sound on the ARP with a short decay. To this I added a short delay with a lot of regeneration (done in the studio with the EMT *251*). Now using double recording speed (30 in/s) I proceeded to play high (and fast!) broken chords in G major. This was 'doubled' eight times (but not rhythmically synchronised). The same process followed at a lower register this time using C major, doubled only six times; then again at a still lower register with D major, doubled four times. The whole was then played back at 15 in/s. The long regenerated delays (now at half speed) created the wavy, lazy, spacey effect required. When mixing, the various chords were blended in one after another. Chorus was added using the EMT *251*. The string melody and the French horn were both created by the ARP *2600*. The sequence on *Salisbury Plain*, similar to the one on *Glastonbury*, was done linking the PPG analogue sequencer to the ARP sequencer and running them in tandem. A difficulty with *Salisbury Plain* was that the music had occasional bars in 3/4 time. This was achieved by manually resetting both sequencers at every uneven bar. The spacey sounds come from the PPG *360*. This machine produces polyphonic digital sounds. It has 30 presets and space for 70 personal sounds. Patching is done via a keypad and the keyboard, and the envelopes can be adjusted using sliders. It has been superseded by the PPG *Wave 2* and *Wave 2.2 Waveterm*.

Earth Magic is the only completely electronic number on the LP. The rhythm machine was provided by the Roboter Werke in Frankfurt. This machine produces synthetic rhythm sounds from modules with each sound recorded on a separate track; the sounds are more 'elegant' than normal rhythm machines. The other sounds all come from the PPG *360*. As can be heard, the music was written normally and exactly notated. All the notes were played by hand and no sequencers were used.

The tempo of *Silbury Hill* was taken from the end of *Earth Magic*, the musicians using the end of the latter as kicking-off point. Since the harmony stays mainly put on one chord (E minor) it was easy to synchronise the acoustic guitars. Jürgen Schröder simply played 16th notes on the harmony, synchronising one guitar on top of another and just changing the registers. The solo passage is a Roland *Guitar Synthesiser* with a definitely synthetic sound. *Genesis* starts with a clap of thunder created by banging the back of an electric Aeolian Harp. This instrument, built by Ludwig Rehberg of EMS, has metal strings stretched over a solid wooden body with resonators and a guitar pickup. The instrument can be struck, blown on, the strings played with the fingers or by a violin bow etc. By using a VC filter one can achieve many effects. The church organ sound comes from the PPG *360*, the slow pedal sequence from the PPG *Module System*.

Glastonbury starts with spacey sounds from the PPG *360*. The wind/jet-plane effect is done with the EMS Rehberg *Vocoder 2000*. An audio sine waveform was set up on the EMS-*AKS Synthi*, voltage controlled by a low frequency sinewave. The resulting audio sound rose and fell between about 200 Hz and 1 kHz. This was fed into the speech input of the vocoder and thus modulated the internal noise input available on the instrument. The modulation rate was slow, but could of course be dispensed with and played by hand from the keyboard. Chorus was added and the effect was complete. This effect was used later in the transition from the *Epilogue* to *Stonehenge Theme*, this time, however, in stereo and phased.

Camelot commences with a slow passage introduced by Gregorian Chant which I had previously recorded in Hamburg's Music High School with special singers. The resultant 'choir' was now transferred three times to 24-track, the punch-in point coming about 2 or 3 seconds later each time. The military drums were doubled normally and with a *Harmonizer*.

The Roland Guitar solo was played by Roy Louis of Passport fame. This

Sounds

Chris Evans

number has no sequence and uses the slow passage as kicking-off point.

The *Epilogue* makes extensive use of the EMS *Large Vocoder*. Here Ludwig Rehberg modulated the vocal sound from the vocoder's patchboard and the excitation sound came from the PPG *360* using a string sound and various voicings. There is no set rule for work of this kind. It's a case of experiment and personal experience. The vocoder sound uses about six tracks (apart from the original voice which is still there).

Symbols — The Numbers (Technical Details)

The keyboards used were the same as for *Stonehenge* apart from a PPG *Computer Sequencer* although I am now using a *Waveterm* system—the manner of working was also similar. The 'Intro' following the Gregorian Chant was done in the following way: A synthetic string passage with the harmonies B♭, C and D minor was copied on to 24-track using the 'barber-pole' method. The same sound was fed into the EMS *Vocoder 2000* excitation input and modulated with a sinewave from the EMS-*AKS*. This made the whole thing very spacey. The bass was added with the ARP *2600*. The fast, high string sequence in 6/8 time which was then blended in to form the transition to the first number, *Dominus*, made things difficult for drummer Dicky Tarrach because *Dominus* kicks off in 4/4 and he had first fills in 6/8 with no count down to give him the feel of the number itself. Jürgen Schröder's acoustic guitar solos on *Where Is It Ever Leading To?* were done directly with the echo. The brass chords on *Tears Of Heaven* were done in the following way: The first D minor chord was recorded on to two tracks. The second chord (E♭m7) was recorded on two new tracks, but starting before the first one had finished. The remaining chords were all done in the same way with the spaces between the chords progressively shortened. We used about 10 tracks which were then premixed down on to two. The 'hissing' at the beginning of this number comes from a very fast sequence I had adjusted on the PPG *Computer Sequencer* and PPG *360* and then sent through the EMS *Filter Bank* letting only the frequencies above 8 kHz through. When the brass passage was over I opened the other frequencies on the *Filter Bank*. Since the brass finish on an A4 chord and the sequence is set to G7, there is a very pleasant 'shifting down' feel in the music. The thunder clap comes from the ARP *2600* and I now wish I had used the real thing!

There is an interesting mix at the end of *Tears Of Heaven*. The whole playback (including reverb) shifts over to the right channel and then shifts back at the beginning of the introduction to *A Question Of Dimension*.

The rapid string sequence (also from the PPG *Sequencer* and *360*) was enhanced using the barber-pole method as was the Gregorian Chant, the punch-in points being very short. The aggressive vocoder sequence was blended in under the strings as follows. A normal analogue sequence was set up using the PPG *Module System* and sequencer. The sequence has to be in the tempo of the piece but the notes themselves are melodically irrelevant since they are used solely to modulate, that is their frequencies and tone colour are important. Therefore experiment is the keyword. Flip results can be obtained using wildly differing frequencies in the modulating sequence. This sequence was fed to the speech input of the EMS *Vocoder*. To the excitation input I then fed the polyphonic PPG *360* and using a hard sound with sharp attack played chords and notes which created the feel I wanted. The EMS *Vocoder 2000* has two switchable response times, steep and shallow, and an adjustable slew time. Greatly differing results in modulation are therefore possible. For this number I used a slew time between 1 and 2 and the steep response time. I'm indebted to Ludwig Rehberg for this idea.

A pretty right/left echo effect on *Colours* was done with my Korg echo machine feeding the direct output to one channel and the effect output to the other. The sound is a very typical one for the PPG *360*. Reverse echoes on the voice were done by playing the 24-track backwards and recording the voice echoes thus. When the tape is played forwards the echoes appear to 'come from nowhere'. Doing this will of course give the sound engineer a headache finding out where the track is he wants to treat and *where* he can record the echoes! This was Michael Bestmann's idea.

The 'heavenly choir' on the run-up to the *Dominus* reprise was also done using the barber-pole method. Of course a similar effect could be achieved using delays but I think the direct signal gives a very much more vibrant sound. We mixed the completed choir down first and fed it back three times on to 24-track staggering the punch-in point a few milliseconds each time. You can get a terrific cathedral sound with this method if mixed with delayed reverb. However, if the track is very rhythmic the effect will be difficult if not impossible.

The vocoder sequence on *Life in the City (Empty Spaces)* was recorded at home as follows. The basic sound was created as described for *A Question Of Dimension* above but differed in that the excitation input was also fed to the speech input, so the sound is not only modulated by the sequencer (fed solely to the speech input) but also modulates itself. This can produce very interesting results with differing sources. Synchronised to the trigger output of the sequencer was the PPG *Computer Sequencer* producing a string-like, repetitive phrase. In part of the song the sequencer speech input was used directly by operating the 'stuffing' switch on the vocoder. The three outputs: the direct vocoder output; the string phrase; and the 'stuffing' output (the direct modulating sequence) were fed to three tracks of a Teac 4-track. This was mixed down on to a Revox machine and later transferred to 24-track.

Studio

Stonehenge and *Symbols* were both recorded and mixed in Europa Sound Studios near Frankfurt, West Germany. This studio complex was built by the owner, Fred Schreier, in 1979 following his earlier studio of the same name in Offenbach. His studios have always been rated amongst the best in Europe, not only for a tremendous sound but also for the complete service rendered there. Worthy of particular mention is Michael Bestmann who engineered all of my albums. Europa Sound have three studios in their complex, two large studios and one for putting down vocal lines or solo tracks.

Studio 1 has 24-track (analogue) with a 60-channel quad mixer. The 120 m^2 of recording area provide variable acoustics with two separate rhythm booths.

Studio 2 has 24-track (analogue) with a 32-channel quad mixer. There are 60 m^2 of recording space with two rhythm booths.

Studio 3 is smaller but has 24-track with a 30-channel quad mixer and the recording area has one rhythm booth.

Various pianos and electronic keyboards are available as well as a big selection of percussion. Studios 1 and 2 are linked for multitrack copying.

Video pictures

The video pictures we used in our planetarium concerts are solely the work of Ludwig Rehberg, an example of which is shown overleaf. He produced them using his *Videosizer L1* which was developed and built for him by Richard Monkhouse and Tim Orr in London. Ludwig has a lot of experience using video and also in producing audio and video sythesisers.

Black and white photos of Stonehenge were fed into the *Videosizer* using a video camera. The photos were colourised and treated with the *Videosizer* then the resultant image on the monitor was photographed and diapositives produced. However, for use in the planetarium any part of the picture which has otherwise nothing to do with the subject must be painted out by hand. The images then appear to float amongst the stars when projected on to the planetarium dome. Since we were projecting four images at once Ludwig Rehberg produced four slightly varied copies of each subject thus increasing the spaciousness of the effect.

Videosizer and technique

Colourisation is done in the following way. A video camera is adjusted on to a photo, or other subject, and transmits this information to the *Videosizer*. This in turn divides the picture into six different luminance values. The colouriser then provides the colour to these various luminance grades with any shade desired, eg the brightest spot on the photo can appear red on the TV monitor, the darkest spot green and other grades receive rainbow colours.

This technique has been known for several decades, however, and has been redeveloped by the German/English EMS team making it createable under live conditions. With it a musician has an instrument in his hands to illustrate visually his individual acoustic imagination.

The visualisation of music has only been possible since the development of the EMS *Videosizer* because earlier video graphic computers and video effects mixers were not very practicable for the quick realisation of ideas. The current *Videosizer L1* is a very compact, logically constructed instrument which can also be played live in the same manner as an audio

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Sacred Sounds

synthesiser.

Before describing the *Videosizer* in detail it must be pointed out that it is only possible to visualise music dynamically and so present an audience with an interesting, new experience when the musician and videoist completely harmonise, not only in a personal sense but also in their artistic intent.

The *Videosizer* is a hybrid system and combines the flexibility of analogue control with the reliability of digital circuitry. The *Videosizer* combines four sections:

- electronic pattern, form and motion generator;
- colour video synthesiser (electronic paintbox);
- visual control by music and other audio signals;
- basic elements of a video studio (ie video sync generator, encoder and video mixer).

Now a brief description of the *Videosizer*'s functions:

Video mixer: Input 1/input 2 mix; inputs/synthesiser mix; fade to any level from black to white; synthesiser video may be keyed over input mix.

Shape selector: Selects one of 256 possible shape selections for each of the two shape generators. Each of these shape selections may be widely varied by the shape generator controls. The shape selections may alternatively be made to cycle in time with an internal clock, or the beat of an external audio input.

Voltage control functions: There are 17 different voltage control functions in the unit which allow pattern warping and movement to be added. These can be routed easily by push-switch blocks on the panel.

Shape generators: Two shape generators are provided, each with nine panel controls for repeat size, roll, size, spacing, symmetry, and offset. These controls allow a large number of continuous variations on each shape selection.

Roll controls: 'Roll' controls on each shape generator allow a continuous pan in any direction over an apparently infinite pattern 'landscape'.

Control oscillators: Two oscillators with an extremely wide frequency range (0.1 Hz to 50 kHz) are available as voltage control sources for the 17 voltage control functions. Output waveform is sine or triangle. These oscillators have an ultra fine frequency control and may be synchronised to audio beat, frame sync, or line sync on appropriate ranges.

Video colouriser: Allows the grey-scale of input 1 or input 2, or a mix of 1 and 2, to be split into six digital levels. These are then fed to the output layer selector. Controls allow variation of the level and spacing of the split.

Output layer selection: Allows any combination of the layers from the video colouriser and the two shape generators to be overlaid one on top of another and automatically generates a background signal which is fed over to the video mixer circuit as a key signal.

Output colouriser: Allows each of the six layers, plus background, to be independently coloured to any hue and brightness. There are two hue controls and a brightness control (rather than RGB controls) for each layer, so that attractive, nicely matching colour combinations may be easily set up. Illegal chroma levels cannot be obtained. An overall brightness control, and an overall colour joystick, allow variation of the balance of the whole picture. Six shading controls allow smooth shading (both overall and shape derived) to be added to the picture.

The visual forms, geometric shapes and undefinable figures are really parts of the music although having been electronically created by the *Videosizer*. Music and video have to be finely tuned to one another so that the musical form is either complemented by the video image or they run in counterpoint to each other. In our case since the music was the basic element providing the visualisation with its fundamental features, the viewers enjoyed an unusual experience because unconsciously aesthetic relationships between the ear and eye took place due to the harmonising of music and video image. The applause at the end of the concerts gave us encouragement to carry on with our experiments in the future for we do not see music and video image (visual experience) as separated elements but as a whole.

Chris Evans

Stonehenge images with planetarium Zeiss projector in silhouette

Planetariums

The planetariums in which we worked are all equipped with Zeiss projectors. Stuttgart has *Model VI*, Hamburg had *Model IV* and is now being equipped with *Model VI*, and Nuremberg has *Model IV*.

Superficially there is not so much difference between *Models IV* and *VI*. These projectors can both project in all about 9,000 stars (fixed stars), but at any one time only 4,500 of these will be seen, that is those visible from any point on the half-globe. These stars cannot be individually moved but can revolve together in all possible directions (with *Model VI* at a positively frightening rate of one daily rotation in 30 s). The planets can also be projected and their position exactly shown over a period of 13,000 years, corresponding to the platonic year (25,800 years) and the earth's precession motion. Such figures alone demonstrate the enormous projection possibilities of planetariums. Additional parts of the instrument project the co-ordinates and the constellations including the Zodiac. One difference between *Models IV* and *VI* is that the latter's stars twinkle whereas those of *Model IV* do not. This is achieved by means of a revolving metal grid around the projector lamps. *Model VI* also uses discharge lamps which are brighter and provide a truer colour to the stars. *Model VI* can zoom Jupiter and Saturn from 1 to 9 and has all the means of control one would expect in a piece of equipment of this complexity and cost. The control desk has sensor control with pre-selection of commands. Computerisation is, however, only to be found in Stuttgart's planetarium which can run automatically controlled by a separate pre-programmable Ampex Memory Unit using 1 in tape. Hamburg's *Model VI* will be controlled entirely by hand.

The Planetariums obviously have additional projectors and effects. These include eclipses, double stars, shooting stars, aurora, clouds, large moving planets, lightning, big bang, rotating galaxy, (zooming) pulsars, sun-up and sun-down. In Stuttgart several lasers are available, one capable of seven colours, which we controlled to move in time with the music using an EMS-*AKS Synthi* and a specially-built interface by Zuckerfabrik, Stuttgart, custom-built for our shows. There are also normal slide and panorama projectors, (projecting either from the centre or periphery) which provide breath-taking all-round views, eg of the moon's surface, an ice-landscape, the earth in a primeval state, etc. There are altogether 12 panoramas available in Hamburg and about 50 in Stuttgart.

The planetariums in question have a diameter of 20 m and are referred to as 'big planetariums'. There are some with diameters of 15 m and less. There is a distance of approximately 10 m projection from the Zeiss instrument located in the centre of the planetarium to the dome's surface. The projectors located at the sides of the planetarium have a projection distance of approximately 15 m. The horizon is normally represented by the panorama of which ever city the planetarium is situated.

Nearly all the effects mentioned above were used by us together with the video photos produced by Ludwig Rehberg. We always aimed for an aesthetic mixture of ideas and effects, combining the various panoramas with appropriate slides, thunder and lightning effects with sudden loud accents in the music and making the video photos 'come from nowhere' out of space by using blending. With *Stonehenge* the video pictures of the stones provided the relationship to the subject while in the later shows with *Symbols of the Seven Sacred Sounds* the direct galactic relationship of the music itself (eg RE = REgina de Coelis = the Moon, SOL = the Sun, LA = LActea = the Milky Way, etc) allowed us to use other photos and the planetarium effects to provide the direct connection.

Some of the best effects, however, are the peaceful ones. Indeed, one problem in planetariums, while doing shows with music, is to find enough appropriate effects for fast passages. In Stuttgart this was realised using laser while in Hamburg the possibility of revolving the planets at a breathtaking rate was used. The interpretation of *Where Is It Ever Leading To?* using the co-ordinates and constellations while the stars slowly revolved, is an effect I shall never forget. It must be said that a successful combination of planetarium effects and music is dependent not only on the operators but also on the kind of music used. When everything harmonises the viewers will find themselves transported to a different world. ■

Stonehenge *and* Symbols of the Seven Sacred Sounds *LPs can be obtained at a price of £5 each (incl postage and packing) from Chris Evans, Werderstr. 48, 2000 Hamburg 13, West Germany. Ludwig Rehberg's address is: Finkenstr. 4, 7257 Ditzingen/Heimerdingen, West Germany.*

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product guide
Tape recorders up to 8-track

This guide covers analogue tape machines only. Digital recorders will be covered in a forthcoming product guide.
A number of the tape recorders given in this listing are available in larger formats. These are marked with an asterisk and will be included in our coverage of 16-track and above recorders next month.
All frequency response measurements are given at 15 in/s unless otherwise specified.

ABE (West Germany)
ABE Becker GmbH & Co, Mainaustrasse 5, D-7750 Konstanz. Tel: 07531 21536.

MTR Series*: 8-track on 1 in, 7½/15 in/s; frequency response ±1.5 dB 30 Hz to 18 kHz; +30 to −50% varispeed; CCIR or NAB EQ.

ACCURATE SOUND (USA)
Accurate Sound Corp, 114 5th Avenue, Redwood City, CA 94063. Tel: (415) 365-2843. Telex: 348327.

Model 2600 Transport*: 8-track on 1 in, 4-track on ½ in and ¼ in, 2-track and full track on ¼ in; 3¾ to 30 in/s.

ALLEN AND HEATH (UK)
Allen and Heath/Brenell Ltd, Pembroke House, Campsbourne Road, London N8. Tel: 01-340-3291. Telex: 267727.
USA: Audio Marketing Ltd, 652 Glenbrook Road, Stamford, CT 06906. Tel: (203) 359-2312.

Brenell Mini 8: 8-track on 1 in; 7½/15 in/s; frequency response ±2 dB 30 Hz to 20 kHz.

