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AUDIO RECORDING

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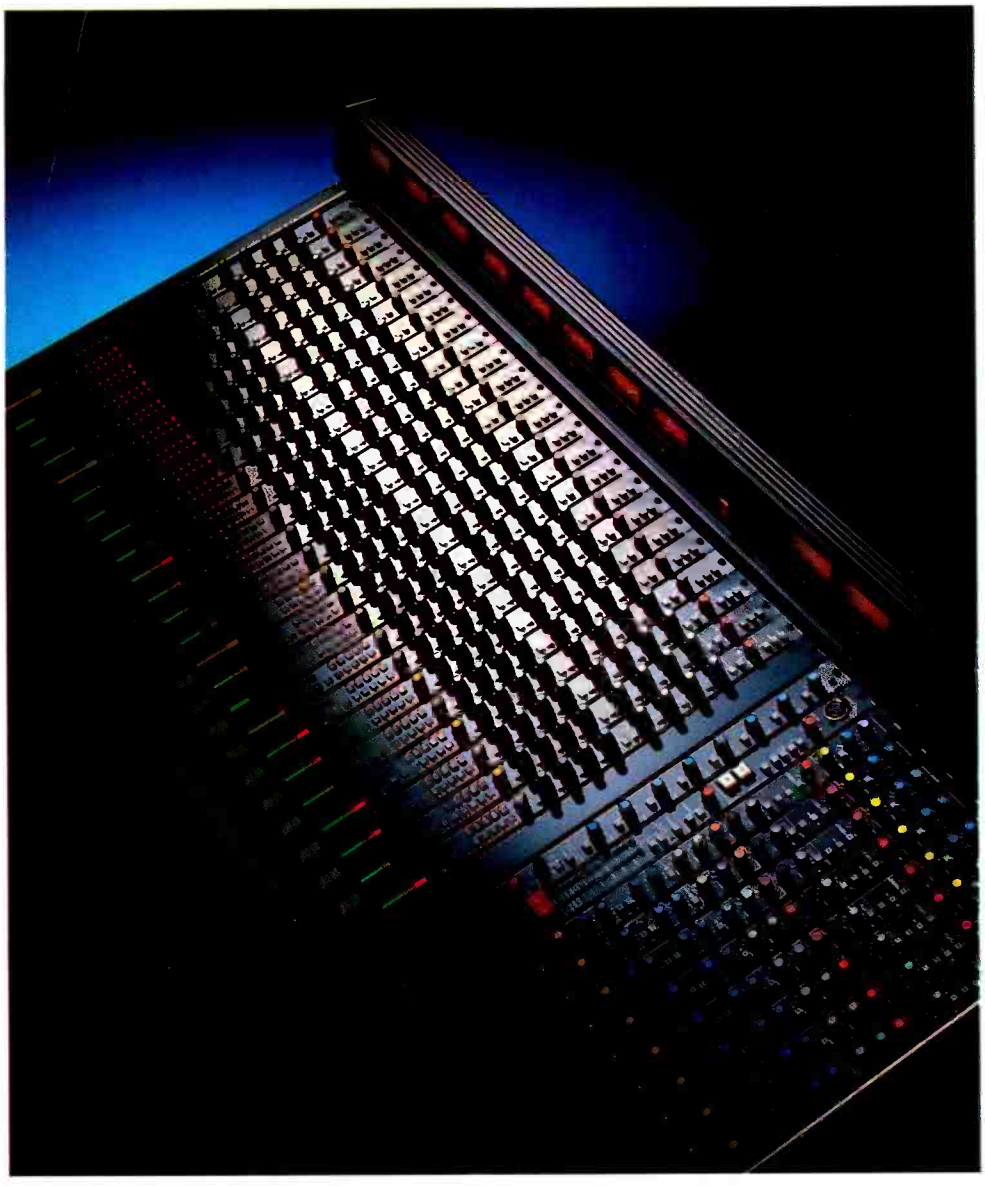

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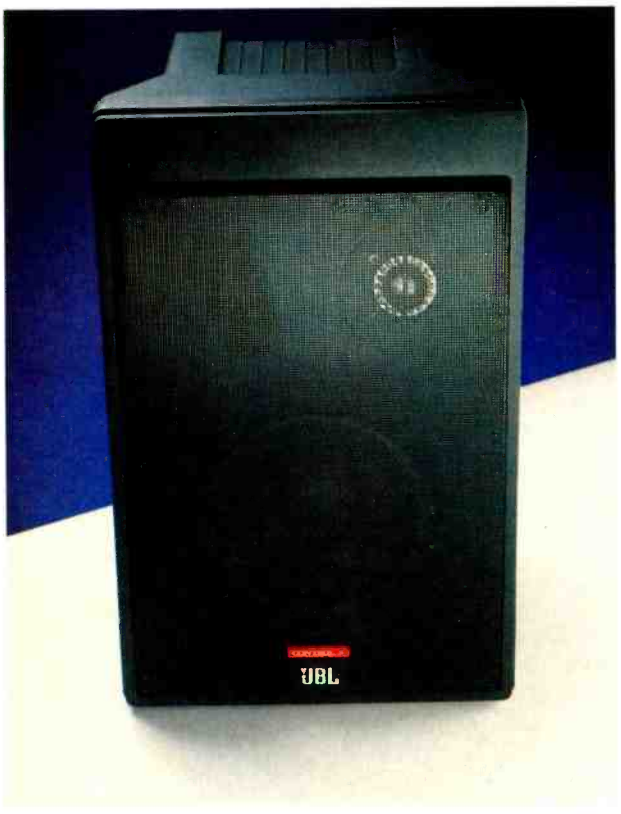

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EDITORIAL
Editor: Keith Spencer-Allen
Production Editor: Ann Horan
Production Assistant: Carrie Love
US Commentator: Martin Polon
Secretary: Elaine Sweeney

ADVERTISEMENTS
Sales Manager: David Reynolds
Copy Controller: Sue Chambers
Advertisement Production: Chris Baillie
Executive Ad Manager: Steve Haysom
USA Advertising/Commercial Manager: Robert J. Sinnott, 2 Park Avenue, 18th Floor, New York, NY 10016. Tel: (212) 779-1212

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Director: Douglas G Shuard

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Circulation Manager: Sally White

Editorial and advertising offices: Link House, Dingwall Avenue, Croydon CR9 2TA, UK
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EDITORIAL

Audio Recording again! There appears to be a pattern developing. Last year we experienced analogue fighting back with the availability of effective new noise reduction systems. The year before it was excitement over hard disk recording systems. The year before that we had the digital multitracks. This year looks like it is the return of digital recording, this time striking from two separate fronts. DAT has made tremendous inroads into the professional market with only a minimal amount of manufacturer support. Digital multitrack is here in its Phase Two guise—the 48-track with at least two new players poised to enter the multitrack arena.

A few years ago we were very worked up about the prospect of an ever increasing proliferation of digital recording standards particularly in the multitrack area. It did seem at the time that there was a prospect of a number of other formats possibly at much lower prices although these have not materialised. Outside the Akai system, which would appear to have a particular market niche, we are left with what seems a stable situation with the DASH and PD formats competing against each other and finding their own adherents. Although the fact that these machines are of incompatible formats is of course annoying and does fragment the largely unified world standards that we have come to love in the analogue domain, the advent of converters allowing direct digital format-to-format copying has made what seemed a terminal problem two years ago, now just annoying. The possibility of the MADI interface will further ease the problem to the extent that problems will be of the level of copying 32-track to 24-track format and vice versa. We had the same problem in analogue between 16- and 24-track and managed to live with that. If we can keep the situation stable in this way then it will be best for the industry as a whole. Certainly the digital multitrack situation is a minor problem when you look at the exploding format situation in the video world.

DAT is of course a world standard and in this way is an improvement on the *F1* format where of course there were NTSC and PAL versions—so that is one less.

If there is a possible danger area it has to lie with the hard disk recording systems. The format of disk or data storage used on the hard disk within the system is largely immaterial, although there is now pressure to consider interchangability of data between different systems. It is in this area that there is possibility for as many formats as there are different systems.

It is very early days in this area. The recordable optical disk is in its early days although Compusonics/Ferrograph and NED are already successfully using certain types albeit for interchange of data. The computer industry, from which hard disk technology has descended, has still to standardise on such systems itself and as such it is unfair to expect audio companies to be ahead of external standards. There is also the problem of what data would we wish to change between differing systems.

These are, however, aspects for discussion and it would, I think, be wise to encourage a push towards standardisation in optical disk formats in the future if even only from the point of view that the audio industry tends to look for a longer life in equipment standards. If the whole industry uses at least the same type of interchangable disk, then we will have far more clout and possibly push a manufacturer to continue production of a type of disk beyond the limited life that the computer industry may have for such an item.

Keith Spencer-Allen

Cover: AMS Logic 1

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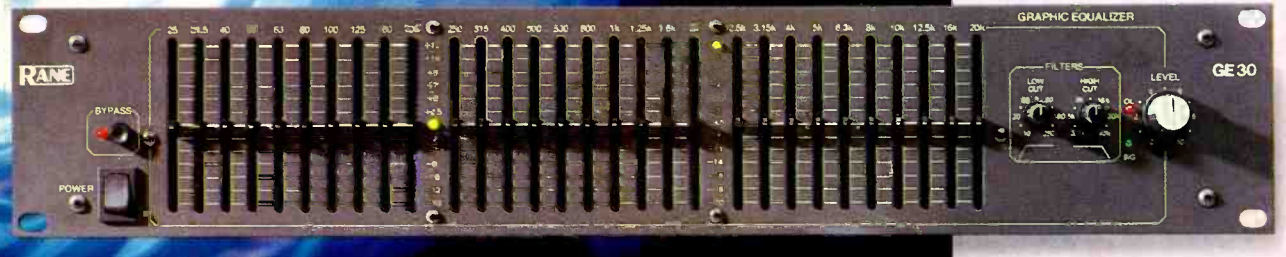

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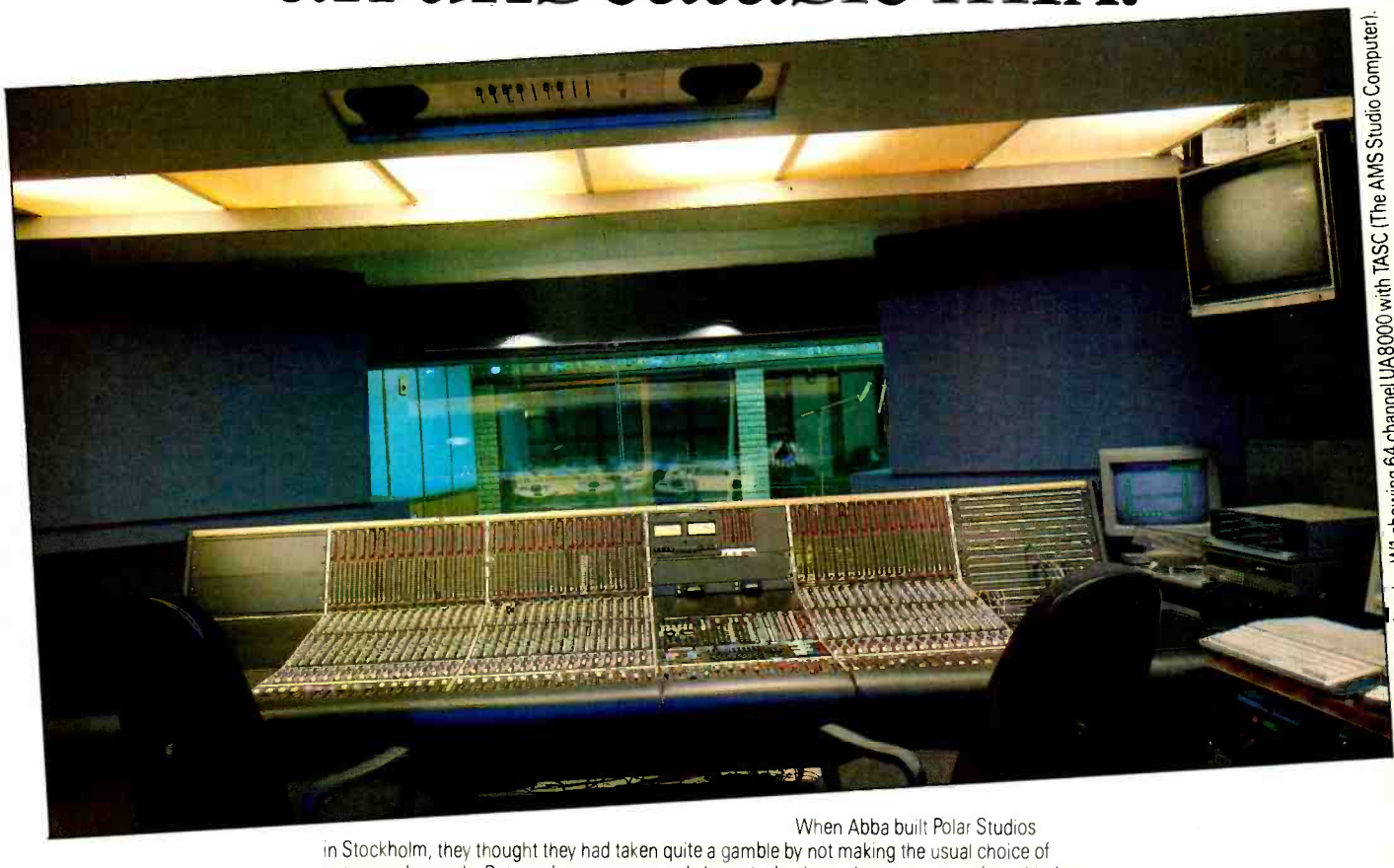

Odyssey Studios, London W1 showing 64 channel UA8000 with TASC (The AMS Studio Computer).

When Abba built Polar Studios in Stockholm, they thought they had taken quite a gamble by not making the usual choice of automated console. But word soon got around about the business they were attracting with the Calrec UA 8000.

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When EMI Abbey Road heard rumours about the audio performance of the UA 8000, they did some in house tests. They were sufficiently impressed to send important members of their team to PUK Studios in Denmark. Just as history has been made at Abbey Road before, it is now being made on a Calrec UA 8000 with TASC (The AMS Studio Computer).

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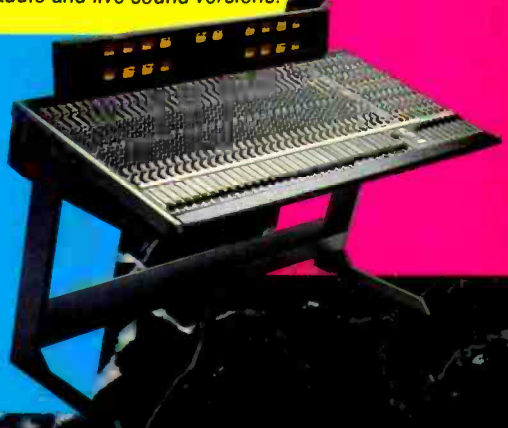

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Balance	> 60dB to 10kHz
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Typically	0dBu Input 1KHz 0.002%
	+10dBu Input " 0.005%
	+20dBu Input " 0.01%
Noise	better than 80dBu below +4dBu output
Frequency response	−3dB at 120 kHz
Power + and − 15 volts, 200ma (average, depending on L.E.D.s in use)	

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NEWS

DASH update announcement

Three signatories to the DASH digital format recently gave an update on their plans for the format in simultaneous (almost) announcements in Japan, UK and USA. First they looked at the current state of the format with the recent introduction of 2-channel DASH machines and current sales figures in excess of 400 multitrack machines.

The Teac Corporation announced that they will be showing a prototype 24-track DASH machine before the end of this year. The machine will be based entirely on Teac proprietary development with the exception of the heads and LSI, which were developed in common with all the DASH companies.

Sony announced the introduction of the updated *PCM-3324A* digital multitrack, which has already been covered in greater detail.

Sony and Studer announced the successful completion of all the joint engineering work necessary for establishing upwardly compatible 48-channel DASH based on the same ½ inch tape width. Both Sony and Studer have confirmed their intention to produce ½ inch 48-channel recorders at the soonest possible date. At least one product announcement will be made before the end of the year. These machines will be introduced by all three companies although they have said they feel 24-channel machines will still be the standard machine for flexibility and cost. The design will allow all 24-channel DASH tapes recorded to be extended to 48-channel on the new range of recorders by the addition of a further 24. The original 24 will remain replayable on a standard DASH 24-channel machine.

The new generation of machines have certain key component areas that have been jointly developed and these will be used in all the machines—the heads, signal processing and interfacing LSI will be in common while all other areas of product development remain strictly independent. It is hoped that this will lead to fully compatible recorders with radically different design characteristics for open competition.

Contracts

● **Sony Broadcast** have announced sales of more than 30 *PCM-3402* DASH 2-tracks in Europe since March. Sales are strong in Eastern Europe with Moscow-based Gostel Radio and Bulgarian Radio both purchasing a pair. In the UK hire company Audio FX and Pickwick Video have both bought machines. On the DAT side European pro-audio sales of the *PCM-2500* are over 500 units since its introduction and there are 150 *PCM-2000* portables currently on order.

● Recent contracts for **SSL** include a 64-channel U-shaped *SL 4080 G* series for Peter Gabriel's Real World Studios, Wiltshire, UK; a 48-channel *SL 4056 G* series for Excalibur Studios, Milan, Italy; a 48-channel *SL 4056 G* series with *Total Recall* for Metalworks, Ontario, Canada; a 52-channel *SL 4056 G* series with *Total Recall* for Arco Studios, Munich, West Germany; an *SL 4056 G* series with 32 mono and eight stereo channels to Little Mountain, Vancouver, Canada; two 56-channel *SL 4056 G* series consoles to Eurythmics' Dave Stewart for The Church Studios in London and Los Angeles; an *SL 4040 E* series with 32 channels to Southern Tracks, Atlanta, USA; an *SL 4032 G* series with 24 mono and eight stereo channels to Tokyo Broadcasting Systems, Japan; an *SL 6040 E* series and *SL 5600* 124 channel mainframe with 96 channels, *G* series computer, *Total Recall* and moving faders (the largest *M* series ever) to Walt Disney, Florida, USA; and an *SL 6044 E* series with 40 mono and four stereo channels to Swedish Television, Gothenburg.

Soundcraft Magnetics buyout

Soundcraft Electronics have announced a management buy-out of their tape machine manufacturing subsidiary, Soundcraft Magnetics. The newly formed company, Saturn Research Ltd, will be headed by Magnetic's Steve Buchanan, Cliff Lawrence and Jenny Street all of whom were closely involved in the development of the Soundcraft *Saturn* multitrack. The company will be based at new premises in Islington, London (Unit 3a, 6-24 Southgate Road, London N1 3JJ. Tel: 01-923 1892). Julian Blyth has joined the company in a general management capacity.

Saturn sales and servicing will continue to be supported worldwide by the Soundcraft distribution network. On the products side, Saturn Research intend to concentrate on the continuing development of the *Saturn* multitrack as well as a new generation of advanced multitracks.

DIE'88 programme announced

The 1988 Digital Information Exchange programme has been announced and continues to be a broadly based approach to digital audio. This takes place over three days November 22nd, 23rd, and 24th at the Private Members' Suite at London Zoo and the organisers have promised a firm emphasis on practical technical solutions rather than a speculative type of approach. The event is sponsored by UK dealer/distributor HHB Hire & Sales and Sony Broadcast though the participating presentations come from a wide range of companies such as Studer, Mitsubishi, Soundtracs, BBC TV, Neve, AMS/Calrec, Quantel/SSL and Sony.

Speakers include John Watkinson, Jeff 'Skunk' Baxter and Dr Roger Lagadec. Following increased support from the sponsors, registration fees have been reduced and application registration forms are available from the Digital Information Exchange, PO Box 46, London SW6 7BU, UK, or tel: 01-381 1991. As associate sponsors of the event, *Studio Sound* and *Pro Sound News (Europe)* will also be carrying registration forms within preceding issues.

In brief

● Group chairman of **Klark-Teknik**, Philip Clarke announced last year that Klark-Teknik plc would become a holding company controlling and co-ordinating the group's activities. As from August 1st, 1988 trade will be conducted by Klark-Teknik Research Ltd, which is a wholly owned subsidiary of Klark-Teknik plc. The decision to form a holding company and to revert to the earlier name of Klark-Teknik Research Ltd is part of plans for future expansion of the group.

● During the APRS exhibition in London **Neve** were running a competition that required the entrant to guess the number of components on a Neve *Prism* equaliser module. The winner was a Mr Scott from BFBS and the correct number of components—804.

● **Agfa** have presented engineers Ivan Sharrock and Bill Rowe the Silver Spool Award for their work on the soundtrack of the motion picture *The Last Emperor*. The film has also won an Academy Award for Best Sound at the 1988 Oscar ceremony.

● Amsterdam-based pro-audio dealer **Special Audio Products** are currently celebrating 10 years in business. To this end they are organising three in-house technical seminars and a small exhibition. The first on tape machines will be over by the time of publication of this issue but the following events on microphones and mixers take place on October 20th-28th and November 17th-25th respectively. More information from Special Audio Products BV, Marius Bauerstraat 233 C, 1062 AK, Amsterdam.

● New **Anchor** distributors have been announced by Executive Audio: Jebrimont c/. Princesa 31, 28003 Madrid, Spain. Tel: 34 1 241 92 17 becomes a second Spanish distributor; Frei Audio, Av Estado da India 4-30 Dto, Lisbon, Portugal, tel: 351 1 251 6870, represents Anchor in Portugal; for France, Societe Audio Sud SARL, Route Laverune, Montee Du Terral, 34430 St Jean de Vedas, tel: 33 67 27 43 05, will handle the portable sound system; APM Werbung und Audiovision, Postfach/Aeschweg 30, CH-3302 Mousseedorf/Bern, Switzerland, tel: 41 31 85 -07 95, will handle the whole range in Switzerland and finally, the Turkish market is to be serviced by Akhan Electronics Inc, Kucuk Bebek Caddesi No 12/1, 80810 Bebek, Istanbul, Turkey, tel: 90 1 165 9790.

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NEWS

Agencies

• Dyer Audio Systems have been appointed the UK distributor for the **Eela Audio** range of broadcast orientated products.

• **DDA** have set up a UK distribution system for their smaller *D, S* and *Q* series consoles. Suppliers of these consoles now include Paul Farrah Sound, London; The Music Company, Bradford; Electromusic, London; DRV in the West Country, as well as Stirling Audio who also are sole UK distributor for the AMR 24 and *DCM 232* consoles.

• **Apogee Electronics Corp** have recently appointed European distributors for their line of digital filters. France, Hilton Sound; Netherlands, Selectronic; Italy, Audio Equipment; Norway, Lydrommet AS; West Germany, Klotz Electronics. Distributors in other markets include Editron in Australia; J-MAR in Canada, AV Craft and Sound Creators Inc in Japan.

• **Allen & Heath** have announced the appointment of Luff Light & Sound as their South London distributors. Luff are a pro-audio dealer and PA sound equipment rental company located at Gautrey Road, London SE16.

• As of June 1st, Autograph Sales Ltd will be handling worldwide sales and marketing of all Cadac products manufactured by **Clive Green & Co.** This arrangement coincides with a move to a purpose-built factory for Cadac products with improved facilities for future manufacturing and product development.

• London dealer The Synthesizer Company have recently been awarded dealerships for **Apple** UK (as full Apple Dealer) and Larking Audio (for **Soundtracs** mixing consoles). TSC believe they are the only UK full Apple dealer specialising in the music industry and have opened a dedicated showroom for these products.

• **Renkus-Heinz** have appointed Vector Marketing exclusive distributors for their loudspeaker systems in UK and Ireland. The company is based at Empress House, 70 Blackstock Road, London N4 2DR. Tel: 01-359 1298.

• **Soundtracs** have split the distribution of their mixing console range into two categories: recording, video post-production and other editing/production applications; and sound reinforcement—mobile or installed. In the UK, Larking Audio continue to distribute the recording consoles; London-based Shuttlesound have recently been appointed to distribute the sound reinforcement products. In Greece, Sound Centre, 22 Tosita Street, Athens 10683 will handle sound reinforcement while Pulse Inc, 35 Egnatia Street, 546 30 Thessaloniki will import the recording and editing consoles. A similar arrangement exists in Holland where sound reinforcement is the responsibility of Iemke Roos, and recording products remain with PAC.

• **BSS Audio Ltd** have appointed the following companies as exclusive distributors in what are now rapidly expanding territories for them: Australia: ATT Audio Controls Pty Ltd, 439 Gaffney St, Pasco Vale, Victoria 3044, tel: (03) 379 1511, fax: (03) 379 9081; Eire: Audio Engineering, 10 Upper Grand Canal Street, Dublin 4, tel: (0001) 686292; and Holland: TEM Holland, Kalskoven 8, 4825 AM Breda, tel: (076) 812872.

• London-based pro-audio distributors Music Lab have become sole UK distributor for the **Neotek** range of mixing consoles.

• Wiring systems suppliers **Anixter** have opened a new sales facility at 48/50 St John Street, London EC1M 4DT. Tel: 01-490 1522. Fax: 01-251 2469.

• Harman Studio Systems have taken on the exclusive UK distributorship of **Esoteric Audio Research** valve products. Harman are situated at Mill Street, Slough, Berks SL2 5DD. Tel: 0753 76911.

• The Sound Department Ltd in London are now sole UK representatives of **MS Audiotron** products, which include the *MCA-Combo* computer-controlled audio system. They can be contacted at Askew Crescent Workshops, Askew Crescent, London W12 9DP. Tel: 01-749 2124. Fax: 01-749 8789.

• HW International are now sole distributors for **Koss** headphones in the UK and are based at 3-5 Eden Grove, London N7 8EQ. Tel: 01-607 2717. Fax: 01-609 0295.

• Feedback Test & Measurement have been appointed by **Grundig** to distribute their oscilloscopes and complementary monitor and TV testing equipment. Feedback T&M operates from Park Road, Crowborough, East Sussex TN6 2QR, UK. Tel: 0892 653322. Fax: 0892 663719.

• **Fane Acoustics** glass fibre horns and flares, previously distributed by Acoustic Sound Systems and Adam Hall will now be distributed exclusively by Fane. UK: from Fane Acoustics, 286 Bradford Road, Batley, Yorks WF17 5PW, UK. Tel: 0924 4766431. Fax: 0924 471799. USA: Fane Acoustics, 872 Thomas Drive, Bensonville, Chicago, IL 60106, USA. Tel: (312) 766-6696. Fax: (312) 766-7397.

• **McKenzie Acoustics** have appointed Sound Music Products, Unit 15T, Askern Industrial Estate, Moss Road, Askern, Doncaster, South Yorks, tel: 0302 702 512, fax: 0302 702496, to handle UK distribution of their chassis, enclosure and amplifier products in an effort to penetrate music shops. No existing agreements with wholesalers, distributors and OEM clients are affected by the appointment.

New APRS guidelines on hired-in equipment

Following a review of certain problems arising from equipment hire arranged by clients (rather than studios), the Association of Professional Recording Studios have endorsed new guidelines that they recommend APRS member studios to observe. In recent cases where clients had hired-in equipment for studios to use, some items provided were lacking in suitability for the job or reliability. The APRS believe that this shift in hiring practice ought not to become the norm as it would lower the quality of the studio's service, undermine the professional relationship of studio and client and finally, for reasons outside the studio's control, jeopardise the success of recording projects. Only when the studio takes responsibility for the whole package, ie its own facilities plus the hired-in equipment, can it effectively ensure that technical difficulties do not disrupt recording. The APRS now urges its members to adhere as far as possible to previous practice where the studio was responsible for all equipment used in a project, whether owned or hired. The APRS also point out that the insurance cover of the studio may not extend to equipment hired-in by third parties.

In brief

• **Matinee Sound and Vision**, Reading, UK have completely refurbished their audio post-production facilities and installed a computerised music workstation enabling direct editing and manipulation to video achieving sync to picture in minutes. They have also recently become APRS members.

• **Air Studios** recently refurbished the control room to Studio One, the Neve console extended by another 16 full channels by Rupert Neve using Focusrite EQ modules. The desk now offers 72 channels. A new machine bay was also installed to take two Mitsubishi *X850* digital recorders. A new video monitoring system and cable television were installed in the private lounge.

• **Green Room Productions Ltd** have announced their intention to open a US office in early 1989, based in New York State, and fully equipped for classical music recording. Tony Faulkner, founder and managing director of the London-based company said that facilities will include a wide range of microphones including vintage types and a full range of digital audio equipment.

• **Spaceward Studios** in Cambridgeshire, UK, have closed while planning a rethink in their recording process with the advent of new technology for the 1990s, and will be reopening 'with an unbeatable package'.