AMPEX (USA)
Ampex Corporation, 401 Broadway, Redwood City, CA 94063. Tel: (415) 367-2011. Telex: 348464.
UK: Ampex Great Britain Ltd, Acre Road, Reading RG2 0QR. Tel: 0734 875200. Telex: 848346.

ATR100: 1- or 2-track on ¼ in, 4-track on ½ in; 3¾/7½/15/30 in/s, also 2-track on ½ in mastering format; frequency response ±0.75 dB, 100 Hz to 15 kHz; closed-loop servo tape drive without pinch rollers; autocue and varispeed options; cue amplifier; 4-speed dual EQ padnet.
ATR700: 1-, 2- or ¼-track on ¼ in; 3¾/7½ or 7½/15 in/s; frequency response ±3 dB 40 to 100 Hz, 100 Hz to 18 kHz ±2 dB; space for extra head; varispeed; *XLR* connectors.
ATR800: 1-, 2- or 4-track on ¼ in; 7½/15/30 in/s; NAB; new centre track time code option.
MM1200*: 8-track on 1 in; 7½/15 or 15/30 in/s; frequency response ±2 dB 50 Hz to 18 kHz 'overall' in sync and record modes; −50 to +150% varispeed; plus EECO time-code synchroniser and other video-orientated accessories.
ATR124*: 8-track on 1 in; 7½/15/30 in/s; frequency response ±2 dB 25 Hz to 20 kHz; varispeed −50 to +200%; accepts up to 16 in reels; NAB/IEC/AES assignable EQ; memory stores of channel and monitor modes; variable shuttle control; optional remote.

ASC (West Germany)
Audio System Componenten GmbH & Co, Seibelstrasse 4, D-8752 Hosbach. Tel: 0 60 21 53021. Telex: 04188571.
UK: Uher Sales and Services Ltd, 30-31 Lyme Street, London NW1. Tel: 01-485 0943/4.

AS6002/38: 2-track, optional ¼-track head, 3¾/7½/15 in/s; frequency response 20 Hz to 25 kHz; plug-in headblock; optional extra head.

AUDIO SYSTEMS COMPONENTS (UK)
Audio Systems Components Ltd, 19 The Green, Theale, Berks RG7 5DR. Tel: 0734 302108.

Revox PR99: customised version of the Revox *PR99* for broadcasters.

CEI (Australia)
Consolidated Electronic Group, PO Box 21, Anderson Road, Thornbury, Victoria 3071. Tel: 44 07 91. Telex: 32463.

Cuemaster 77 Mk VC: full and 2-track on ¼ in, 4-track also available; 3¾/7½/15 in/s; frequency response ±2 dB 30 Hz to 20 kHz; slant 'S' tape path for easy access, varispeed spooling, auto capstan shut-off after 2 min of non-operation; IEC EQ with NAB option.
Cuemaster 77 Mk VI: identical to *VC model* but with different deck size for 10½ in reel.
Cuemaster Series 2000: mono or stereo on ¼ in; 7½/15 in/s or 3¾/7½ in/s; frequency response ±1 dB 30 Hz to 20 kHz; modular construction; servo-controlled tape tension; NAB or cine reels; front panel cue and alarm indicator.

ELECTRO SOUND (USA)
Electro Sound, 160 San Gabriel Drive, PO Box 60639, Sunnyvale, CA 94088. Tel: (408) 245-6600. Telex: 346324.

Tape recorder: full 2-track and stereo on ¼ in, 4-and 8-track on 1 in, ¼ in transport 7½/15 in/s or 3¾/7½ in/s, 1 in transport 7½/15 in/s or 15/30 in/s, frequency response ±2 dB 30 Hz to 20 kHz; NAB EQ with IEC as option; built-in audio test oscillator; optional third reel for ease of tape editing; bias indicator light; edit footswitch; transport for 8-track is scaled-up version of smaller decks and is substantially larger.


Ampex tts PR-8


Ampex ATR-100

ENERTEC (France)
Enertec SA, Dept Audio Professional, 1 Rue Nieuport, 78140 Velizy-Villacoublay, France. Tel: 946.96.50. Telex: 697430.
UK: Crow of Reading Ltd, PO Box 36, Reading RG1 2NB. Tel: 0734 595025. Telex: 847056.

F462: full, 2-track or stereo on ¼ in; 7½/15 in/s, options for 3¾/7½ or 15/30 in/s; CCIR/NAB EQ; optional pilot track models.
F500: mono, mono/stereo compatible (0.75 and 2 mm), 2-track, 2-track with sync play, mono with *Neopilot*, stereo with *Synchrotone*, and stereo with *Nagrasync* on ¼ in; 3¾/7½/15 in/s; CCIR/NAB EQ.

FERROGRAPH (UK)
Ferrograph Recorders, Unit 21, Royal Industrial Estate, Jarrow, Tyne & Wear NE32 9XX. Tel: 0632 893092. Telex: 537227.
USA: Neal-Ferrograph (USA) Inc, 652 Glenbrook Road, Stamford, CT 06906. Tel: (203) 348-1045. Telex: 643678.

Studio 8: 1- or 2-track on ¼ in (or 0.15 in to special order); 3¾/7½ in/s or 7½/15 in/s; varispeed; mic inputs optional; built-in monitor speaker amps; variable (preset) spool speed; bin/dump or standard edit; LED elapsed-time display; available with penthouse electronics.
SP7: 1- (full or ½) or 2-track (½ or ¼) on ¼ in; 3¾/7½/15 in/s, 1⅞/3¾/7½ in/s or 15/16/1⅞/3¾ in/s; frequency response ±2 dB 30 Hz to 20 kHz; variable speed spooling; fast start on Run (0.1 s for correct speed); three motors, heads and speeds; tape/source switching; IEC or NAB EQ; range of accessories available; logging and delay versions available with IBA approval.
Logic 7: 2-track (½ or ¼) on ¼ in; 3¾/7½/15 in/s, 1⅞/3¾/7½ in/s, 15/16/1⅞/3¾ in/s; frequency response ±2 dB 30 Hz to 20 kHz; command memory; variable speed spooling; fast start on Run (0.1 s for correct speed); three motors, heads and speeds; tape/source switching; range of accessories available.
Edit 7: replay only for editing use, can handle up to 8¼ in reels; 3¾/7½/15 in/s with continuously variable fast wind speeds; mono or stereo versions; headphone provisions.
SP744: 4-channel version of *SP7* for multichannel work; three motors, heads and speeds; command memory; accepts all reel types and can handle up to 10½ in reels with variable speed spooling; full sync capability.

FOSTEX (Japan)
Fostex Corp, 512 Miyazawacho, Akishima, Tokyo. Tel: 0425-45-6111. Telex: 2842-203.
USA: Fostex Corporation of America, 15431 Blackburn Avenue, Norwalk, CA 90650. Tel: (213) 921-1112.
UK: Bandive Ltd, Brent View Road, London NW9 7EL. Tel: 01-202 4366.
A-8: 8-track on ¼ in (2 × 4-channel record, 8-channel reproduce); single speed 15 in/s; ±10% pitch control; frequency response ±3 dB 45 Hz to 18 kHz; IEC EQ; accepts 7 in spools; incoporates Dolby-C noise reduction; optional remote; return to zero.
A-4: 4-track on ¼ in; 7½/15 in/s; ±10% pitch control; frequency response ±3 dB 40 Hz to 22 kHz; NAB EQ optional IEC; accepts 7 in spools; optional remote; return to zero.
A-2: 2-track on ¼ in; 7½/15 in/s; ±10% pitch control; frequency response ±3 dB 40 Hz to 22 kHz; NAB EQ optional IEC; accepts 7 in spools; optional remote; return to zero.

IEM (USA)
International Electro-Magnetics Inc, Eric Drive and cornell Avenue, Palatine, Ill. 60067. Tel: (312) 358-4622.

1100A Series: 1- or 2-track on ⅛ in, 4-track on ½ in; 7½/15/30 in/s; frequency response ±2 dB 30 Hz to 15 kHz; crystal-controlled servo capstan with 7½ to 30 in/s varispeed; servo-controlled spool motors; plug-in headblocks.
1100B Series: 4-track on ½ in, 4-/8-track on ½/1 in and 8-track on 1 in; 7½, 15 or 30 in/s; other features as *1100A Series*.
1000 Series*: 8-track on 1 in; 7½/15/30 in/s: frequency response ±2 dB 30 Hz to 15 kHz; features as *1100 Series*, plus 14 in reel handling.

ITAM (UK)
Industrial Tape Applications Ltd, 1-7 Harwood Avenue, Marylebone Road, London NW1. Tel: 01-724 2497/7368. Telex: 21879.

806: 8-track on ½ in: 15 in/s: frequency response: ±2 dB 40 Hz to 22 kHz via tape; ±3 dB 70 Hz to 17 kHz for sync mode; relay-solenoid logic (based on Studer/Revox transport); servo-controlled capstan with 100% varispeed; modular plug-in electronics; Dolby-A and dbx.
810: 8-track export only version of the *1610* 16-track machine. 8-track on 1 in; 7½/15/30 in/s; frequency response ±2 dB 30 Hz to 22 kHz; ±50% varispeed. Plug-in headblock with rotating tape guides; modular plug-in electronics; dbx.

LEEVERS-RICH (UK)
Leevers Rich Ltd, 319 Trinity Road, London SW18 3SL. Tel: 01-874 9054. Telex: 923455.

Proline 2000TC: 1- or 2-track on ¼ in; 3¾/7½ in/s, 7½/15 in/s, 15/30 in/s; frequency response ±2 dB 30 Hz to 18 kHz; twin DC servo-controlled capstans with crystal reference; DC spooling motors with constant velocity, variable speed spooling; 5.9 32 in/s varispeed; dump edit; constant tape tension in all modes, speeds and reel sizes; NAB/DIN (IEC) switched EQ; plug-in open face headblock and modular electronics; provision for external capstan drive; various control panel options for TV, radio and recording studios.
Proline 1000/SC: 1- or 2-track on ¼ in; 3¾/7½ in/s, 7½/15 in/s, 15/30 in/s; frequency response ±1 dB 100 Hz to 10 kHz; mains-locked capstan motor on *1000*, or servo-controlled on *1000SC*; servo tape tension control; variable speed spooling; plug-in open face headblock; modular electronics; varispeed for *1000SC*; NAB/DIN (IEC) switched EQ; electronic adjustment of starting tensions and

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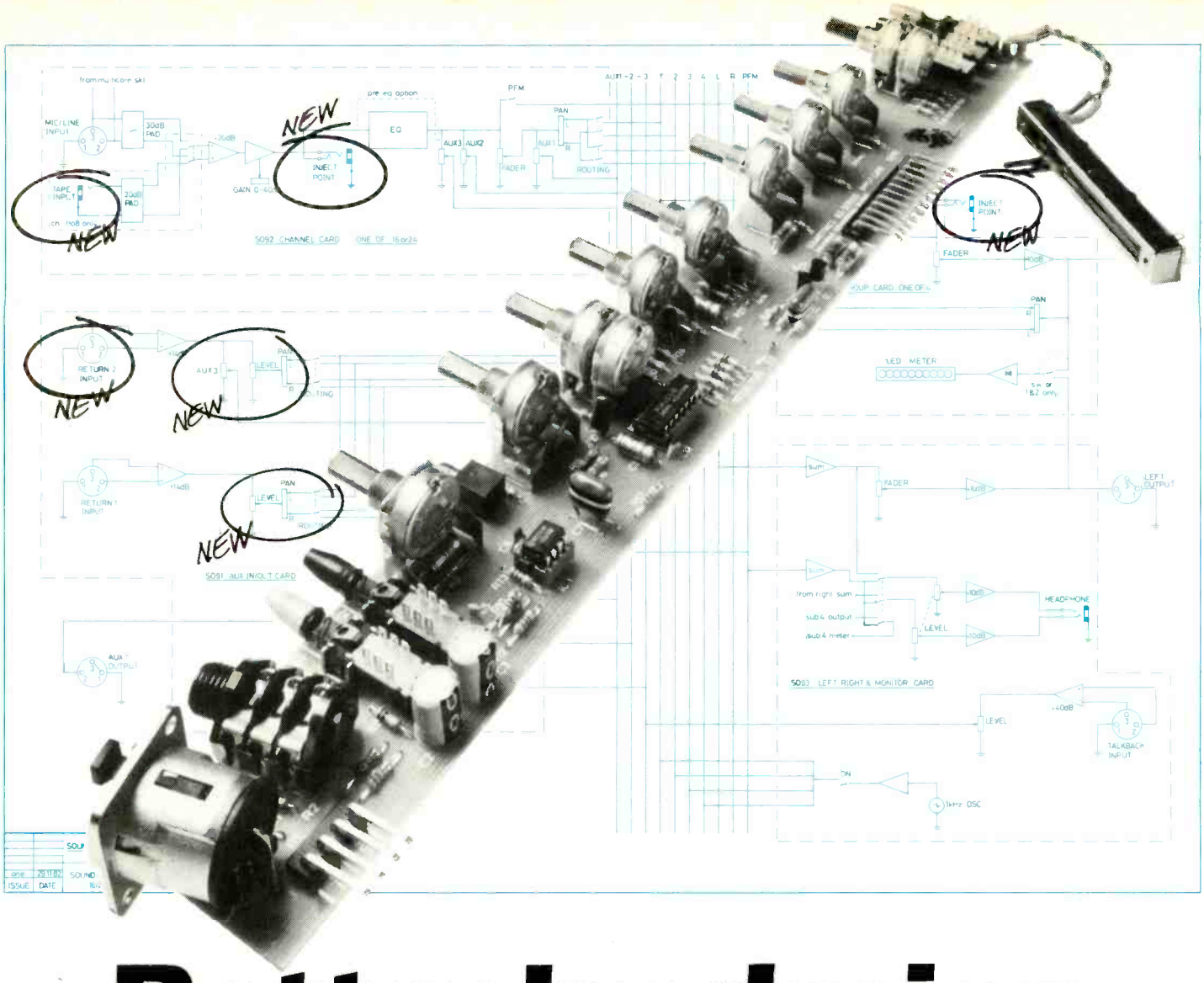

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product guide
Tape recorders up to 8-track

specially-designed air damping for optimum starting and spooling conditions.
E200: 1- or 2-track on ¼ in; 3¾/7½ in/s,7½/15 in/s; frequency response ±2 dB 40 Hz to 18 kHz; 'logic semi-interlock'; modular tape transport and electronics; servo-controlled tape tension; plug-in headblock; NAB or DIN (IEC) EQ on plug-in cards.

Lyrec TR55

LYREC (Denmark)
Lyrec Manufacturing A/S Hollandsvej 12, DK-2800, Lyngby. Tel: 02 87.63.22. Telex: 37568.
UK: Lyrec (UK) Ltd, c/o Feldon Audio, 126 Great Portland Street, London W1N 5PM. Tel: 01-580 4314. Telex: 28668.
USA: Rupert Neve Inc, Berkshire Industrial Park, Bethel, CT 06801. Tel: (203) 744-6230. Telex: 969638.

TR532*: 8-track on 1 in; 15/30 in/s; frequency response ±1 dB 60 Hz to 18 kHz at 30 in/s for record/repro; DC servo direct-drive capstan; search-to-cue and 7½ to 60 in/s varispeed; full sync plus 'aux sync' on all tracks; servo-controlled winding tape tension with adjustable winding speed limit; swivel-mounted transport; interchangeable headblocks; optional audio and tape controller; positive/negative tape timer; varispeed with speed read out; shuttle mode between two positions; playtime computing for shuttle distance.
TR55: 1- or 2-track on ¼ in; 7½/15 in/s; frequency response ±1 dB 60 Hz to 18 kHz; varispeed −50 to +100%; accepts reels up to 14 in; search-to-cue; variable wind speed. NAB or CCIR EQ

MARK LEVINSON (USA)
Mark Levinson Audio Systems, 55 Circular Avenue, Hamden, CT 06514. Tel: (203) 281-6333. Telex: 966405.
UK: Harman (Audio) UK Ltd, Mill Street, Slough SL2 5DD. Tel: 0753 76911. Telex: 849069.

ML5 Recording System: comprises *ML5* recorder, *LNP2* preamp, Bruel & Kjaer mic system. *ML5* 2-track on ¼ in (various other configurations including 24-track available); 15/30 in/s frequency response ±0.5 dB 125 Hz to 20 kHz; NAB or IEC EQ; uses Studer transport.

MCI (USA)
MCI Division of the Sony Corporation of America, 1400 W Commercial Blvd, Fort Lauderdale, FL 33309. Tel: (305) 491-0825. Telex: 514362.
UK: Sony Broadcast Ltd, City Wall House, Basing View, Basingstoke, Hants RG21 2LA. Tel: 0256 55011. Telex: 858424.

JH-110 Series: 1- or 2-track on ¼ in, 4-track on ½ in, 8-track on 1 in; 3¾/7½/15 in/s or 7½/15/30 in/s; frequency response +75/−2 dB 50 Hz to 20 kHz at 30 in/s; DC capstan servo systems; three transformerless differential inputs and outputs, differential head coupling; linear phase response; switchable NAB/CCIR EQ; QUIOR circuitry; option to accept 14 in spools; return-to-zero facility; tape velocity indicator.
JH-24*: 8-track on 1 in; 15/30 in/s; frequency response +1.5, −2 dB 30 Hz to 26 kHz; DC servo-controlled *JH-114* type transport for reels up to 14 in; QUIOR circuitry; NAB/CCIR/AES selectable EQ, remote controls as standard; transformerless electronics; spot erase; accessories include autolocator.

MECHLABOR (Hungary)
Electroimpex, PO Box 296, H-1392 Budapest. Tel: 321330. Telex: 225771.

STM-600 Series: mono, stereo, 2-track; 7½/15 in/s or 3¾/7½ in/s; frequency response ±3 dB 30 Hz to 18 kHz.

3M (USA)
3M Company, 3M Centre, St Paul, MN 55101. Tel: (612) 736-9567. Telex: 297434.
UK: 3M (UK) Ltd, PO Box 1, Bracknell, Berks RG12 1JU. Tel: 0344 26726. Telex: 849371.

M79*: 8-track on 1 in; 7½/15 in/s or 15/30 in/s; frequency response +1/−2 dB 50 Hz to 15 kHz; DC servo capstan and spool motors; Isoloop drive system; 3.9 to 49 in/s varispeed; sync facility.

MOBILE FIDELITY (USA)
Mobile Fidelity Sound, PO Box 2157, Olympic Valley, CA 95730. Tel: (916) 583-2664.

Supermaster: stereo on ½ in; 30 in/s; frequency response ±1 dB 15 Hz to 30 kHz (−3 dB at 50 kHz); record/replay electronics mounted on Studer *A80* transport; electronics completely Class A push-pull with discrete electronics; individually buffered power supplies for each channel; no transformers, phase compensated electronics; electronics may be purchased separately.

NAGRA (Switzerland)
Kudelski SA, CH-1033 Cheseaux-sur-Lausanne. Tel: 021 91.21.21. Telex: 24392.
UK: Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St Peter, Bucks SL9 9UG. Tel: 0753 88447. Telex: 849469.
USA: Nagra Magnetic Recorders Inc, 19 W 44th Street, Room 715, New York, NY 10036. Tel: (212) 840-0999. Telex: 710-581 2443.

IV-S: 2-track plus *Nagrasync* on ¼ in; 3¾, 7½, 15 in/s; frequency response ±1 dB 30 Hz to 20 kHz; portable—mains or battery powered; built-in reference oscillator; NAB or CCIR switchable EQ; variety of options and accessories available including large reel adaptor, mic preamps, and Dolby.
4.2: 1-track plus *Neopilot* on ¼ in; 3¾, 7½ and 15 in/s; frequency response ±1.5 dB 30 Hz to 20 kHz; features similar to *IV-S*.
E: 1-track on ¼ in; 3¾ in/s; frequency response ±2 dB 50 Hz to 15 kHz; mains or battery powered portable derived from *4.2* transport; NAB or CCIR EQ; diagram and spare parts for field maintenance.
SN: 1-track (with or without pilot-tone) on 0.15 in; 1⅞ and 3¾ in/s; frequency response ±2 dB 80 Hz to 15 kHz at 3¾ in/s; miniature battery powered portable; variety of accessories available.
SNS: ½-track; 1⅞ and 15/16 in/s cm/s version of model *SN*.
T-1: 4-channel on ⅛ in; 15/32/15/16/1⅞/3¾/7½/15/30/60 in/s; frequency response direct module (AM) 40 dB S/N 150 Hz to 60 kHz, FM module from DC in all cases 46 dB to 5 kHz. *T-1* is an instrument recorder designed to operate to the IRIG intermediate band specification; twin capstan drive; built-in autolocator; search to zero; plug-in channel amps for AM or FM recording switchable constant amplitude/linear phase.
T-Audio: based on the *T1* instrument recorder; 2- or 4-track on ¼ in; 3¾/7½/15/30 in/s; frequency response ±1 dB 30 Hz to 20 kHz; twin capstan drive; detachable remote and search-to-zero; accepts 12 in spools.
T-RVR: 1- or 2-track plus timecode track on ¼ in; 15/16/1⅞/3¾/7½ in/s; frequency response 58 dB S/N 170 Hz to 15 kHz at 3¾ in/s; rack mounting logging recorder; high speed search facility on playback ×4 or ×16; power required 20 to 30 V DC. Accessories include second track; timecode track; timecode generator with master clock to IRIG B standard; continuous self-check circuit; time corrector ×0.5 to ×2 with pitch alteration.
IS: full track plus optional *Neopilot* on 3¾/7½ in/s; frequency response ±2 dB at −20 dB 50 Hz to 15 kHz; mains or battery powered portable; capstan motor controlled with tachometric speed stabiliser, reel motors electronically controlled by tension arms; phantom powering; two mic inputs; high impedance line input; selection or metering; NAB or CCIR EQ.

OTARI (Japan)
Otari Electric Co, Otari Bldg 4-29-18 Minami, Ogikubo, Suginamiku, Tokyo. Tel: 03 333-9631. Telex: 26604.
USA: Otari Corp, 2 Davis Drive, Belmont, CA 94002. Tel: (415) 592-8311.
UK: Otari Electric (UK) Ltd, Herschel Industrial Centre, Church Street, Slough, Berks SL1 1EL. Tel: 0753 38261. Telex: 849453.

MX 5050B-II: 2-track on ¼ in; 3¾/7½ in/s or 7½/15 in/s; frequency response ±2 dB 30 Hz to 20 kHz; 4-band option-erase; ½-track record and replay, plus ¼-track replay; sync facility; DC servo capstan with variable speed.
MX-5050 BQII: 4-track on ¼ in; 7½/15 in/s; ±2 dB 30 Hz to 20 kHz; DC servo capstan with ±7% varispeed; NAB or IEC EQ: interface for dbx or Dolby; separate transport and electronics module; plug-in head assembly.
MX-5050-Mk III-8: 8-track on ½ in; 7½/15 in/s; similar to *MX-5050-BQII*.
MX-7800: 8-track on 1 in; 7½/15, 15/30 in/s; frequency response ±2 dB 30 Hz to 18 kHz; NAB EQ; DC servo capstan drive ±12% varispeed; head lifter defeat for cueing; plug-in heads.
MTR-10: 2-track on ¼ in, 4-track on ½ in; 3¾/7½/15 in/s or 7½/15/30 in/s; frequency response ±2 dB 30 Hz to 20 kHz; switchable NAB/IEC/AES EQ; DC PLL servo tape transport; microprocessor based; hinged top deckplate; adjustable phase compensation; bias, record and playback levels; integral multi-frequency square/sinewave generator; return to zero. A version for ½ in 2-track use has been recently introduced where the LF head response has been optimised for 30 in/s.
MTR-90-II*: 8-track on 1 in; floor standing unit; will take NAB reels up to 14 in diameter; pinch rollerless direct drive capstan with ±20% varispeed; servo controlled reel motors; 15/30 in/s speeds; full sync capability; 6-digit time display; switchable NAB/IEC EQ.

PHILIPS (Netherlands)
Philips Industries, Eindhoven, Netherlands. Tel: 040 72.33.31. Telex: 51121.
UK: Philips Electrical Ltd, City House, 420-430 London Road, Croydon, Surrey CR9 3QR. Tel: 01-689 2166.
USA: Philips Audio Video Corp, 91 McKee Drive, Mahwah, NJ 07430. Tel: (201) 529-3800.

N4520: 2-track on ¼ in; 3¾/7½/15 in/s; frequency response ±2 dB 30 Hz to 26 kHz; NAB or IEC EQ; quartz locked direct drive.

SCULLY (USA)
Ampro/Scully, Newton Yardley Road, Newton, PA 18940. Tel: (215) 968-9000.
UK: Lee Engineering Ltd. Napier House, Bridge Street, Walton-on-Thames, Surrey KT12 1AP. Tel: 09322 43124. Telex: 928475.

280B Series: full, ½-, 2- and 4-track on ¼ in, 4-track on ½ in and 8-track on 1 in; 3¾/7½/15/30 in/s; frequency response: ±2 dB 60 Hz to 20 kHz at 30 in/s; DC servo or AC capstan; ±20% varispeed; remote control and Varisync options; *284B Series* accepts 14 in reels.
250: 1- or 2-track on ¼ in; 3¾/7½, 7½/15 in/s; ±2 dB 50 Hz to 18 kHz; hysteresis synchronous direct drive capstan.
255: 3¾/7½ in/s replay only version of *250* for broadcast use.

SONY (Japan)
UK: Sony UK Ltd, Pyrene House, Sunbury-on-Thames, Middlesex TW16 7AT. Tel: 09327 89581/876441. Telex: 266371.
USA: Sony Corporation of America, 9W 57th Street, New York, NY 10019. Tel. (212) 371-5800.

TC766-2: 2-track on ¼ in; 7½/15 in/s; frequency response ±3 dB 30 Hz to 22 kHz; closed loop dual-capstan drive with AC servo control; four heads including ¼-track playback.
TC765: ¼-track version of *TC766-2*.
TC880-2: 2-track on ¼ in; 7½/15 in/s; frequency response ±3 dB 25 Hz to 35 kHz; similar to *TC766-2* plus 'optical monitoring' with switchable VU; PPM or peak hold; calibrated input and output controls; varispeed.
TC510-2: 2-track on ¼ in; 3¾/7½ in/s; frequency response ±3 dB 30 Hz to 20 kHz at 7½ in/s; battery or mains powered portable; stop, record and playback on 3-position click-stop switch; varispeed.

SOUNDCRAFT (UK)
Soundcraft Magnetics Ltd, 5-8 Great Sutton Street, London EC1V 0BX. Phone: 01-253 9878. Telex: 21198.
USA: Soundcraft Inc, PO Box 2023, Kalamazoo, MI 49003. Tel: (616) 382-6300. Telex: 224408.

SCM381-8*: 8-track on 1 in; 15 in/s; varispeed +15/−50%; frequency response +1/−2 dB 30 Hz to 20 kHz; NAB EQ; removable front panel for remote control; capstan drives outside of tape; jack or multipin connectors; sync output.

STELLAVOX (Switzerland)
Stellavox, CH-2068 Hauterive/NE. Tel: 038 33.42.33. Telex: 35380.
UK: Future Film Developments, 36-38 Lexington Street, London W1V 3LE. Tel: 01-437 1892. Telex: 21624.
USA: ADB Alnaco, 6630 Tailor Road, Box 108, Blacklick (Columbus), OH.

SM8/SQ7: 2-track *(SM8)* and 4-track *(SQ7)* on ¼ in; 7½ and 15 in/s; frequency response ±2 dB 20 Hz to 28 kHz; battery or mains powered portable; built-in loudspeaker; twin PPM or VU metering; single transport control; mic/line inputs; 12/48 V mic powering; mic attenuators.

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product guide
Tape recorders up to 8-track

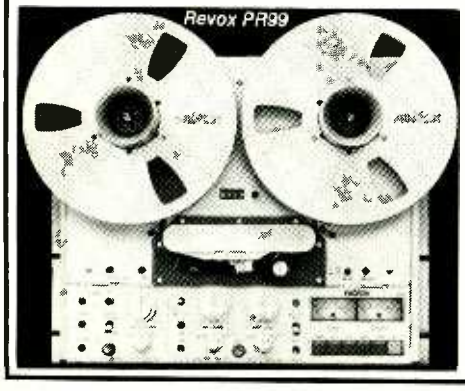
SP8: 1- or 2-track on ¼ in; 3¾, 7½ and 15 in/s; plug-in headblocks; frequency response ±2 dB 30 Hz to 18 kHz in stereo mode at 7½ in/s; similar to *SM8* with 50/60 Hz pilot generator and cue track playback amp or synchroniser; EBU time code recording option also available.
TD88: 1-track (optional *Neopilot*) or 2-track (optional *Synchrotone*) on ¼ in, 2-, 4- or 8-track on ½ in and *Perfotape* for 16 mm magnetic tape; 1⅞, 3¾, 7½, 15 and 30 in/s plus 24 and 25 frame/s; interchangeable headblocks; varispeed option; plug-in head/electronics units.

STEPHENS (USA)
Stephens Electronics Inc, 3513 Pacific Avenue, Burbank, CA 91505. Tel: (213) 842-5116.

Capstanless Multitrack*: 4-track on ½ in, 8-track on 1 in; 15/30 in/s, plus 60 in/s scan; capstanless tape transport system utilising servo-operated supply and take-up motors coupled with motion sensing; integral VSO system provides 10 to 80 in/s varispeed; reels may be of differing sizes (and may be interchanged) as self-adjusting electronics 'guarantee proper tape tension'; optional self-contained 12 V battery pack providing over four hours of recording time; sync lock for vertical sync pulse or 60 Hz on tape; various remote control units and *Q11* autolocator containing 10 memory locations available as extras. Standard deck is mounted in a custom built wooden cabinet. Portable cases are available on request. *Model 811D* electronics (4-, 8- and 16-track) features separate rotary channel-select switches for record/ready/sync selection.

STUDER/REVOX (Switzerland)
Studer International AG, Althardstrasse 150, CH-8105 Regensdorf. Tel: 01 840.29.60. Telex: 58489.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Tel: 01-953 0091. Telex: 27502.
USA: Studer Revox America Inc, 1425 Elm Hill Pike, Nashville, TN 37210. Tel: (615) 254-5651. Telex: 554453.

B67 Mk II: 1- or 2-track on ¼ in; 3¾/7½/15 in/s or 7½/15/30 in/s; frequency response ±1 dB 60 Hz to 15 kHz; varispeed and 'fader-start' options: NAB or CCIR EQ on plug-in cards; sync facility; tape dumping (motor off); accepts 11 in tape pancakes.
A80/RC: 1- or 2-track on ¼ in; 3¾/7½ in/s, 7½/15 in/s, 15/30 in/s; frequency response ±1 dB 60 Hz to 15 kHz; remote control and varispeed options; NAB or CCIR EQ on plug-in cards; variable spooling in edit mode; electronic tape timer plus 'zero locator'.
A700: 2-track (½- or ¼-track) on ¼ in; 3¾/7½/15 in/s; frequency response ±1.5 dB 50 Hz to 18 kHz; crystal-controlled capstan; four mic inputs plus mixing slide sync; varispeed and remote control as options.
B77: 2-track (½- or ¼-track) on ¼ in; 3¾/7½ in/s or 7½/15 in/s; frequency response +2/-3 dB 30 Hz to 20 kHz at 7½ in/s; self-sync; slide sync, varispeed and remote control option.
B77 Special Versions: There are almost 70 variants of the *B77*, 2-track or ¼-track; standard 3¾/7½ in/s, high speed 7½/15 in/s in NAB or IEC, low speed 1⅞/3¾ in/s, super low speed 15/16/1⅞ in/s; dissolve head amp for analogue control signals; dia-synchro for impulse type signals; free head for external electroncs; autostart with variable threshold separately adjustable for each channel; self-sync with separate sync amp and monitoring facilities; and Dolby-B.



PR99 Series: 2-track on ¼ in; 3¾/7½ in/s and 7½/15 in/s; frequency response ±1.5 dB 50 Hz to 18 kHz; NAB EQ: fader start facilities; tape dump mode; balanced *XLR* inputs and outputs; optional balanced mic input; self sync and editing facilities; calibrated/uncal operation; optional seven semitone varispeed; designed for the multiple needs of the broadcast studio.
A80/VU MkII: 1-/2-/4-track on ¼ or ½ in, 4- or 8-track on ½ or 1 in; 7½/15 in/s, 15/30 in/s; frequency response ±2 dB 30 Hz to 18 kHz; CCIR or NAB EQ; similar to *A801RC*; prewired for autolocator; comprehensive remote control and varispeed; full selsync on all channels; variable spooling in 'edit' mode; amp functions may be remote controlled; pivoting transport; available in console or transport plus electronics module. *TLS2000* tape lock system can be used to synchronise two machines to an accuracy of ± 100 μs, with a lock-up time of about 3s.
A800*: 8-track on 1 in; 7½/15 in/s, 15/30 in/s; frequency response ±2 dB 30 Hz to 20 kHz, microprocessor controlled; electronic or manual edciting; master NAB/CCIR switching; master bias setting; digital timer in realtime; zero locator; address locator; optional *Tapelock* synchroniser; varispeed; complex metering and monitoring electronically switched.
A810: Full track, stereo 2-track and 2-track with timecode versions; 7½/15 or 15/30 in/s; NAB or CCIR EQ.

TANDBERG (Norway)
Tandberg A/S, Fetveien 1, PO Box 53, N-2007 Kjeller.
UK: Tandberg (UK) Ltd, Unit 1, Revie Road Industrial Estate, Elland Road, Leeds LS11 8JG, West Yorkshire. Tel: 0532 774844. Telex: 557611.
USA: Tandberg of America Inc, Labriola Court, Armonk, NY 10504. Tel: (914) 273-9150. Telex: 137357.

TD20A: 2-track (½- or ¼-track) on ¼ in; ¼-track 3¾/7½ in/s, ½- and ¼-track, 7½/15 in/s; frequency response ±2 dB 20 Hz to 30 kHz; phase correction network; selsync; front panel bias; optional infra-red remote control; 4-motor drive; reel tension switch; mic attenuators. Also *AP* version playback only.
TD20A-SE: similar to *TD20A* but features special equalisation capability (in addition to NAB/IEC) which reduces tape noise to – 80 dB at 15 in/s. Also features *Dyneq* dynamic equalisation amplifiers which automatically adjust HF gain on record to avoid overloading. Both machines use *Actilinear* circuitry in signal handling.

TEAC/TASCAM (Japan)
UK: Harman (Audio) UK Ltd, Mill Street, Slough SL2 5DD, Berks. Tel: 0753 76911. Telex: 849069.
USA: Teac Corp of America, 7733 Telegraph Road, Montebello, CA 90640. Tel: (213) 726-0303. Telex: 677014.

22-2: 2-track on ¼ in; 7½/15 in/s; frequency response ±3 dB 0VU 40 Hz to 22 kHz; NAB EQ: accepts 7 in spools; optional dbx.
22-4: 4-track on ¼ in; 7½/15 in/s; pitch control ±6%; frequency response ±3 dB 0VU 40 Hz to 22 kHz; NAB EQ; accepts 7 in spools; optional dbx.
44: 4-track on ¼ in; 7½/15 in/s; frequency response ±3 dB 0VU 40 Hz to 22 kHz; ±6% varispeed; NAB EQ; accepts 10½ in NAB reels; synchronous capstan drive.
32-2B: 2-track on ¼ in; 7½/15 in/s; frequency response ±3 dB 0 VU 40 Hz to 20 kHz; selectable EQ; closed loop transport system; varispeed; 2-position bias and EQ.
Series 30: range of three machines with similar facilities but differing head configuration; 32, 34 4-track on ¼ in and the 38 8-track on ½ in tape; all machines 10½ in reel capacity with 7½ and 15 in/s except 38 with 15 in/s only; return to zero facility and range of options.
Series 50: 52 2-track on ¼ in and 58 8-track on ½ in; all transport motors under servo control and capable of SMPTE compatibility; 58 is 15 in/s with IEC EQ, 52 7½ and 15 in/s NAB or IEC EQ. (See review this issue).

TECHNICS (Japan)
UK: National Panasonic Ltd, 308-318 Bath Road, Slough SL1 6JB, Berks. Tel: 0753 34522. Telex: 847652.
USA: Panasonic Co, 1 Panasonic Way, Secaucus, NJ 07094. Tel: (201) 348-7000. Telex: 710-992 8996.

RS1500US: 2-track on ¼ in; 3¾/7½/15 in/s; frequency response ±3 dB 30 Hz to 30 kHz; isolated loop tape path; DC servo-controlled capstan; 4-head including ¼-track playback; mic/line inputs; 3-way bias and EQ selection; remote control and battery adaptor (24 V DC) options.
RS1700: similar to *RS1500* but auto reverse.
RS1800: 2-track; 30 in/s; frequency response—10 dB 30 Hz to 35 kHz; auto play, auto repeat, etc.

TECHNICOBEL (France)
Technicobel, 8 rue de la Croix-Matre, BP26, F-91122 Palaiseau Cedex. Tel: (1) 920.80.39. Telex: 692543.

MGB 60: 1- or 2-track on ¼ in; 7½/15 in/s standard, 3¾/7½ in/s and 15/30 in/s to order; frequency response ±2 dB 30 Hz to 18 kHz; servo-controlled DC spooling motors; constant tape tension for all tape sizes; twin servo-controlled DC capstans with built-in varispeed; variable spooling speed.

TELEFUNKEN (West Germany)
AEG-Telefunken, Postfach 2154, D-7750, Konstanz. Tel: 07531 862460. Telex: 733233.
UK: Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St Peter, Bucks SL9 9UG. Tel: 0753 88447. Telex: 849469.
USA: Gotham Audio Corp, 741 Washington Steet, New York, NY 10014. Tel: (212) 741-7411. Telex: 129269.

M15A*: 1- or 2-track (optional pilot tone or time code) on ¼ in, 4-track on ½ in, 8-track on 1 in; 7½/15 in/s, 15/30 in/s; frequency response ±1 dB 60 Hz to 15 kHz; autolocator with nine locations; varispeed; tuned record and bias switching for gapless click-free drop-in; interchangeable headblocks and modular electronics.
M124: 1- or 2-track (optional pilot tone) on ¼ in; 3¾/7½ in/s, 7½/15 in/s; frequency response ±1.5 dB 30 Hz to 16 kHz; horizontal or vertical operation; interchangeable headblocks.
M21: mono, stereo and 2-track on ¼ in with tape speeds of 3¾/7½/15/30 in/s; 12½ in reel capacity; compact design with rack mount capability. Microprocessor controlled operation. ±10% varispeed, 5-digit counter, return to cue facilities.
Telex Magnecord 3000 series

TELEX (USA)
Telex Communications Inc, 9600 Aldrich Avenue South, Minneapolis, MN 55420. Tel: (612) 884-4051. Telex: 297053.
UK: Avcom Systems Ltd, Newton Works, Stanlake Mews, London W12 7HA. Tel: 01-749 2201. Telex: 897749.