• **Harrison Systems** has announced an expansion of its dealer network with new appointees including Audio Video Research of Massachusetts; Continental Far East Inc, Tokyo; CSF ve Isik Sistemleri, Istanbul; Ernatec, Brussels; Interface Audio, Atlanta; Omni Technology, Fort Lauderdale; Pro Sound Equipment, Jamaica; and Seki Electronics, Seoul, Korea.

• Special Audio Products of Amsterdam have been appointed distributor for **Lyrec** equipment in the Netherlands as well as pro-dealers for **Yamaha** studio equipment.

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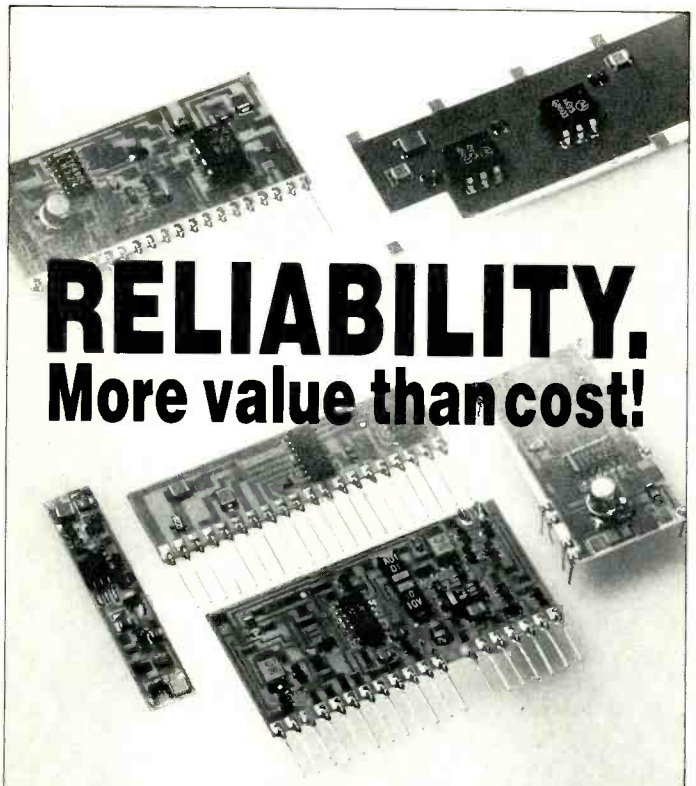

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ALESIS Micro Limiter £108
ALESIS MMT-8 Midi Sequencer £260
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ALESIS S-150 2x15 Band Graphic £156
ALESIS S-310 31 Band Graphic £156
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ALESIS Microverb II Ex-demo £155
FOSTEX B16 Boxed, Mint £2,495

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NEWS

The under 24 hour CD

Shape Optimedia and the Newport Classic record label recently collaborated to achieve a fast turnround of CDs. Newport Classic digitally recorded the performance of pianist Michael Ponti at the Newport Festival on Rhode Island on the night of Friday 22nd July. At the end of the concert, the recording was digitally edited, duplicated and then driven to the Sanford, Maine, CD manufacturing plant of Shape Optimedia Inc. In the early hours of Saturday morning the CD replicating process was begun. Less than 11 hours later, 500 CDs were finished and handed over to the record company who then distributed them that night at the Festival while other copies went into the record stores. Newport Classic planned to produce four more 24-hour CDs during the Festival and are contracted to repeat the operation for the next five years.

Exhibitions and conventions

September 23rd to 27th International Broadcasting Convention '88, Metropole Conference and Exhibition Centre, Brighton, UK.
September 29th to October 3rd International Broadcasting and Telecommunications Show, South Pavilion, Milan Trade Fair, Italy.
September 29th to October 3rd MITAS '88 Show of Technology Equipment and Services for Entertainment (including discotheques, ballrooms, theatres, cinemas, congress centres and organisations), South Pavilion of the Milan Trade Fair, Italy.
September 29th to October 3rd 3rd International Broadcasting and Telecommunications Show (IBTS), MeM-Mediterranean Market (International Market of Audio/Video Programmes and Services), South Pavilion of the Milan Trade Fair, Italy.
September 30th to October 9th BBC Radio Show, Earls Court, London, UK.
October 5th to 11th Photokina, Cologne, West Germany. Contact Köln Messe, Messe- und Ausstellungs-GmbH. Tel: (221) 821.1. Fax: (221) 821-2574.
October 11th 13th Sound Broadcasting Equipment Show, Albany Hotel, Birmingham, UK. Admission by invitation. Contact: Point Promotions. Tel: 0734 583086.
October 17th to 19th Entertainment '88, Harrogate Exhibition Centre, Harrogate, UK. Exhibition organiser Peter Scull may be contacted through Brintex Ltd, 178-202 Great Portland Street, London W1N 6NH. Tel: 01-637 2400.
November 3rd to 6th 85th AES Convention, Los Angeles Convention Center and Los Angeles Hilton, Los Angeles, CA, USA.

1989

January 21st to 25th MIDEM, Palais des Festivals, Cannes, France. Contact: Peter Rhodes, International Exhibition Organisation Ltd, 4th Floor, 9 Stafford Street, London W1X 3PE, UK. Tel: 01-499 2317.
February 21st to 22nd Sound '89, Heathrow Penta Hotel, London, UK. Contact: Sound & Communications Industries Federation, Slough, Berks. Tel: 06286 67633. Fax: 06286 65882.
March 7th to 10th 86th AES Convention, Congress Centre, Hamburg (CCH), AM Dammtor, D-2000 Hamburg, West Germany.
April 28th to May 2nd NAB, Las Vegas, USA.
June 7th to 9th ARPS 89, Olympia 2, London UK. Contact: APRS Secretariat. Tel: 0923 772907.
June 17th to 23rd ITS Montreux, Switzerland.
October 3rd to 9th World Broadcasting Symposium, Geneva, Switzerland.
October 4th to 7th Broadcast 89, Frankfurt, West Germany.

1990

March 30th to April 3rd NAB, Atlanta, USA.

AES 85th Convention plans announced

Basic plans for the Los Angeles Convention have been announced by convention chairman, Dr Marshall Buck. The core committee have been announced as Marshall Buck, chairman; Ron Streicher, vice-chairman; Eric Benjamin, papers chairman; Don McCroskey, workshops chairman, Les Harrison, facilities chairman; Shelley Herman, banquet chairman; Norm Marshank, exhibitor liaison; Van Webster, special projects co-ordinator; Ron Bennett, publicity officer; Judy Bennett, graphic arts; Jeff Haberman, technical tours chairman; and Arthur Gruber, AES treasurer. The facilities will be as for the 81st Convention with the exhibits at the LA Convention Center and the live sound demonstrations and papers/workshops at the LA Hilton a few blocks away with a shuttle bus running between the two.

The theme chosen for this year is 'A century of technology in the service of artistry' to reinforce the interdependency of the creative and technological sides of the audio industry and to celebrate the 100th anniversary of recorded sound.

Address changes

- **Musicomp** have relocated and are now based at 3 Petley Road, London W6 9SU, UK. Tel: 01-386 8019.
- **BSS Audio Ltd** have moved to Hertfordshire. Their new address is Unit 5, Merlin Centre, Acrewood Way, St Albans, Herts AL4 0JY, UK. Tel: 0727 45242. Fax: 0727 45277.
- **Whiteley Electronics Ltd** have moved their audio manufacturing division (RAM, Dynamix and Tantek) from Marham in Norfolk to the main factory in Nottinghamshire. The new address is Victoria Street, Mansfield, Notts NG18 5RW, UK. Tel: 0623 421300. Fax: 0623 420484.
- **McKenzie Acoustics** have relocated both offices and manufacturing to 286 Bradford Road, Batley, W Yorks WF17 5PW, UK. Tel: 0924 477102. Fax: 0924 471799.
- **Studiospares** have moved to 61/63 Rochester Place, Camden Town, London NW1 9JU, UK. The telephone numbers are unchanged: 01-485 4908; order desk: 01-482 1692.

Half-rack standard proposed

An ad-hoc group of manufacturers met at the NSCA Convention earlier this year and began the process of developing a mechanical and electrical standard for the increasingly popular half-rack format pro-audio equipment. The working name for the standard is HR.

Like the EIA 19 inch rack standard, the aim of the HR standard is to assure compatibility in mounting half-rack products from different manufacturers. The standard will provide a method by which two 1¾ inch high modules may be secured together horizontally and installed in a 19 inch rack, or mounted vertically in a 5 U rack space (8.75 inch) frame. A secondary goal is to provide a universal low voltage powering method which will permit all equipment so powered to be exempt from UL listing requirements, with all HR units using identical supply voltages and connectors.

Companies participating in the HR Standard Committee so far are Applied Research & Technology (ART), Ashly Audio, Furman Sound, Rane Corporation and Symetrix. The committee plans to publish its standard and make it available to all interested manufacturers. To be included on the HR standard mailing list contact Jim Furman at Furman Sound, 30 Rich Street, Greenbrae, CA 94904, USA.

Courses and seminars

September 20th to 22nd Digital Processing of Signals in Communications, Institution of Electronic and Radio Engineers, Loughborough University of Technology, UK.
November 3rd to 6th Reproduced Sound 4, Hydro Hotel, Windermere. Contact: Institute of Acoustics, 25 Chambers Street, Edinburgh EH1 1HU, UK.
November 6th Stereo Sound for Television, BKSTS, London WC1. Contact: Anne Fenton, tel: 01-242 8400.
November 22nd to 24th Digital Information Exchange, Private Suite, London Zoo. Contact: DIE, PO Box 46, London SW6 7BU. Tel: 01-381 1991.

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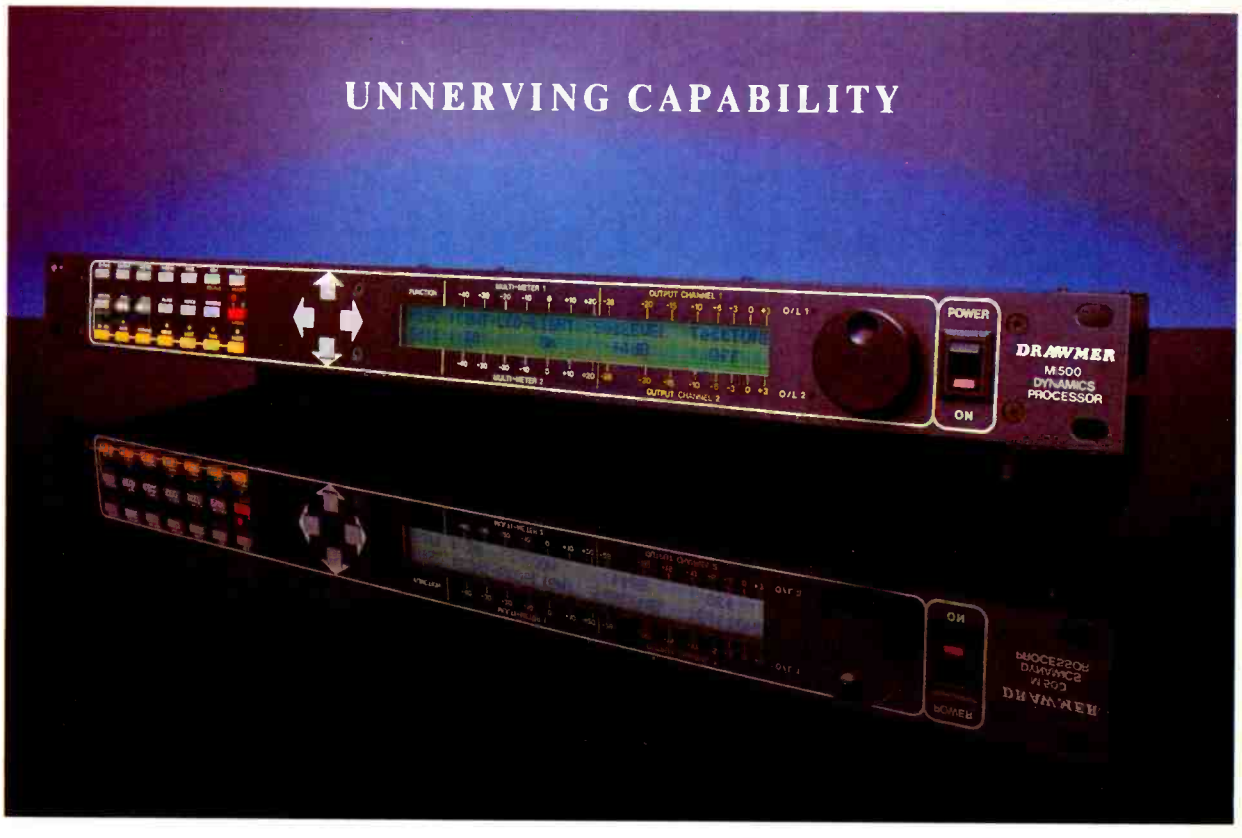

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NEWS

New pro audio show for Asia

The Business and Industrial Trade Fairs Group of Hong Kong have announced their intention to sponsor a new trade show aimed at the Far East/Pacific Basin pro-audio market place. To be known as 'Pro Audio Asia '89—The International Trade Exhibition for Professionals in the Broadcast, Recording, Public Address, Contracting, Installation and Duplicating Industries', the show will take place at the Hong Kong Convention Centre, July 6th-8th 1989. Attendees are expected from India, Japan, New Zealand, Australia and neighbouring countries of Hong Kong. Further details can be obtained from: North America fax: (818) 709-6773 (USA); UK & Europe fax: 0869 38040 (UK); and tel/fax: (03) 235-5961 (Japan).

BBC Research and Real World Research agreement

Dr Bruce Moffat, head of the BBC Engineering Research Department at Kingswood Warren has signed a co-operative agreement with Real World Research covering the development of hardware and software for the newly launched Real World Research *Audio Tablet* random access audio editor. The BBC has already ordered six *Tablets* for Broadcasting House and the Maida Vale studios. The research agreement will integrate the BBC's experience in broadcast random access techniques and research experience into products described as being both attractive to broadcasters and recording studios. The first results of the venture will be on demonstration at the BBC Engineering stand at the IBC Convention, Brighton, UK.

Contracts

• BBC Television Centre has taken delivery of their second **Calrec** Assignable console. Installed in Studio Three, the 96-channel console is the first of two similar consoles to be supplied and brings the total number of Calrec consoles at TV Centre to nine.

• **Musicomp** have announced the sale of a digital multitrack converter type *MIS 3248* to General Traders Ltd of Japan for use with a Sony *PCM-3324* and a Mitsubishi *X850*. The package included an *MPS 3202* Patch Box.

• Dyer Audio have announced the sale of 32 channels of **telcom** *c4e* noise reduction to the UK National Theatre in the form of two 12-channel units and one 8-channel. A further 4-channel telcom unit has been supplied for their in-house studio applications.

• **Ambassador Television** of Pasadena, California, a TV production facility associated with the Worldwide Church of God have purchased an NED *Synclavier* digital audio system and an 8-track *Direct-to-Disk* recorder.

• Videosonics have ordered a custom **Trident** *80 VP* console incorporating an AMS *AudioFile* as well as specific video features through Pro-Britro who are also supplying a third 10-channel **Sonosax** *SX-S* portable console to Thames Television.

• Odyssey Studios, a London two-room facility have installed a 48-channel **Calrec** *UA8000* mixing console with *TASC* automation in their Studio One.

Contracts

• **DDA** have announced sales through Stirling Audio Systems of *AMR 24* consoles to musician Matthew Fisher (ex-Procul Harum), two consoles to Marcus Music for their new London studios, one to Mole Studios in Bath, and one to Berwick Street Studios in central London. A 36/24 is on order for Solid Gold Studios in Singapore.

• **Amek** *Classic* consoles have been supplied to Kratky Film, Prague; TV New Zealand (x3) and RPS, Nottingham, part of the Chrysalis Group in their outside broadcast scanner vehicle. The RPS contract also included an Amek *BCII* for the on-board editing position.

• Anvil have become the first UK dubbing studio to be fully equipped with **Dolby** *SR* with the delivery of 48 tracks of *SR* in three *XP* racks.

• London-based post-production facility **Silk Sound** have ordered a Lexicon *Opus* digital post-production system from FWO Bauch.

• Following Harman UK's APRS introduction of the *REIMS* mixing console six orders have been announced. The first console goes to producer/composer Simon Franglen, closely followed by systems for keyboard player/producer Adrian Lee, Sniff 'n' the Tears guitarist Loz Netto for his The Country House studio, songwriter and film/television composer Keith Hopwood, Glentham video post-production house and 'a well known live venue'.

People

• Martin Capp has joined **DDA** as international sales manager and his responsibilities will include overseeing the DDA distributor network. Capp was previously UK sales manager for TEAC UK. John Coles has been appointed production manager joining DDA from Audio Kinetics.

• **RG Jones Studios** of Wimbledon, London, have announced the appointment of Irene Hogan as studio manager. She was previously at Eden Studios where she undertook both engineering and administrative tasks.

• **Solid State Logic** have announced the appointment of the following to the board of directors: Antony David, formerly head of sales becomes sales director; Chris Jenkins, becomes director of product development, having previously headed that department; head of manufacturing Mike Kervell becomes manufacturing director and Graham Longton, in addition to being company secretary at Quantel is now also finance director designate at SSL.

• Bill Aitken, formerly head of marketing at SSL has moved across to **Quantel** where he now takes responsibility for closer ties between the two companies in audio and video product development as marketing liaison manager.

• Becky David has been appointed sales and promotional marketing co-ordinator at **JL Cooper Electronics**, LA, USA. Formerly with Western Audio Sales, David will be responsible for inside sales, advertising, trade shows and office administration.

• Chris Bolton has left HHB to concentrate on servicing and developing musical talent in Zimbabwe and other 'front line' African states. As part owner of **Front Line** studios in Harare he already has extensive experience of Southern African music and musicians, and will be setting up a 20 kW PA system, which was booked up straight away for Nigerian Artists Against Apartheid and the Bhundu Boys' tour of Zimbabwe, Zambia, Botswana and Mozambique. He may be contacted in London on 01-571 5151 or in Harare on (+263) 4473 06/7.

• Phil Myers has been appointed production manager of sound broadcast equipment manufacturer and facilities company **Audionics**. Myers has worked at independent radio stations in Sheffield, Coventry and Hull as senior engineer.

• **Celestion** has appointed Martin Brady sales and marketing manager—hi-fi, with worldwide responsibility. He takes over from Peter Curry who has left the company. Professional audio sales and marketing continue to be the responsibility of Clive Bradbury. The new UK sales manager—professional audio products is Martin Claydon, previously in charge of technical liaison at Akai. His main responsibility will be for promotion and sales of the new SR systems and professional loudspeaker components. Martin Prescott has left to rejoin Martin Sound and Light, which he formed in 1982.

• The board of **Canford Audio** plc has appointed Chas Kennedy as fourth director on the board. His responsibilities include all manufactured output as well as managing all BBC contracts.

• Chris Daubney has joined **Channel 4** as chief engineer. He comes from IBA where he was an assistant director of engineering. In his new Channel 4 position he is assisted by Martin Connelly.

• Trevor Cash has left Trace Elliot where he was sales director to form **Trevor Cash International** marketing consultancy. Tel: 01-455 0053/4.

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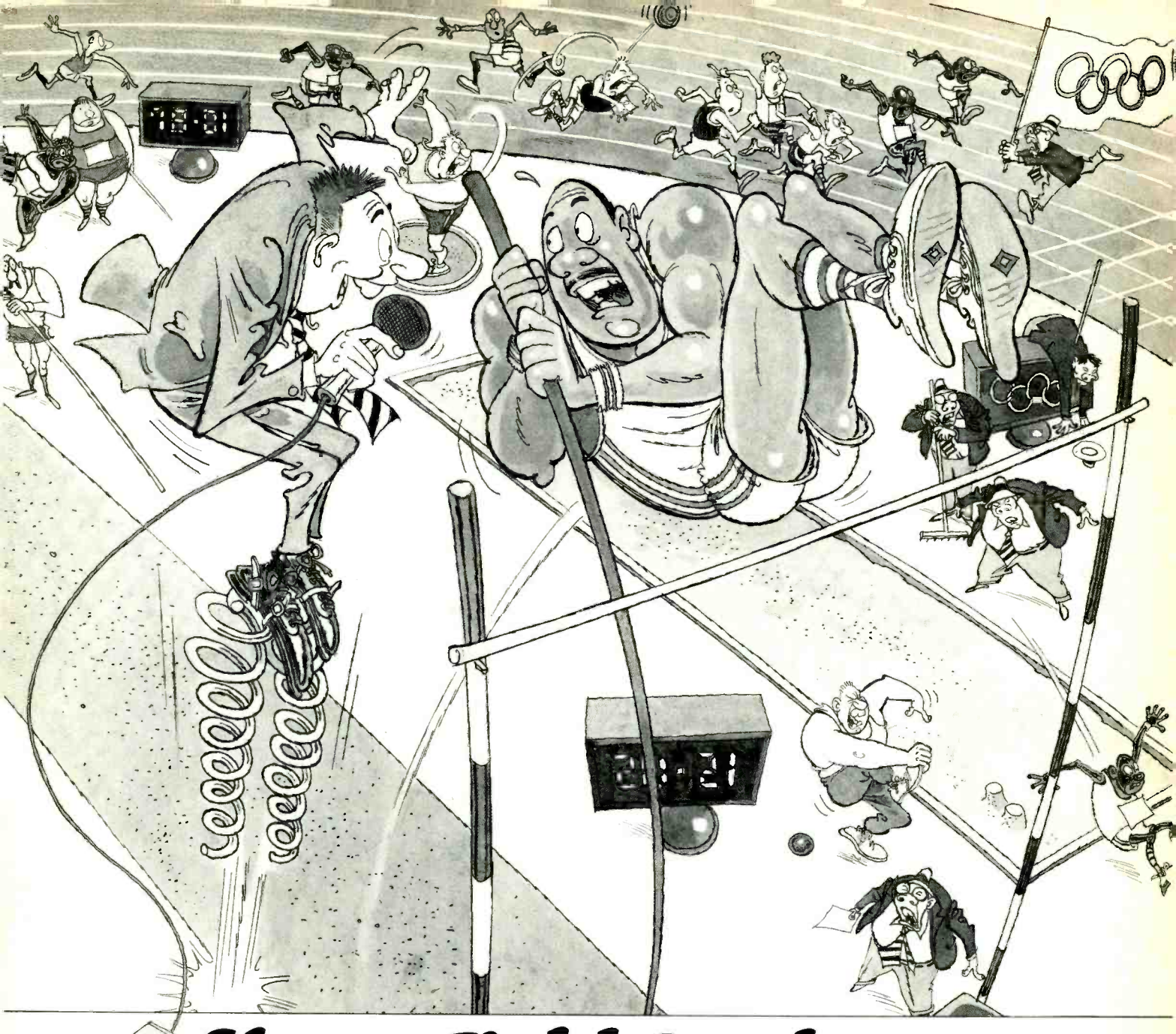

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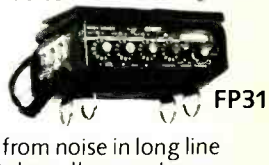

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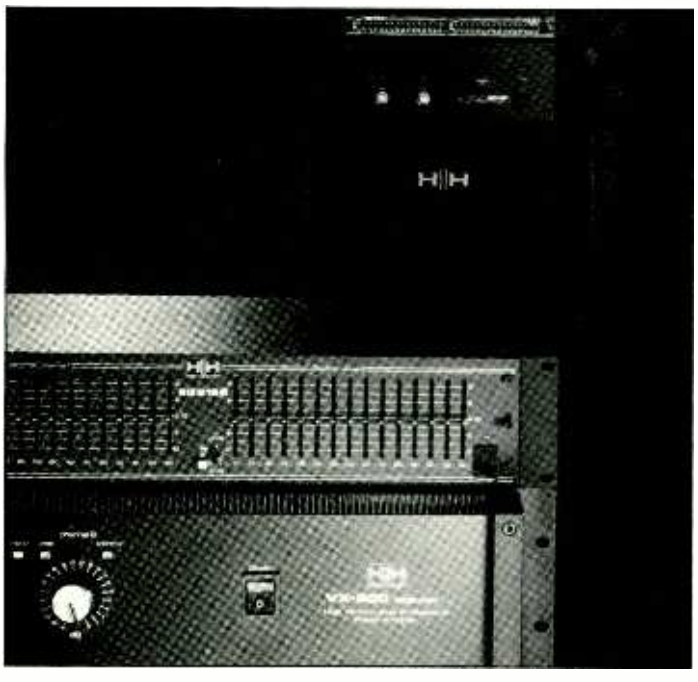
NEWS

HH Electronics graphic equalisers

HH Electronics have added two graphic equalisers to their expanding product range, the *EQ215P* and *EQ215S*. Both are rackmount twin-channel 15-band ⅔-octave equalisers, differing chiefly in their physical layout. The *P* version, designed for installations tight on space, is 1U high and employs centre-detented rotary controls giving ±12 dB of control on each band, while the *S* version uses 60 mm sliders to give the same degree of control in a larger 2U package. Both units feature 18 dB of gain control, peak LED indication and a subsonic filter, and various mounting options including flush and recessed rackmounting and optional see-through tamperproof front cover.

HH Electronics Ltd, 9 Clifton Road, Off St Peters Road, Huntingdon, Cambs PE18 7DW, UK. Tel: 0480 432227. Fax: 0480 411375.



Bäcchus C1 editing software

Bäcchus Software Systems have announced versions of their editing packages for the Yamaha *TX81Z* and *TX802/DX7II* running on Yamaha's new *C1* music computer. Taking advantage of the highest resolution available on the *C1*'s LCD display, the packages feature the expected full mouse-based window environment including the use of graphic control panels and multiple overlapping windows.

Bäcchus Software Systems, 2210 Wilshire Boulevard, #330, Santa Monica, CA 90403, USA. Tel: (213) 820-9145.

TimeLine Lynx post-production system

TimeLine's new *Lynx* post-production system joins the growing range of hardware using the ESbus remote control and interfacing format. The system comprises a keyboard control unit and a separate rackmounted system supervisor. Up to four ESbus transport control ports drive *Lynx* modules and other ESbus devices in a daisy chain configuration, and up to eight other devices such as cart machines and turntables can also be triggered by the system. The system supervisor incorporates three timecode generators and a MIDI option on this unit allows control of sequencers, synthesisers and so on from within the system. Control of the whole installation is provided by the keyboard control unit, whose features include a detailed status information display, a multi-function wheel and programmable soft keys.

TimeLine Inc, 279 Lafayette Street, New York, NY 10012, USA. Tel: (212) 431-0330.

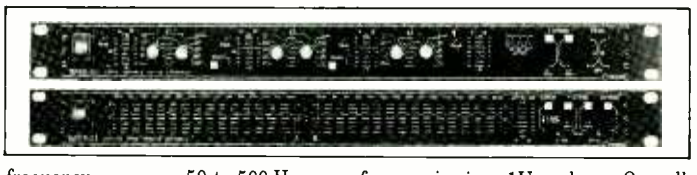
Export: Gexco International, The American Industrial Center, 317 St Paul Avenue, Jersey City, NJ 07306. Tel: (201) 653-2383. Fax: (201) 653 2386.

UK: Stirling Audio Systems, Kimberley Road, London NW6, UK. Tel: 01-624 6000.

Citronic SPX5-41 and SPX7-21 crossover and graphic EQ

New products from Citronic aimed at PA and reinforcement applications include the *SPX5-41* state variable frequency dividing network. This is a fully variable crossover system that can be used as a 2-, 3- or 4-way divider with independently adjustable crossover frequencies at each crossover point and for each channel. The three possible crossover frequency areas are 50 to 500 Hz, 200 Hz to 5 kHz and 2 to 11 kHz, and the gain in each resulting band is adjustable ±10 dB (again independently on each channel). Each band can also be phase inverted. Citronic see the unit as being of particular use to installation and commissioning engineers for fine-tuning systems to a degree unattainable with conventional plug-in crossover boards. The 1U panel can be security protected with a clear cover featuring a special tag, which cannot be removed without destroying the tag.

Also new is the *SPX7-21* dual 15-band ⅔-octave graphic equaliser, offering a choice of ±6 or ±12 dB of control at standard ISO centre frequencies in a 1U package. Overall level control is provided on each channel, together with high- and lowpass filters, a bypass switch and peak indicators.



Citronic Ltd, Bowerhill, Melksham, Wiltshire SN12 6UB, UK. Tel: 0225 705600. Fax: 0225 709639.

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NEWS

Audio Design PRODAT

Following their successful upgrades of the original EIAJ *F1/701* digital recording processors, Audio Design have launched PRODAT, a similarly-conceived series of upgrades to the established *DTC1000* R-DAT recorder. Two levels of upgrade are offered; *PRODAT 1* provides electronically-balanced inputs and outputs operating at line level, domestic and professional EBU digital inputs and outputs, recording at sampling rates of 44.1 and 48 kHz, error status indication with printout possibilities, and a copy-defeat function, while the *PRODAT 2* version adds a full *1630/1610* interface, pre-emphasis switching, video sync and a word-clock output, and the optional fitting of Apogee filters.

Audio Design, Unit 3, Horseshoe Park, Pangbourne, Berks RG8 7JW, UK. Tel: 07357 4545. Fax: 07357 2004.

Abacus Electrics ARTA 80 spectrum analyser

Abacus Electrics has launched a new addition to its range of spectrum analysers, the *ARTA 80* hand-held battery-powered analyser. Measuring 24×16×8 cm and weighing 1.5 kg, the *ARTA 80* incorporates a wide range of features including a built-in pink noise generator, inputs for a microphone and two line level sources, and an LED matrix display with a switchable range offering resolutions of 1 or 2 dB. Fast and slow response times are provided, and C-weighting is switchable on the microphone input. Thirty non-volatile memories are also provided for storing measured data and any one of these stored displays may be viewed simultaneously with the live measurements. Interfaces are included; an RS232 port allows downloading of data to a PC for archiving (software is included to enable data to be saved in an IBM spreadsheet compatible format) and a parallel printer port allows print-outs of *ARTA 80* data directly on to a dot-matrix printer.

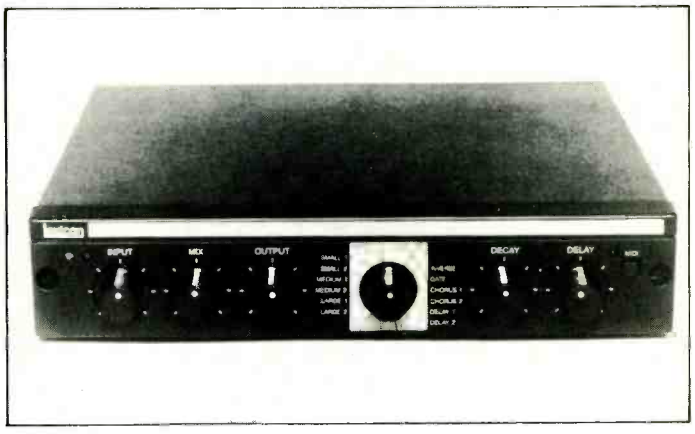
Abacus Electrics, 10 Barley Mow Passage, London W4 4PH, UK. Tel: 01-994 6477.

Lexicon LXP1 reverb

Lexicon's response to the growing market in low-cost digital reverberation processors is the *LXP1*. This offers 16 basic programs in stereo, with overall adjustable pre-delay and decay time parameters. A further six parameters are controllable via MIDI using the optional *MRC* remote controller, which is capable of controlling up to four *LXP1*s.

Lexicon Inc, 100 Beaver Street, Waltham, MA 02154-8425, USA. Tel: (617) 891-6790.

UK: Stirling Audio Systems, Kimberley Road, London NW6. Tel: 01-624 6000.



Reflexion Arts visual monitoring system & crossovers

Three new products from Reflexion Arts introduce a novel approach to checking the integrity of monitor signals right through to the drivers. Two 4-way crossovers specifically designed for the studio provide a choice of 18 or 24 dB/octave slopes, with the 24 dB/octave version having what Reflexion Arts describe as a specially contoured entry into the slope, avoiding the brick wall crossover effect of conventional units while maintaining the phase advantage of 24 dB/octave filters.

The *EPQ* visual monitoring system is an array of nine miniature CRT displays showing in detail the actual signal arriving at the monitor drivers. A central CRT shows the stereo information at the crossover inputs and loudspeaker level feeds are fed from each driver to individual CRTs displaying low, low mid, high mid and high frequencies for each channel. Time base and level adjustments are provided for the displays, and the aim is to show any overload or clipping, even on fast transients, as well as DC shifts and amplifier instability. Originally produced as a diagnostic tool, the unit is apparently finding use as a console-mounted adjunct to existing metering and monitoring systems.

Reflexion Arts, Atlantis Buildings, High Street, Bruton, Somerset BA10 0AE, UK. Tel: 0749 812260.

Cadac RME 100 studio equalisers

First in a new range of rackmount signal processing equipment from Cadac is the *RME 100* rack of equaliser modules. While the equalisers are not a straight lift from the Cadac consoles, they do offer a few more facilities than mere EQ, such as phantom powered microphone inputs, phase reverse, mic/line switching and an illuminated mute switch. The equalisation itself is fully parametric in four overlapping bands, giving control from 31 Hz to 18 kHz with ±18 dB of control in each band. Each band can be switched to shelving configuration—two high and two low—or switched out completely, and switchable variable high- and lowpass filters are also provided. A complete 8U rack comprises 10 of these vertical modules and a built-in power supply.

Cadac, Clive Green & Co Ltd, One New Street, Luton, Beds LU1 5DX, UK. Tel: 0582 404202.

UK & worldwide distribution: Autograph Sales, 2 Spring Place, London NW5 3BA. Tel: 01-267 6677/485 3749.

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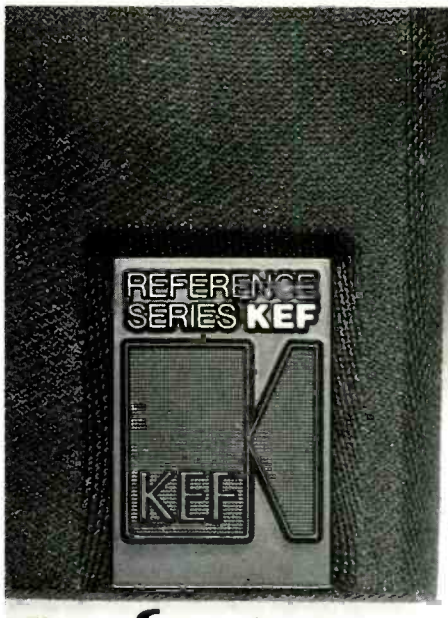

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NEWS

Harman UK Reims project

The Reims Project is Harman UK's design to meet the demands of new studio working practices in a flexible console offering large numbers of inputs, versatile configuration and simple but powerful SMPTE-based automation facilities. The key is a hybrid combination of in-line and split formats, where not only are subgroups treated in a split configuration but each channel has two inputs to provide in-line monitoring when required. These two inputs can share the channel's splittable 4-band equaliser, which in conjunction with additional inputs on the subgroup section provides 76 equalised inputs on a 32/24/2 console.

The automation is a mute-only system but provides muting on virtually every signal path including aux sends and the insert points of both channels and groups. Automation control is via a small informative LCD display and keyboard on the console, and is software-based allowing for future updates. Emphasis is also placed on the console's audio integrity, aiming to meet the needs of analogue, digital and MIDI sequencer recording methods.

Harman UK Ltd, Mill Street, Slough, Berks SL2 5ED, UK. Tel: 0753 76911. Fax: 0753 35306.

DDA Q series console

DDA's *Q* series console is a development from the established *S* series desks, offering an 8-bus configuration with a choice of 16, 24 and 32 channels. Eight aux buses are also provided together with direct channel outputs, and an unusual feature is the ability to route a channel's direct output via its Aux 1 control, providing independent controllable auxiliary feeds from each channel. This effectively gives up to 32 dedicated effects sends in addition to the overall aux and group buses, which DDA see as useful in PA applications. Adaptable configuration options include EQ'd subgroups for PA use, output matrices, EQ'd effects returns and up to 24 tape monitor returns.

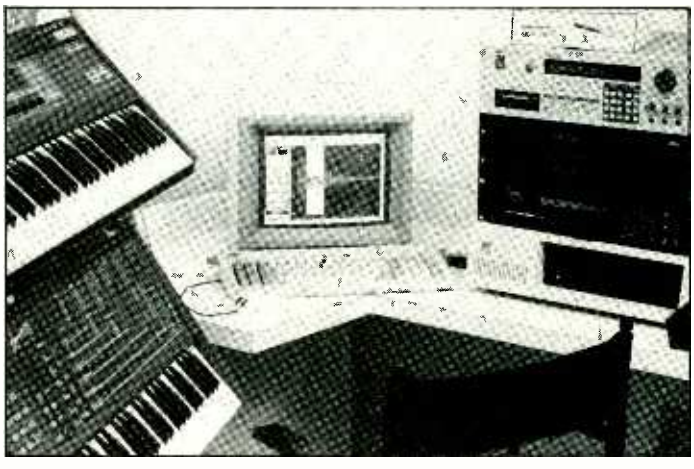
Dearden Davies Associates Ltd, Unit 1, Inwood Business Park, Whitton Road, Hounslow, Middlesex TW3 2EB, UK. Tel: 01-570 7161. Fax: 01-577 3677.

USA: Klark-Teknik Electronics Inc, 30b Banfi Plaza North, Farmingdale, NY 11735. Tel: (516) 249-3660. Fax: (516) 420-1863.

SDS computer-aided crossover design software

Scientific Design Software's Computer Aided Crossover Design (CACD) package for the IBM (*Mac* version available shortly) sets out to minimise the time-consuming trial-and-error processes involved in the design of active or passive crossover networks. Using a set of driver parameters such as its impedance curve, frequency response curve and Thiele/Small parameters, an accurate electrical model of the real driver is simulated, a target filter correction response is calculated to tailor the driver to a user-defined target response curve, and a user-suggested circuit topography is optimised to achieve the closest possible approximation to this target curve. At each stage full graphic displays are generated showing the progress of the process, including the predicted impedance response of the finished network in order to ensure that the impedance never falls below safe limits. Target responses can be defined in terms of 1st, 2nd, 3rd or 4th order slopes or by entering required levels at specific spot frequencies and driver calculations are simplified by the provision of a database, with full search and sort facilities, of over 700 actual loudspeaker drivers. This database can be updated to include additional drivers as required.

Scientific Design Software, PO Box 3248, Chatsworth, CA 91313, USA. Tel: (818) 718-1201.

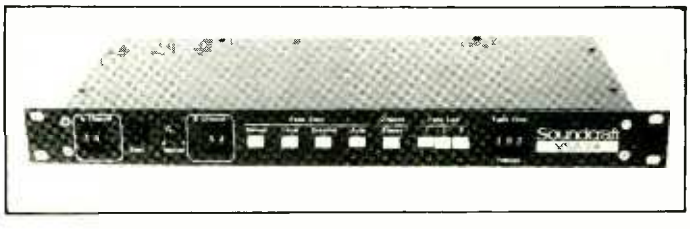


Soundcraft VSA 24 serial interface

The Soundcraft series *200 BVE* audio editing console may now be interfaced to virtually any video editor or switcher with the use of the *VSA 24* serial interface unit. This is to provide true audio-follow-video crossfades and also to control audio effects independently of the video editor itself. The unit responds to editor commands present on the communication link between the editor and the vision mixer and will respond to crossfade information (start point and fade rate) from up to eight video source machines; additional units allow larger consoles to track up to 24 machines. For independent audio crossfades, three Fade Law patterns are selectable and crossfades can be executed between any two channels (or pairs of channels) under manual control or following a preset fade time, which in turn can be remotely triggered.

Soundcraft Electronics Ltd, Unit 2, Borehamwood Ind. Park, Rowley Lane, Borehamwood, Herts WD6 5PZ, UK. Tel: 01-207 5050. Fax: 01-207 0194.

USA: Soundcraft Electronics, PO Box 2200, 8500 Balboa Boulevard, Northbridge, CA 91329. Tel: (818) 893-4351.



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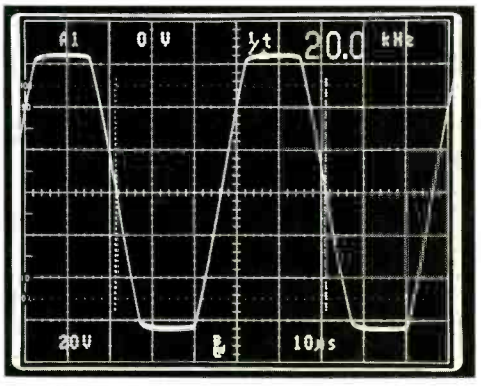
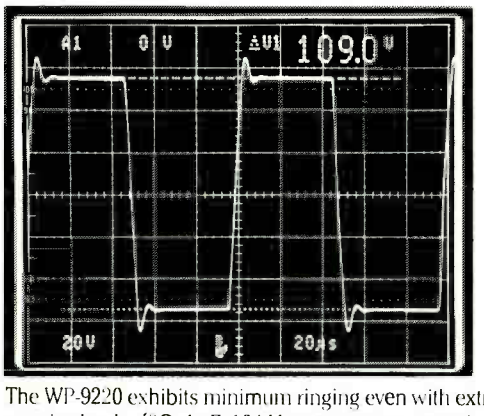


The WP-9920 exhibits gentle overload characteristics even when overdriven 3dB into 4Ω Load at 20 kHz (643 Watts).



The WP-9220 exhibits minimum ringing even with extremely reactive loads. (8Ω, 1μF; 10 kHz square wave input.)

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*Ramsa amplifiers carry a 5-year limited warranty.

*Not all models currently available in the UK.

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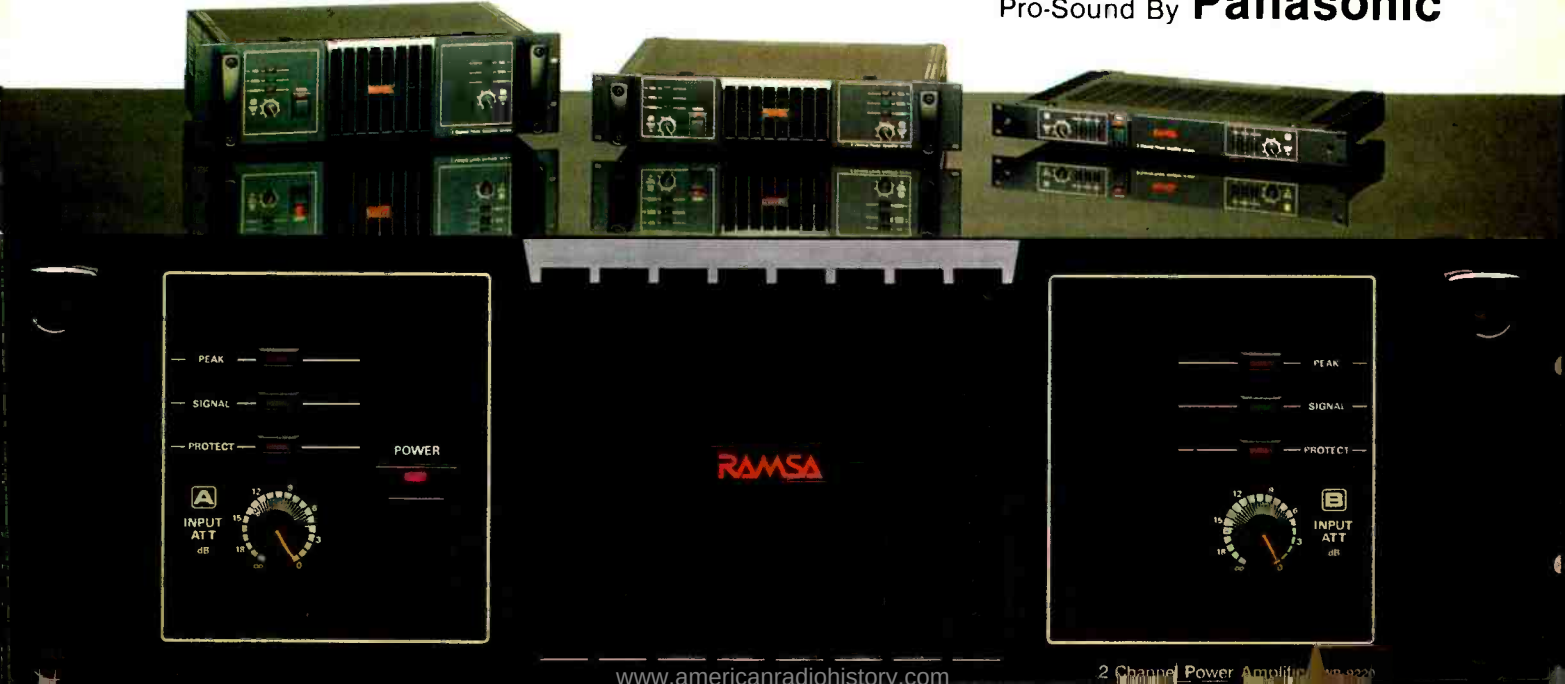

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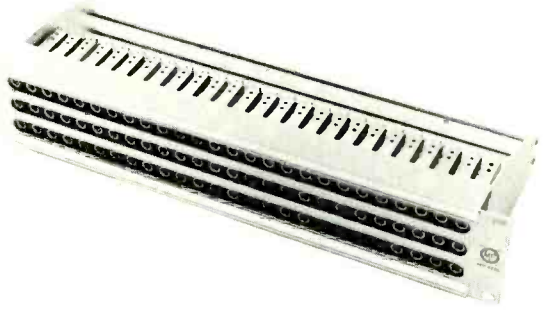

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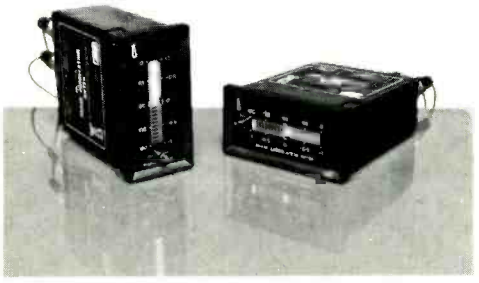

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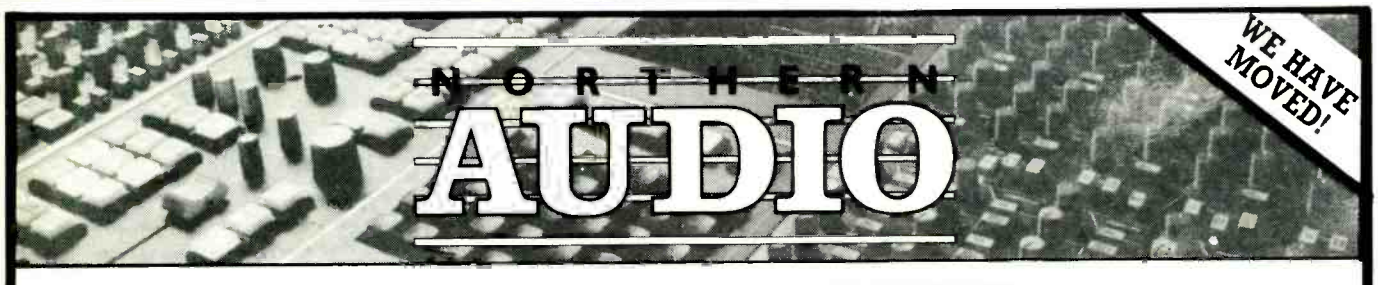

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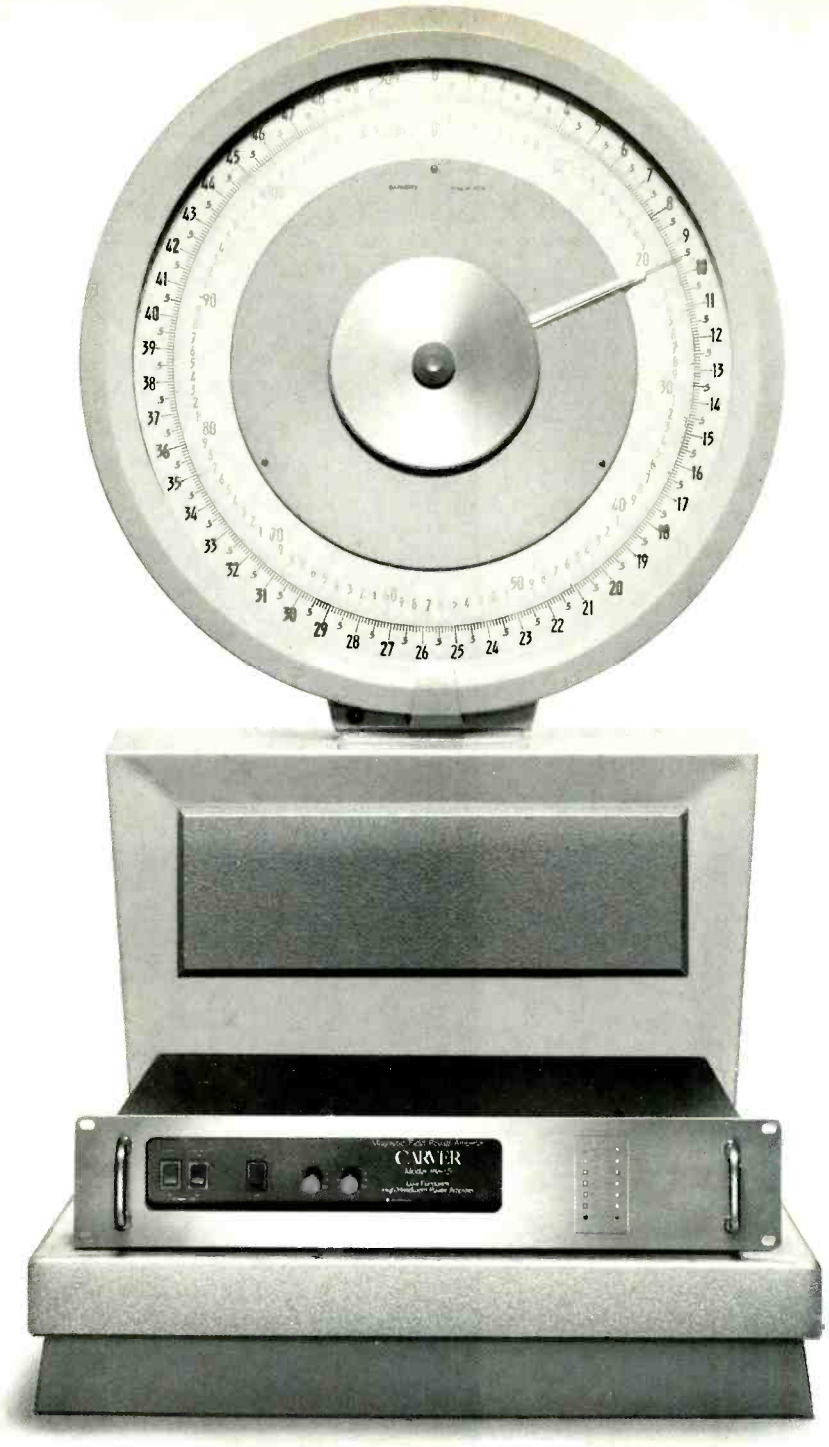

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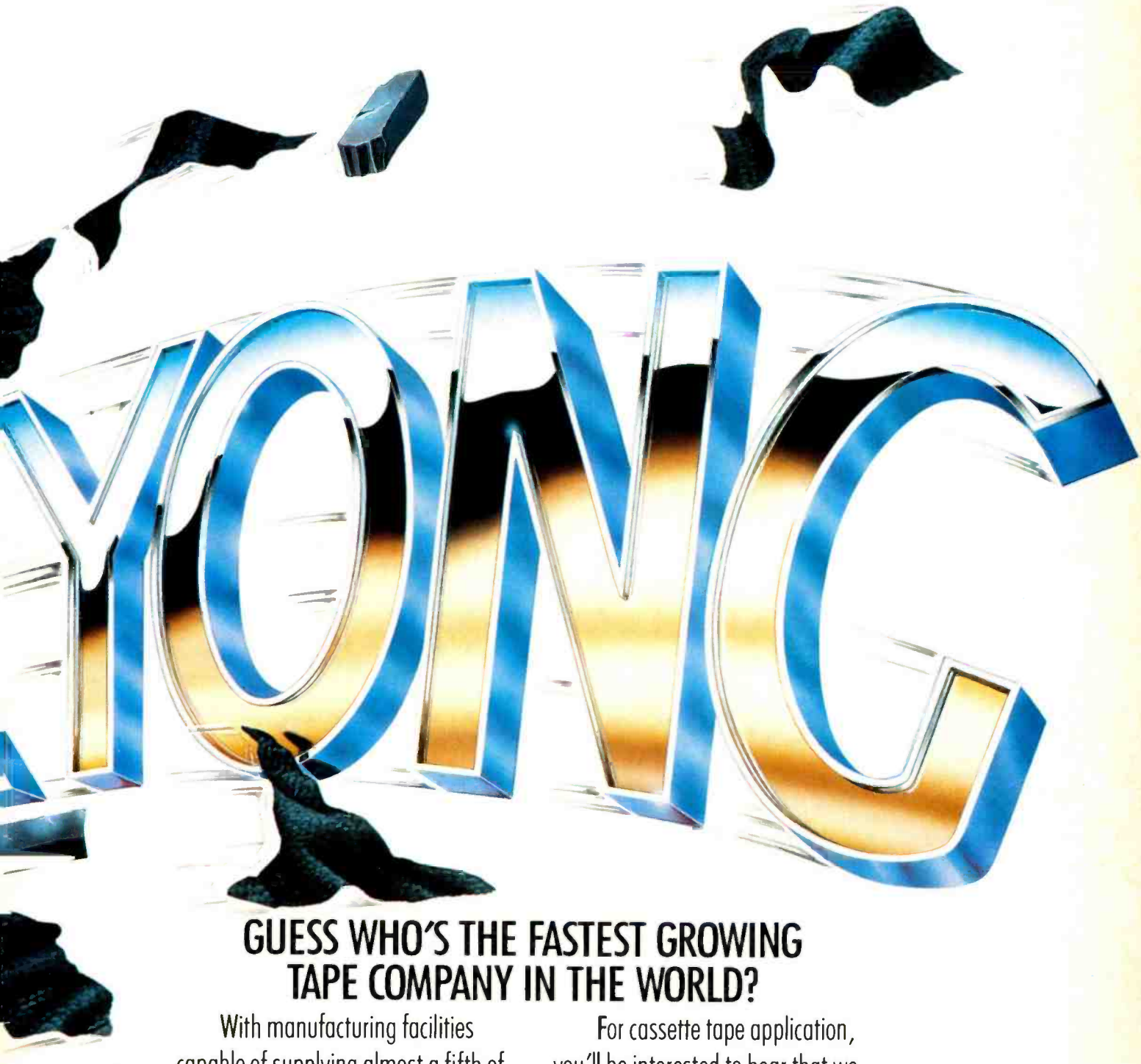

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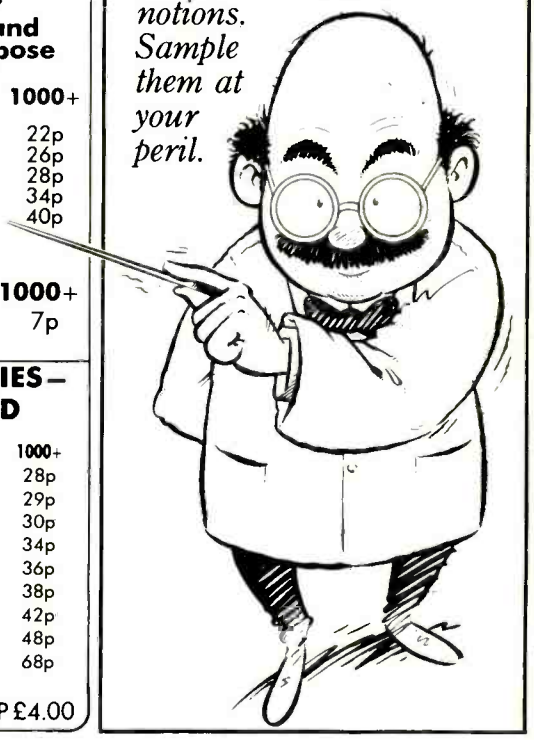

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LOGIC 1

Logic 1 is the first of a series of digital consoles planned by AMS. Patrick Stapley describes how the system operates

Calrec/AMS have put a lot of R&D effort over the last three years into designing a digital console, and the first product to come out of this is the *Logic 1*. It will form part of a family of desks, all sharing the same hard and soft technology, ranging from a small standalone editing desk to be launched shortly *(Edit 1)* to a full scale music console.

Logic 1 is designed to interface with the *AudioFile* where it will offer a comprehensive array of signal processing plus dynamic automation on all functions. The system has been shown at recent trade shows as a prototype, although this applies more to the hardware side, as the software structure is complete. The finished product should be available early next year.

At AMS I was shown drawings of the finished control surface as well as the prototype. The finalised, standard desk will provide 12 channels all with a stereo capability, two stereo group channels and a main stereo output fader.