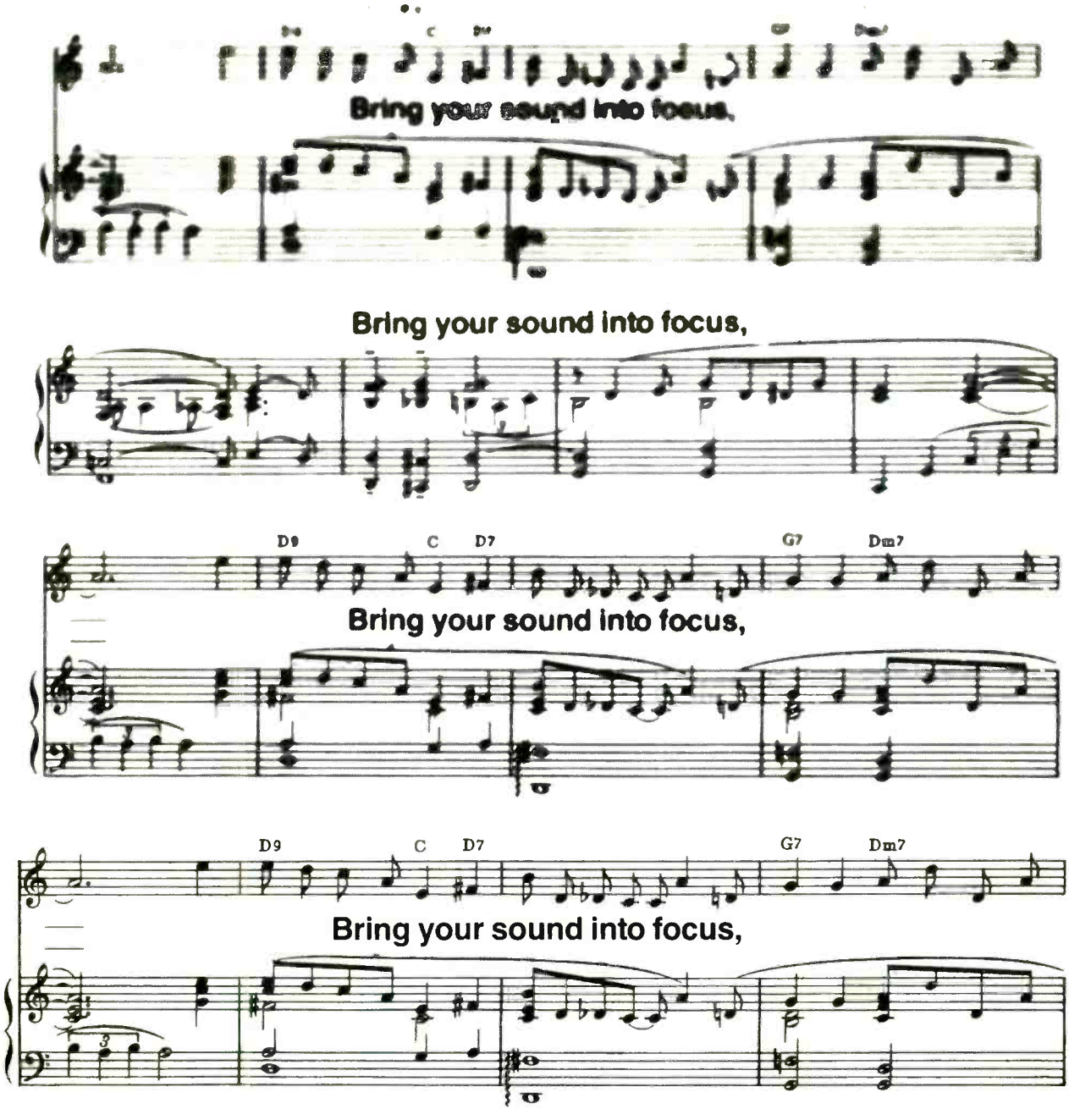
1400 Series: 1- or 2-track on ¼ in; 3¾/7½/15 in/s; frequency response ±2 dB 35 Hz to 22 kHz; DC servo capstan.
230: series of heavy duty tape transports, 2-speeds, three motors suitable for remote controlled or automatic operation. Available in a wide variety of formats including *230L* version as a logging recorder.
3000 Series: 1-, 2- or 4-track on ¼ in tape transports including amps, cables and rack mount adaptor; speeds 3¾/7½ in/s or 7½/15 in/s. Features include automatic cycling, automatic cue release and transformer isolated CMOS logic controls.

TTS (West Germany)
TTS-Electronics GmbH, Dammuhlenweg 4, D-6270 Ildstein. Tel: 61 26 2014. Telex: 4182297.

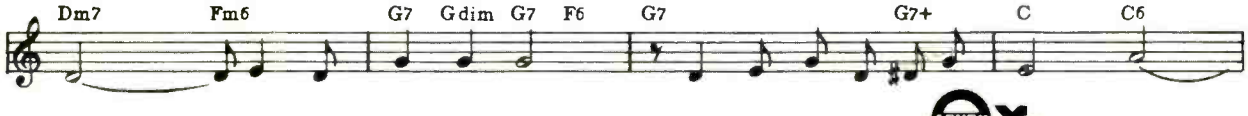
PR-8: 8-track on ½ in; 15 in/s (optional 7½ in/s); IEC EQ (NAB option); uses Studer transport and incorporates *High-Com* noise reduction.

UHER (West Germany)
Uher Werke Munchen, Barmseestrasse 11, D-8000, München 17. Tel: 089 78721. Telex: 0522932.
UK: Uher Sales and Services Ltd, 30-31 Lyme Street, London NW1. Tel: 01-485 0943/4.

SG630: 2-track (½- or ¼-track) on ¼ in; 1⅞/3¾/7½ in/s; frequency response 20 Hz to 25 kHz at 7½ in/s, 4-motor *Omega Drive* without pinch roller interchangeable heads. *4000/4400/C*: ½-track mono (*4000/C*), ½-track stereo (*4200/C*) and ¼-track stereo (*4400/C*) on ¼ in; 15/16/1⅞/3¾/7½ in/s; frequency response 30 Hz to 20 kHz at 7½ in/s; battery or mains powered portables; built-in monitor loudspeakers.
1200 Synchro: 1-track plus *Neopilot* on ¼ in; 7½ in/s frequency response ±1 dB 60 Hz to 12.5 kHz; connects to *W352* unit, comprising a pilot-frequency amp, resolver and running-time moderator for frame-synchronisation. ■



Aphex II



Available in the U.K. through:
AKG Acoustics, Ltd.

Aphex Systems, Ltd.
7801 Melrose
Los Angeles, CA 90046
(213) 655-1411
TWX: 910-321-5762

Tascam 58

MANUFACTURER'S SPECIFICATION

Tape: ½ in, 1.5 mil, low noise, high output tape.
Track format: 8-track, 8-channel, track width 0.039 in (1.0 mm).
Reel size: 10½ in (large) hub.
Tape speed: 15 in/s (38 cm/s).
Speed accuracy: ± 0.5% deviation.
Pitch control: fine ± 0.7%, coarse ± 15%.
Wow and flutter: ± 0.08% peak (DIN/IEC/ANSI weighted); ± 0.12% peak (DIN/IEC/ANSI unweighted); 0.04% RMS (JIS/NAB weighted); 0.07% RMS (JIS/NAB unweighted).
Fast wind time: 120 s for 10½ in reel, 2,400 ft.
Spooling wind time: 370 s for 10½ in reel, 2,400 ft.
Start time: > 0.8 s to reach standard wow and flutter.
Tape drive system: capstan motor FG (frequency generator), DC, direct drive motor. Reel motors—slotless DC motors.
Head configuration: three heads—erase, record and reproduce x2.
Tape cue: manual and automatic (RTZ and STC).
Motion sensing: 0.5 s ± 0.15 s delay time stop to next motion, tension sensing servo system.
Mounting: standard 19 in rack with optional RM-500.
Remote control: full/basic functions available with optional RC-51/RC-50.
Dimensions: 432 × 505 × 316 mm (whd) (17 × 19⅞ × 12 7/16 in.
Weight: 35 kg (77 3/16 lb).
Line input: impedance 50 kΩ unbalanced; maximum source impedance 2.5 kΩ; nominal input level —10 dBV (0.3 V); maximum input level + 19 dBV (8.9 V).
Line output: impedance 500 Ω unbalanced; minimum load impedance 10 kΩ; nominal load impedance 50 kΩ; nominal output level —10 dBV (0.3 V); maximum output level + 19 dBV (8.9 V).
Bias frequency: 150 kHz.
Equalisation: infinity + 35 μs IEC standard.
Record level calibration. 0 VU reference—250 nWb/m tape flux level.
Frequency response: record/reproduce 40 Hz to 20 kHz, ± 3 dB at 0 VU; 40 Hz to 20 kHz, ± 3 dB at —10 VU; sync and reproduce 40 Hz to 20 kHz, ± 3 dB.
Total harmonic distortion: 0.8% at 0 VU, 1 kHz, 250 nWb/m; 3% at 12 dB above 0 VU, 1,000 nWb/m.
Signal-to-noise ratio: at a reference of 1 kHz, at 12 dB above 0 VU, 1,000 nWb/m —69 dB A-weighted (NAB), 62 dB unweighted; 107 dB A-weighted (NAB) with dbx; 100 dB unweighted with dbx.
Adjacent channel crosstalk (overall): better than 50 dB down at 1 kHz, 0 VU.
Erasure: better than 70 dB at 1 kHz, + 10 VU reference.
Headroom: record amplifier better than 26 dB above 0 VU at 1 kHz. Reproduce amplifier better than 44 dB above 0 VU at 1 kHz.
Connectors: line inputs and outputs—RCA jacks; remote control, accessory (ext sync) and dbx unit (control signal) multi-pin type connector.
Power requirements: 100/120/220/240 VAC, 50/60 Hz, 180 W for general export model.
Manufacturer: Teac Corporation, 3-7-3 Naka-cho, Musashino, Tokyo, Japan.
UK: Harman (Audio) UK Ltd, Mill Street, Slough, Berkshire SL2 5DD.
USA: Teac Corporation of America, 7733 Telegraph Road, Montebello, CA 90640.

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HES
electronics

12 x 4 AUDIO CROSSPOINT SYSTEM

The ACS AUDIO CROSSPOINT SYSTEM is a 12 x 4 audio switcher built into a 1U x 19" case, designed for applications requiring only a limited number of crosspoints. It can be operated in mono or stereo configurations, and two units can be linked together to double the capacity. Each unit uses a dedicated micro-processor which can be controlled in a variety of ways, including simple push-button selection.

Technical specifications:

electronically balanced inpuf
electronically balanced output (with transformer option)
max. output level ..... +22dBm into 300Ω
distortion ..... 0,1% at +20dBm
crosstalk ..... better than 100dB
signal to noise ..... better than 90dB

HES
electronics

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Spring Reverbs are notorious for the odd sounds that they tend to produce. Many manufacturers have tried to remedy this with limiters, equalisers and the like. In the design of 'The Great British Spring' we took a different approach. We started out with a custom spring unit that sounds good without any fancy electronics. The unit simply has a variable line input and a stereo output.

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0582 26693

THE Tascam *58* is an 8-track machine using ½ in tape with a capacity for 10½ in NAB spools running at the single tape speed of 15 in/s. Equipped with four feet at the back and also on the bottom, the machine may be used horizontally or vertically and being 17 in wide can be easily mounted into a standard 19 in rack with the optional adaptor.

At the back of the machine is the fixed power cord, a slide switch for using external speed control and two multipole sockets. One of these is used for remote control and the other for 'accessory' connection. The audio inputs and outputs take the form of phono sockets at the bottom of the rear panel.

To the front, the spool motor shafts are fitted with very good NAB spool hold-downs which positively clamp the spools with a single twist of the outer knob. From the spools the tape passes to spring-loaded guides, the positions of which are sensed optically, the guides each being twin ball bearings.

On the payoff side there is then a large diameter roller guide equipped with an optical tachometer disc for the tape timer etc. There follows the headblock which consists of an alloy plate to which the three heads are attached, the individual heads being fitted with DIL plugs which fit into sockets on a small printed circuit which itself is attached to the head plate. Removal of the head plate for replacing heads is relatively easy, but there is no plug-in headblock as such. At the entrance to the head plate is a fixed guide post before the staggered ferrite erase head. Following the erase head is a further fixed guide, the metal record/sync head, a flutter roller, the metal replay head and a final fixed guide post. I don't know the history of the review machine but as received, the heads, guides and the two metal tape lifter pins were covered with a sticky black deposit.

From the head area the tape passes over the 7.801 mm diameter capstan onto which it is pressed by a large diameter pinch roller driven by the common solenoid-operated arm. The head area is fitted with a hinged cover with a pop-up headshield giving good access to the heads for editing.

To the left of the head area is the pushbutton power switch and a manual tape lifter defeat lever which operates in the fast modes and does not lock in position. Also in this area is a push-button with a warning LED for engaging variable speed operation in the replay or record modes, the speed being controlled by two slide potentiometers, one coarse and one for fine control.

To the right of the head area are the normal tape transport controls which appeared to take the form of Hall effect switches, the record function being interlocked with the replay button when entering the record mode. The record button has a nearby red LED which flashes when the record mode is entered without any tracks set to record, but becomes steady when any track is actually in record.

A green LED by the fast buttons is associated with a very nice feature. If a fast wind button is pressed once, the machine enters the common fast wind mode which itself is not excessively fast. However, pressing the fast button a second time enters a constant and reduced speed fast wind mode and illuminates the green LED.

Two further coloured buttons in this area with warning LEDs are the edit button and the pause button. Pressing the edit button releases the brakes and allows rock and roll editing, no dump edit being provided with the edit mode being abandoned if any other mode is selected. The pause button may be used to pause when already in the record or replay modes but cannot be preset such that replay or record must be entered before using the pause function—I regard this as an undesirable interlock.

Above the tape movement controls is the tape timer reading in minutes and seconds up to ±99 min 59 sec associated with which are four buttons operating Hall effect switches. One button resets the tape timer to zero, a second button initiates a search to zero function at the fast wind speed. Of the remaining buttons one allows a cue time to be stored whilst the tape is in motion with the second button initiating a fast search to cue.

Beneath the tape transport section is the signal routing section to the right of which is a splicing block with 90° and 45° angles and to the left of which is a locking remote/local pushbutton with a warning LED.

To the right are three interlocked master output select buttons which select input, sync or reproduce with red, yellow and green warning LEDs.

Individual track selection is by two rows of eight locking pushbuttons, one row for record on/off and the other for input/sync. Each record button has a nearby red LED which flashes in the record ready setting and becomes steadily illuminated when record is entered either by preselecting tracks and using the master record button or by already setting the master record function and subsequently entering individual tracks into record.

Each input/sync button also has an associated LED which is illuminated yellow when a track is set to sync. When a track is in record ready and the machine set to master sync, the individual track sync button allows the output to be derived from the input or from sync until the master record is pressed when the output automatically switches to the input.

At the bottom of the unit are the eight illuminated VU meters each of which contains a red peak indicator LED. Removal of four non-captive Allen screws allows the VU meter to be hinged down on two rather flimsy hinges to give access to the audio electronics. These consist of a master oscillator board and a single audio board for each track, all the boards being fitted with sockets which plug into a mother board. Each board has a very clean layout with clear component identifications but the alignment controls could be better identified.

At the front of each board are eight potentiometers for setting record, reproduce and sync levels and equalisation plus a low frequency equalisation control and a bias control. Further back on the boards, but accessible from the front, are potentiometers for setting input level, the VU meters and the peak indicators.

The tape transport electronics are located on various boards within the unit behind the tape transport, all the boards being of good quality and with few exceptions all the connections being socketed.

The tape transport itself is based on a 5 mm thick alloy plate which appeared to be punched, rather than machined, to accept the various tape transport components. The reel motors mount behind the transport plate with the band brakes above the transport plate. Also mounted behind the transport plate is the capstan motor with its magnetic tachometer. The remaining transport components reference to the top of the transport plate with the complete unit being reasonably substantial with generally a good standard of finish.

Attached to the transport plate are alloy mouldings which in turn are fitted to the sheet steel sides, top and bottom, which support the electronics.

Tape handling was generally very good with the machine running at a constant 100 g tension (suitable for standard play or long play tape) except when accelerating. Using Ampex 456 or BASF SPR 50 tape the quality of winding was reasonable in the fast modes and generally good in the constant speed wind mode of 90 in/s.

The interlocking of the tape movement functions was excellent with the search functions arriving smoothly at the search points with the minimum of hunting and the machine reducing speed as the search point approached. In the event of power failure the tape came to a steady halt and on tape runout the machine stopped within a reasonable time.

Inputs and outputs

The impedance of the unbalanced inputs was found to be constant with gain at 54 kΩ with the sensitivity as received being −7 dBm to record a fluxivity of 320 nWb/m on Ampex 456 tape corresponding to +1.5 VU. Altering the input level allowed 0 VU to correspond to −10 dBm upwards with the record level control allowing the gain to be increased by 10 dB, the inputs being capable of handling in excess of +22 dBm.

At the unbalanced outputs the source

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AKG
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The AKG 567 is a professional omnidirectional miniature condenser microphone of exceptionally rugged construction and excellent acoustic qualities. Because it is small, it is perfectly suited for use by singers, speakers and interviewers and also as an instrument-mounted pick-up for the violin, piano, flute, saxophone and acoustic guitar.

The C567 is supplied complete with tie-pin and clip, for attachment to clothes and instruments, allowing completely free movement by the user, whilst maintaining a constant working distance.

All in all, the C567 is a little masterpiece.

Technical Data:

Directional characteristic: omni-directional

Frequency range: 20-20,000 Hz

Sensitivity: 6 mV/Pa ≙ 0,6 mV/μbar (–64.5 dBV, no-load operation at 1,000 Hz)

Electrical impedance: 200 ohms ± 20% balanced

Max. sound pressure level (for 1,000 Hz and 500 ohms load impedance, harmonic distortion k = 1%): 80 Pa ≙ 132 dBSPL

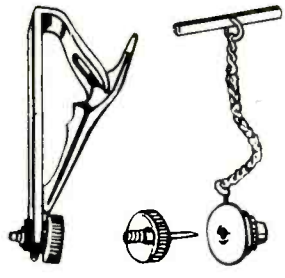
Connector type: 3-pin standard XLR-type connector
pin 1: ground
pin 2: audio (inphase)
pin 3: audio (return)

Dimensions:
11 Ø 24 mm (microphone)
7/16" Ø x 1"
21 Ø x 80 mm (output-module)
13/16" Ø x 3-3/16"

Cable length: 1,3 m (≈ 4 ft)

Weight: 9 g (microphone only) – 0.35 oz approx. 100 g net (microphone + output module) – 3.5 oz

Included accessories:
Wire-mesh windscreen W37
Tie pin H 20
Universal clip H 21
Belt clip H 16



AKG

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impedance was on the high side at 570 Ω with a drive capability of +21 dB.7V into 10 k Ω or greater or +14 dBm into 600Ω.