My first impression of the *Logic 1* was of it being compact, with easy access to sensibly placed and sized controls. I was also struck by the abundance of indicators, displays and metering; these are so prolific that someone suggested the desk could actually be operated in the dark (I'm not about to embark on the virtues of heightened aural perception in a blacked-out control room!). Perhaps the most impressive and ingenious of these is the ring of light display around the head of each rotary control. This gives a precise indication of settings so one can tell at a glance the amount, say, of EQ being boosted or cut. The display has the added advantages of taking up no extra space and not getting obscured by other controls. The way it works is very simple: on the PCB below the knob is a ring of LEDs that switch on and off following the value of the control; they transmit light via fibre-optic filaments, built into the knob, to the segments at its head. Thus the continually rotating control will always display the correct value.

The channel

The channel strip provides all control functions locally, that is to say, there are no assignable control areas shared between the channels, as for example with SSL's *01* or Trident's *DiAn*. Each channel has eight rotary controls, split equally into two modules, and these controls can assume various roles governed by the function and select buttons. So, for example, if I press the EQ button the four rotary controls above will act as lift/cut controls for the four bands of parametric EQ displayed in the associated alphanumeric windows. What I have selected here is EQ page 1, and by looking at the knobs and alphanumerics I can see frequency, gain and also whether a band has been selected to bell or shelf. In addition to page 1, I can call up three other pages using select buttons 2 to 4. Page 2 provides frequency selection, page 3 alters Q on each band and page 4 switches between high and low shelf and bell. There is also a page 1B, which is selected by a sustained press on the EQ button, this provides a lift/cut dB value in the alphanumerics as well as the display on the knob. Once an EQ has been set up using the various pages it is switched in and out of the channel using the knob designated 'EQ On' in the page called up on pressing the on select button.

Also controlled from the top module are high- and lowpass filters, compression/limiting and gating/expansion. These functions operate in the same manner as EQ with their parameters distributed among the different pages.

The module below works the same way although it has one less select button. The two top controls are designated to controlling the four auxiliary sends which are split into aux 1+2 and aux 3+4 functions. The next control down, on page 1 of both functions provides level control over a send to the *AudioFile* for recording cues. In page 2, the control selects this send to pre or post, and if selected to page 3, operates as an input mic/line selector. The bottom rotary control is responsible for a different function on each page; page 1 is a panpot, page 2 is phase reverse and page 3 is input gain following the mic/line selector. The functions of the lower pair of controls are independent of the aux 1+2/aux 3+4 selection. When the rotary control acts as a 2-way switch as in pre/post, mic/line, etc, the knob displays a single segment display moving between 11 o'clock and 1 o'clock.

All the function buttons have a tricolour LED, which informs the user of the following:

Off—Function is deselected from controls and is switched out of the channel

Green—Function is selected to controls but is switched out of the channel

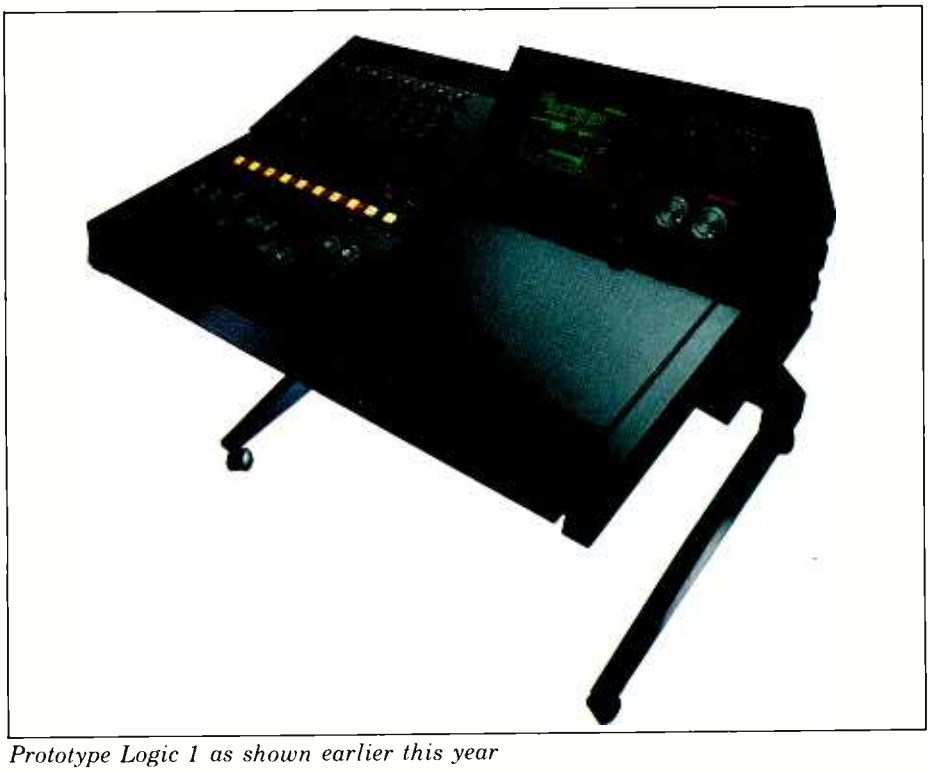
Yellow—Function is selected to controls and is switched into the channel

Red—Function is deselected from controls but is switched into the channel

This gives the user an important indication as to how the console is configured as well as avoiding the need to check back to see which functions have been used and which haven't.

Underneath the function and select buttons are a group of buttons responsible for changing local automation mode for the two modules (more of which later).

Working downwards, there are two display windows. The first gives an 8-character ID of the input selected to the channel, and this could be a cue from the *AudioFile* or an external source such as a mic or CD player. The other 4-character display shows the *AudioFile* track number to which a cue relates, followed by the group number the channel is assigned to. Below this are the assignment button and *AudioFile* record button. To assign a channel to one of the two groups, the master assign button on the group is pressed and held while the channel assign buttons are selected. The channel assign button is also responsible for selection of the input and the insert. If the assign button is pressed and held the eight rotary controls will take on new functions. The top four controls will select



Prototype Logic 1 as shown earlier this year

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between one of four possible inserts, patch it pre or post fade and switch it in and out. The bottom four controls will select through all the different inputs and switch one into the channel input path. The inputs can be from analogue or various digital sources, including of course, the *AudioFile*, and it will be up to the user to specify his interface requirements. As mentioned earlier, inputs can be mono or stereo but there is no provision for dual mono. Stereo inputs can be split with left and right legs controlled in adjacent channels.

The next section down supplies the usual solo and cut facilities and there is another group of buttons, which govern mode switching for the fader and cut during automation.

The linear motorised fader was designed by AMS and has a top to bottom time of 100 ms, with 2,048 possible positions. This spec is very similar to a Massenburg fader and the light non-resistant feel is also reminiscent.

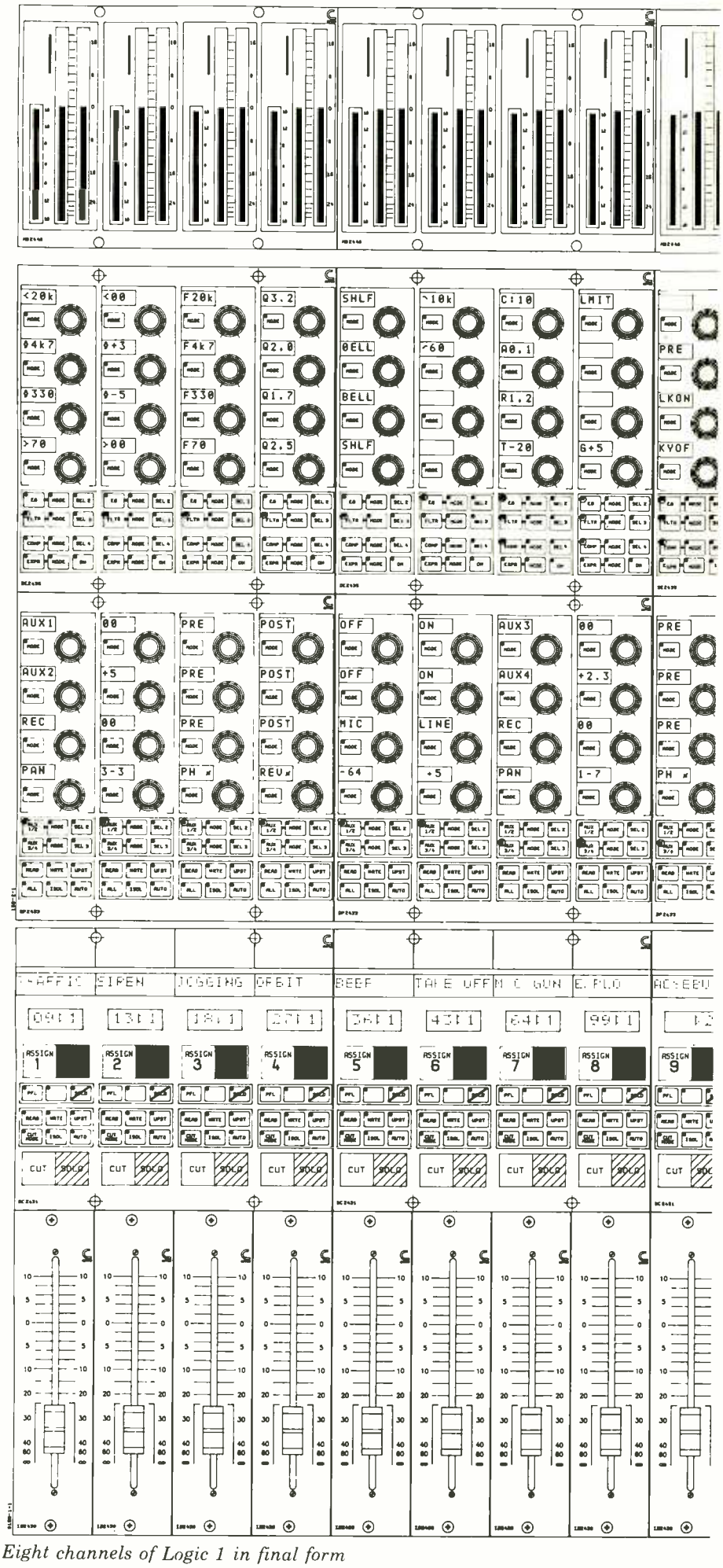
Going now from the bottom to the top of the console brings us to the meter bridge. Each channel and group has three bargraph meters. Two are concerned with the stereo output, and are coloured red and green (port and starboard). If the channel were in mono, just the left hand meter would operate. They can offer three types of ballistics—vu, ppm and fast attack digital ppm with hold. The third bargraph displays the workings of the dynamics, with an orange section going into red for the compressor/limiter, and a green section directly below for the expander/gate. The group 1+2 meters each have a special switching panel that allows them to tap into parts of the signal path throughout the desk.

That covers the channel strip, apart from the Master Control buttons situated to the right of channel 12. There are five groups of these buttons and their job is to act as overall masters for each of the function select and automation buttons on the channels and groups. For example, if I press the EQ master, all 12 channels and both groups will switch to EQ page 1; using the master select buttons I can step through the other pages.

Control surface

Situated on the right hand side of the console are the four auxiliary masters, the talkback selector and the monitor section. The auxiliaries and talkback are self-explanatory but the monitor—in addition to its designated selection buttons—incorporates an interesting rotary control labelled Select. It behaves like the input selector on the channel and switches through all the possible inputs with a display showing the interface and input numbers (1/4, 2/1, etc). This provides a quick and easy way of checking if inputs are working and where they are connected; the group metering will also follow this selection when 'follow monitor' is chosen.

All audio interfacing is done at the processor rack with the A/D conversion being 16 bit linear with 4x oversampling. No audio passes through the desk, which acts solely as a digital control surface. The system's internal working is 32 bit floating point and includes extensive use of transputers. When the R&D team had completed their functional analysis of the project they gave considerable thought to the best language to use, and decided on Occam. This in turn led to the incorporation of the transputer, which is an extremely powerful 32 bit microprocessor with built-in high-speed serial links. Transputers produce a linear increase in execution speed when linked together and are ideal components for use in a system that needs to be highly expandable



Eight channels of Logic 1 in final form

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LOGIC 1

but retain continuity.

Automation

The master automation controls for the basic status–read, write update and isolate can be operated both from the desk and the *AudioFile*. Further status and commands are accessed via the *AudioFile*'s keyboard and VDU.

On the console the automation is split into two distinct areas: the faders and the rotary controls and cuts. As mentioned earlier, each of these sections has its own set of master status controls and each channel has a set of local controls.

The faders can be switched as an entity via the master buttons or can be accessed individually using the local buttons. There is also a button labelled Cut Mode that enables the cut to assume status preselected using the upper status buttons.

The rotary controls also have access to master and local switching, and include mode switches, which act as status selectors for individual parameters. Each mode button has a tricolour LED indicating status: Off–Isolate (Control is disconnected from the automation); Green–Read; Red–Write; Yellow–Update.

Mode buttons are distributed among single parameters, local functions and master functions, thus enabling a comprehensive network of switching. The arrangement of buttons is such that sectional status selection is made easy while providing a permanent display.

The update status acts as a relative trim function for both faders and dynamically operating controls, ie reads previous data offset from new control settings. In update, a fader null display appears at the input ID window. This consists of an arrow pointing in the direction of the null and a bar to indicate matched levels. There are two other master statuses using this display–takeover write and autotakeover. In write mode takeover puts the fader into write as it is touched, and automatically returns it to the previous level when released. Autotakeover also switches the fader into write on touch but will only return it to read if it is moved back to the null area. The various automation status can operate concurrently throughout the console.

Whenever new information is added to a mix, it is stored in an incremental fashion. That is to say, the system does not copy all previous data with the addition of the new moves but merely stores the new data in a separate layer. This method of storage creates a number of advantages. Firstly, it is very efficient with space and there is no danger of running out of room. Secondly, there is no delay in waiting for the mix to play back, and this fits in well with the almost instant rollback speed of the *AudioFile*. Thirdly, as the entire history of the mix exists in layers, they can be peeled away returning the user to any previous point. It is not until a final archive copy of the mix is made, on the *AudioFile* floppy, that the data is squashed down or 'compacted'.

The automation also caters for snapshots and merging. Snapshots can be taken or reloaded on or off line, and they can be edited on the desk without affecting their operation in the mix. *AudioFile* events that have been time slipped will retain their dynamic data.

All automation data is stored on a 180 Mbyte Winchester hard disk situated in the *Logic 1* processor rack. This 19 inch 9U rack also houses the control cards and power supply. *Logic 1* is slaved to the *AudioFile* and the two are linked by a high-speed serial link (128 Mbit/second).

Another function that has its control situated among the automation buttons, is dynamic grouping. The auto button is responsible for assigning a particular fader or control as a group master. In the case of the fader it is a matter of pressing and holding the fader auto button on the channel that is to be master, and then pressing the fader auto buttons on the channels to be grouped. This ties in nicely with the procedure for assigning channels to one of the audio groups. Once a fader group has been constructed, the faders will follow the master in a proportionate manner. To create a dynamic group on one of the other functions, the desired function button is hit while holding the auto button below the rotary controls. This will provide a useful facility for setting up identical parameters on a number of channels, as well as some interesting effects.

Conclusion

The amalgamation of AMS and Calrec has produced a team with a great deal of expertise and the *Logic 1* reflects this. A theme that is strong in the *Logic 1*, and for the future, is the provision of a control surface that is familiar to the user. Not only do controls look and behave in a recognisable manner but they are positioned in a traditional way. The assignable architectures seen in other consoles (including Calrec) have been avoided. Also, there is a great deal of permanent information communicated to the user without the need for constant rechecking. The console offers a good balance between hi-tech and ergonomics.

It is difficult to be 100% objective and provide a keen critical appraisal of a system that, at the time of writing, is still a little way from full implementation. What I would say, is that *Logic 1* appears, on paper, to be a very well thought out mixing console, which when combined with the *AudioFile*, should produce a seriously versatile package.□

Editor's note: It is necessary to put the *Logic 1* into the context of future AMS digital developments. The *Logic 1* is as a digital mixing partner for the *AudioFile*. The system described in this article has several developments that have not been shown to date. Shortly we will see the first showing of the *Edit 1*. This is a digital mixer with many of the functions of the *Logic 1* but designed for standalone use.

Following the development of these two products a certain amount of work has been carried out on ways of using the transputer technology and general control surface approach (although expanded in facilities) in large scale multitrack music recording consoles although this is currently still some way off.

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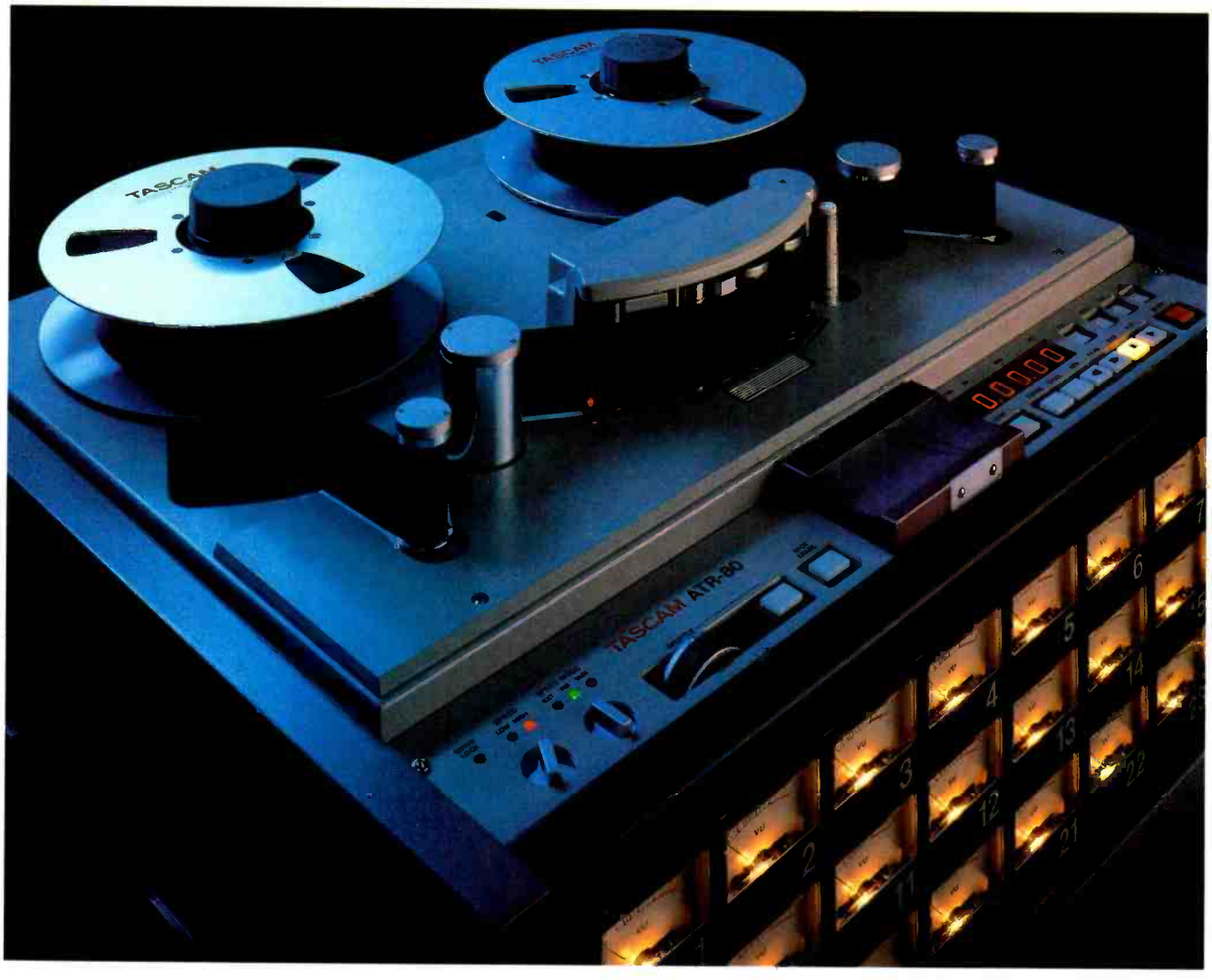

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CBS ROOFTOP

As part of an overall update, CBS added the Rooftop to its studio complex in London. Janet Angus reports

CBS opened a brand new facility on May 11th, 1988, at their premises in London's West End. The new Rooftop studio has generated a buzz of interest throughout the record business and created a demand for studio time that would be the envy of any studio in the UK during what is proving to be a difficult time. The entire third floor of this purpose-built studio complex is given over to a self-contained production area providing total privacy and security for uninterrupted sessions.

CBS has been running a recording studio complex on this site for 16 years. There is currently an overall update plan being implemented, of which the creation of the Rooftop studio is only a part. Last summer Studio Two, the Workroom, was refitted. Studio One, the Soundstage, is next and work commences in November. The object of the exercise is not only to bring the rooms up to date with the latest equipment and design but also to create a specific identity for each one—Soundstage for orchestral work, Workroom for tracklaying and the Rooftop for recording and mixing.

Meanwhile a second CD mastering suite has been completed bringing the total of ancillary services to two disc cutting rooms, two CD mastering suites plus a general make up/copying/dubbing suite. At the same time the other non-technical areas (ie corridors and offices, etc) are receiving a facelift and being refurbished.

Design of the Rooftop was a much sought after contract, which was awarded to Neil Grant of Harris Grant Associates. Studio manager Rodger Bain explains: "We visited some of his studios and looked at photographs of others, including Swanyard and Peter Gabriel's studio the Real World. Of course we were very impressed with other designers' studios, too, but what finally clinched it was the strong organisational back up behind Neil. His support team allows him to concentrate on design.

"On a total build programme of six months we had only six days' slippage, which I think is quite remarkable. It shows how well site-managed and run the project was."

CBS's own technical personnel worked in conjunction with Grant's team on the technical requirements. Apart from a dubbing suite (which was moved to the second floor) the studio facilities on the third floor had been more or less run down over the last couple of years and Grant was virtually given a free design hand. They felt that they wanted a separate machine room and that the studio should have live and dead areas; the rest was up to the designer.

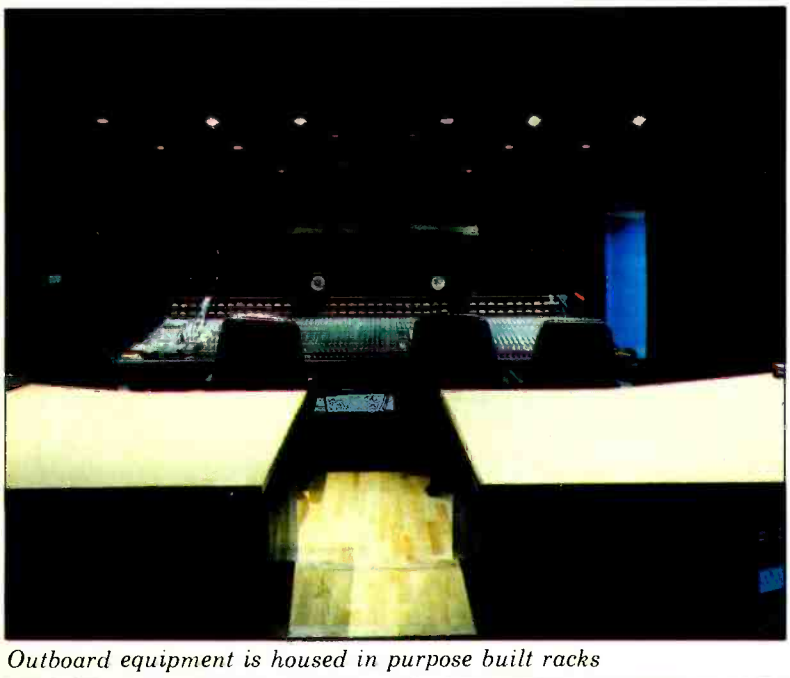
The result is a large control room area on three split levels overlooking the two areas of the studio and looking across a corridor to the machine room. The original Studio Three has been turned on its head—what was the control room is now the studio and vice versa. The reason for this is that Grant was required to utilise the existing floating floors and the former studio area was the largest one of these.

"CBS is a 1969/71 purpose-built studio complex," explains Grant, "one of the first multi-studio rock and classical complexes to be built in London and yet the floor capacities were not high enough to take the loads. We had to partly suspend and build off modified floating floors. It is complicated utilising old floors and splicing them with new but the cost of cutting up and dumping floating floors did not come within the CBS budget. From our point of view it would have been ideal to take out the old ones and simply put in new."

CBS also enquired about the possibility of bringing daylight into the working areas. Grant took this brief to the limits allowed by building regulations: "We put as many holes in the external walls as we were allowed: there are 12 windows in the control room. The result is very 'un-London studio-ish'. It is very atmospheric and I think this has been reflected by its popularity."

The result also gives a rooftop view across the West End, which is particularly spectacular at night. Curiously, Rodger Bain says he has had reports from clients that when the sun comes up at 9 o'clock in the morning it can be a bit disconcerting, so they are going to fit blinds to the windows. The sun obviously rises late in the West End.

Grant was striving for a very modern control room. "We wanted a room on different levels with enough space for musicians to work at the back within the stereo image of the monitoring." The room's three tiers are also there for practical reasons: because it is built on an existing floating floor, the console was raised on to a small platform; two effects consoles (which double as producer/artist worktables) are then raised behind this in the middle of the room, with a gangway between them giving access to the third raised area at the back, which is large enough, as Bain says, for a keyboard player for instance to bring his stage racks in and work with them in his usual set up. The tiers provide a 3-dimensional feel to the room as well as providing plenty of underfloor area in which to run cabling.



Outboard equipment is housed in purpose built racks

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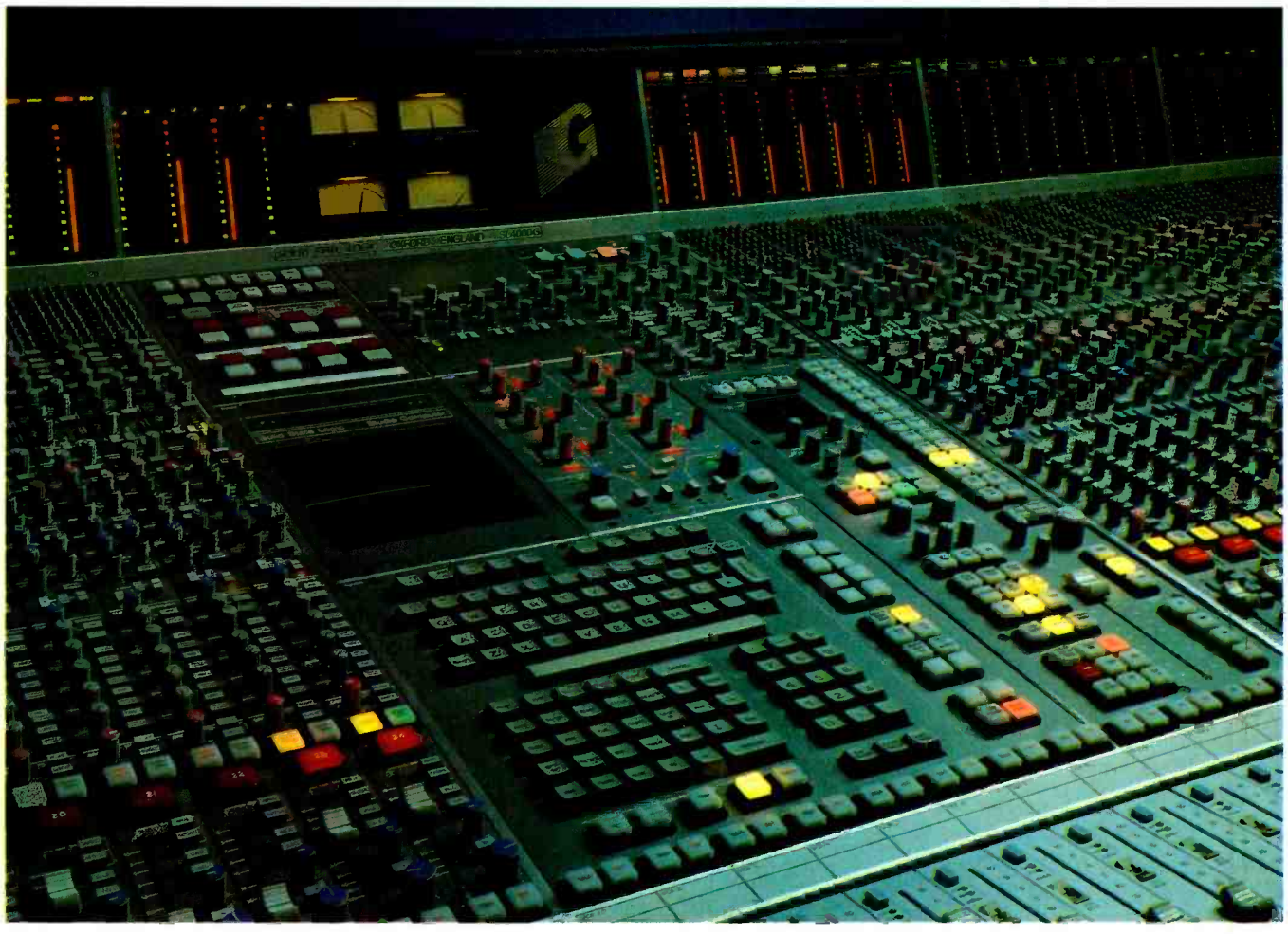

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CBS ROOFTOP

The entire back wall and round into the corners on each side are given over to ash RPG diffusers. "We are using ever more sophisticated clusters of RPGs," says Grant. "The control room ones are based on a sequence of the number 19. The result is that all over the room you can still perceive stereo no matter where you stand. The returns from the back wall are no longer phase coherent so there is an added benefit of no notch filtering in the monitoring."

The timber (rather than aluminium), RPG is becoming increasingly popular: "People seem to feel that studios shouldn't have metal in them—it looks wrong. The timber ones have the advantage of being slightly less absorptive. We have installed well over 1000 RPGs now in Europe and abroad, and the majority are timber."

CBS chose a 52-channel (plus four stereo channels) SSL *SL 6000 E* mixing console with the *G* series options in order to gain maximum flexibility and potential client base, incorporating as it does video facilities. This is the first SSL console to be installed in the premises. "It's the one that customers want, the one everyone asks for," said Bain. "For the *Total Recall* I suppose, its ease of use—it's very user friendly—and it enables you to do more creative and complex mixes." Because of the studio's location in the heart of London's 'Ad-land' they are likely to attract video commercials work, "We are very conscious of the video and TV market and would certainly want to be in the running for that."

The banks of outboard equipment contain a host of units including AMS *RMX16*, Lexicon *480L, 224 XL* and *PCM60* digital reverbs; Yamaha *SPX90* and *REV7*; dbx *160X* limiters; Neve (original valve) compressors; UREI *UA1176, 1178* and *176* limiters, Audio Design *Vocal Stressers*; Klein+Hummel *UE400* and Massenburg parametric EQs; Universal Audio graphic equaliser; Neve *1080* equaliser; Bel flanger; Drawmer *DX201* noise gates and *M500* effects units; dbx de-esser rack; Eventide *949 Harmonizer*; Bel *BDE2600S* sampler; Eventide *1745* delay; AMS *15.80S* DDL/sampler; Sean Davies valve microphone amplifier; Sycologic MIDI matrix and a Publison *IM90 Infernal Machine*.

Studio monitors are the Discrete Research *Boxer Four* system. "We find that people are using the *Boxer* system in our rooms all the time now," said Grant, "as well as in other rooms, for example the Eurythmics', although it was originally specifically designed for our rooms." Bain is very pleased with the system even though they have managed to blow the tweeters twice in as many months. Grant attributes this to the way in which certain clients had been handling the monitoring! "We have got 18 or 19 *Boxer* systems out now and people tend to go through their tweeters once every six months. The system is very reliable."

The other side of the corridor has been given over to a large machine room and an echo plate store (housing four EMT plates). Tape machines include two MCI 24-track recorders and MCI mastering machine. There are also two Sony *3324A* digital multitracks on order. CBS opted for the flexibility of having two 24-track digital machines (which may be used in the other studios if required) rather than a single 32-track.

Spanning the width of the building lies the studio area, or areas to be more accurate. The company specified live and dead areas in their design brief although in the event the 'dead' area is only relatively so, in line with today's requirements. This has been achieved with liberal use of RPG diffusers (again in ash). In fact all studio timber is ash, including an exposed floor area in the 'live' section and all wall and ceiling timber work. There are three large reinforced concrete pillars, which take the building's principal loads, around which Grant had to work. One of these is in the studio, midway between the two outside walls. The back wall of the room therefore protrudes into the room, around the pillar. Splayed surfaces in the live area eliminate repeating reflections and create a very bright room, reputedly good for drum sounds.

Again windows have been introduced wherever possible bringing daylight and views across London. A microphone store off the live area may also be used as an isolation booth. It was decided not to break the two studio areas physically with sliding glass doors since the same effect can be achieved with the custom-built (by Discrete Research) screens if and when desired.

Tannoy/Lockwood monitors are built into the wall in the live area and secreted behind acoustically transparent fabric. There is also CCTV although there are plenty of visual access points between control room and both studio areas.

The entire third floor, as mentioned before, is self-contained with an electronic lock at the point of entry for absolute privacy and security. There is a dining area as you step out of the lift in which dinner is served every evening (and also in which a pretty mean drum sound can be achieved). Before reaching the studio there are all the usual facilities (kitchen, shower, toilet, etc) as well as rest and recreation rooms, and a producer's office in which he can carry on his business relatively peacefully and uninterrupted.

Neil Grant describes the Rooftop project as having been a very complicated and difficult job, executed with 'not a lot of money': "And I'm very proud of it." For his part, Rodger Bain, is very pleased with the result. Its unusual aspect over London, its self-contained facilities, comprehensive and top market equipment plus the modern design add up to a fairly unique recording facility. The fact is that it was booked solidly from its opening day and, at the time of this interview, for the next six months.□

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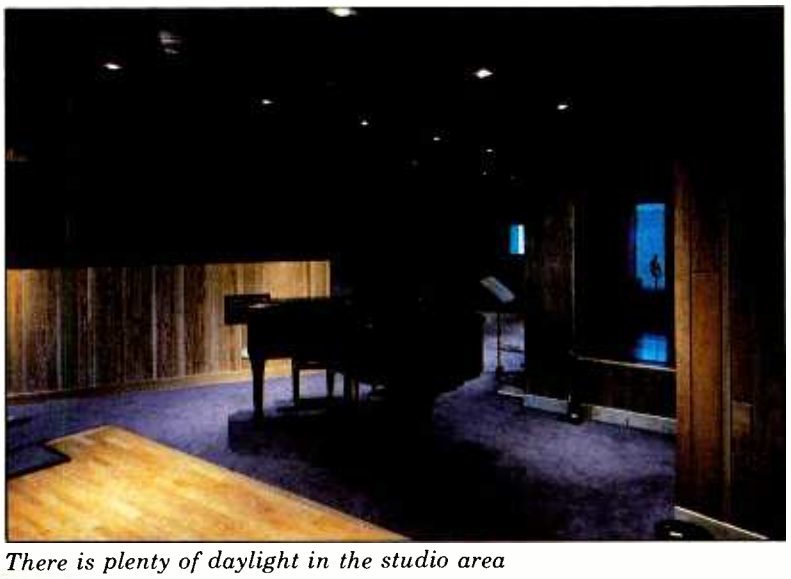

There is plenty of daylight in the studio area

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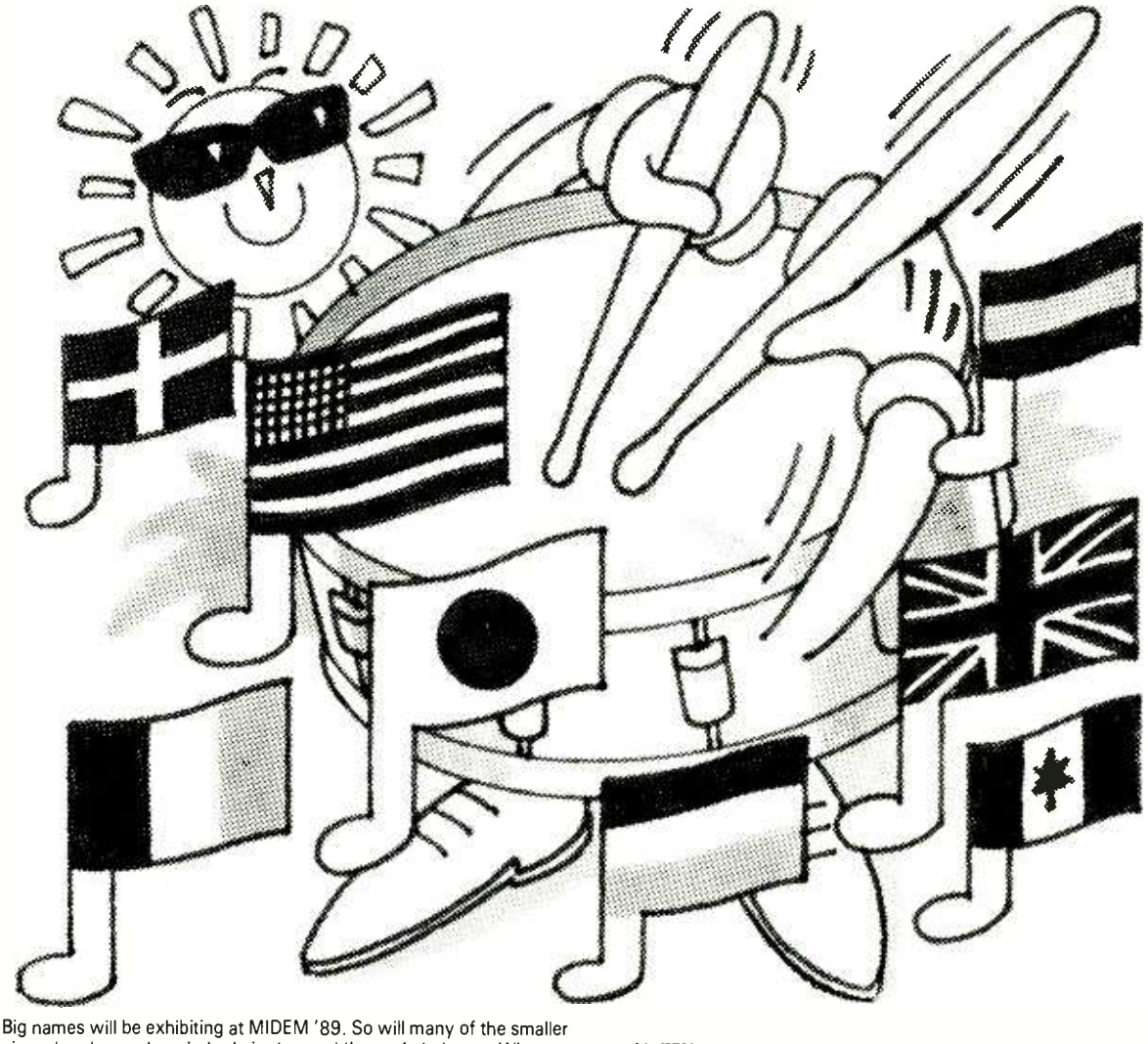

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WHAT IS A HARD DISK?

Advances in technology mean so many new learning curves that there is often no time to appreciate the basics. Francis Rumsey explains how a hard disk works

If you haven't noticed that hard disk editing systems have been crawling out of the woodwork for the last year then you must have had your head buried very deep in the sand. But just what is a hard disk? Generally they are invisible to the user, packaged up in a sealed box, and many people do not have the slightest idea what lives inside. Also, how can such a computer peripheral device be used to record audio and what problems are encountered? A number of people are surprised when they discover that most hard disks are fixed in the system and cannot be taken away or swapped for empty ones when they are full, which rather suggests that some enlightenment is in order.

Disk versus tape

Disks have one major advantage over a serial medium like tape: this is the fact that any piece of information stored on a disk can be accessed very quickly. One only has to think of an LP record versus a cassette: in order to start playing at the track you want on the record it is a quick operation to drop the stylus at the right place, whereas you have to wind serially through a tape to find the start of the track, which takes longer. It is perhaps not unreasonable to suggest that this is the one over-riding factor in favour of recording audio on disks, because there are many disadvantages.

Winchester disks

The 'Winchester' disk drive is the type incorporated into most of the audio systems in question today. It is used in such products as the AMS *AudioFile*, the DAR *SoundStation II* and the Solid State Logic *01*. The Winchester drive has been used in computers for quite some time now, as it provides enough room for the storage of a large amount of data in a relatively small space, it is reliable and the cost is now reasonable. The Winchester drive is different from some other hard disk drives because it is a sealed unit and the physical disks inside it cannot be removed to make way for others. It is not like the floppy disk drive present on most micro-computers, which allows you to insert and remove disks at liberty.

The drive is the combination of physical disk surfaces on which the data is stored, the heads that pick up the data from the surfaces, the motor that rotates the surfaces, the servo mechanism controlling the moving parts, and the electronic section controlling the data flow to and from the surfaces and which interfaces to the rest of the system. In a floppy drive, all these parts except the disk surface itself remain in the fixed system but the storage surfaces (the floppy disks themselves) can be removed.

The Winchester drive must virtually be sealed (except sometimes for a small pressure relief vent) in order to prevent the surface of the disks from becoming contaminated. The lack of contamination and the fact that the disks will never be removed means that fine tolerances can be used in manufacture, allowing a larger amount of data to be stored in a given space than is possible with removable drives.

Fig 1 shows that more than one disk resides inside a Winchester drive. These are rigid, not floppy, and all rotate on a common spindle. Each surface has its own 'pickup', or read/write head, which can be moved across the disk surface to access data stored in different places. The heads do not touch the surface of the disks during operation: they float just a small distance above the surface, lifted by the aero-dynamic effect of the air on the head carrier due to the rotation of the disk. A small area of the disk surface is set aside for the heads to land on when the power is turned off, and this area does not contain data.

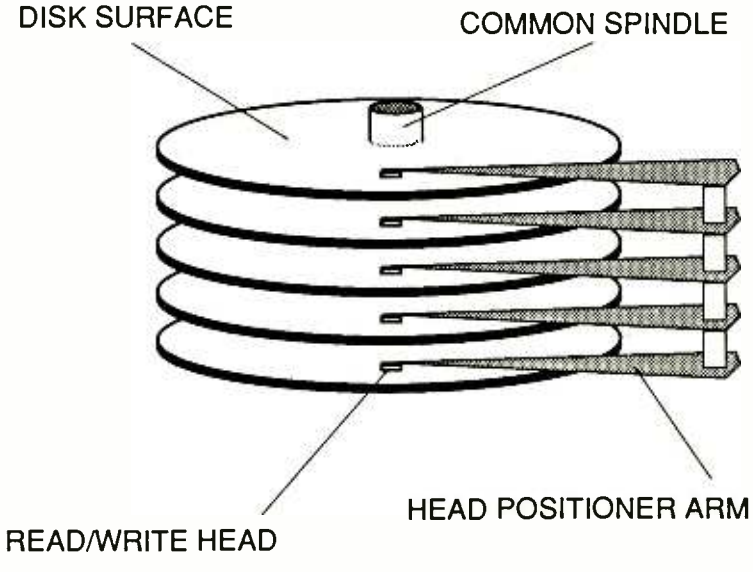
Data and the disk

Audio has not been mentioned very much so far but this is because we are really in the realm of computers and data. Now that we have digital audio it is possible to take advantage of computer technology, because sound is now simply a collection of numbers and can be treated like any other data.

Unlike the LP record or compact disc, data is not stored in a continuous spiral on the Winchester drive, it is stored in a series of concentric rings 'tracks' each divided up into chunks called 'blocks'. The term 'cylinder' relates to all the tracks, which reside physically in line with each other in the vertical domain on the different surfaces, and the term 'sector' refers to a 'block' projected on to the multiple layers of the cylinder (see **Fig 2**). Data is stored and read in chunks, which fit into these subdivisions of the storage surface, so immediately this implies that data must come off and go on to the disk in non-continuous form.

In order to 'go and fetch' a particular piece of data it will be necessary to move the head on the relevant surface to the relevant track, and then to wait while the disk rotates until the start of the data section arrives under the head. So there are some delays involved:

Fig. 1: Multiple disk surfaces in a Winchester drive



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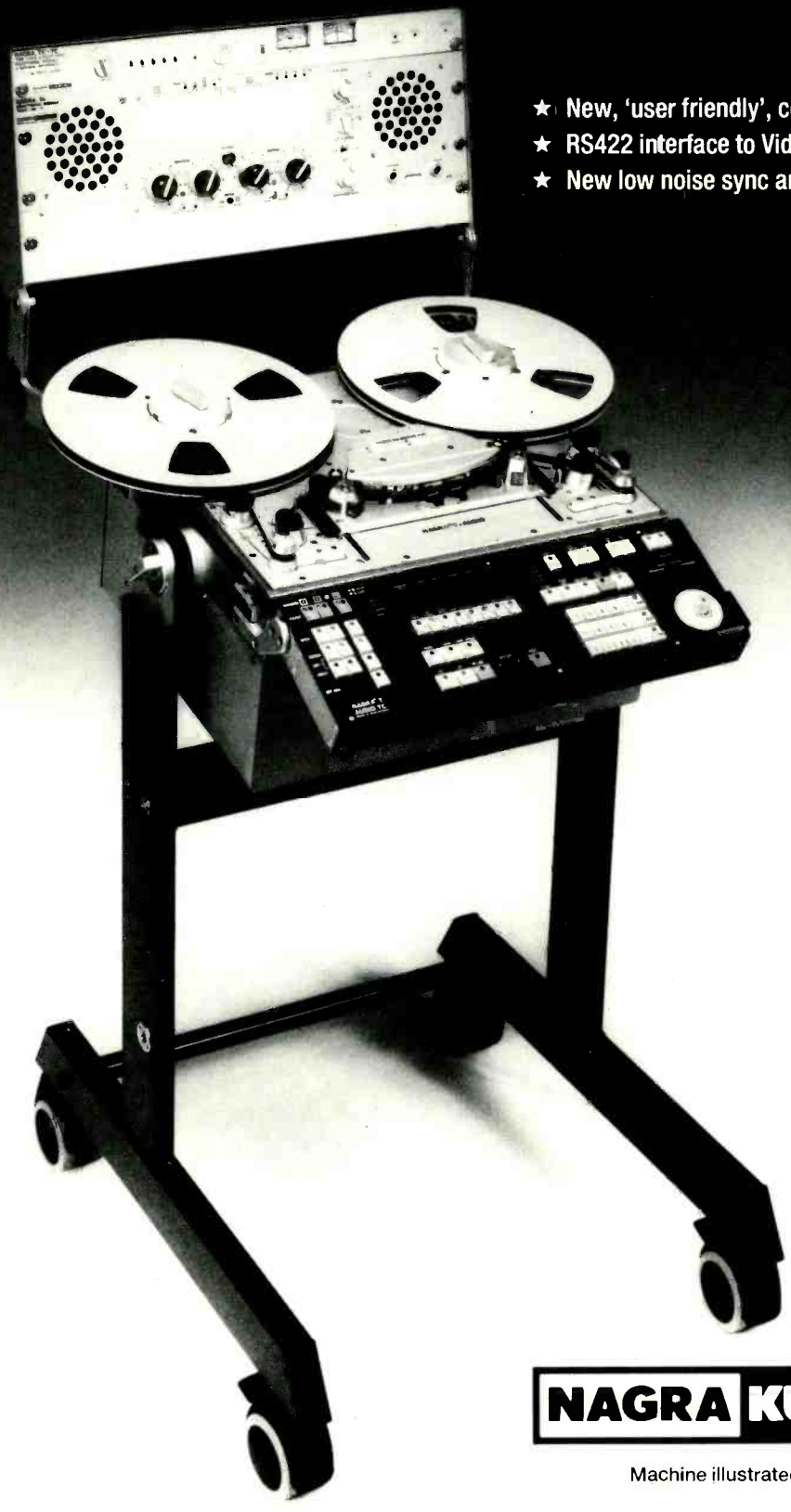

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WHAT IS A HARD DISK?

Delay 1 – Move head across surface
Delay 2 – Wait for data to come under head
Delay 3 – Transfer data from disk to rest of system

Of these probably the longest is the time taken to move the head to the right place on the right surface. The first two delays combine (in simple terms at least) to limit what is known as the 'access time', and this can be a number of milliseconds. The speed at which data can be transferred to and from the disk is known as the 'transfer rate', and in a Winchester drive used for audio will usually be of the order of at least 8-10 Mbit/s.

Audio and the disk

One of the things most people expect is for sound to be recorded and played back without breaks. There is an inherent contradiction between this requirement and the 'burst' nature with which audio will come off a Winchester disk, because of the fact that the audio data will be spread about in different sectors mean that there are gaps in data transfer while the heads move between sectors.

In order to produce a continuous audio output from disk a memory 'buffer' is used, which takes audio in bursts from disk (during replay) and which can be drawn from to supply audio samples continuously to the converters. Conversely, during recording the buffer takes continuous audio from the converters and this can be written to the disk in the right sized chunks, directed by the disk controller. The buffer is a bit like a bucket with a hole in the bottom: as long as the bucket is partly full of water it can be filled intermittently (in bursts) from a tap, yet a continuous stream of water will come out of the hole. It can probably be appreciated that the tap must fill the bucket enough during the intermittent bursts to keep it reasonably full, otherwise the water will leave the hole in the bottom faster than it is coming into the bucket from the tap, so the instantaneous flow of water from the tap must be a lot faster than the rate of flow from the hole. We could trade off a faster flow rate from the tap for longer gaps between bursts, or a slower tap for more regular bursts (see **Fig** 3).

The other main point when considering the use of Winchesters for audio storage is that audio samples contiguous in time in the real world may not be physically close on the disk surfaces. This may at first seem quite contradictory to the requirement for fast transfer of data, because one would think that the fastest transfer of audio would occur when all the pieces of audio were located close together, as the access time delays would be minimised. Nonetheless, one must consider the situation in which pieces of audio are being edited together, which were a long way apart in realtime: in this case there is now a disadvantage in having contiguously recorded data blocks, especially if the disk drive is being used for more than one 'real' audio track (multiple outputs, or 'multitrack' operation) because the drive will be required to provide samples from a number of different locations, which may be a long way apart physically on the drive surfaces. Thus the ordering of audio data blocks on the different surfaces and between the sectors is a very complex business, and not one which there is space to go into here. It is sufficient to say that a compromise must be reached between the size of audio data 'units' (which may not be the same size as blocks), the number of contiguous samples recorded close together, the wastage of space on the disk surfaces, and the eventual average transfer rate that is achieved given a particular application.

One extreme is the situation in which a mono audio signal is recorded continuously for half an hour, and which will only ever be played back on its own in the same order as it was recorded, in which case there would be little disadvantage in the approach which laid down audio data blocks in physical succession on the drive surfaces. The other extreme is one in which there are a large number of small sound files stored on the disk, all of which could be requested by the system at any time and assigned to any output, and which could have any number of temporal relationships between them. In this case the idea that each file should be contiguously recorded would slow things down enormously as the pickup head would have to keep nipping backwards and forwards between the sectors that were most urgently required to feed particular outputs. Careful 'scatter-storage' would be more appropriate in this case, as the

Fig. 2: Arrangement of disk tracks, blocks, sectors and cylinders

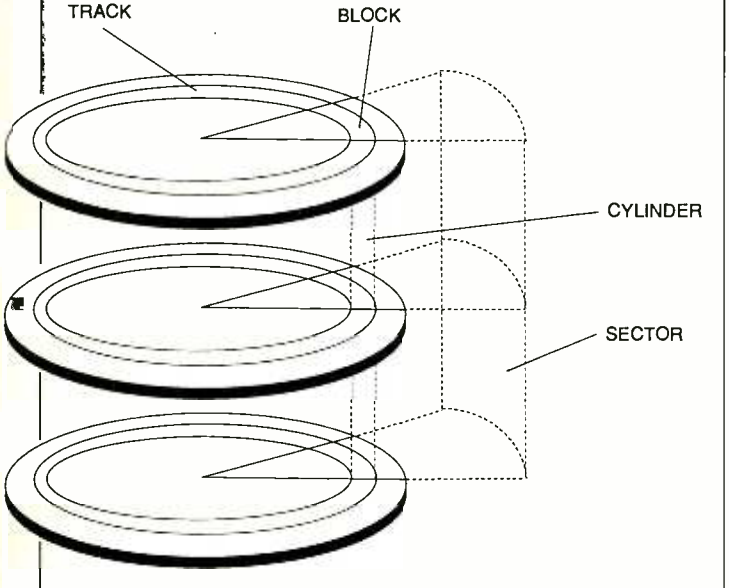
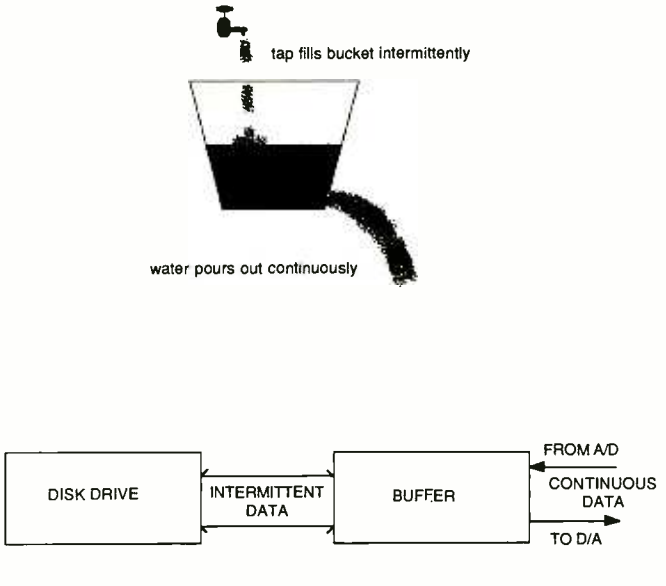


Fig. 3: Memory buffer/water bucket analogy



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Fairlight Instruments Inc.,
2945 Westwood Blvd.,
Los Angeles CA 90064
Phone No. (213) 470 6280
Fax No. (213) 474 9716
Contact: Paul Broucek

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Fairlight Instruments Inc.,
110 Greene Street,
New York City NY10012
Phone No. (212) 219 2656
Fax No. (212) 334 6153
Contact: Adam Groden

NASHVILLE
Fairlight Instruments Inc.,
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49 Music Square West,
Noshville, Tennessee 37203
Phone No. 615 329 0414
Contact: Richard Hayden

UNITED KINGDOM
Fairlight Instruments (U.K.) Ltd.,
Kimberley Road,
London NW67SF
Phone No. 01 624 6000
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physical location of sound files on the drive does not favour any one particular temporal relationship between files.

When one listens to a system that uses Winchester disk drives in operation, it is possible to hear the heads stepping backwards and forwards at high speed between cylinders as they access different blocks of data.

Audio channels and the disk drive

Another common problem encountered in the understanding of the use of disk drives for audio is that of the number of 'tracks' that can be recorded. We are used to multitrack tape recorders with a number of physical tracks, each of which feeds a given audio output. The disk drive is simply a large block of storage space, and no single area of this space is physically set aside for a particular track or audio channel. If a disk-based system has four audio outputs, it is a relatively easy matter to assign a sound file to any one of them by redirecting the output of the buffer to the appropriate converter.

A disk-based system with enough storage space to store an hour of monophonic audio could be configured to use the same space for ½ hour of stereo or ¼ hour of 4-track. The limitations to this subdivision of the space into 'tracks' come with the limit on the maximum rate at which the disk controller can get data on and off the disks. One channel of 16 bit digital audio at 48 kHz generates data at a rate a little under 1 Mbit/s. It is possible to see that to handle four channels simultaneously, the drive would have to be able to transfer data at a rate of nearly 3 Mbit/s, and this increases proportionally as more simultaneous outputs are required. There will come a point at which the disk cannot output data as fast as it would be required. Going back to the bucket analogy, it is as if the hole in the bucket were now very large, and the tap couldn't fill it up fast enough to keep it full. Most current commercial systems reach this limit with around eight simultaneous outputs, and some have chosen to make the number of simultaneous outputs per drive lower than this in order to make for more flexibility in the cross-fading and editing of files.

There is an important point to be made here with regard to the usage of space on disk for audio 'tracks', and this is that if one is using the drive to store a number of short sound files (say for dubbing a TV programme), there is no space wasted in the silences between effects files that would have to be present on multitrack tape. Thus the total number of 'disk minutes' that are used up to dub a ½ hour programme with eight 'tracks' will be nothing like the length of the programme.

Adding storage

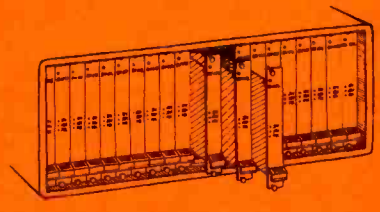
Many systems which incorporate disk drives for storing audio use a common computer interface called the SCSI bus (the Small Computer Systems Interface). This means in theory that a number of SCSI drives could be added to increase the amount of storage available. The number of drives possible is often limited by the manufacturer for commercial reasons. This also means, in theory, that if other SCSI storage devices of a different type (say magneto-optical drives in the future) became available, these could be retrofitted to the existing system without too much trouble. These could increase storage capacity and allow for

WHAT IS A HARD DISK?

removable disks.

Many of the drives currently available in commercial systems have a capacity around 360 Mbyte, which will give about an hour of 'disk time', which can be subdivided between channels. Often another drive or two may be added to boost this. The presentation of the 'disk time' to the user is entirely up to the manufacturer, as to whether the system is configured as a multitrack dubbing system or a stereo editor.