In the sync or replay modes as delivered, a fluxivity of 320 nWb/m corresponded to −7 dBm and +1.5 VU with the range of adjustment being such that a fluxivity of 320 nWb/m could provide a maximum output of 0 dB.7V.

Frequency response

The replay equalisation was found to be to the CCIR 35 μs standard with the individual replay channels being accurately aligned to within +1, −0.5 dB from 63 Hz to 20 kHz as determined with a calibration tape.

Using Ampex *456* tape over-biased 3.5 dB at 10 kHz, the overall frequency response in the record/replay mode was typically as shown in **Fig 1** which could be bettered, with the −1 dB point at 20 kHz falling to −3 dB at 31.7 kHz.

In view of the use of identical record and replay heads the potential sync frequency response was identical to the record/replay response. In the input mode the frequency response from the inputs to the outputs was as shown in **Fig 2** with the −1 dB points at 6.5 Hz and 22 kHz.

Whilst the bias control could offer enough bias for any current tapes the minimum available bias was only just able to peak at 10 kHz with Ampex *456* tape and might make biasing difficult with low bias tapes. Further, the record equaliser had an extremely restricted range as shown in **Fig 3.**

The range of the low frequency equaliser which is common to the replay and sync modes is shown to be sensible in **Fig 4**, which also shows the sensible range of a high frequency replay equaliser, the sync high frequency equalisers having the same range.

Distortion

A selection of tracks were investigated for harmonic distortion at the reference fluxivity of 320 nWb/m, 0 VU and the 3% third harmonic maximum output level at 1 kHz giving the results shown in **Table 1.**

The second harmonic content at the lower levels remained very low, but at the MOL it varied widely from track to track but remained below 0.3%. In the direct input to output mode the harmonic distortion remained below 0.03% at all levels below clipping. The recording and reproduction of a 1 kHz square wave is shown in **Fig 5** demonstrating only a mild overshoot.

Noise

Noise was measured in several outputs and found to be entirely consistent from track to track with noise in the sync mode being identical to that in the replay mode with no significant hum or other tones in the outputs with or without the head shield in position.

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FIG 5

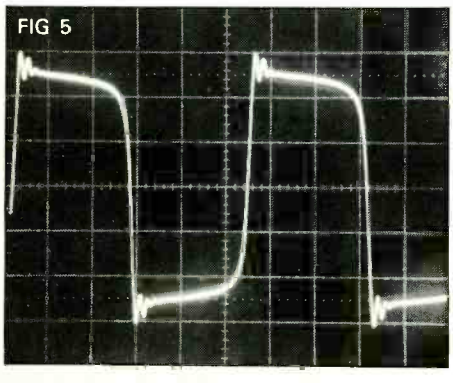


FIG.1
TASCAM 58
FREQUENCY RESPONSE
IN RECORD/REPLAY
MODE

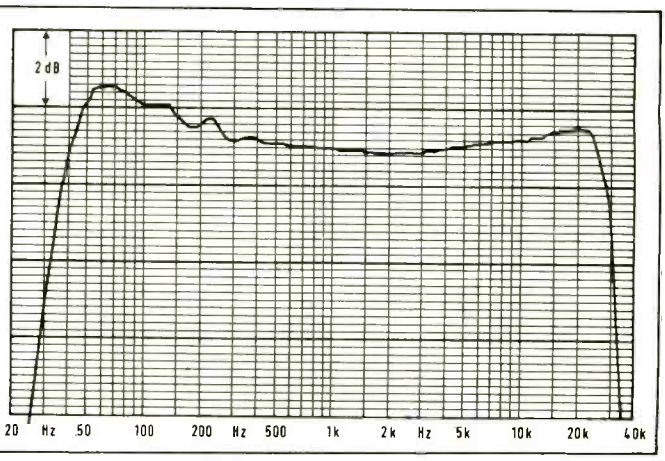


FIG. 2 TASCAM 58 FREQUENCY RESPONSE INPUT MODE

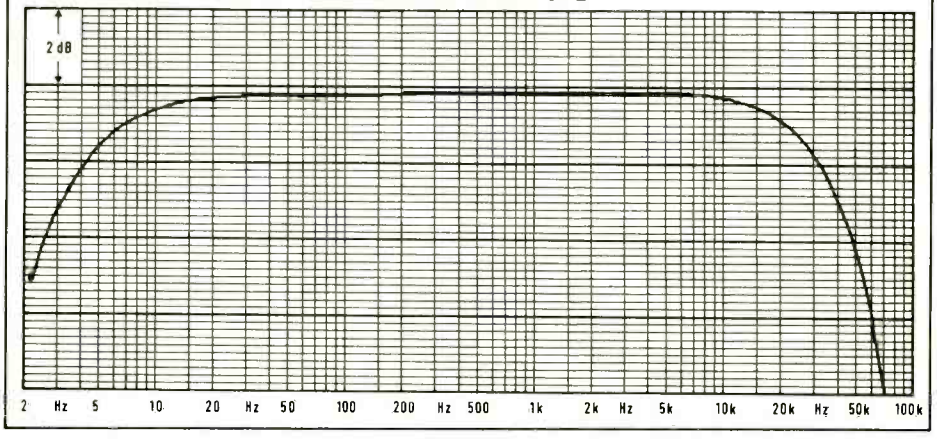


FIG.3
TASCAM 58
RECORD EQUALISER

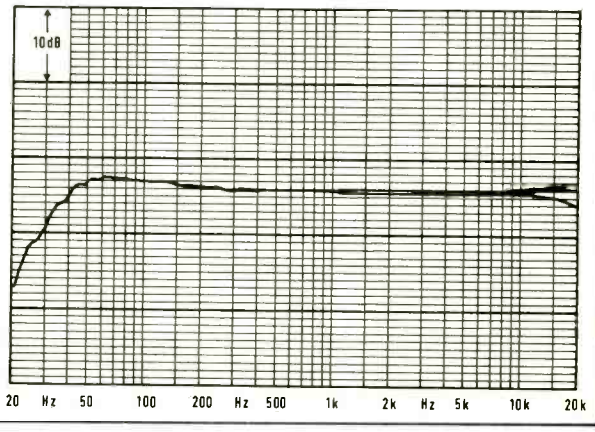


FIG.4
TASCAM 58
REPLAY/SYNC EQUALISERS

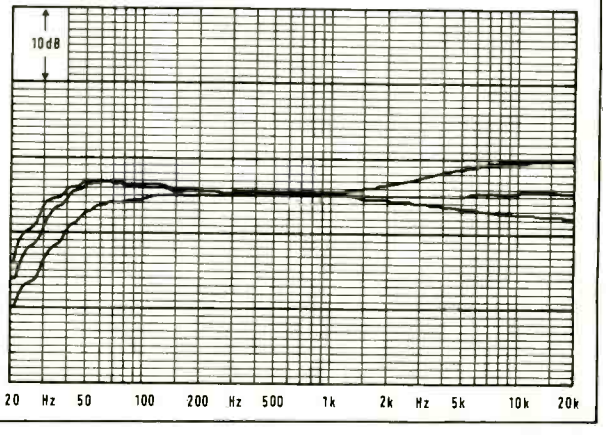


Table 2 shows noise referred to a fluxivity of 320 nWb/m for the machine only, and the machine with machine erased Ampex *456* tape.

The above shows a good margin between machine and tape noise under all measurement conditions, the dynamic range being obtained by adding the MOL of +11 dB to the above figures with Ampex *456* tape. With the outputs selected from the inputs all forms of noise were negligible compared with machine replay noise.

Wow, flutter and speed

Wow and flutter to the IEC peak weighted method was measured at the beginning, middle and end of a full reel of Ampex *456* tape and found to be consistently to a good standard. The measured results recording and subsequently replaying were 0.035% at beginning, 0.03% at the middle and 0.033% at the end.

In the variable speed mode the centre position of the controls was close to the nominal speed with the fine control giving −1.2% variation and the coarse control −16%. Speed drift from one end of a reel to the other was reasonable at 0.018% for standard play tape.

Fig 6 shows the flutter components as determined by undertaking a spectrum analysis of a 10 kHz tone recorded and replayed, the figure showing distinct sidebands at −50 Hz but an otherwise clean performance.

Phase jitter between tracks 1 and 8 at 10 kHz gave the good results shown in **Fig 7** being at the worst −10°, the horizontal scale being 0.5 s/division.

Crosstalk

The crosstalk when replaying track 4 whilst recording tracks 3 and 5 is shown to be good in **Fig 8** being better than 60 dB above 200 Hz.

Leakage from the erase head as determined by measuring the loss of a pre-recorded 20 kHz tone on one track due to leakage from the erase head whilst recording the adjacent tracks was minimal at 0.3 dB.

When replaying in the sync mode the crosstalk introduced from the unwise procedure of recording an adjacent track is shown in **Fig 9**. Bearing in mind the excellent sync frequency response this is a particularly good performance.

Other matters

The VU meters were found to be genuine instruments to the ASA standard C16.5 with 0 VU correctly aligned for tapes such as Ampex *456*. Similarly the peak indicator lights were correctly aligned, becoming illuminated at 3% distortion at 1 kHz. At mid frequencies the lights were fast in operation giving a clear indication with only one half a cycle of 1 kHz overload.

A nice feature was that the output switching was ramped such that for instance switching between replay and input did not produce clicks.

Summary

Having regard to the overall class of recorder this is a well made machine which offers a good performance in almost all parameters. It is well thought out and a good tape handler under all conditions.

The only real complaint I have is the very restricted range of record equalisation which means that the bias/equalisation can only be optimised for a restricted range of tapes. **Hugh Ford**

FIG.6
TASCAM 58
SPECTRUM
ANALYSIS OF 10kHz
TONE RECORDED
AND REPLAYED

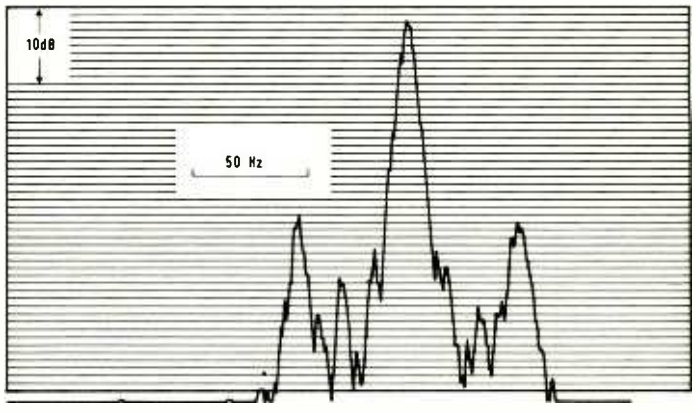


TABLE 1

3% MOL at 1 kHz	+11 dB ref 320 nWb/m
Distortion at 320 nWb/m	0.20/0.28%
Distortion at zero VU	0.18/0.25%

TABLE 2 Reference level (320 nWb/m) to noise

Measurement method	Without tape	With tape
22 Hz to 22 kHz RMS	58.0 dB	53.5 dB
A-weighted RMS	68.0 dB	58.5 dB
CCIR-weighted RMS ref 1 kHz	62.0 dB	50.5 dB
CCIR-weighted quasi-peak ref 1 kHz	58.5 dB	46.5 dB
CCIR-weighted ARM ref 2 kHz	68.5 dB	57.0 dB

FIG 7

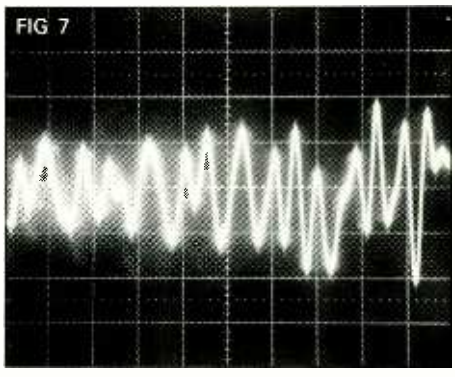


FIG.8
TASCAM 58
CROSSTALK, RECORD 3+5,
PLAY 4

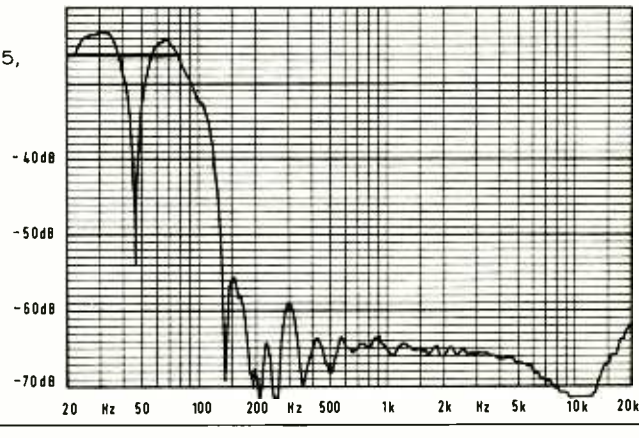
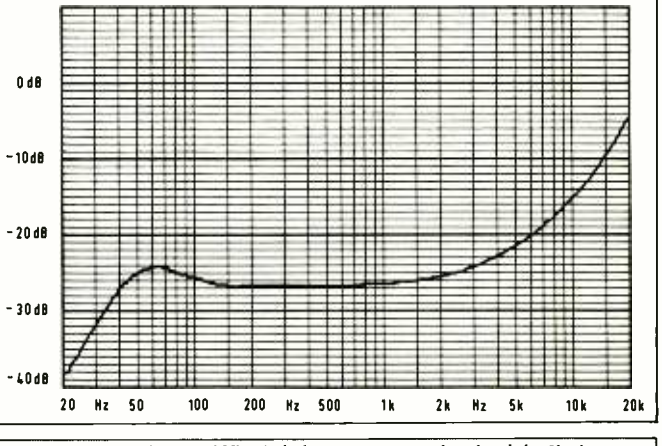


FIG.9
TASCAM 58
CROSSTALK, RECORD 5,
SYNC PLAY 4



Manufacturer's comment

By way of explanation we would like to answer the points Hugh Ford has raised about bias/eq presets.

The *58* has been designed primarily for use with the current range of high output/low noise tapes (Scotch *226*, Ampex *456* or similar), and the presets are designed for easy daily maintenance work with these tapes. Obviously the wider the preset range, the more erratic and difficult it becomes to maintain tight limits on this regular set up procedure. If, indeed, a studio wishes to use a particularly low bias tape then we can offer a very simple modification to adjust the presets' range.

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Tascam's deservedly successful **85-16B** 16 track/1" Recorder and Allen & Heath's sensational new **1616** Mixer. Each represents top value-for-money in its class; put them together and you have a professional performance recording team that will amaze even the most sceptical ear! The 1616 desk complements perfectly the 85-16B – the truly affordable multitrack package for the musician or studio with unlimited creative resources, but a not-so-unlimited budget.

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Enertec F500

MANUFACTURER'S SPECIFICATION

Tape speed: 3¾ to 7½, 15 in/s ±0.2%; variable speed with ±7 half-tone by the varispeed unit.
Wow and flutter: 3¾ in/s ≤0.15%, 7½ in/s ≤0.08%, 15 in/s ≤0.06%; peak value weighted measured R + P with EMT *424* and weighted according to DIN 45507.
Capacity: CCIR, DIN, NAB, CINE hubs up to 290 mm.
Tapes of utilisation: all types of tapes (50 μm) nominal or high level long time (37 μm) in option. Specify the type of tape with the order.
Starting time: ≤0.5 s for twice normal wow and flutter.
Rewinding time: ≤100 s for 2,000 ft of tape.
Input conditions: ≥5 kΩ from 31.5 Hz to 20 kHz balanced input; 0 dB minimum level; +6 dB or +12 dB nominal level; +22 dB maximum level.
Output conditions: load impedance ≥600 Ω; source impedance ≤50 Ω from 31.5 Hz to 20 kHz balanced output: +12 dB or +6 dB (source impedance ≤30 Ω) nominal level; +18 dB maximum level; 0 dB minimum level.
Playback/recording standards: CCIR or NAB on request.
Crosstalk at 10 kHz: stereo ≥40 dB; twin-track ≥46 dB.
Erasing: ≥75 dB at 1 kHz.
Power supply: 115, 127, 220, 240 V ±10%; frequency 50 Hz or 60 Hz; consumption 120 VA.
Environment temperature: from +10° C to 40° C for all datas warranted. From 0° C to 50° C without failures in using conditions. From −20° C to 70° C in stockage conditions.
Dimensions: 483 mm x 440 mm x 220 mm (stripped machine, without VU-meter panel).
Weight: 26 kg.
Manufacturer: **Enertec Department Audio Professional, 1 rue Nieuport B.P. 54, 78140 Velizy-Villacoublay, Cedex, France.**
UK: Crow of Reading Ltd, PO Box 36, 76 Katesgrove Lane, Reading, Berkshire RG1 2NB.

		3¾ in/s	7½ in/s	15 in/s
Response curve (R + P):				
±2 dB		40 Hz-10 kHz	31.5 Hz-16 kHz	31.5 Hz-18 kHz
±1 dB		60 Hz-8 kHz	60 Hz-12 kHz	60 Hz-16 kHz
Signal to noise ratio to CCIR standard (R + P) with PER 525:		**3¾ in/s**	**7½ in/s**	**15 in/s**
Mono (320 nWb/m)	weighted	≥55 dB	≥58 dB	≥61 dB
	unweighted	≥55 dB	≥58 dB	≥61 dB
Stereo 2.75 mm (510 nWb/m)	weighted	≥55 dB	≥58 dB	≥61 dB
	unweighted	≥55 dB	≥58 dB	≥61 dB
Twin track 2 mm (320 nWb/m)	weighted	≥52 dB	≥54 dB	≥56 dB
	unweighted	≥52 dB	≥54 dB	≥56 dB
NAB standard with 3M 202 (370 nWb/m)	mono	≥63 dB	≥65 dB	≥65 dB
	stereo 2.75	≥60 dB	≥62 dB	≥62 dB
	twin track 2	≥59 dB	≥61 dB	≥61 dB
High level NAB standard (1040 nWb/m) for 3% distortion with Ampex 456:				
mono			≥74 dB	≥74 dB
stereo 2.75			≥71 dB	≥71 dB
twin-track 2			≥70 dB	≥70 dB
Measurement conditions unweighted 31.5 Hz to 20 kHz RMS 0.2 s. Weighted with CCITT RMS 0.2 s.				
Harmonic distortion: CCIR standard	320 nWb/m	≤2%	≤1%	≤1%
	510 nWb/m	≤3%	≤2%	≤2%
NAB standard	185 nWb/m	≤1.5%	≤1%	≤1%

THE Enertec *F500* is a ¼ in recorder available in a number of different versions. Firstly it may be supplied with mono, stereo 2.75 mm or twin-track 2 mm heads with appropriate signal switching. Further options include a portable version in a handled transport case for vertical operation, a similar version for horizontal operation, a rack mount version or a stand mounted version as the stereo review machine.

All versions are 3-speed machines operating at 3¾, 7½ and 15 in/s with the equalisation being CCIR or NAB fixed as supplied unless the audio electronics are changed. In the case of the stand model the recorder is bolted to the fairly substantial stand and fitted with four castors. The form of construction of the recorder itself is novel as are many features of the tape transport and electronics. To the rear of the recorder is a substantial alloy casting which partly forms a heatsink for the tape transport control power transistors and also supports the XLR audio connectors and a 3-pin locking type DIN connector for the monitor loudspeaker.