References:
'Random Access Editing of Digital Audio'; Ingebretsen and Stockham. *JAES* 32.3 March 1984
'Efficient editing of digital sound on disk'; C Abbott. *JAES* 32.6 June 1984
The Art of Digital Audio; J Watkinson. Focal Press 1988



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d&b audiotechnik

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Medium/large control room main monitor. 4-driver, 3-way design, gives ±2dB 28Hz to 20KHz, at 122dB SPL RMS. Amplifier unit includes 4 x 1000W power amps, all active crossovers and full protection.

1025B

1019A

Compact 2-way active monitor for near-field or OB truck use. Exceptional frequency response of ±2dB 60Hz to 20KHz @ 101dB SPL from 7.5 litre enclosure.

1022B

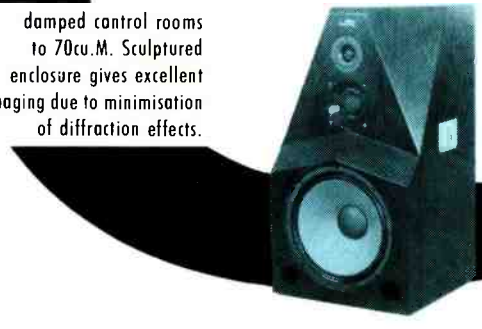
Radical enclosure design in advanced plastics materials, gives tightly controlled radiation characteristics, with bass response to 38Hz, 110dB sound pressure levels, very low coloration, and superb stereo imaging. This 3-way active system is ideal for music recordings and editing in small/medium sized rooms.

S30

3-way, integrated, active monitor for near-field or small control room use. ±2dB 43Hz to 20KHz, 105dB SPL. Horizontal desk-top version also available. Features include full protection circuits and ultra-smooth ribbon tweeter.

1024B

Medium sized, 3-way active, integrated system with 32Hz bass end and 115dB SPL (RMS) for normally damped control rooms to 70cu.M. Sculptured enclosure gives excellent imaging due to minimisation of diffraction effects.



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DISK-BASED RECORDING SYSTEMS

This survey looks at systems that record audio in a digital form on to hard disks. The nature of audio data is such that large amounts of disk space are consumed when stored, which in turn is expensive. As a result of this some manufacturers have seen their products not so much a storage device as a workstation for audio editing and manipulation. In this survey we have not made a distinction between these different approaches as with such systems, being by their very nature under software control, should the manufacturer decide to modify the parameters of his product he has the ability to do so. Further, the developing nature of most of the products mentioned here means that some products included may do more than we have mentioned should the market see it as necessary.

AMS

AudioFile: Hard disk-based 16 bit record, edit and playback system. Can be configured mono, stereo or multitrack.
AMS Industries plc; AMS Industries Park, Burnley, Lancs BB11 5ES, UK. Tel: 0282 57011.
USA: AMS Industries Inc, 3827 Stone Way North, Seattle, WA 98103. Tel: (206) 633-1956.

Ariel

A line of low cost digital disk recorders based around PC-type computers together with digital signal processing systems.
Ariel Corporation, 110 Greene Street, Suite 404, New York City, NY 10012, USA. Tel: (212) 925-4155.

Audio+Design

SoundMaestro: Hard disk-based audio recording editing system designed around the Atari *Mega ST* computer with 16 Gbyte storage capability. 2-channel 16 bit with 44.1 and 25.5 kHz sampling rate. Plans for multichannel versions and specialist software versions.
Audio+Design (Recording) Ltd, Unit 3, Horseshoe Park, Pangbourne, Berks RG8 7JW, UK. Tel: 07357 4545.
USA: Audio+Design/USA, 4611 Columbia Pike, Arlington. VA 22204. Tel: (703) 522-7780.

Compusonics

DSP-1000: WORM-based 5¼ in optical disk format giving 72 min of 44.1 kHz sampling rate, 16 bit stereo of up to 512 min mono speech-type material using CSX process.
DSP-1500: Magnetic disk in cartridge format digital recording giving 7½ min stereo music at 32 kHz with possible external computer control.
DSP-1200: Replay only version of *DSP-1500*.
Compusonics: 2345 Vale Street, Palo Alto, CA 94306, USA. Tel: (415) 494-1184.

Digital Audio Research

Soundstation II: Hard disk-based digital recorder/editor. Basic system is four channel expandable to eight. Full range of interfaces for storage systems and inputs. Touch sensitive screen operation.
Digital Audio Research Ltd, 2 Silverglade Business Park, Leatherhead Road, Chessington, Surrey KT9 2QL, UK. Tel: 03727 42848.
USA: Digital Audio Research (USA), PO Box 275, Rheem Valley, CA 94570. Tel: (415) 376-2760.

Denon

DN-052ED: Hard disk-based 16 bit recording system operating 2 or 4 channels. Part of comprehensive editing system intended mainly for music editing.
Nippon Columbia Co Ltd, 14-14, 4 Chome Akasaka, Minato-ku, Tokyo 107, Japan. Tel: (03) 584-8111.
UK: Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St Peter, Bucks SL9 9UG. Tel: 0753 888447.
USA: Denon Digital Industries Inc, 1380 Monticello Road, Madison, GA 30650. Tel: (404) 342-0637.

Fairlight

Series III: A development of the series *III* it is a disk recording system recording 16 bit at sampling frequencies up to 96 kHz which can be used with the *MFX* controller.
Fairlight Instruments Pty Ltd, 15-19 Boundary Street, Rushcutters Bay, NSW 2011, Sydney, Australia. Tel: (02) 331 6333.
UK: Stirling Audio, Kimberley Road, Kilburn, London NW6. Tel: 01-624 6000.
USA: Fairlight Instruments Inc, 2945 Westwood Blvd, Los Angeles, CA 90064. Tel: (213) 470-6280.
USA: Fairlight Instruments Inc, 110 Greene Street, New York, NY 10012. Tel: (212) 219-2656.

Ferrograph

Model 9000: Compusonics *DSP-1500*—write once, read many (WORM) 5¼ in optical disk format.
Model 9500: Compusonics *DSP-1500*—magnetic disk in cartridge format for broadcast use.
Model 9200: Compusonics *DSP-1200*—playback-only version of *DSP-1500*.
Ferrograph, Unit 21, Royal Industrial Estate, Jarrow, Tyne & Wear NE32 3HR, UK. Tel: 091-489 3092.

For.A

Sirius-100: Hard disk-based record/replay system with up to eight channels of audio available. Capability to handle a number of control panels simultaneously on the same system.
For.A Company Ltd, 3-2-5 Nishi-Shinjuku, Sinjuku-ku, Tokyo 160, Japan. Tel: (03) 346-0591.
UK: Cameron Broadcast Systems, Burnfield Road, Giffnock, Glasgow G46 7TH. Tel: 041-633 0077.
USA: For.A Corporation of America, Nonantum Office Park, 320 Nevada Street, Newton, MA 02160. Tel: (617) 244-3223.

Image Video

AES-2000: Hard disk-based digital recording/editing system operating at 16 bit 48 kHz sampling rate.
Image Video Ltd, 705 Progress Avenue, Unit 46, Scarborough, Ontario, Canada M1H 2X1. Tel: (416) 438-3940.

Lexicon

Opus: Digital audio production system with hard disk record/replay capability. Full sound mixing, equalisation, etc, with expandable recording capability.
Lexicon Inc, 100 Beaver Street, Waltham, MA 02154, USA. Tel: (617) 891-6790.
UK: FWO Bauch Ltd, 49 Theobald Street, Borehamwood, Herts WD6 4RZ. Tel: 01-953 0091.

New England Digital

Synclavier: Direct-to-disk recording system that can be run up to 32-track. Designed to work in conjunction with the other synthesis and sampling aspects of the system although not necessarily so. Expandable in time capacity.
New England Digital, Box 456, White River Junction, VT 05001, USA. Tel: (802) 295-5800.
UK: Harman (Audio) UK, 114 Charing Cross Road, London WC2H 0DT.

Real World Research

The Audio Tablet: Hard disk-based editing/recording system. Pressure sensitive screen operation with dedicated software for differing working environments. Two channel system with tape streamer back-up.
Real World Research, Bath, UK.
UK & Worldwide: Syco, 20 Conduit Place, London W2. Tel: 01-724 2451.

SSL

01 Digital Production Centre: Integrated 8-channel mixer with signal processing containing hard disk recording editing/recording system configured to work as three stereo machines. Designed for mastering applications.
Harry Sound: Product developed for sister company Quantel as part of their *Harry* system.

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Sound Effect Libraries

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for IBM AT-Compatible PCs

Cataloging Software

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- Search by description, category or example
- Refine searches by format, media, length, project, recordist or library
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- Print & update cross referenced catalogs
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- Update vocabulary changes throughout library

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- Thesaurus links synonyms when searching
- Allows unlimited length of descriptions
- Optional multi-user L.A.N. version
- Optional spotting & transfer ordering functions simplify sound editing projects

Music Library Organization

An optional enhancement provides an alternate set of screens & printouts tailored to the task of music library management.

Presorted CD Libraries

Spare yourself from tedious typing by using our effect information data on floppy disks: BBC, Sound Ideas, Valentino, DigiEfx, SFX The Library, Dimension, Elektra, Audio Fidelity, Bainbridge, Hanna Barbara and many more.

Controls Sony CDK-006

The optional CDK interface system provides complete control of Sony's 60-disk CD jukebox:
- Fast scan, reverse scan, play select or auto-all
- Cue within 1/10th on second any track or index
- Loop between two points on any track or index

NEW ADDRESS:

Leonardo Software

10378 Holman Avenue • Los Angeles, CA 90024
Phone: (213) 277-5161 • Fax: (213) 827-8578
Compuserve: 72167,3514 • MCI: DSTRUMPELL

Uses graphics tablet operation with four channel recording and editing capability in conjunction with *Harry*.
Solid State Logic, Begbroke, Oxford OX5 1RU, UK. Tel: 08675 4353.
USA: Solid State Logic, 320 West 46th Street, New York, NY 10036. Tel: (212) 315-1111; 6255 Sunset Boulevard, Los Angeles, CA 90028. Tel: (213) 463-4444.

WaveFrame

AudioFrame: A digital audio workstation that currently is heavily screen-based in operation. Will expand to include longer recording times although currently based around sampling-type systems.
WaveFrame Corporation, 4725 Walnut Street, Boulder, CO 80301, USA. Tel: (303) 447-1572.
UK: Syco, 20 Conduit Place, London W2. Tel: 01-724 2451.

DAT

Because of the rather sensitive nature of DAT in the consumer market place, there are a number of DAT machines that could have a professional application but information is rather scarce with denials about marketing plans being imminent. Some companies have, however, been far more open about their professional products, or products that could have a professional application—and in the case of DAT that line is very hard to define. This following list is then the companies who have announced and/or are marketing DAT.

Akai: Have machines developed but no information is available on their marketing plans.

Top: Panasonic SV-250 portable DAT recorder; centre: Panasonic SV-3500 studio DAT recorder/player; above: Audio Design PRODAT 1 version of Sony DTC1000 DAT recorder.

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Audio+Design

Audio+Design Ltd, Unit 3, Horseshoe Park, Pangbourne, Berks, UK. Tel: 07357 4545.
USA: Audio+Design USA, 4611 Columbia Pike, Arlington, VA 22204. Tel: (703) 522-7780.

PRO-DAT 1: Professionalised *DTC1000* DAT recorder with electronically balanced in/outs, digital in/outs and additional EBU in/out. Recording at 44.1 kHz. EBU sync, copy prohibit and error status indicator.
PRO-DAT 2: As PRO-DAT 1 but with S/DIF in/outs and Apogee filters. Programme is available at all three digital outputs simultaneously.

Casio: Have a small portable DAT unit that is quite obviously a consumer-type unit but is not being distributed by Casio to the best of our knowledge. The *DA-1* is however being directly imported into certain territories and remains currently the cheapest DAT machine available.

Denon: Will be showing a professional 20-bit model at the Tokyo Audio Fair. There are no immediate plans to market machines outside of Japan in the immediate future.

Fostex: Have been showing prototype machines for the last year at trade shows for the professional market. Have developed a system enabling reading of timecode for synchronisation with external sources.

Sony

Sony Corporation, Tokyo International, PO Box 5100, Tokyo, 100-31 Japan.
UK: Sony Broadcast Ltd., Belgrave House, Basing View, Basingstoke, Hants. RG21 2LA. Tel: (0256) 55011.
USA: Sony Corporation of America, Sony Drive, Park Ridge, New Jersey 07656. Tel: (201) 930-1000.
One of the few manufacturers to have delivered products at the time of writing.
PCM-2000: Portable professional robust DAT recorder with linear timecode track. Line and mic inputs. Phantom power. AES/EBU digital I/O. Switchable 44.1/48 kHz sampling frequency.
PCM-2500: Studio DAT recorder. 44.1/48 kHz switchable sampling frequency. SDIF and AES/EBU digital I/O. Balanced 600 Ω analogue (+4 dBm level). Wired or wireless remote control. Records and edits START and SKIP ID's.
The models *DTC1000* and *TC10D* (portable) are available in the UK through HHB Hire & Sales, 73-75 Scrubs Lane, London NW10 6QU. Tel: 01-960 2144 who also supply Sony professional models as well.
Teac-Tascam: Have announced plans for a full range of professional DAT machines. Currently only two definite models, the *DA-50* from Tascam, a professional 19 in rackmount model; and from Tascam, the *R-1* which is free-standing with a door over transport controls.

Technics

USA: Panasonic Industrial Company, Secaucus, NY 07094. Tel: (201) 392-6004.
Have two machines announced so far but distribution is not yet worldwide mainly being restricted to the US.
SV-250: Portable recorder with *XL*-type input connectors.
SV-3500: Studio-type machine—full function with analogue and digital inputs.

PCM VIDEO BASED RECORDING SYSTEMS

Akai

Akai Electric Co Ltd, 12-14, 2-Chome, Higashi-Kojiya, Ohta-ku, Tokyo, Japan.
UK: Akai (UK) Ltd, Haslemere Heathrow Estate, Silver Jubilee Way, Parkway, Hounslow, Middx TW4 6NF. Tel: 01-897 6388.
USA: Akai Professional Products, PO Box 2344, Fort Worth, TX 76113. Tel: (817) 336-5114.

DR-1200 PCM: 12-track on 8mm video cassette which records 12 digital PCM channels, 16 bit linear. 17 min recording time on a standard 90 min Video 8 cassette using linear tape speed of 72.76 mm/s.

Audio+Design

Audio+Design (Recording) Ltd, Unit 3, Horseshoe Park, Pangbourne, Berks RG8 7JW, UK. Tel: 073 57 4545.
USA: Audio+Design/USA, 4611 Columbia Pike, Arlington, VA 2204. Tel: (703) 522-7780.

Digi-4: Two modified Sony *PCM701ES* processors with video encoding equipment enabling 4-channel phase coherent recording/playback.
PRO 701: Professionalised version of the Sony *PCM701ES* with electronically balanced in/outs, CTC, pre-emphasis, copy prohibit, PAL/NTSC record standard and digital in/outs.

By The Numbers

By The Numbers, PO Box 8359, Incline Village, NV 89450, USA.
Tel: (702) 831-4459.

Collossus: 4-channel PCM processor 16 bit with 50 kHz sampling rate. NTSC standard TV output. Portable. Digital standards conversion option allows full compatibility with Sony *1610/1630* format.

Denon

Denon/Nippon Columbia Co Ltd, 14-14 Akasaka 4-Chome, Minatu-ku, Tokyo 107, Japan. Tel: (03) 584-8111.
UK: Hayden Laboratories Ltd, Chiltern Hill, Chalfont St Peter, Bucks SL9 9UG. Tel: 0753 888447.
USA: Denon Digital Industries Inc, 1380 Monticello Road, Madison, GA 30650. Tel: (404) 342-0637.

DN-039R: 2- and 4-channel PCM processor with NTSC standard outputs. 16 bit with switchable 48/44.1 kHz sampling rate (also 44.056 kHz under certain conditions). Can be edited using Denon editing system or to 1/30 s accuracy with two recorders.

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JVC

Victor Company of Japan Ltd, Tokyo, Japan.
USA: JVC Corporation, 41 Slater Drive, Elmwood Park, NJ 07407. Tel: (201) 794-3900.

VP-900: 2-channel PCM processor 16 bit with switchable sampling rate 44.1/44.056 kHz. Output conforms to NTSC TV signal. Uses JVC Bi-Parity recording format. Forms part of the JVC *DMS 900* mastering system, which comprises digital editing and mixing components.

Sony

Sony Corporation, Tokyo International, PO Box 5100, Tokyo 100-31, Japan.
UK: Sony Broadcast Ltd, Belgrave House, Basing View, Basingstoke, Hants RG21 2LA. Tel: 0256 55011.
USA: Sony Corporation of America, Sony Drive, Park Ridge, NJ 07656. Tel: (201) 930-1000.

PCM-1630: 2-channel PCM processor 16 bit with switchable 44.1/44.056 kHz sampling frequency. Fully compatible with *PCM-1610* format. Optional read after write, digital delay and AES/EBU boards.
PCM-701ES: 2-channel PCM processor similar to *F1* but not portable and has no mic inputs.

DIGITAL REEL TO REEL RECORDING

Mitsubishi

Mitsubishi Electric Corporation, Mitsubishi Denki Building, Marunouchi, Tokyo 100, Japan.
UK: Mitsubishi Pro Audio Group, Unit 13, Alban Park, Hatfield Road, St Albans, Herts. Tel: 0727 40584.
USA: Mitsubishi Pro Audio Group, 225 Parkside Drive, San Fernando, CA 91340. Tel: (818) 898-2341.

X-850: 32-channel PD format multitrack plus two analogue tracks, timecode track and two aux digital tracks for user data. 30 in/s tape speed with 1 in tape and 14 in reel capacity. Switchable 48/44.1 kHz sampling at 16 bit.
X-400: 16-channel PD format multitrack plus two analogue tracks, timecode track and one aux digital track for user data. 30 in/s tape speed with ½ in tape and 14 in reel capacity. 16 bit at 48/44.1 kHz switchable sampling.
X-86: 2-channel PD format mastering machine plus two analogue tracks, timecode and aux digital track. Standard version 15 in/s tape speed with 14 in reel capacity, switchable 48/44.1 kHz sampling rate and future upgradable. Version *X-86LT* as standard but with 7½ in/s tape speed.
X-86HS: Similar to the *X-86* but with 96/88.2 kHz sampling rates giving possible audio response up to 40 kHz. Also records and replays at 48/44.1 kHz sampling rates when it becomes fully compatible with standard *X-86*.
X-86C: Offers full playback compatibility with *X-80* series format tapes enabling replay on *X-86*.

Sony PCM-3324A and RM-3310.

Otari

Otari Electric Co Ltd, 4-29-18 Minami-Ogikubo, Suginami-ku, Tokyo 167, Japan. Tel: (03) 333 9631.
UK: Otari Electric (UK) Ltd, 22 Church Street, Slough, Berks SL1 1PT. Tel: 0753 822381.
USA: Otari Corporation, 378 Vintage Park Drive, Foster City, CA 94404. Tel: (415) 341-5900.

DTR-900: PD format multitrack available as 32-channel or 24-/32-channel plus two analogue tracks, timecode and two aux digital tracks for user data. Tape speed 30 in/s on 1 in tape with 14 in reel capacity. 16 bit with 48/44.1 kHz switchable sampling rate.

Sony

Sony Corporation, PO Box 10, Tokyo Airport, 149, Japan.
UK: Sony Broadcast Ltd, Belgrave House, Basing View, Basingstoke, Hampshire RG21 2LA. Tel: 0256 55011.
USA: Sony Corporation of America, Sony Professional Audio Division, Sony Drive, Park Ridge, NJ 07656. Tel: (201) 930-1000.

PCM-3324A: 24-channel DASH format plus two analogue tracks, control track and one user data track. Tape speed 30 in/s for 48 kHz sampling rate on ½ in tape with 14 in reel capacity. 16-bit with switchable 44.1/48 kHz sampling rate.
PCM-3402: 2-channel DASH format mastering machine. Will operate at 7½ in/s (DASH-S) and 15 in/s (DASH-M) using Twin DASH format. Switchable sampling 44.1/48 kHz with 16 bit operation. Full electronic editing capabilities with pair of machines.

Studer

Studer International AG, Althardstrasse 10, CH-8105 Regensdorf, Switzerland. Tel: (01) 840 29 60.
UK: FWO Bauch, 49 Theobald Street, Borehamwood, Herts WD6 4RZ. Tel: 01-953 0091.
USA: Studer Revox America Inc, 1425 Elm Hill Pike, Nashville, TN 37210. Tel: (615) 254-5651.

D820X: 2-channel DASH format mastering machine with timecode, reference data and two audio cue tracks. Uses Twin DASH format running 15 in/s at 48 kHz sampling 16 bit switchable to 44.1 kHz, ¼ in tape width with 14 in reel capacity. Same transport and functions as *A820* analogue machine. Four cue tracks, aux, ref data, SMPTE and EBU. Digital AES/EBU and analogue output. ±12.5% varispeed.

Tascam

Tascam have announced plans for the launch of a 24-track DASH compatible machine in the near future. A prototype is to be shown at AES Los Angeles and production is planned for spring '89.

ANALOGUE RECORDING

Akai

Akai Electric Co Ltd, Electronic Musical Instrument Division, 335 Kariyado, Nakahara-ku, Kawaski-Shi, Kanagawa, Japan.
UK: Akai (UK) Ltd, Haslemere Heathrow Estate, Silver Jubilee Way, Parkway, Hounslow, Middlesex TW4 6NQ. Tel: 01-897 6388.
USA: Akai Professional Products, IMC, PO Box 2344, Fort Worth, TX 76113. Tel: (817) 336-5114.

MG14D: ½ in Akai cassette-based recorder with 12 channels plus control track and sync track. Tape speeds of 3¾ and 7½ in/s and uses dbx NR. Also compatible with *MG1214* combined mixer/recorder format.

AEG

AEG Aktiengesellschaft, Professional Tape Recorder Branch, Bucklestrasse 1-5, D-7750 Konstanz, West Germany. Tel: 07531 862370.
UK: Hayden Labs, Chiltern Hill, Chalfont St Peter, Bucks SL9 9UG. Tel: 0753 888447.

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USA: Quad-Eight Westrex, 225 Parkside Drive, San Fernando, CA 91340. Tel: (818) 898-2341.

M21: 2-track master on ¼ and ½ in.
M20: 2-track on ¼ in; four speeds, digitally adjustable functions.
M15A: 8-track on 1 in, 16-, 24- and 32-track on 2 in with autolocate.

ASC

Audio System Componenten GmbH & Co, Seibelstrasse 4, D-8759 Hoesbach, West Germany. Tel: (0 60 21) 5 30 21.
UK: RJ Education Supplies Co Ltd, Unit 2, Westerham Trade Centre, London Road, Westerham, Kent TN16 3BR. Tel: 0959 62255.

AS 6000: 2-track transportable 3-speed machine on ¼ in with high and low speed versions. Provision for extra replay head and other options.

Digitec

Societe Anonyme des Techniques Digitales, 57 bd de la Republique BP 51, 78401 Chatou, Cedex France. Tel: (1) 30 71 16 95.
UK: The Professional Recording Equipment Company Ltd, 21 Summerstown, London SW17 0BQ. Tel: 01-946 8774.

F 500: Mono, stereo and 2-track versions on ¼ in; variety of timecode options.

Ferrograph

AVM-Ferrograph, Unit 20/21, Royal Industrial Estate, Jarrow, Tyne & Wear NE32 3HR, UK. Tel: 091-489 3092.

Series 77: 2-track mono and stereo versions on ¼ in; Revox transport and electronics.

Fostex

Fostex Corporation, 560-3 Miyazawacho, Akishima, Tokyo, Japan.
UK: Harman (Audio) UK Ltd, Mill Street, Slough, Berks SL2 5DD. Tel: 0753 76911.
USA: Fostex Corporation of America, 15431 Blackburn Avenue, Norwalk, CA 90650. Tel: (213) 921-1112.

E Series: 8- and 16-tracks on ¼ in and ½ in respectively with Dolby *C*; also ¼ in and ½ in 2-track master recorders with centre-track timecode.
Model 80: 8-track on ¼ in; 7 in reels; Dolby *C* incorporated.
Model 20: 2-track master based on Model *80*, with centre-track timecode.

Lyrec

Lyrec Manufacturing A/S, Box 199, Hollandsvej 12, DK-2800 Lyngby, Denmark. Tel: 2 876322. Fax: 2 882540.
UK: Pro-Britro Ltd, 35 Britannia Row, London N1 8QH. Tel: 01-226 1226. Fax 01-359 1454.
UK: Lyrec (UK) Ltd, Ardhaven House, Old London Road, Milton Common, Oxford OX9 2JR. Tel: 08446 8866. Fax: 08446 8810.

TR533: Improved with slightly altered tape path and optional Dolby *HX Pro;* 16- and 24-track versions on 2 in tape; 14 in max reel size.
TR55: 2-track master recorder on ¼ in tape; 14 in max reel size.
TR55-2/TC Centre-track timecode version of TR55.
FRED: Editing machine with dump mode. Version without built-in scissors and fade in/out.

Nagra

Kudelski SA, CH-1033 Chesaux/Lausanne, Switzerland. Tel: (021) 731.21.21.
UK: Hayden Labs, Chiltern Hill, Chalfont St Peter, Bucks SL9 9UG. Tel: 0753 888447.
USA: Nagra Magnetic Recording Inc CA, 1147 North Vine Street, Hollywood, CA 90038. Tel: (213) 469-6391.
USA: Nagra Magnetic Recording Inc, 19 West 44th Street, Room 715, NY 10036, New York. Tel: (212) 840-0999.

T-Audio: Stereo, 2-track and 2-track plus timecode versions on ¼ in tape; four speeds with max spool diameter of 11.8 in. Extras for linking to video systems available.
Nagra 4.2: Full-track mono portable on ¼ in tape; Neo pilot option.
Nagra E: Low cost version of *4.2*.
Nagra IV-S: 2-track stereo plus Nagrasync; ¼ in portable.
Nagra IV-SJ: Instrumentation version of *IV-S*, but sync track replaced by FM track.
Nagra IV-S TC: Timecode version of the IV-S.
Nagra SN: Full- and ½-track mono versions on ⅛ in tape; very small.
Nagra SNST: Stereo version of *SN*, using 0.15 in tape; with expander and compressor.
Nagra JBR: Sub miniature cassette tape recorder using special cassettes.

Otari

Otari Electric Co Ltd, 4-29-18 Minami-Ogikubo, Suginami-ku, Tokyo 167, Japan. Tel: (03) 333-9631.
UK: Otari Electric (UK) Ltd, 22 Church Street, Slough, Berks SL1 1PT. Tel: 0753 822381.
USA: Otari Corporation, 378 Vintage Park Drive, Foster City, CA 94404. Tel: (415) 341-5900.

MTR-90-II: 1 in 8-track, and 2 in 16- and 24-track machines.
MTR-20: Mastering recorder in five versions ¼ in 2-track, ¼ in 2-track with centre-track timecode, ¼ in stereo, ½ in 2-track and ½ in 4-track; 14 in max reel size, plus automated audio calibration.
MTR-12-II: ¼ in 2-track, ¼ in 2-track with centre-track timecode, ½ in 2-track and ½ in 4-track versions; 12½ in max reel size.
MTR-100A: 24-track 2 in. Self alignment.
BQ2: ¼ in 4-track, external synchroniser.
MX-55: ¼ in compact in full-track, 2-track stereo, 2-track with centre-track timecode, 4-track and 2-track desktop overbridge design.
MX-70: 8- and 16-track versions on 1 in; 10½ in NAB reels.
MX-80: 16-, 24-, 24/32 and 32-track versions on 2 in; 10½ in max reel size; Dolby *HX-Pro* incorporated.
MX-5050 tabletop series: *Mk III/2* 2-track on

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¼ in; *Mk III/4* 4-track on ½ in; *Mk III/8* 8-track on ½ in tape; *B-II* 2-track on ¼ in.

Solidyne

Solidyne, Tres de Febrero 3254, 1429 Buenos Aires, Argentina.
GMS-200: 2-track on ¼ in, convertible to 4-, 8- and 16-track on ½ and 1 in tape; full digital control of editing and synchronisation.

Sony

Sony Corporation, PO Box 10, Tokyo Airport, Tokyo 149, Japan. Tel: (03) 448-2111.
UK: Sony Broadcast Ltd, Belgrave House, Basing View, Basingstoke, Hants RG21 2LA. Tel: 0256 55011.
USA: Sony Corporation of America, Professional Audio Division, Sony Drive, Park Ridge, NJ 07656. Tel: (201) 930-1000.