The power transformer is bolted to the centre of the casting within the cabinet and the IEC power input, voltage selector and line fuses are contained within an enclosure behind the transformer. At the top of this is the power on/off rocker switch.

Each side of the casting is extended to form a hinge for the tape transport which is steadied by a pneumatic brace. The remainder of the case is a steel frame with a moulded plastic trim with the VU meter and audio control panel angled at the rear of the unit.

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The entire base of the unit is covered by the power supply and transport control printed circuit board which is equipped with connectors for all input and outputs including two 'D' connectors at the rear. These feed the optional varispeed unit and remote control unit. At the front of the board the single audio electronics board fits vertically into two connectors with the normal adjustments being at the top such that they are readily accessed for alignment.

Both boards are of very good quality with clear component identifications and all integrated circuits being socketed. However the value of the four fuses on the control board and two on the heatsink was not identified.

The control board has only three preset potentiometers with sockets being fitted for the optional balancing audio transformers. Other than the normal alignment controls the audio board has only two potentiometers and a variety of plugable links. At the time of writing the functions of these are not known as no instruction manual was available.

Turning to the tape transport this is based on a substantial ribbed alloy casting which is machined with reference faces on the top and bottom to support the tape transport components—good traditional engineering here! Both spools are driven directly from DC servo motors with the capability of taking ciné, European or NAB spools with suitable adaptors to fit on the ciné type spindles. A very unusual feature is that the shafts are braked by magnetic clutches as opposed to mechanical brakes with solenoids, each spool platter being fitted with an optical tachometer disc feeding the microprocessor-controlled transport logic which controls the tape tension.

From the pay-off spool the tape passes to a roller guide mounted on to a substantial cast spring-loaded arm with ball bearings. This roller is fitted with an optical tachometer disc which feeds the tape timer and an optical position sensor which detects tape present and loaded.

There follows a large diameter roller before the head area which starts with a fixed ceramic guide post before the flutter roller and full-track ferrite erase head. These and the following components are mounted onto a machined area of the main casting.

Within this area there follow the metal record and replay heads which have extremely stable mountings and are in turn followed by another fixed ceramic guide post before the capstan. In between the flutter roller and erase head the record and replay heads are solenoid-operated ceramic tape lifter pins.

The capstan which takes the form of a 13.84 mm diameter sleeve on the shaft on the DC servo motor is directly driven with the pinch roller being mounted on to a substantial cast arm operated by a conventional spring-tensioned solenoid linkage. Between the capstan and the take-up spool there is a single roller guide. All transport components are particularly solid in construction and well finished, all parts being replaceable with the greatest of ease.

Control of the tape transport is by a row of paddle switches at the front left of the machine, each switch having an associated LED which indicates the current mode. At the centre is a tape timer indicating hours, minutes and seconds in real time with further locate, edit and set counter to zero paddle switches to the right with a 3-position tape speed switch at the end of the panel.

Two locate functions are available. Pressing the locate button searches for tape time zero, but first pressing the record button (which is interlocked with play) and then the locate button searches for the point at which the tape transport was last started—a useful feature. Pressing the edit button in the stop mode applies the spool brakes and allows the tape to be unloaded for editing whilst in the normal stop mode the tape may be rock-and-roll edited. A dump edit mode is entered by first pressing edit followed by play.

A further feature of the tape transport controls is that simultaneously pressing the fast forward and fast rewind controls enters a variable speed spooling mode with the tape in contact with the heads. In this mode the tape direction is controlled by the fast buttons with the tape speed being set according to how long the fast button is held down, tape speed being constant.

To the rear the VU meter panel includes a small monitoring loudspeaker with self-illuminating type record/safe button between the two VU meters. Associated with each meter are the audio controls. These include for each channel an A/B toggle switch, two potentiometers and two self-illuminating type locking pushbuttons. These allow calibrated or uncalibrated input/output levels with the potentiometers controlling the uncalibrated levels.

Behind the tape transport controls a headphone jack and the monitor level control together with a mono/stereo toggle switch and associated LED protrude through a removable strip which covers the preset controls. These are clearly identified screwdriver-operated potentiometers.

Each channel has separate bias, record treble equalisation and record level controls for each tape speed. Similarly the replay chain has separate high frequency equalisation and gain controls.

The control of tape tension was very good being 70 g in the play mode increasing to 120 g when accelerating in the fast wind modes. Using Ampex *456* or Agfa *PEM 526* tape, the standard of winding was also very good at all speeds. However, in the review machine the tape was very slow to stop when unloading—but this function is being modified.

The locate function, when locating zero or the last start position, was accurate to within 100 mm over any length of tape at 15 in/s, the tape coming to a smooth halt but with slightly erratic tension control.

Access to the heads for editing was excellent with single-handed rock-and-roll edit location being possible by rotating the take-up spool.

Inputs and outputs

The impedance at the balanced inputs was found to be 96 kΩ in the balanced mode or 60 kΩ unbalanced with the inputs being capable of handling +30 dBm. For some reason the common mode rejection of the two channels was completely different as shown in **Fig 1**, it being suspected that channel 1 was faulty.

At the balanced outputs, the machine could deliver +21 dBm loaded into 600Ω from a source impedance of 27Ω, +4 dBm in the case of the inputs and outputs corresponding to 0 VU. At the headphone output the maximum voltage was 5 V from a very low source impedance less than 100 mΩ.

As supplied a fluxivity of 320 nWb/m at 15 in/s and 7½ in/s or 250 nWb/m at 3¾ in/s corresponded to an output of +8 dBm with the calibrated range of adjustment being +4 dBm to

70 ▶

FIG.1
ENERTEC F500
COMMON MODE REJECTION
(SEE TEXT)

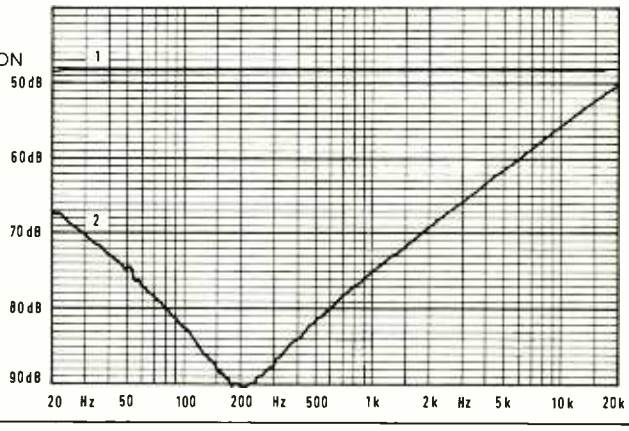
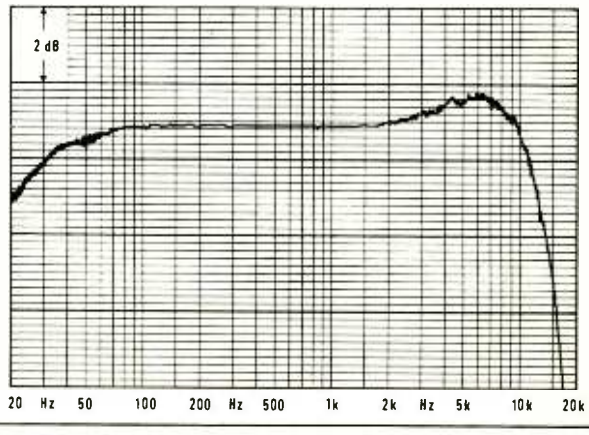


FIG.2
ENERTEC F500
3¾ in/s RECORD/REPLAY
PEM 368



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*The PC2002 is identical to the PC2002M but without the twin Peak Output meters.

Add to all this a smooth, accurate frequency response (10Hz -50kHz), a slew rate of 60 Volts/microsecond even at maximum output, and the result is an amplifier that can power anything from broadcast and recording studio systems to Disco or Rock PA, with hum, noise or distortion definitely a thing of the past.

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+17 dBm and the normal uncalibrated setting allowing the full range up to +18 dBm.

In the case of the inputs the level to record the above fluxivities could be adjusted from +3 dBm to +17 dBm in the calibrated setting. In the normal uncalibrated mode the control had a full range with a maximum sensitivity of −1 dBm for recording the above fluxivities.

Frequency response

The frequency response to the VU meters and also from the inputs to the outputs when monitoring the inputs had −0.5 dB points at 10 Hz and 16 kHz falling to −1 dB at 6 Hz and 22 kHz, a rather excessive high frequency roll-off. The replay frequency response was checked for both channels using BASF calibration tapes to the CCIR standards and found to be virtually identical for the two channels.

At 15 and 7½ in/s the response was within ±1 dB from 40 Hz to 18 kHz with the response at 3¾ in/s being within ±1 dB from 31.5 Hz to 12.5 kHz above which the response fell due to azimuth variations in the form of azimuth jitter rather than a steady azimuth error.

Using Agfa *PEM526* tape overbiased by 3.5 dB at 20 kHz at 15 in/s or 10 kHz at 7½ in/s or Agfa *PEM368* long play tape over biased 3.5 dB at 5 kHz at 3¾ in/s the record/replay frequency response could be aligned as follows.

Fig 2 shows the performance at 3¾ in/s with the low frequency response being excellent and demonstrating a very good head design without any low frequency ripples with the high frequency response being −1 dB at 12.5 kHz or −3 dB at 14 kHz. At 15 and 7½ in/s similar remarks apply with long wavelengths at 15 in/s also showing very minor frequency response deviations as shown in **Fig 4** where the response is −1 dB at 24 kHz and −3 dB at 27.3 kHz. The performance at 7½ in/s is shown in **Fig 3** where the response is −1 dB at 23 kHz or −3 dB at 25.4 kHz.

The range of the bias controls was more than adequate for any tape types but setting the control with accuracy was a rather sensitive operation in view of the use of single turn potentiometers.

The full range of the replay equalisers for the three tape speeds was more than adequate as shown in **Fig 5** with accurate adjustment being easy. Similarly the record equalisers had a good range, the performance with the Agfa tapes being shown in **Fig 6.**

Distortion

Distortion was measured using Agfa *PEM368* tape at 3¾ in/s or *PEM526* at the higher tape speeds overbiased 3.5 dB at 20/10/5 kHz for the three speeds.

As shown in **Fig 7** for 15 in/s there was some overshoot for a 1 kHz squarewave, similar results being obtained at 7½ in/s.

Harmonic distortion was measured in terms of third harmonic, the even harmonics being at negligible levels, with the results shown in **Table 1.** Performance was identical for the two channels with record or replay clipping levels in the electronics being greater than +14 dB reference 320 nWb/m. 0 VU was correctly aligned to be around −10 dB reference 3% third harmonic distortion.

Noise

Noise in the outputs was measured without tape and with machine erased Agfa *PEM526* at the

72 ▶

FIG. 3
ENERTEC F500
7½ in/s RECORD / REPLAY
PEM 526

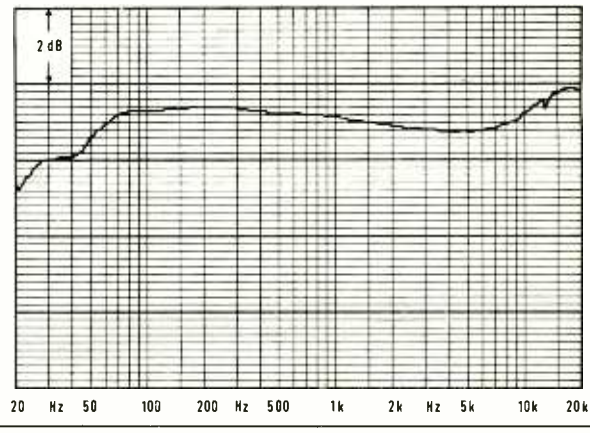


FIG. 4
ENERTEC F500
15 in/s RECORD / REPLAY
PEM 526

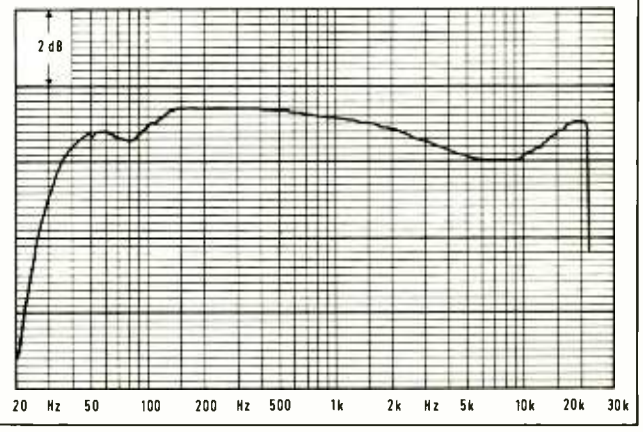


FIG. 5
ENERTEC F500
REPLAY EQUALISERS

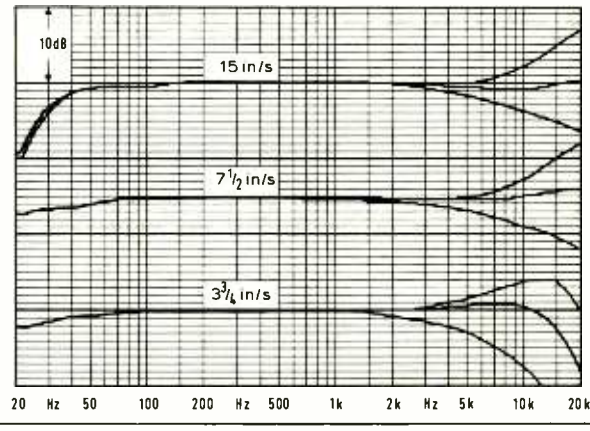
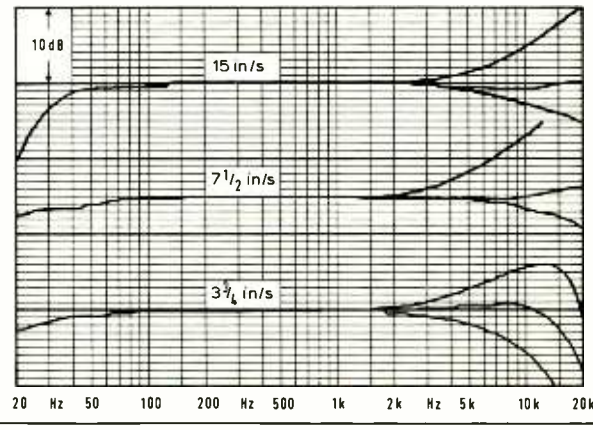


FIG. 6
ENERTEC F500
RECORD EQUALISERS



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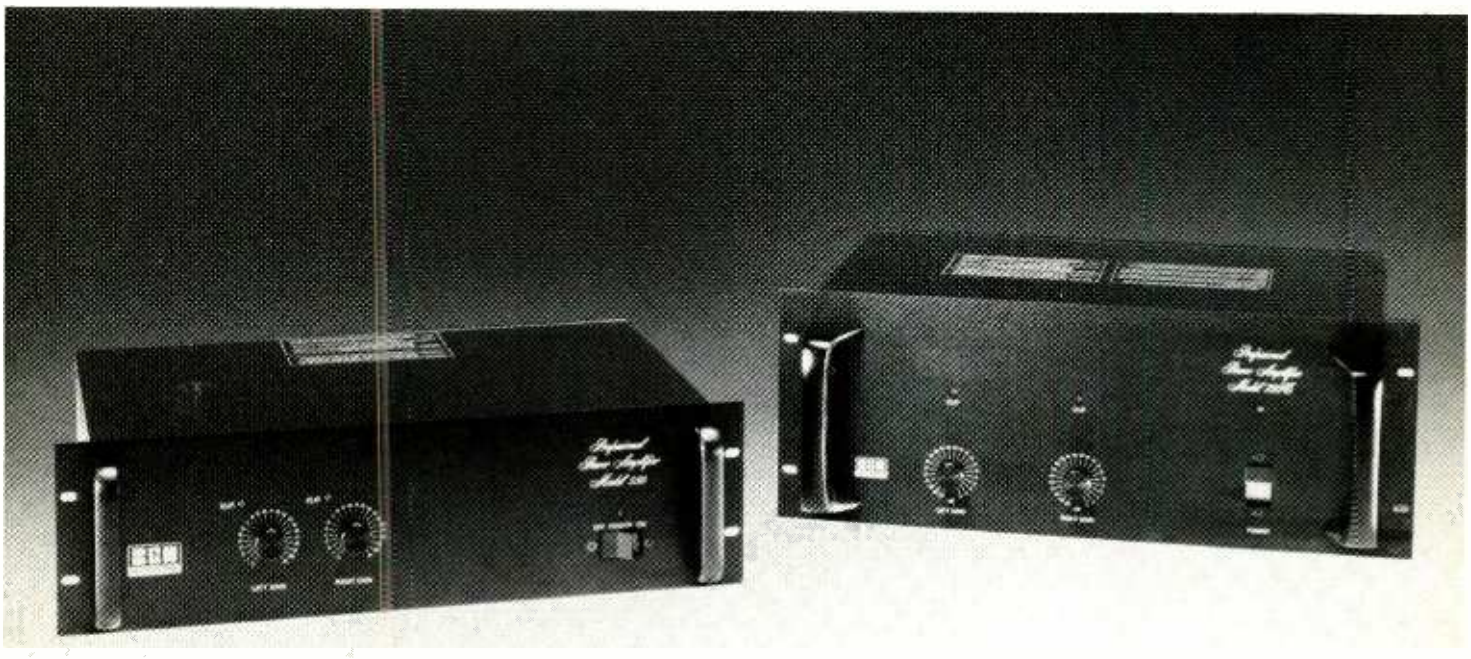

Specifications	Model 550	Model 750
Output power 8 ohms	200w	225w
4 ohms	325w	360w
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higher tape speeds or *PEM368* at 3¾ in/s, **Table 2** showing reference level (320 nWb/m at the higher two speeds or 250 nWb/m at 3¾ in/s) to noise.

At the higher speeds the two channels were within 1 dB of each other, but at 3¾ in/s the right channel had a fairly large component at 17.47 kHz which is presumably crosstalk from the microprocessor logic. With tape this component was masked by tape noise (see **Table 3**).

Other than the problem of the 17.47 kHz tone no other tones were significant in the noise with power line hum being at a very low level. When monitoring the input noise in the output was satisfactory. As can be seen there is a very good margin between tape noise and machine noise.

Wow, flutter and speed

Wow and flutter was measured to the IEC-weighted method at the beginning, middle and end of a 2,400 ft reel of tape at the three tape speeds and found to vary little with tape position (see **Table 4**).

TABLE 4	IEC-weighted wow and flutter		
Tape speed	Beginning	Middle	End
15 in/s	0.04%	0.045%	0.05%
7½ in/s	0.04%	0.05%	0.05%
3¾ in/s	0.10%	0.10%	0.10%

Drift from one end of reel to the other was remarkably small at less than 0.002% with the relation between the speeds being within better than 0.01%.

The spectrum analysis of a 10 kHz tone recorded and replayed at 15 in/s as shown in **Fig 8** shows well contained flutter sidebands with the predominant components at ±25 Hz and ±50 Hz from the 'carrier'.

Phase jitter between tracks was extremely good with a 10 kHz tone at 15 in/s peaking just over ±3° as shown in **Fig 9** where the vertical scale is 1° per division and the horizontal scale 0.5 s per division.

Other matters

Whilst the VU meters exhibited the correct rectifier characteristic the ballistics were far from the genuine VU meter with a 300 ms tone burst only driving the needle to −2.5 dB instead of overshooting zero.