JH-24 series: 8-track on 1 in, 24-track and 16-track on 2 in.
APR-5000: Range of mono, stereo and 2-track mastering machines on ¼ in with stereo ½ in version and centre-track timecode options.

Saturn

Saturn Research Ltd, Unit 3A, 6-24 Southgate Road, London N1 3JJ, UK. (Worldwide distribution).
UK: Larking Audio, 15 Cam Square, Hitchin, Herts SE4 0TZ. Tel: 0462 422466.

Saturn: 24-track on 2 in, with *Total Remote* and interface for timecode reading, noise reduction, sync. Automated system for tape alignment and equalisation setup.

Stellavox

Stellavox, 2068 Hauterive/NE, Switzerland. Tel: 038 33 42 33.
UK: Future Film Developments, PO Box 3DG, 114 Wardour Street, London W1A 3DG. Tel: 01-437 1892. Fax: 01-437 9354.

TD-9: Twelve ¼ in versions include mono, stereo, stereo with timecode, stereo mastering and 4-track instrumentation; ½ in versions are stereo and 4-track mastering; will also handle 16mm film in mono, stereo and 4-track; exchangeable heads and plug-in sync module; full microprocessor control.
SP 8: Battery-operated portable, plug-in headblocks for full- and 2-track mono or ¼- or ½-track stereo; sync for TV, film and instrumentation.

Studer-Revox

Studer International AG, Althardstrasse 10, Regensdorf, CH-8105, Switzerland. Tel: 018 40 29 60.
UK: FWO Bauch Ltd, 49 Theobald Street, Borehamwood, Herts WD6 4RZ. Tel: 01-953 0091.
USA: Studer-Revox America Inc, 1425 Elm Hill Pike, Nashville, TN 37210. Tel: (615) 254-5651.

A820: 8-, 16- and 24-track versions on 1 or 2 in; Dolby *HX-Pro* fitted as standard; optional interface for Dolby *A, SR* or *telcom* NR; auto-alignment, 40 assignable functions in memory. ¼ in and ½ in stereo versions with 14 in spool and 40 assignable functions in memory.
A80: Cassette loopbin mastering, QC cassette pancake and video layback versions only.
A807: 2-track, mono and stereo on ¼ in, with centre-track timecode imminent.
A810: Similar to above with CTTC, FM and neopilot code.
A812: Broadcast replacement for *A80*, centre-track timecode in-console with optional VU penthouse.
Revox-B77: Transportable mono, stereo and 2-track on ¼ in.
Revox PR99: 2-channel general purpose recorder. 2-speed with two high/low options.
C270: 2-channel ¼ in Dolby *HX-Pro* as standard, NAB/IEC plus timecode version.
C274: 4-channel, ¼ in.
C278: 8-channel, ½ in.

Studio Magnetics

Studio Magnetics Ltd, Featherbed Lane, Shrewsbury, Shrops SY1 4NJ, UK. Tel: 0743 236672/66671.
UK: MusicLab, 72-76 Eversholt Street, London NW1 1BY. Tel: 01-388 5392.
USA: Power Studio Supply, 13452 Hollo Oval, Cleveland, OH 44136. Tel: (216) 238-9426.

SML1216 Mk II: Budget 16-track version, ½ in.
AR2400: 24-track on 2 in.
AR1600: 16-track on 2 in.
Omega: 24- and 32-track machines on 2 in.

Tascam

Teac Corp, 15-30 Shimorenjaku, 4-Chome, Mitaka, Tokyo, Japan. Tel: 0422 45-7741.
UK: Teac UK Ltd, 5 Marlin House, Marlins Meadow, The Croxley Centre, Watford, Herts. Tel: 0923 225235.
USA: Teac Corp of America, 7733 Telegraph Road, Montebello, CA 90640. Tel: (213) 726-0303.

ATR-80-24: 24-track on 2 in; optional computer interface.
ATR-60: Available as 2-track and 2-track with centre-track timecode on ¼ in; 2-, 4- and 8-track on ½ in; SMPTE/EBU, timecode and sync code lock on 8-track version; high speed 15/30 in/s on 2- and 4-track versions.
ATR-60-16: 1 in 16-track with built in dbx NR.
MS 16: 1 in 16-track.
MSR 16: ½ in 16-track, with built in dbx NR.
40 series: 2- and 4-track on ¼ in, and 8-track on ½ in; SMPTE timecode.

Uher

Uher Werke Munchen GmbH, Industriestrasse 5, Bad Homburg 1, D-6380, West Germany. Tel: (6172) 106350.
UK: TISL, TISL House, St Johns Road, Isleworth, Middx TW7 69L. Tel: 01-847 3033.
USA: Mineroff Electronics Inc, 946 Downing Road, Valley Stream, NY 11580.
USA: Uher of America, 7067 Vineland Avenue, North Hollywood, CA 91605.

4000 series: 4-speed portables, battery or mains powered; *4000* is ½-track mono with pulse track, stereo version can record mono on one channel with sync on the other; *4200* is ½-track stereo, *4400* is ¼-track stereo, both accommodating sync like *4000*; all have 5 in reels using ¼ in tape.□

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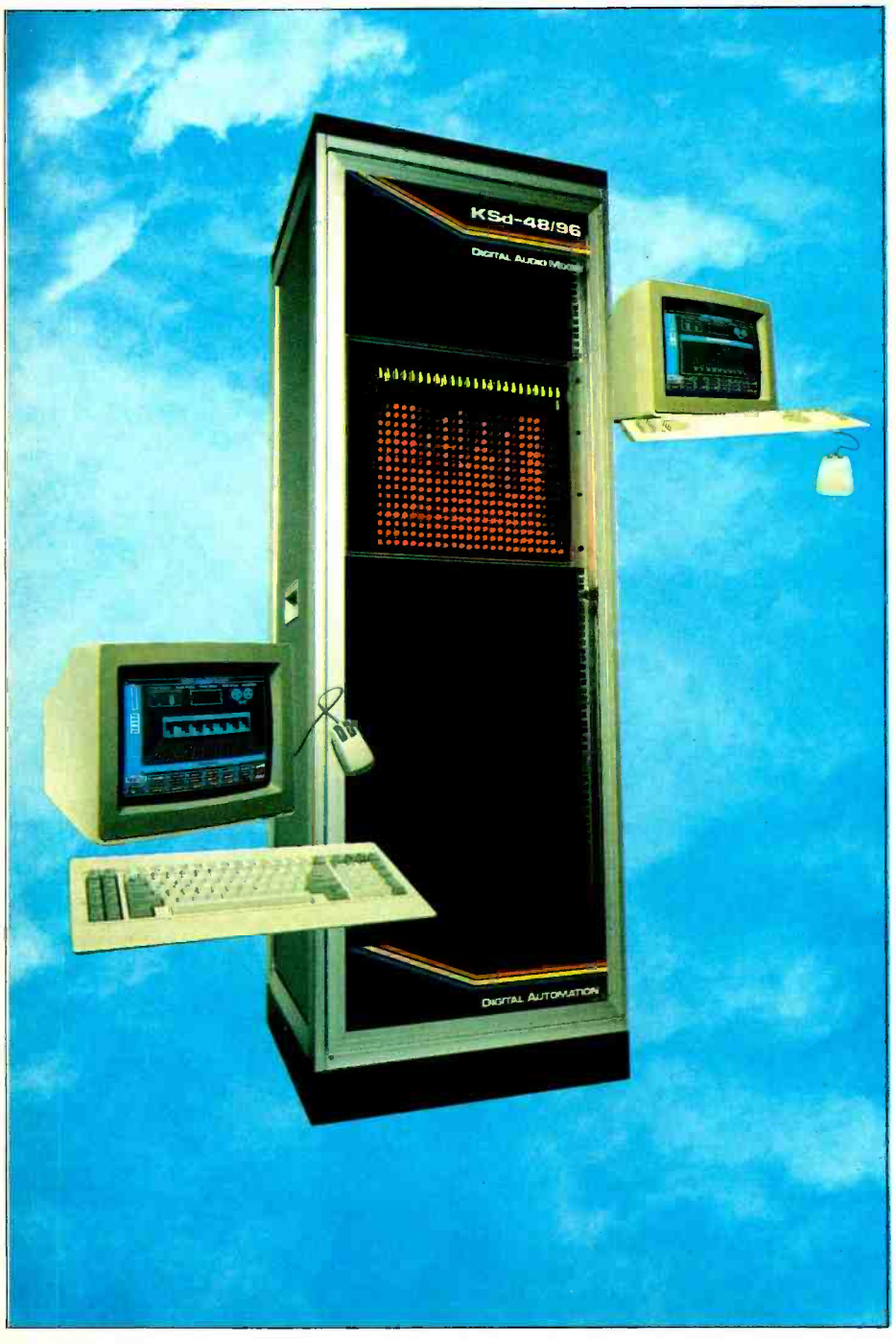
KSd 48/96 DIGITAL MIXING

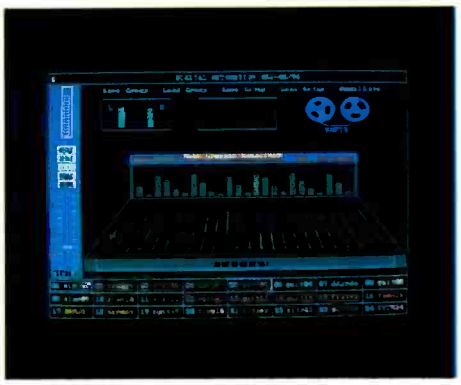
Just a rack system and a PC comprises the KSd digital mixing system from Digital Automation. Patrick Stapely describes its operation while David Shapton from Digital Automation describes the manufacturer's aims

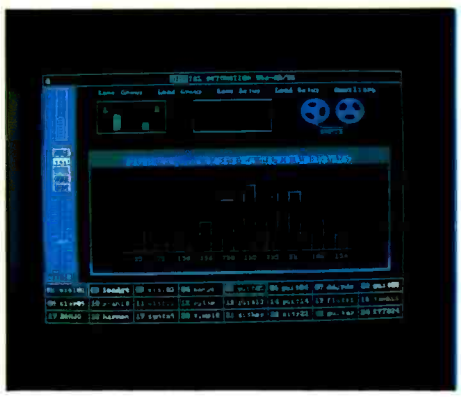


Imagine a mixing console providing 96 inputs and 48 outputs with fully parametric EQ, dynamics, reverb, delay, phasing/flanging, pitch shifting, automatic panning, etc. on each channel. Consider the package as completely digital, sampling at up to 96 kHz with a 24 bit output and that each channel has its own digital signal processing. You might wonder how such a console would fit into the average control room and how anyone could afford it! Well, let me alert you to the fact that such a console does exist and it measures 19×19 inches with a 'suggested price' tag of approximately half that of a good analogue desk.

Designers Kevin Sparkes and David Shapton have spent the last two years getting the *KSd 48/96* off the drawing board and into its present physical state. Although the software is not completely finished, the system works in a basic demonstrable manner and was shown at this year's Paris AES and APRS in London.

The system comprises a 20 MHz 80286 PC with a 40 Mbyte hard disk, high resolution monitor, terminal and mouse. There is also a rack, which houses the DSP boards, power supply and mother board.





Control of the system is via a mouse using the various screens on the monitor, with some commands emanating from the terminal. The main screen depicts a simplified mixing desk with faders receding in perspective to a meter bridge. To the left of this display is a graphic representation of a channel strip, which provides access to the different signal processing and routing screens.

Using the mouse in a horizontal plane, the cursor is swept across the desk to select a fader. Once selected, vertical movements will push the fader up and down. The channel strip display automatically follows fader selection and by moving the cursor into this area the various channel functions can be operated. So, for example, to mute the channel, simply move the

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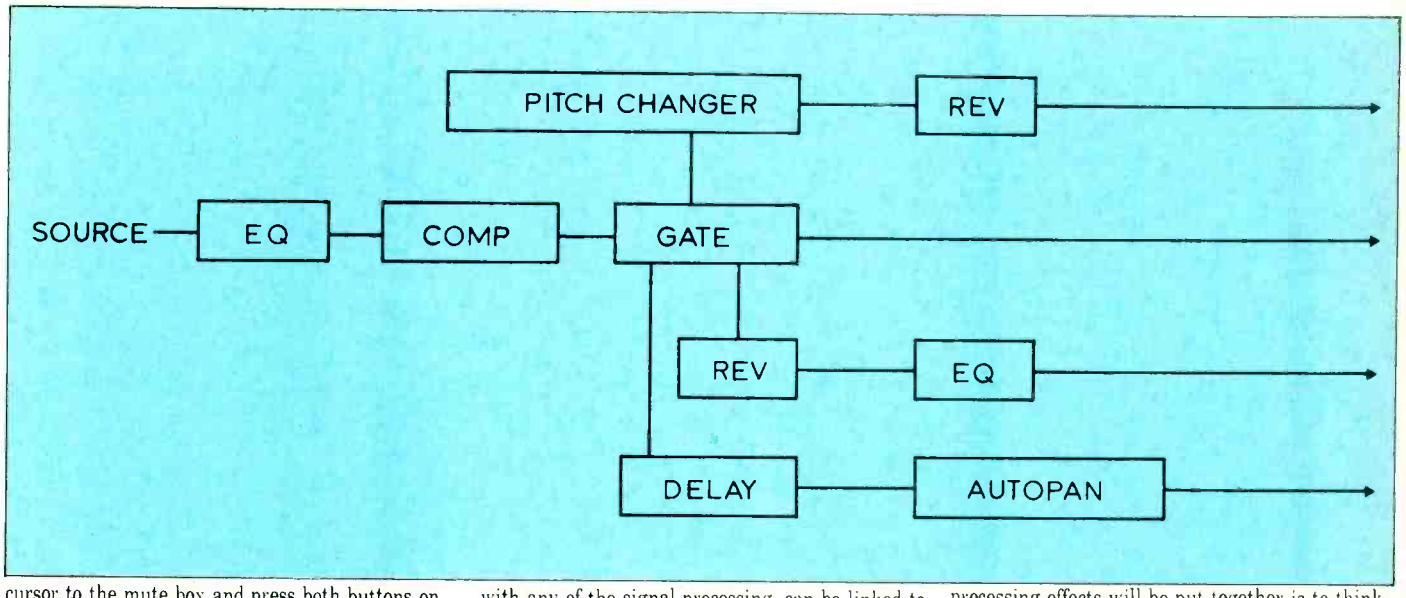

cursor to the mute box and press both buttons on the mouse. This will switch on an indicator, above the fader on the console display, showing that the channel is muted.

Solo is activated in the same way, although there will be a menu available to choose the kind of solo required and also to select which solo condition the system will default to.

At present, EQ is displayed as a 10-band graphic but this is soon to be replaced by a 20-band graphic and a fully parametric EQ display, which will offer bell, shelving and variable Q as well as highpass, lowpass and notch filtering. There are also plans to enable the user to draw in personalised EQ curves. The EQ, along with any of the signal processing, can be linked to other channels so that one set of controls activates a group of channels simultaneously.

As each channel has its own DSP, there is an enormous amount of processing power available, and this is how individual channels can support such a comprehensive array of effects. However, in the event of a channel using up its processing quota, it can be linked to another to provide more space. So as long as there are enough spare channels, one can keep on adding and adding.

Each type of effect will have its own screen with control over the various parameters, and it will be possible to create more than one sound from the same screen. The way to imagine how the various processing effects will be put together is to think of each as a box, which can be added on to or joined at any point rather like a stack of outboard gear.

Other functions controlled from this area include panning and routing. The panning function is controlled by moving a bar across a rectangular box and there are two displays—one for monitor and one for tracks. The routing matrix selects the channel's source and destination, although at the time of writing it was a complicated procedure to route to a track that was not direct.

Groups are constructed by hitting G on the terminal after selecting each fader. The heads of

Although digital multitracks, consoles and effects have been around for years, I believe we are only now reaching the stage where it is possible to have a truly digital studio. The transition from analogue audio to digital is not a one-step operation. Think of a delay line; delay effects started out as tape echoes and delay related effects like phasing and flanging were achieved by abusing tape transports in various ways, and then came 'Bucket Brigade' devices. BBDs were half-way between analogue and digital in that they sampled the signal but stored it as an analogue quantity. Then came 'Digital' Delay Lines, which sampled the signal and gave it a numerical value that could be stored and read out after the required delay. For the first time you could have digital phenomena like infinite repeat. Pitch change (for chorus, flange, etc) is obtained on DDLs by varying the sample rate; wherein lies a problem.

Digital tape recorders and mixers use a fixed sample rate and a conventional DDL can't talk digitally to a fixed-rate device. So, even if you have a digital multitrack, digital console and digital master machine, you have to go back into analogue to use an effect. This is rather bad news, as you begin to lose the advantages of digital processing—and, to that extent, you might as well stay with analogue. The answer to this is to use effects with fixed sample rates. There is a trend towards this but it will be a long time before they are commonplace; not least because of cost.

The *KSd 48/96* was designed from the outset as the digital engine at the centre of a digital studio. In addition to digital mixing it provides all the normal (and some abnormal) studio effects. In fact, each channel is capable of providing each effect. The signal need therefore never leave the digital domain.

There are broadly two approaches to digital mixer design. 'Conventional' digital mixers have one processor that does everything. It must look at each channel in turn, reading fader positions, equalising and summing and can only do one thing at a time, so it has to be extremely fast, consuming a lot of power and giving off a lot of heat. The machines tend to be very big and very expensive but this is not to say they are not very capable machines.

The *KSd 48/96*, however, has multiple processors, each providing local processing power. Every audio channel has two processors, one of which is a DSP. ('Digital Signal Processor' is the generic name for a fast microprocessor which has been optimised for digital signal processing.)

The console is controlled by a 20 MHz IBM compatible PC, which is responsible for display, storage (of parameters, not sound) and providing the user interface. Every aspect of a mix is represented by numbers, so it is relatively easy to arrange for total automation of all functions and settings. Giving these numbers a timecode reference results in dynamic automation (see below for more detail). Instructions (filter coefficients, fader levels, etc) are passed to the DSP on the relevant mixer channel by means of a fast serial link.

During each sample period, which at a sample rate of 44.1 kHz is 22 μs, a DSP can run a program hundreds of lines long. The time can be used for creating several effects simultaneously and the effects can be used as if they are entirely separate units. For example two delays can be used in parallel and then fed to the same EQ. This is possible because within the sample period, it doesn't really matter what the DSP does or in what order it does it, except when effects are in series, as long as the finished sample is ready to be output before the next one arrives.

The DSP is interrupt driven—when a sample comes along, signalled by system sync clock, the DSP stops whatever it is doing and runs the effect program, thereby ensuring that every sample is processed. In background mode, ie when no sample is present, the DSP can be, for example, calculating a fast fourier transform, or simply receiving data from the control computer.

Every aspect of a mix can be described by a number or set of numbers. Storage and recall of these is straightforward but some changes generate a huge volume of numerical data; so much, in fact, that processing, storage and transfer of the data would be a problem. The *KSd 48/96* avoids potential bottlenecks by describing the direction and rate of change, rather than listing all the points through which a parameter might pass. A simple fader movement could be reproduced from two timecode addresses and the start and end points of the fader travel. That's four pieces of information instead of upwards of 65,000. More complex movements can be described in terms of rate of change of rate of change, etc.

Perhaps the best way to think of this type of machine is as a black box with an input and output, which can do anything it is told to by its software, within the limits of its internal structure. With suitable software each channel could be a synthesiser, a sampler, or could even be used for cleaning up old recordings. In other words, this is a soft machine, whose utility is largely a function of its software.

As processors and memory get more powerful and cheaper, machines will get softer. The audio industry will become software driven, like the computer industry. But one thing won't change: we're here to record music. **David Shapton**

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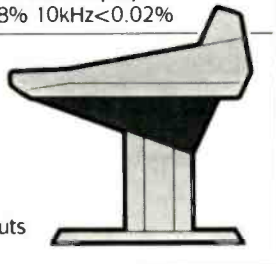
Microphone/line
1kHz<–85dBr 10kHz<–75dBr
Monitor
1kHz<–88dBr 10kHz<–85dBr
Between any two channel line inputs
1kHz<–88dBr 10kHz<–85dBr



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KSd 48/96 DIGITAL MIXING

the faders will change from white to one of 256 colours making grouped channels easily distinguishable. ENTER is pressed after the final fader has been connected to the group and a prompt appears at the 'text window' (situated above the console) asking for the group to be named. The group can now be operated by moving any fader within it and the display adopts the appearance of a motorised fader group with the faders moving in a fixed proportion to one another. Below the console is a track sheet which correspondingly changes the colour of its characters to match the group selection.

There are two inputs available on each channel, so a 48-channel desk provides 96 inputs. Each input has independent access to signal processing and these can be sent—individually or together—to a track, monitor, or back into another channel. This is achieved by using the two faders, that appear on the channel strip, along with the matrix screen. These two faders are also used in the MINI MIX function, that combines predesignated channels into a subgroup for rerouting.

The metering as it stands is provided by a 30-segment bargraph at the top of each fader, and a main left and right display at the top left of the screen. There are plans to provide a more accurate 256-segment metering facility on a separate screen.

The automation side of the desk in its basic form, is controlled from the top of the screen where commands to save and load snapshots and mixes are executed. Snapshots can be useful in a number of ways: to set console status, ie reconfigure for track laying or remixing whilst zeroing all the parameters; or to reinstate the console to a previous working setup; or to insert preset static sections into a mix, which can be performed on- or off-line. There are all kinds of possibilities bearing in mind that every function of the console is 'snappable'.

The automation will be totally dynamic, remembering anything that moves. When I looked at the system, the automation was not ready for a proper demonstration so I am unable to give full details.

The system includes a built-in timecode reader/generator, which deals with the usual array of codes. At present, the system is accurate down to a ¼-frame but it will be possible to achieve accuracy of a single sample. Timecode values are entered without punctuation via the terminal and are read out below the display of a moving reel-to-reel, which mimics tape transport.

Cue points are available in the form of namable labels and are entered on- or off-line. Snaps, mixes, groups and labels all exist in lists, which can be scrolled through and loaded via the text window. Any of the screens will print out for reference and by using a memory resident processor program, note page facilities become available.

Another feature that seems to be getting more and more common, is the HELP facility; by putting the cursor on the relevant operational area and pressing ? on the terminal, the computer will provide full instructions. It is not inconceivable that the complete user's manual could be incorporated into software.

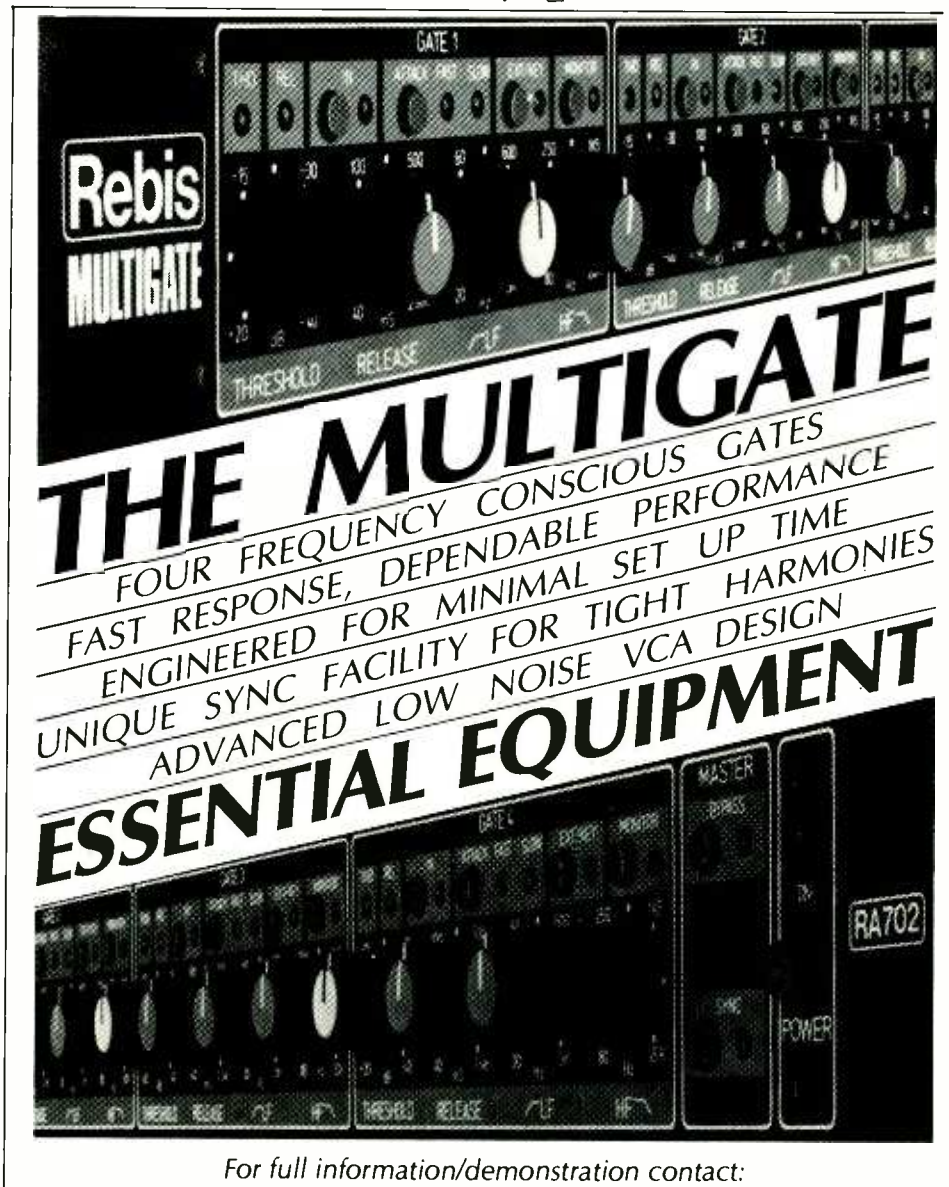
Apart from the mixing and effects facilities discussed, the system offers some useful and interesting extras. In a somewhat chameleon-like way, a channel can turn itself into a synthesiser and, via the MIDI link, interface quite happily to a keyboard. If a synth is not what you are looking for, it can change into a sampler or it could do resynthesis. There are many possibilities.

The system can support additional outboard equipment via digital I/Os or Apogee D/A converters. There is an auxiliary fader that controls the channel output to external devices and this will provide discrete outputs if required although this is not considered very likely with the signal processing capabilities available onboard, especially as the designers believe they can recreate almost any effect. A number of discrete sends may be more widely used, however, for foldback circuits.

In addition to the above in/outs there are dedicated connectors for digital multitracks and stereo machines, as well as the usual code and clock connectors.

It is possible to control the system from an analogue desk by outputting a tone from each analogue fader into a control input on the *KSd 48/96*. The computer would then calculate the various amplitudes and provide fader related functions. It may also be possible to connect other controls by using white noise.

The mixer will be available in five channel sizes—16-, 24-, 32-, 48- and a special mini version for stereo work. The first fully operational packages should be available in September of this year.□



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MARTIN POLON'S PERSPECTIVE

I must apologise to my loyal readers yet again for another period where I have had to be in the care of Doctor Conundrum at the Shady Acres Rest in beautiful downtown Slough. My columns have been written by my trusty computer during this period of my ordeal, which goes to validate the statements of many of my trusty readers that 'any old thing could turn out his column'. But now, with the excessive err...expressive attentions of Nurse Feelgood I am returning to normal. But first I must again thank my wonderful editor and the staff at *Studio Sound* who have speeded my recovery. Just the other day, the editor said to me, "I know we have a group medical policy but that does not mean all your doctors and nurses form the group!"

It is often said that I use this column as a vantage point to illuminate issues for the varied and sundry elements of the professional audio industry. In fact, I view this column as a privilege granted me by the management at Link House and I would never, ever, abuse that privilege. In fact, just the other day the Managing Director was saying that he would spare every expense in supporting the good works that I do. I feel the need to repay all of the support and kindness that I receive from these endeavours so I have decided to present here my story, so that no-one else in our wonderful industry will suffer the pangs and arrows of suffering from the purchase of a professional audio product. This will be terribly useful to all of you in the 'business' because with this in hand you will be able to truly understand those gentle folks around the world who make all of our wonderful equipment—so that we might make all the beautiful music in the world come to life. Why, all of you out there are wonderful and the world is beautiful and bountiful and this is the best of all possible days and Golly Gee, I feel higher than the proverbial kite. Why I think that the nice lady who gave me those large green and white capsules here at the 'home' has slipped me something other than aspirin but I don't care because I am floating awaaaaaayyyy...