Erasure of a 1 kHz tone was very good giving 88 dB at 15 in/s or 91 dB at 7½ in/s. Similarly the inter-channel crosstalk was good as shown in **Fig 10** for 15 in/s, the crosstalk shifting down one octave at 7½ in/s.

A minor complaint about the tape transport is that the machine will run when it is incorrectly loaded the wrong side of the large diameter roller guide. Either this should inhibit the machine running or the manufacturer should provide a line on the top panel trim showing the correct tape path.

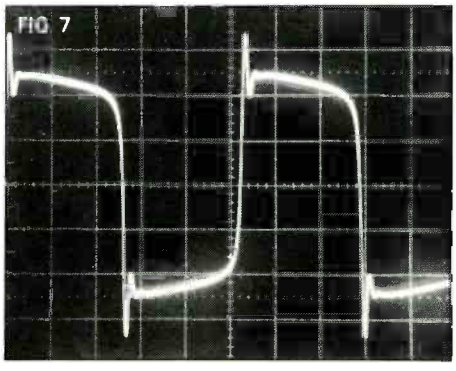
Summary

The Enertec *F500* proved to be a very good general purpose studio recorder. The tape transport is clearly designed to take severe punishment with the minimum of servicing—in fact the only adjustments are the pinch roller pressure and azimuth. The complete unit has first class access for servicing of the mechanics and the electronics with all adjustments except the bias controls having a sensible range and being easy to adjust accurately. It is hoped that the manufacturer will attend to the few minor criticisms in this review, none of which are very serious or difficult to right. **Hugh Ford**

TABLE 1	15 in/s	7½ in/s	3¾ in/s
315 Hz 5% ref 250 nWb/m	—	—	+ 10 dB
1 kHz 3% ref 320 nWb/m	+ 6 dB	+ 5 dB	—
315 Hz at 250 nWb/m	—	—	0.5%
1 kHz at 320 nWb/m	0.7%	1.0%	—
At 0 VU	0.3%	0.5%	0.2%

TABLE 2		Reference level to noise—without tape	
Measurement method	15 in/s	7½ in/s	3¾ in/s
22 Hz to 22 kHz RMS	64 dB	62 dB	58/56 dB
A-weighted RMS	75 dB	70 dB	66/63 dB
CCIR-weighted RMS ref 1 kHz	72 dB	68.5 dB	64/62 dB
CCIR-weighted quasi-peak	68 dB	64 dB	60/58 dB
CCIR-weighted ARM ref 2 kHz	78.5 dB	75 dB	70/69 dB

TABLE 3		Reference level to noise—with tape	
Measurement method	15 in/s	7½ in/s	3¾ in/s
22 Hz to 22 kHz RMS	60 dB	58.5 dB	58 dB
A-weighted RMS	64 dB	61.5 dB	62.5 dB
CCIR-weighted RMS ref 1 kHz	56 dB	53 dB	54 dB
CCIR-weighted quasi-peak	51.5 dB	49.5 dB	50 dB
CCIR-weighted ARM ref 2 kHz	62 dB	59.5 dB	60.5 dB



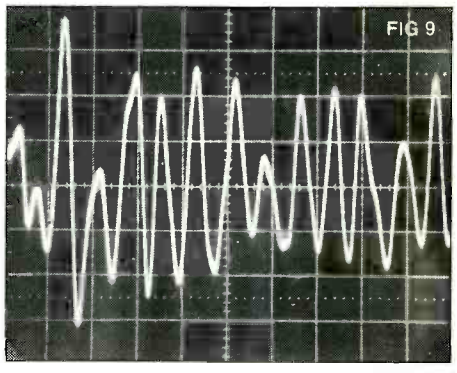


FIG.8
ENERTEC F500
SPECTRUM ANALYSIS 10 kHz TONE
RECORDED AND REPLAYED 15 in/s

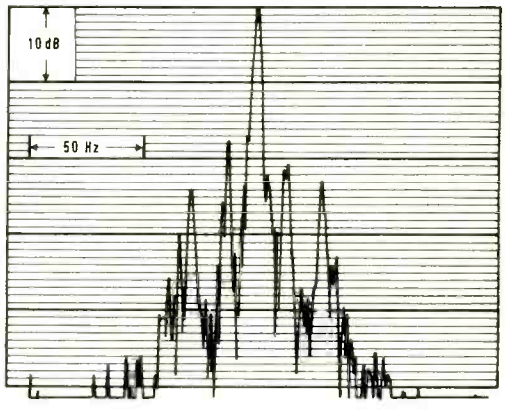
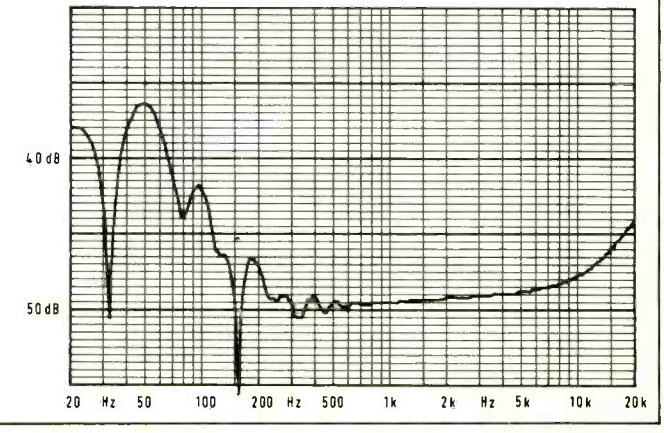


FIG.10
ENERTEC F500
15 in/s CROSSTALK



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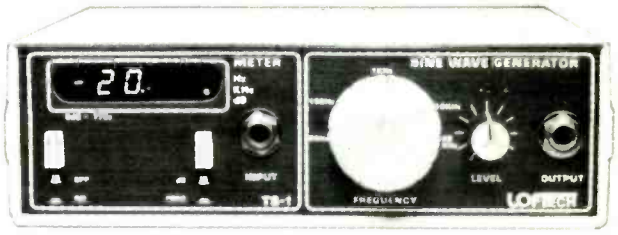

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Otari MX5050-Mk III/8

MANUFACTURER'S SPECIFICATION

Tape width and tracks: ½ in (12.7 mm) tape; eight tracks (0.04 in or 1.0 mm track width).
Tape speeds: 7½ and 15 in/s (190.5 and 381 mm/s); maximum deviation ±0.2% measured with 1.5 mil (0.038 mm) tape.
Reel sizes: ½ × 10½ in NAB.
Heads: three—8-track in-line, erase (ferrite), record, reproduce (both hard permalloy).
Motors: capstan—DC servo-controlled motor (pitch control range ±7%); reels—two torque motors.
Rewind time: approximately 100 s for 2,500 ft (760 m) NAB reel.
Operating position: horizontal (table top type).
Power requirements: 100, 117, 220, 240 V, 50 Hz or 60 Hz, single phase AC.
Power consumption: 150 W.
Operating environment: 40° to 104° F (5° to 40° C) 20% to 80% relative humidity.
Storage environment: −5° to 113° F (−20° to 45° C).
Dimensions: (whd) 17.3 × 17.3 × 26.6 in/438 × 438 × 675 mm.
Weight: 77 lb/35 kg.
Mounting: coloured leatherette-finished cabinet.
Remote control unit: *CB-110* remote control unit (remote control functions of transport and amplifier and timer) *CB-114* remote control unit (remote control function of transport).
Connectors: line input, line output—standard 3-pin XLR; external oscillator—standard single-conductor phone jack; phones—standard 2-conductor phone jack.
Inputs: line—variable or fixed level front panel switch selectable, unbalanced 50 kΩ; fixed level—+4 dBm or −8 dBm switchable (minimum −9 dBm or −18 dBm); external oscillator minimum 18 dBm, unbalanced 10 kΩ.
Outputs: line fixed level +4 dBm or 8 dBm rear panel switch selectable; load impedance more than 600Ω; maximum line output level +21 dBm with 600Ω load.
Headphone jack: −19 dBm with an 8 Ω load; load impedance—8 Ω or greater.
Equalisation: NAB or IEC for 7½ and 15 in/s.
Frequency response: record/play—15 in/s, 40 Hz to 25 kHz ±2 dB; 7½ in/s, 20 Hz to 20 kHz ±2 dB. Sync/replay—15 in/s, 40 Hz to 15 kHz ±3 dB; 7½ in/s, 30 Hz to 10 kHz ±3 dB. Specifications refer to a 1 kHz reference when recorded on 3M type *226*.
Signal-to-noise ratio: 15 and 7½ in/s NAB- or IEC-weighted 70 dB, unweighted 66 dB.
Crosstalk: better than −55 dB.
Wow and flutter: NAB-weighted, 15 in/s less than 0.05%; 7½ in/s less than 0.06%.
Distortion: less than 0.5% at 1 kHz at 250 nWb/m.
Erase efficiency: greater than 70 dB.
Test oscillator frequency: nominal 1 kHz and 10 kHz.
Bias and erase frequency: 200 kHz.
Peak indicator: trigger level—1040 nWb/m (15 dB above Ampex operating level) recorded flux level.
NOTE: signal-to-noise ratio is measured with respect to a recorded level of 1040 nWb/m to biased tape noise when using 3M type *226* magnetic tape. Unweighted—using a 30 Hz to 18 kHz RC filter to eliminate noise outside the audio spectrum. Weighted—using an NAB or ASA A-weighted filter and a 1 kHz reference.
Manufacturer: Otari Electric Co Ltd, 4-29-18 Minami, Ogikubo, Suginami-Ku, Tokyo, Japan.
UK: Otari Electric (UK) Ltd, 22 Church Street, Slough, Berkshire.
USA: Otari Corporation, 2 Davis Drive, Belmont, CA 94002.

THE Otari *MX-5050 Mark III/8* is a portable ½ in, 8-track machine capable of using 10½ in NAB spools or cine centred spools with excellent NAB adaptors being provided. Whilst the machine is intended for table top use and is fitted with four good non-slip feet, a pedestal with four castors is available as an optional extra as is the remote control unit.

A ¼ in alloy plate forms the basis of the tape transport with alloy 'spider' castings being secured to the sides of the alloy plate. The sheet steel base of the machine is attached to the alloy sides with the remainder of the housing being formed from sheet steel, the sides having a substantial wooden trim.

To the back of the machine the eight illuminated VU meters face the operator in a penthouse which includes switched input level potentiometers with the switches giving a fixed calibrated input sensitivity.

Individual track switching is in two rows of eight switches with four associated rows of LEDs on an almost vertical panel at the front of the machine. The top row are 2-position toggle switches giving the ready/safe function for the eight tracks. When in the ready position a red LED flashes by the switch, the LED being permanently illuminated once the track is put into record.

In the second row the toggle switches have three positions for selecting the output between the input, normal replay or sync replay. Three LEDs in vertical array above the switches indicate the current status of each track—yellow for input, green for sync and orange for replay. To the left of this arrangement a vertical row of five interlocked pushbuttons provide overall control with LEDs indicating the status which may be all tracks replay/sync/input, individual control or remote control.

At the right of the front panel a ¼ in headphone jack provides monophonic monitoring of any combination of tracks with the selection being by means of eight locking pushbutton switches. To the left of the panel a further ¼ in jack is fitted for a test input to all tracks. A 4-position rotary switch feeds all tracks from the eight inputs, the single test input or an internal test oscillator at 1 kHz or 10 kHz.

To the front of the tape transport a small panel extending the width of the machine has the normal tape motion controls to the right, the switches being momentary pushbutton switches with the record button not being interlocked. A red LED near the record button flashes when any tracks are in the ready status and is permanently illuminated in the record mode with or without any tracks recording. This means that any track may be dropped into record or out of record with the safe/ready switches or any preselection of tracks may be manipulated with the record button with or without the tape in motion.

To the left of this panel locking pushbutton switches provide the power on/off, reel size (tension) selection and selection of two tape speeds which are normally 15 and 7½ in/s. Within the section there is a momentary button for dump editing, and a green warning LED showing when dump edit is selected.

Within the tape transport, real tape time is indicated in hours, minutes and seconds with the timer going negative when reversing past zero. One pushbutton within the timer resets the indication to zero with another button moving the tape at high speeds to zero indication. At the centre of the transport a variable speed potentiometer is provided; pulling out the knob

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Japan	Continental Far East Inc.	Tokyo	Singapore	Auvi Private	Singapore
Spain	Singleton Productions...	Barcelona	Denmark	Sweet Silence	Copenhagen
Hong Kong	Audio Consultants....	Kowloon	Holland	Audio Script	Loosdrecht

initiates variable speed operation with a red LED giving warning of this condition.

The final operator control is a mechanical cue lever which removes the tape lifters in the headblock from the tape path in the fast and stop modes.

The tape transport is conventional in design with the two AC spooling motors being fitted to the transport plate on folded steel brackets. The spools are directly driven and have height adjustment available, with the far end of the motor shafts having solenoid-operated band brakes.

From the pay-off spool the tape passes over a rather flimsy spring-loaded tension arm before the tape timer roller which is equipped with a tachometer disc. Following this is the removable headblock secured on to the transport plate by screws in three fixed guide posts, the head wiring being fitted with connectors. The three heads are suspended from an alloy plate which is secured on to the guide posts with positive azimuth adjustment for the record and replay heads.

The first fixed guide is located before the erase head, the second between the erase and record heads with the third at the exit from the head block. No further guides or flutter rollers are within the head area which is surmounted by a hinged cover fitted with a splicing block. From the head area the tape feeds to the direct drive metal capstan, with the long shaft DC motor being screwed to pillars fitted to the transport plate.

The large diameter pinch roller is solenoid operated via a reasonably substantial linkage which also operates the tape lifters in the headblock. Finally before the take-up spool, a further rather flimsy spring-loaded tension arm operates a 'tape present' microswitch.

Within the case the large laminated power transformer is slung below the transport plate—a practice which I do not care for in view of the weight of the transformer and heating of the transport plate. A printed circuit board in the base contains the power supplies and the microprocessor-driven control logic with various other subsidiary boards being used for other control and display functions.

All the audio electronics are contained on eight plug-in boards under the VU meter panel, these boards and one other being positively located in sockets on a mother board.

The arrangement is such that all normal preset controls in the form of conventional potentiometers can be screwdriver-operated through holes in the rear panel, each audio board having 14 potentiometers and two slide switches. The two switches give a choice of input and output levels such that the recorder may be interfaced with other professional or domestic equipment.

Separate potentiometers are provided for setting 0 VU and the threshold of the peak indicator LEDs located within the VU meters. Record and replay equalisation at high frequencies have separate adjustments for the two tape speeds with each track having a bias control (no master bias control being fitted) and an oscillator input level control.

In addition to HF equalisation the replay channels have a low frequency control with the sync replay using the replay equalisers. The remaining audio controls are all level controls with the secondary board in the audio department having a control for setting the 10 kHz oscillator level and a standby on/off switch. The latter allows all channels in the standby mode to automatically switch to input in the stop and fast

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FIG.1 OTARI MX-5050III/8 LINE IN FREQUENCY RESPONSE, INPUT TO OUTPUT

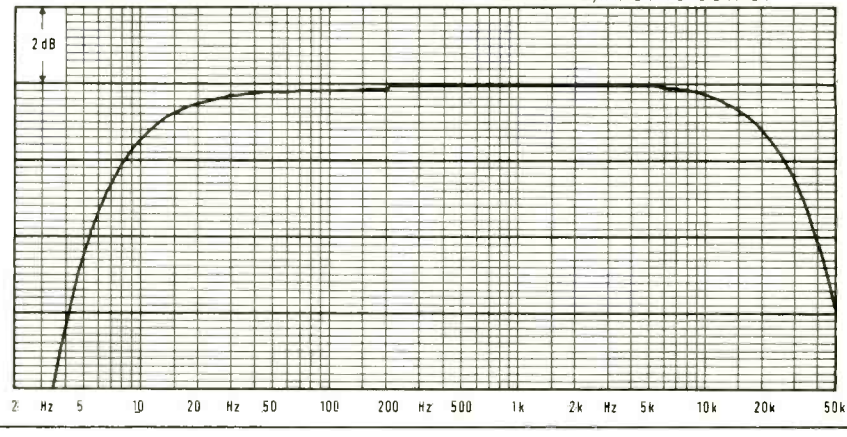


FIG.2
OTARI MX-5050 III/8
15 in/s RECORD/REPLAY
FREQUENCY RESPONSE

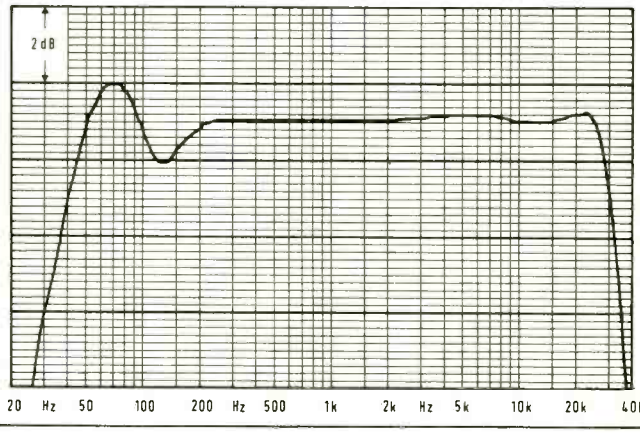


FIG.3
OTARI MX-5050 III/8
7½ in/s RECORD/REPLAY
FREQUENCY RESPONSE

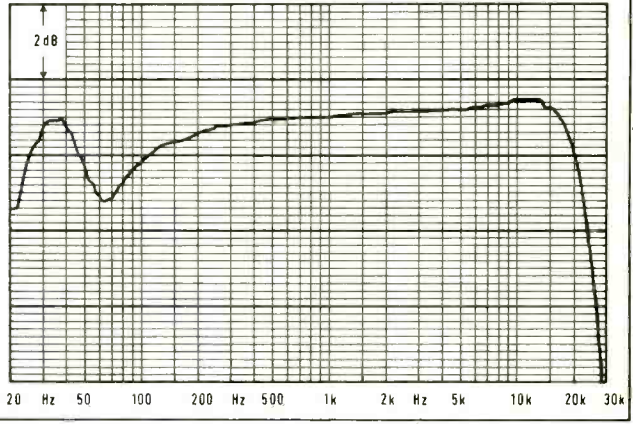
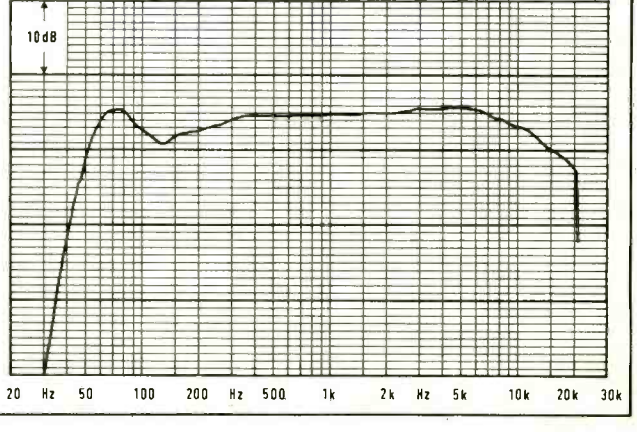


FIG.4
OTARI MX-5050 III/8
15 in/s SYNC REPLAY
FREQUENCY RESPONSE



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wind modes.

Whilst obviously built to a price the standard of construction was generally good from a mechanical point of view with the printed circuit boards being to a first class standard with excellent component identifications. Furthermore the instruction and maintenance manual was very good including circuits, parts lists, exploded diagrams and maintenance information.

Whilst access to the tape transport components was reasonable, the internal wiring was rather untidy and not all components were fitted with connectors such that replacing some transport components and printed circuit boards involves soldering.

All connections are located at the bottom rear of the recorder with the audio connections being unbalanced at XLR connectors. Power input is via an IEC connector with the internal fuses being properly identified.

Two multipole connectors allow the use of the remote control unit and also an autolocator which will be available shortly. There is also the possibility of linking the machine with a synchroniser.

Remote control unit

Connecting to the recorder with approximately 40 ft of multiway cable the remote control unit duplicates all tape movement and track selection functions plus the tape timer. It is contained in a case about 12 in (w) by 7 in (d) fitted with a tilting foot with the locking connector for the cable being under the remote unit.

On top, the two horizontal rows of track selection switches with their associated LEDs have the same format as on the recorder, again with interlocked pushbutton to the left for overall control of all input/replay/sync and individual settings.

The tape time again has a reset and return to zero button with the tape movement controls being identical to those on the recorder.

Entering the remote mode inhibits all track selection controls on the recorder but all the indicators on the remote unit and the recorder remain active.

However the tape timer buttons and the tape movement controls (including record) were always working at the remote unit and the recorder, a feature which I do not like.

Inputs and outputs

The unbalanced audio inputs were found to have an impedance of 47 kΩ in the high level setting or 50.5 kΩ in the low level setting, both remaining constant with the input gain. As supplied 0 VU corresponded to +4 dBm or −8.5 dBm in the calibrated condition for the high and low sensitivity switch settings with the maximum uncalibrated sensitivities being −8.5 dBm and −18.5 dBm.

With a capability of handling in excess of +30 dBm together with the high input impedance and wide sensitivity range, the inputs are fully compatible with domestic and professional environments.

At the audio line outputs there was again a wide range of level from an unbalanced source with an impedance less than 1Ω. As supplied the output for a fluxivity of 320 nWb/m was +5 dBm or −7 dBm depending upon the output level switch setting, these levels corresponding to +1 VU. The maximum output capability was +21.5 dB.7 V or +20.8 dBm loaded into 600Ω with 0 VU corresponding to +4 dBm or −8 dBm depending upon the setting of the output level switch. Relative to these settings the

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TABLE 1

Measurement method	Reference level (320 nWb/m) to noise: No tape, 15 or 7½ in/s	With tape, 15 in/s	With tape, 7½ in/s
22 Hz to 22 kHz RMS	−65.0 dB	−55.8 dB	−58.0 dB
A-weighted RMS	−72.0 dB	−59.5 dB	−62.0 dB
CCIR-weighted RMS	−66.2 dB	−51.5 dB	−53.0 dB
CCIR-weighted quasi-peak	−62.0 dB	−48.0 dB	−49.5 dB
CCIR-weighted ARM	−72.5 dB	−58.0 dB	−60.0 dB

TABLE 2

Measurement method	Reference level (320 nWb/m) to noise: No tape, 15 or 7½ in/s	With tape, 15 in/s	With tape, 7½ in/s
22 Hz to 22 kHz RMS	−62.5 dB	−56.5 dB	−58.0 dB
A-weighted RMS	−70.4 dB	−61.0 dB	−62.5 dB
CCIR-weighted RMS	−64.5 dB	−52.5 dB	−54.0 dB
CCIR-weighted quasi-peak	−60.5 dB	−48.5 dB	−50.0 dB
CCIR-weighted ARM	−71.5 dB	−59.0 dB	−60.5 dB

TABLE 3

Measurement method	Reference level (320 nWb/m) to noise: Fixed input	Variable input
22 Hz to 22 kHz RMS	−73.0 dB	−70.0 dB
A-weighted RMS	−75.2 dB	−72.0 dB
CCIR-weighted RMS	−66.2 dB	−63.0 dB
CCIR-weighted quasi-peak	−62.0 dB	−59.0 dB
CCIR-weighted ARM	−72.5 dB	−69.5 dB

FIG.5
OTARI MX-5050 III/8
SYNC FREQUENCY RESPONSE
7½ in/s

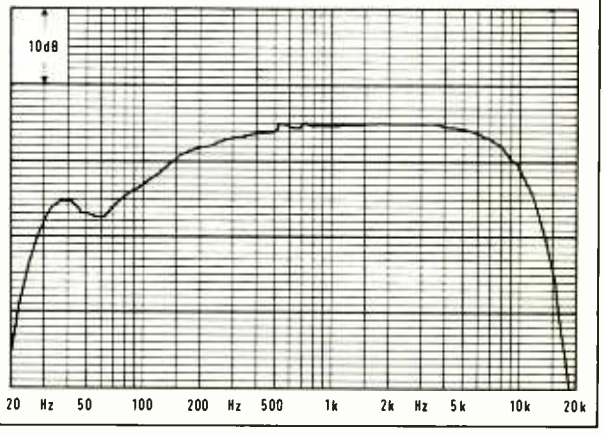


FIG.6
OTARI MX-5050 III/8
REPLAY EQUALISER AT 15in/s

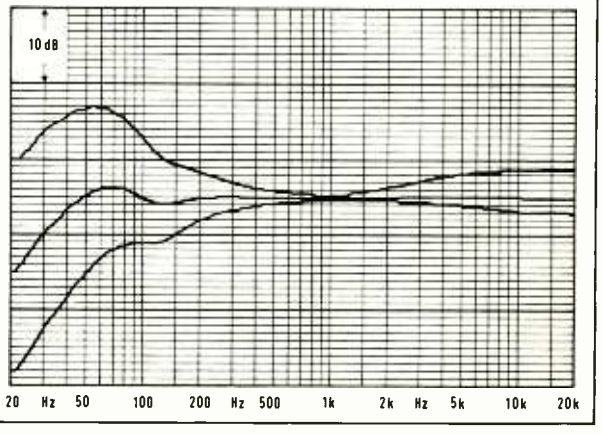
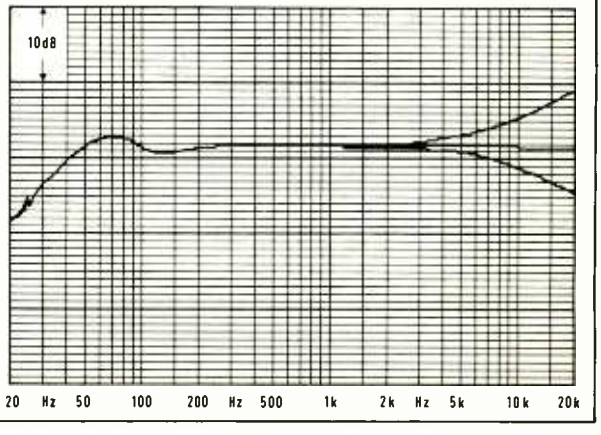


FIG.7
OTARI MX-5050 III/8
RECORD EQUALISER AT 15in/s



output level preset offered a range up to +10 dB boost with the record level preset having an adequate range of +4/−5 dB.

The monophonic headphone output had a maximum drive capability of 10 V RMS from a source impedance of 148 Ω suitable for virtually any type of headphones.

At the external oscillator input the impedance was adequately high at 21.3 kΩ with 380 mV being required for an indication of 0 VU in the calibrated gain settings independent of the gain switch position but with the variable gain control active in the uncalibrated position.

Frequency response

When using the external oscillator input for alignment the frequency response to the VU meters or the line outputs was not particularly satisfactory with −1 dB points at 80 Hz and 18 kHz falling to −3 dB at 40 Hz and 33 kHz.

The frequency response from the input to the output in the direct mode was reasonably satisfactory as shown in **Fig 1** with −1 dB point at 12 Hz and at 18 kHz. Checking the replay frequency response with a calibration tape showed that the machine had been accurately calibrated at both tape speeds with the response at 15 in/s being +0.6 dB, −1.0 dB up to 18 kHz reference 1 kHz.

The optimised record/replay frequency response at 15 in/s is shown in **Fig 2** and that at 7½ in/s in **Fig 3** both showing reasonable low frequency head contour effects and a very flat response. The −1 dB high frequency point at the two speeds were at 26 kHz and 18 kHz falling to −3 dB at 30 kHz and 21.7 kHz.

In the sync mode as is normal the high frequency performance was degraded compared with the replay mode; however, the performance at both 15 in/s and 7½ in/s was satisfactory as shown in **Fig 4** and **Fig 5.**

Fig 6 shows the very sensible range of the high and low frequency equalisers for the NAB equalised machine at 15 in/s with an identical range at 7½ in/s. Similarly the record equalisation is well contrived with a sensible range as shown in **Fig 7** for BASF *SPR-50* tape at 15 in/s when over biased 3 dB at 10 kHz.

In addition it was found that the available range of bias was more than adequate with the bias oscillator being buffered so that the number of tracks in record had no measurable effect upon bias. Leakage of the erase head on to adjacent tracks as determined by recording 20 kHz at 15 in/s on one track and then recording both adjacent tracks with bias and measuring the loss of the 20 kHz level, was negligible.

Noise

Noise as measured at the line outputs was virtually identical for the eight channels. As expected, noise varied 12 dB depending upon the setting of the output level switch, this being equal to the change in output level. Whilst the input level switch had no effect upon noise, setting the unit to the variable input sensitivity mode increased noise irrespective of the gain setting with the increase varying 0.5 dB with the setting of the gain control such that it decreased with increasing gain.

Noise in the replay mode without tape and with BASF type *SPR-50LH* tape recorded with bias alone was as shown in **Table 1** in the replay mode referred to a fluxivity of 320 nWb/m.

Table 1 shows a very good margin between machine noise and tape noise, there being a complete absence of hum and other unwanted

TABLE 4

Tape speed	Beginning	Middle	End
15 in/s	0.042%	0.065%	0.10%
7½ in/s	0.075%	0.055%	0.08%

FIG.9 OTARI MX-5050III/8 SPECTRUM ANALYSIS 10kHz TONE, RECORD AND REPLAY 15 in/s

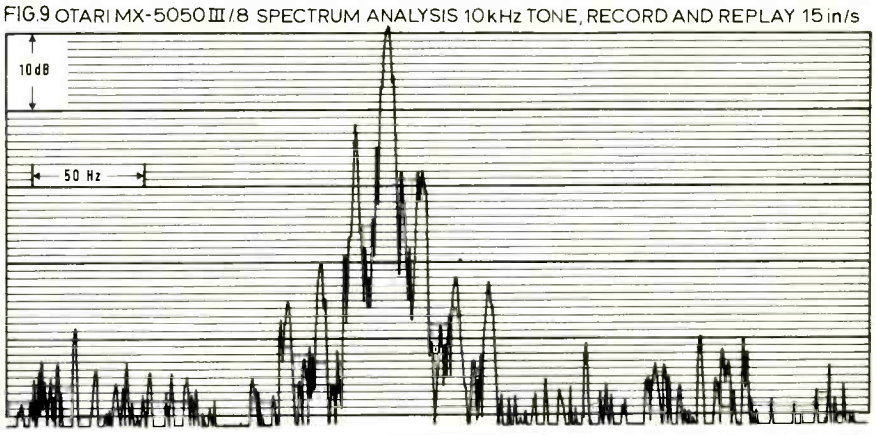


FIG 8

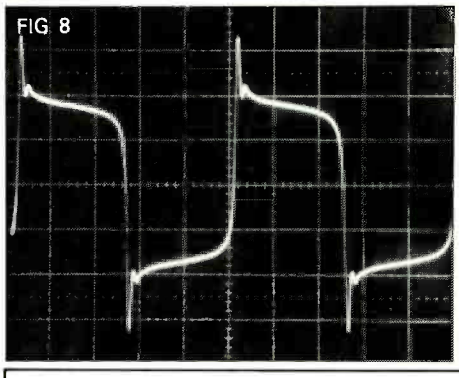


FIG 10

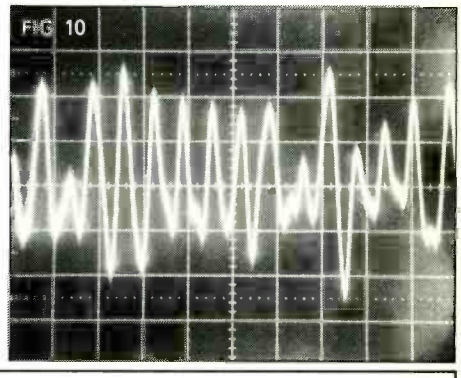
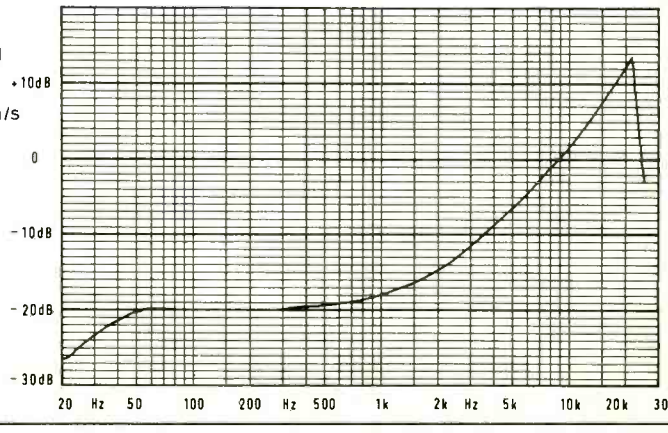


FIG.11
OTARI MX-5050III/8
CROSSTALK ADJACENT
TRACKS 7½in/s

FIG.12
OTARI MX-5050III/8
CROSSTALK BETWEEN
ADJACENT TRACKS,
TRACK 5 SYNC AND
TRACK 6 RECORD 7½in/s



tones in the output. As might be anticipated noise in the sync mode was good and still offered an excellent standard of performance with reduced bandwidth as shown in **Table 2.**

When switched to the input the noise at the output was fairly close to the replay amplifier noise (see **Table 3**), particularly when weighted, but the margin between tape noise and amplifier noise made the amplifier noise of little significance.

In spite of the lack of any form of head screens the unit seemed to be remarkably free of hum pickup from external sources.

Distortion

Using BASF type *SPR-50LH* tape over biased 3 dB at 10 kHz when running at 15 in/s the third harmonic distortion was measured when recording a fluxivity of 320 nWb/m. Good results were obtained being 0.20% at 15 in/s or 0.28% at 7½ in/s.

At both tape speeds the maximum output level for 3% third harmonic distortion was satisfactory at +9.5 dB reference 320 nWb/m with other harmonics being at a very low level.

Both the record and replay amplifiers could handle in excess of +15 dB reference 320 nWb/m before serious distortion. Recording and replaying a 1 kHz squarewave produced **Fig 8** at 15 in/s with a relatively similar amount of overshoot at 7½ in/s.

Wow and flutter etc

IEC-weighted peak wow and flutter was measured at both tape speeds at the beginning, middle and end of a reel of BASF type *SPR-50LH* tape and found to vary quite widely but to remain at a good standard (see **Table 4**).

A spectrum analysis of a 10 kHz tone recorded and replayed at 15 in/s shown in **Fig 9** demonstrates the flutter components around the carrier. The main flutter components which are located at approximately ± 15 Hz and multiples thereof from the carrier result from the 7.801 mm diameter capstan. In other respects the spectrum is very clean.

Drift from one end of a 2,400 ft reel to the other was reasonable at 0.032% with the relationship between the two tape speeds being better than 0.016%. The variable speed function which is available in both replay and record had a range of +7.1% to −8.3% with reasonably accurate control by its 270° potentiometer. The phase drift between the outer tracks at 10 kHz and 15 in/s as shown in **Fig 10** peaks about ±12°.

Other matters

Crosstalk between adjacent tracks in the replay mode was to a good standard as shown in **Fig 11** but crosstalk in the sync mode requires some caution in use. This is always a compromise between the sync frequency response and crosstalk. When recording one track and replaying the adjacent track in the sync mode the result is shown in **Fig 12** which demonstrates an effective gain above 9 kHz. However, in practical use it is most unwise to use adjacent tracks and the crosstalk improves by 23 dB overall with one track left between the operational tracks.

The VU meters were found to be correctly set for Ampex *456* tape and to have the correct rectifier characteristics and ballistics. However the peak indicators were set at too high a level, but this is a simple matter of resetting the preset controls. The response time of the peak indicators for a reasonably visible indication was about 5 ms.

Erasure of a 1 kHz tone at 7½ in/s varied from track to track but was always acceptable at greater than 82 dB using BASF type *SPR-50* tape.

The internal alignment oscillator was a useful feature with low distortion (worst case 0.3% second harmonic at 1 kHz) and accurate frequencies of 987 Hz and 9,932 Hz.

In operation the machine handled tape well at sensible tensions around 120 g when running but with a rather heavy boost when starting. Failure of the mains supply brought the tape to a steady halt from any mode and the machine when set for 240 V operation worked quite happily at 200 V.

Summary

I have few criticisms of this machine which together with its remote control unit are well conceived.

The selection and range of the pre-set control was very good which made alignment straightforward with a good instruction and maintenance manual.

As the machine is built to a price the mechanical construction is not particularly solid, but more substantial machines cost very much more.

Hugh Ford

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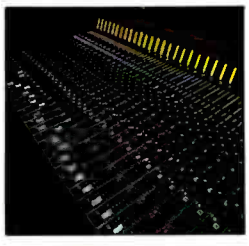

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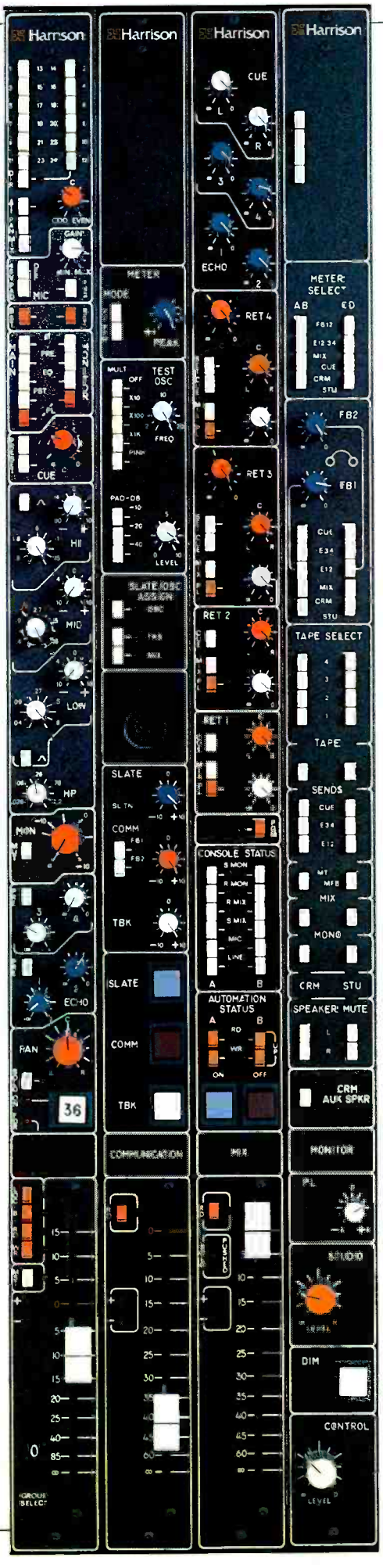

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