Now many of you might wonder how I ended up in this position again. After all, how many baskets can I weave in one lifetime? The last time I had a nervous breakdown it was due to the quality of service manuals for a tape recorder. This time, it all started with the warranty on a new product I had purchased. Like many of my readers in the audio business, I was intrigued by one of the new digital audio devices on the market. It seemed a useful tool to accentuate our business of providing forecasting presentations to our clients. At this point, we were buying our audio presentation from a service which used units similar to the one we purchased.

Despite a career in the audio business that began in my teens and has so far spanned several decades, I maintain a policy of paying my own way. I want no special favours; then I have to grant none myself. I shopped the advertisement in the various electronic musicians magazines. I found one ad that I liked so I sat down and called the toll-free 800 number. The store was located in New York City. The phone was answered by a man who sounded like this month's Attorney General in the Reagan administration, Ed Meese. It began to sound more like Ed Sleaze as the sales pitch unfolded. It was clear that this device would turn me into the down home version of Jan Hammer 15 minutes after I first sat down with it. Despite the clear sense of oversell about this transaction, I wanted this toy too much, too soon. I had made many other calls and none of the other dealers had the unit in stock. Back ordered, they all would say. I nervously surrendered my credit card number and the game was afoot.

I waited with anticipation for the delivery of my new musical personality. It was supposed to be sent 'Enhanced Delivery' with overnight service. They just forgot to tell me over which night. When the unit finally arrived, the box was torn from some kind of impact. The delivery man acknowledged the problem with a grunt and a card with a phone number on it. He said that he could not take the time off to deal with the possible damage but that they would at that phone number. I opened the box to discover that the extruded foam plastic insert had taken most of the punishment with just a scratch on the unit itself.

I set the unit up and began to use it without looking at the manual. It was a truly amazing application of computer and music technology. I was making beautiful music. The unit seemed to be looking at me with its one rectangular green LCD eye. It seemed to have a soul. I was in love. Then the unit delivered a blood curdling synthesis of all the death rattles performed in every Hollywood movie made since the 1940s. The scream was so awful that my neighbours came to my assistance assuming that I had been the victim of an attack by an alien giant vampire snail from the planet Melmac (with apologies to Alf).

After I recovered my sanity, I proceeded to try to restore life to my new found friend. Alas and alack, nothing I did would restore a single beat. The LCD screen glared at me woefully lacking any message. There was nothing I could do. The circuit breaker on the unit, the power switch, the memory reset, etc, were powerless to restore musical or any other function to the machine. I considered holding a wake but rejected the idea due to a lack of sufficient liquid refreshment on hand. I was now forced to turn to the WARRANTY...

I had never before used a warranty. In my circle of acquaintances, warranties were only mentioned in a hushed voice. One never could admit publicly to making such an unwise choice as to need the services of a warranty centre. One's audio macho was on the line. Even if the audio unit in question contained three 32 bit microprocessors, a hard disk drive and a full LORAN (long range aid to navigation) capability, the public posture was to say—"Oh that, I fixed it in the garage on Saturday morning before the bike ride to Canada." There was also the issue of international relations to consider. Never before in my experience had a Japanese product failed to operate for at least a 15-year life span. I just did not know if I had the heart to report this transgression back to the humourless chairman of one of Japan's largest electronic conglomerates; who, I just knew read every such complaint. I flinched at the image of a loyal Japanese production worker bidding farewell to his co-workers on each side of the production line as the chairman stood above him, shaking his head in disapproval. The thought of this gentle little worker kissing the picture of his wife and children and then committing Sepeku on his soldering iron because my unit had failed and I had reported it, was almost more than I could bear. Could I live with that burden? The beautiful Japanese children crying for their departed father. All because I had used my warranty!

So armed to receive my due, at least as far as repairs were concerned, I thumbed through the manuals and other publications that had accompanied my digital wonder. I discovered that there was a toll-free telephone number to the repair centre in New Jersey. As the sound of the name of that ill-fated state ran off my lips, my blood ran cold. I knew that there were 11,332 repair centres in the state of New Jersey or so it seemed. It did appear that New Jersey had more repair centres than it had toxic waste dumps or diners (often confused for toxic waste dumps) and if you know New Jersey that takes a lot of doing. Anyway, I tried calling the number. Busy. I tried again. Busy. I let the phone auto redial the toll-free number 15 times. Busy. Busy...etc...etc. You get the picture. I tried in the morning, just after the repair centre opened up. I tried before lunch. I tried after lunch. I tried calling just before they closed at 6pm. Either I got a busy or else a recording thanking me for calling and sweetly informing me that tomorrow would be a new day (to get a busy?). Finally, I was able to get through on the seventh day (Biblical significance?). I was told to pack the unit up and send it back to them in New Jersey with my proof of purchase.

I boxed up the unit and trundled over to my neighbourhood Federal Express centre. They would not insure the unit unless I put it into sturdier packaging. The box I had used had contained a set of bar bells but who am I to question City Hall? A sturdier box was obtained, which looked as though it would have served as a suitable tank trap for Rommel on Normandy beach. The unit was sent to New Jersey. Two weeks pass then a letter arrives. The letter is from the repair centre. The centre needs my proof of purchase and a cheque for $9.75. I become frenzied having supplied them with the proof and none of the documentation having mentioned the need for money. After all, this was supposed to be a warranty repair on a brand new product. The letter also stated that if I didn't get back to them within 15 days, they would consider my unit to be unclaimed and dispose of it.

Back to the telephone. Four more days trying to get through on the toll-free phone. Finally, I decide to check with New Jersey directory assistance to get the regular phone number for the aforementioned repair centre. Now I place an expensive long distance call. I am greeted at the

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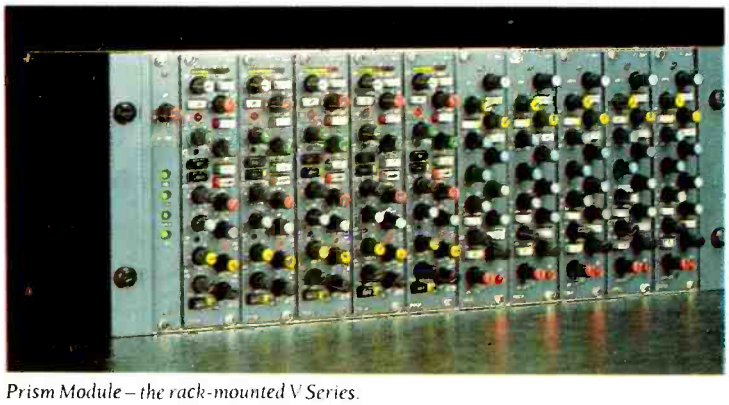
WHAT'S GOING ON?



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MARTIN POLON'S PERSPECTIVE

phone centre by a computer synthesised voice that tells me to push various buttons to reach various departments. I push for repair and then proceed to wait 20 minutes for the 'next available operator' at $1 per minute for long distance. Finally I reach a human being who informs me that only the original proof of purchase will do. The being I am talking to ignores my question about people forging proof of purchases and goes on to explain that the $9.75 is a standard charge for shipping and handling. End of discussion. Period.

I race to the post office so that I may please the noble repairers of my humble unit. The tribute is so posted and two more weeks pass by. Then I am the recipient of yet another missive from 'the repair centre'. It is getting to be almost like having a large, impersonal pen pal. But this letter ain't from any pal of mine in this life or even in the next. This letter tells me that they are not going to even fix the unit since it was purchased on the 'grey market' and it is an unauthorised device for sale within the US. They added that unless I sent them an additional $14.73 for 'return of unit unauthorised for domestic repair', the machine would again be relegated to some toxic waste dump in New Jersey (or perhaps it could prop up a diner in Hackensack). I had the same 15 days to comply with these marching orders. At least initially, I felt fortunate to escape with my life.

Back to the telephone. Only this time I discovered that the repair lines were always busy and that my success with the expensive local numbers had been a fluke. Waiting on hold at a dollar per minute is not my favourite thing to do so I felt relegated to sitting on the toll-free 800 number armed with several good audio magazines to pass the time. Eventually, a real living person explained to me that I had all of the chances of a chicken trying to walk through a convention of foxes (wonderful colloquialisms in rural New Jersey). I replied that there was no way to know that the store was selling 'grey' merchandise and if they knew it was 'grey' from the serial number, why was I made to wait many weeks before this confrontation? I was told that they needed my original proof of purchase so they could begin court action against the store. I replied that for all I knew, the store was owned by Oliver North and that the profits helped aging Ayatollahs to settle in Florida—just outside of Miami. I then asked for a supervisor. If I thought the first wait was long, I had a real wait the second time around. Finally, the supervisor was pried away from his game of jacks and opted to listen to me. I made no progress until I mentioned the magic words—attorney and Federal Trade Commission. He agreed to fix my unit post haste ex post facto. Right away. He agreed that I was just the innocent victim. The he told me that repairs on these units were running six to eight weeks.

To finally conclude this tale of woe, I waited two months until the unit arrived. It was not the one we had sent in, as evidenced by different serial numbers. It also did not work at all. Stone cold dead. I gathered up my courage, prepared to end the term of yet another loyal factory retainer in Japan as I reported the deceased to its maker. Seven weeks later and another $9.75 poorer, I finally received a unit that would work when used. I say 'would' because I am so nervous about ever having to return to the tender mercies of the 'repair centre' that I keep the unit wrapped in plastic on a high shelf.

Now, boys and girls, this story is a composite of various experiences others have reported to me and that I have experienced personally as well. These problems seem to occur on both sides of the Atlantic and on both sides of numerous borders within the EEC. It is not to say that there are not equitable warranty practices in the professional audio industry. It is just that what frequently happens is a contradiction of terms—literally! Below you will find a list of other terms that frequently have several meanings within the context of the professional audio industry.

Available: a term that indicates a positive notion of 'Rapid' delivery of a specific product, system and/or parts from 'available' stock at the manufacturer's location—prior to any order being placed. After the order has been placed and payment made, the term changes to 'Coming' (see listing). The intent of the term 'available' can vary wildly from company to company. For some, it may indicate that prior to the close of the twentieth century, the product in question will again be made. For others, it can indicate that within a given decade or year the potential for availability. It seems similar to the delivery guarantees given by the US Post Office for their 'Express Mail' service. The Post Office guarantees delivery overnight. They just don't tell you which night.

Coming: a term that indicates the payment of some instrument of financial exchange to the manufacturer for the 'prompt' delivery of either parts or of a complete unit has taken place and the customer is now awaiting that 'prompt' delivery. Prior to payment being received by the equipment maker, the customer is given the term 'available' in answer to a question about delivery. The term 'coming' is the standard response on the telephone to the increasingly harried queries from the customer. When the manufacturer or his agent is called, the customer is told that his shipment is 'coming'. No matter how many times the customer calls, he or she will be told that it is 'coming'. In fact the term may well indicate that crucial parts for the product were last manufactured in 1944 and the remaining supply is in the belly of an Nazi submarine sunk in the Thames Estuary and as soon as salvage of the submarine has been approved by the Admiralty and is complete, the ordered product will be assembled and shipped via donkey cart from East Anglia.

Consumer professional product: an audio device, usually a speaker system or an amplifier or cassette deck that is similar to professional units in appearance. See 'Professional product'.

Custom: this term is supposed to imply that the product in question has one or more special features specific to that product and the result of a design crew labouring for years on those specific features. In fact, it is more likely the result of the manufacturer's brother-in-law Hiro who got smashed on sake one night at his local yakatorium with a parts rep who has an oversupply of input connectors machined from depleted uranium. Hiro, having taken the entire supply of these glow-in-the-dark connectors swears up and down that they will be instrumental in selling products to those who do all of their hookup in the evening. Since the company now has a supply of these connectors sufficient to last until the 'second coming' (see listing), they become the much heralded custom feature. The owner is faced with the added dilemma of just how much his wife Hiroka will miss her 'little' brother Hiro if the Yakuza is called to take Hiro on a pleasant jaunt to see the inside of an active volcano—once.

Professional consumer product: a consumer product with black front panel and controls, at least one XL-type connector per channel and rack mounting. The electronics are entirely the same. If a loudspeaker, a black finish and larger speaker connectors are provided. Otherwise the unit is identical with the consumer product.

Second coming: not a religious reference exactly, although for those who hear the term, a trip to a sanctuary for prayer is usually the best course of action. When a manufacturer is called to check on a promised delivery of a paid order and after the first time the term 'coming' is used by said manufacturer, then the term 'second coming' is used.□

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AIDA-OPERA IN THE STADIUM

David Mellor reports an increasing interest in opera, which calls for special sound reinforcement treatment as larger venues are necessary

Opera has a reputation for being an arcane and inaccessible art form. You dress up in dinner-jacket and bow tie and pay a small fortune to hear fat ladies sing in a language you don't understand.

But once exposed to a few good performers, you'll be hooked—and your wallet will never be the same again.

It is generally more expensive to see opera than to go to the conventional theatre. But you will see and hear probably three or four times as many performers than you would at a typical musical.

But just how popular is opera? The true test of popularity would be to put on a run of seven performances at one of the country's largest venues and see how well it does. That test was carried out with Vittorio Rossi's production of Verdi's *Aida* at London's Earl's Court in June/July. The 'sold out' signs testified to its crowd pulling capabilities. *Aida* was seen by around 15,000 people every night of the run.

Opera is principally an 18th/19th century phenomenon. Most of the operas popular today were written—or their style is rooted—before the moving-coil loudspeaker was invented. Verdi wrote music to be appreciated in its natural unamplified condition. That obviously restricts the number of people who can attend each performance. London's two principal opera houses—Covent Garden and the Coliseum—have capacities of around 2,000. Performances at larger venues, the Albert Hall for example, tend to be a bit on the quiet side when you are any distance from the stage.

For a 15,000-seat venue, amplification is essential. Yet the audience, many of whom will be experienced opera-goers, will expect the sound to appear completely natural. It's a tall order to amplify eight principals, full orchestra and chorus and achieve this. Joint sound designers Bill Cadman and Simon Johnston (who also operated the show) were brave enough to attempt the almost impossible.

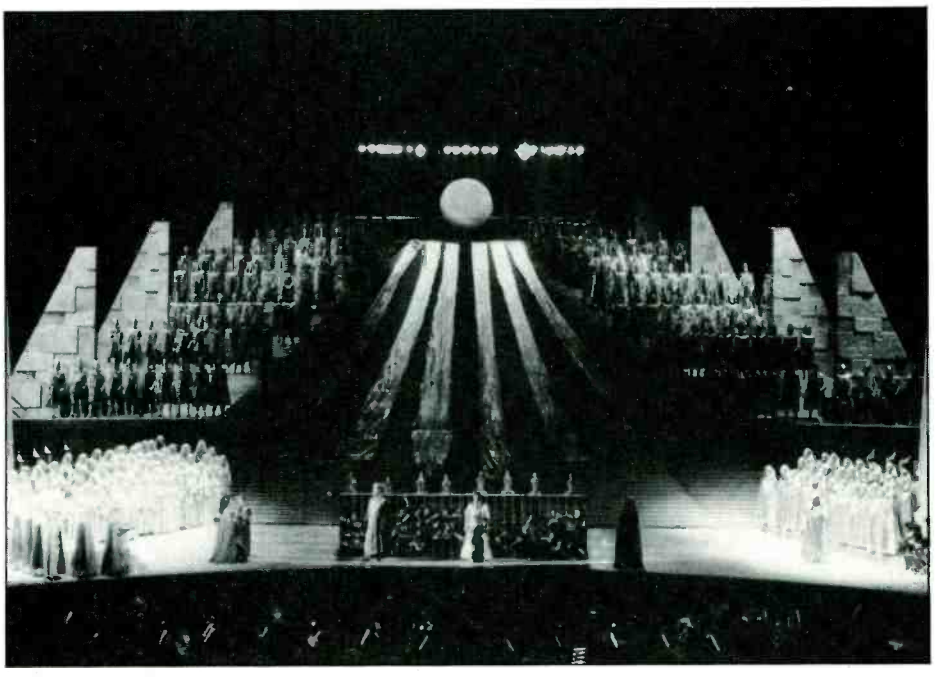
Bill Cadman has worked on stadium opera before, on *Aida* and *Nabucco* (also by Verdi) in the Palais Omnisport at Bercy, Paris. How does he feel about the project?

"I find stadium opera a tremendous challenge. It's on the physical scale of a large rock and roll concert. It has the operational complexity of a West End musical and demands the finesse associated with classical music. The operatic voice is a challenge too."

If asked about amplifying music written before amplification was invented, Bill Cadman would reply that he feels the same way about that as he feels about performing opera in such a large venue. Verdi wrote for the theatre, not the all-purpose giant arena—which can only exist because of 20th century architecture and building techniques. (Although the classical amphitheatre can contain audiences of as many as 20,000 in the open air.) If there is a large enough market for opera that people want to see performances in arenas the size of Earl's Court, then amplification is mandatory. It is no more contrary to the spirit of the opera than the space in which it is performed.

Cadman and Johnston's aim for *Aida* was to take the natural sound of the performance, and make it accessible to the more remote reaches of the house. Not to try to 'improve' the sound, just to take what's there and make it bigger. This necessitates a degree of liaison with the musical director—the 'Maestro'—Nello Santi.

Cadman: "We wouldn't really wish to mess



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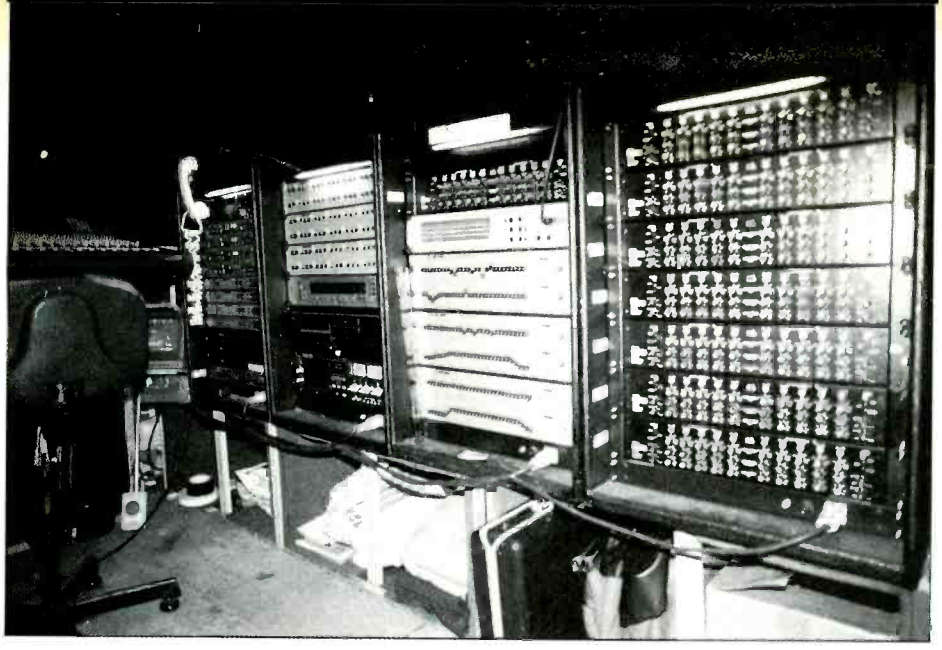


about with the sound of the show, neither from the maestro's position nor from the first third of the stalls. It's quite loud enough on its own merits.

"What we're trying to do is take the last two thirds of the house, and the upper reaches of the house, and hopefully recreate what the maestro is creating down here. We work closely with him, there is a very close dialogue that goes on every day."

Cadman explains that in previous productions, with a longer rehearsal and planning schedule, it has been possible for the conductor's assistant to wander around the arena, taking notes on the sound quality.

Speakers

Aside from the human contribution of sound designer and mixer, the most important factor in obtaining a good result is probably the choice and positioning of the loudspeakers. In this instance, Meyer loudspeakers were used exclusively.

Fortunately, Bill Cadman and Simon Johnston found the acoustics of the Earl's Court arena very much to their liking: "It's big. It has a particular sound—rather a pleasant one. People have talked about Earl's Court over the years, saying that it's a dreadful place to do concerts, but perhaps they have been talking about the Rolling Stones and other such applications. I don't think that anyone has ever had the chance to really listen to it at these sorts of levels. We have been pleasantly surprised..."

The loudspeaker system is split into separate vocal and orchestral systems: "The principals are handled by a centre cluster of 10 Meyer *MSL-3*s in a long-throw configuration. On the bottom of that cluster are four *UPA-1A*s, which fill in the middle area of the arena.

"The vocal system continues with a small delayed support system at the back of the house, consisting of three pairs of *UPA-1A*s. They describe an arc around the centre cluster for the gallery at the back of the hall. The sides of the stage, which are sold seats both at stalls and gallery level, are handled by two clusters of four *UPA-1A*s. One pair dedicated to upstairs, one pair dedicated to downstairs.

"At stage level there are two *UPA-1A* loudspeakers set into the front of the stage filling in and bringing the vocal image down to the floor, rather than it coming down from the heavens in the front rows. There are also two very small loudspeakers, *UPM-1*s at the front of the orchestra pit. Again the purpose is to pull the vocals down to something like stage level so it's not all coming from above.

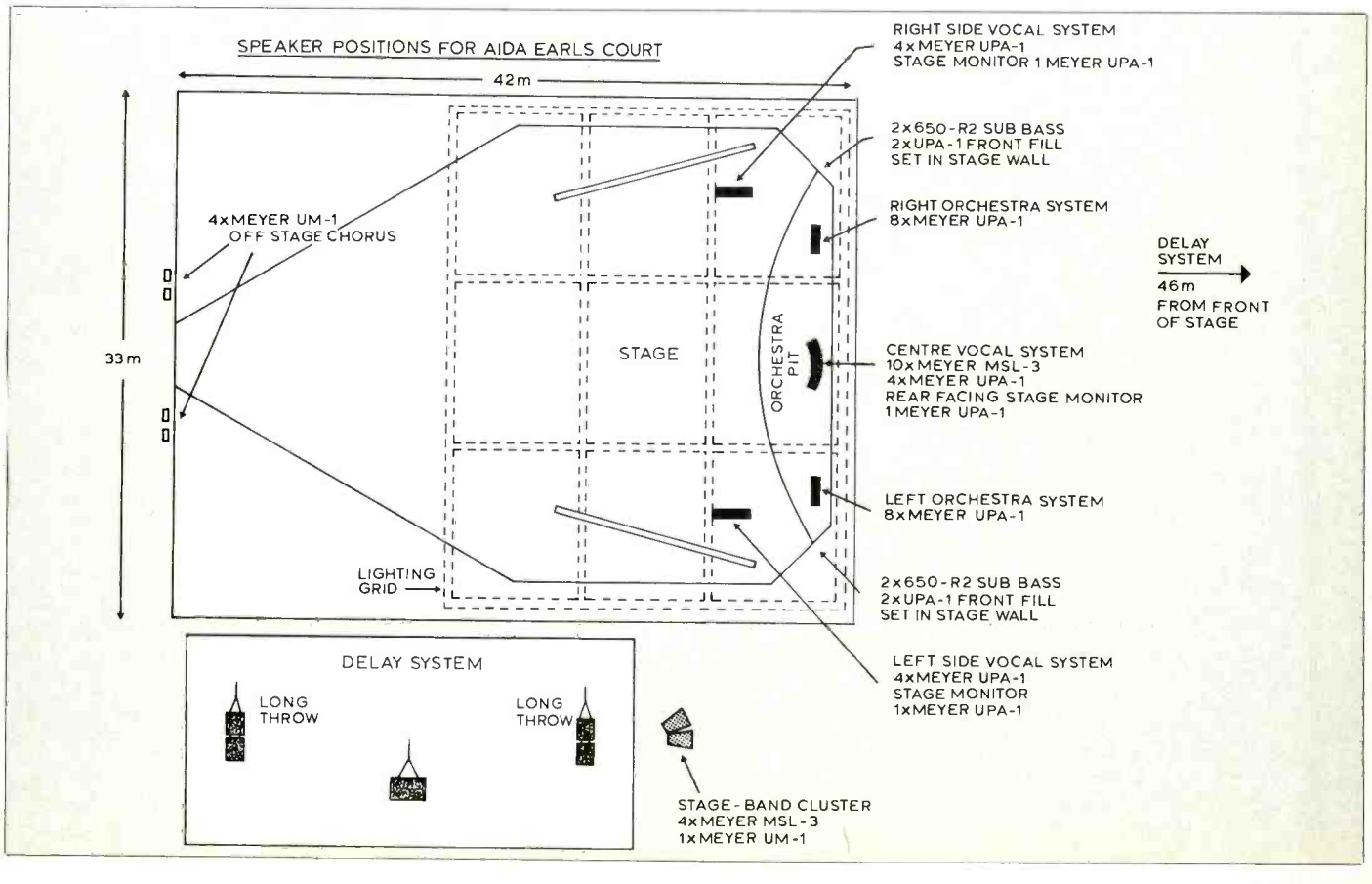
"The orchestral reinforcement is handled by two clusters, each consisting of six *UPA-1A*s in a long throw configuration. The left and right clusters each have a side-facing pair, which takes the mix of the other side, to compensate for the proximity effect of half of the orchestra to the people sitting at that side of the house. Supporting the orchestral system are two subwoofers at each side of the stage."

In addition to the principals, the chorus and the orchestra, there is also an offstage chorus and band. These are common features in opera, and in this case have been given their own loudspeaker system—a cluster of four *MSL-3*s with a *UM-1A*, which fills in the space immediately below. In effect, these sources are outside the performance area so they need their own discrete reinforcement.

Also, for particular effect, there are four *UM-1A*s placed at the far upstage at the top of the pyramidal set. (*Aida* is set in Egypt, hence the pyramid.)

Miking and foldback

Following usual practice for musical shows, all



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AIDA-OPERA IN THE STADIUM

seven principal singers use radio mics, Sennheiser *MKE2*s with Micron transmitters. Diversity receivers are used in conjunction with a remote display of RF level at the mixing position. The chorus is picked up by a series of float microphones (foot mics) and rifle microphones.

"Principals wear radio microphones placed where experience and intelligent guesswork suggest. This is an opera, not a concert, and a lot of disciplines are involved. You don't always get to put the mic in the ideal position because of costume and staging requirements. We all have to work together and make compromises.

"The choirs are picked up by some very traditional forestage ambient microphone techniques. Float mics are five Schoeps *MK5*s, and eight rifle mics are a combination of Sennheiser *416*s for the close up choral groups, and Neumann *KMR 82*s and Sennheiser *816*s for the more distant groups. They are placed to cover particular areas where the choir stands.

"Zone miking is used for the orchestra using six Schoeps *BLM*s mounted on stands designed for the occasion. There is an overhead pair of Schoeps *MK4*s and a crossed pair of *MK4*s on the woodwinds. The only instruments that are spot miked are the two backstage harps and the two orchestral harps. The microphone arrangement is designed to fit in with the look of the pit and remain discreet."

Foldback in opera is normally rather less than the kilowatt-handling wedge monitors used in rock and roll. It is, however, essential.

"Foldback is provided by three flown *UPA-1A*s, one behind each side cluster and one behind the centre cluster. It's not really a foldback system, we are just giving enough level to make it a comfortable singing environment. We have shortened the first reflection by effectively lowering the height of the Earl's Court ceiling from 32 metres to 16.

"We were somewhat surprised to have to put any orchestra in the foldback but we have done. In early tests it became apparent that, apart from downstage centre, the orchestra is very easily lost. We are trying to make the whole of this very deep set as comfortable to sing on as when you are standing downstage centre, very close to the orchestra pit."

Operation

Of all the gadgets that could be used, Bill Cadman and Simon Johnston restrict themselves to very few. Compression, apart from the essential limiting used in the Micron transmitters, is not employed. Equalisation is only intended to compensate for the room's characteristics—not to 'enhance' the vocal sound. Artificial reverberation is only used for the offstage band and chorus. There are no taped effects.

But is the amplification used making the performance louder than it would be in a normal theatre?

"I go to see operas in opera houses and I think we are being fairly faithful. On the other hand we are also trying to be faithful to the visual image, so there may be times when it is slightly louder than in an opera house. But then it's so much more massive to the eye that it would be false and wrong for it not to be louder in this particular space. That's something one has to be ready for—to look at the 15,000 people around you, at the event taking place before you, and react correctly.

"You can't mix an event of this nature without looking at the stage. There are times when it's very tempting to bring someone who's way up high on the set, and has some sort of authoritative role in the scene, up to an authoritative level. It's a very deep three-dimensional image in front of you. If we were to play around too much with the perspective, the ear would disagree with the eye."

As far as operation during the show goes, the aim has been to let the orchestra balance itself. The orchestral faders are not moved. (The only exception to this was when the Philharmonia Orchestra took over from the London Symphony Orchestra for one night. A level change was necessary for the double basses. The reason for this was found to be the height of a player close to the microphone. The microphone position was adjusted during the interval and the fader returned to its previous level!)

Vocals are handled in a similar way: "Our role is very much a passive one. It is purely to make sure that the two thirds of the house that are too far away to hear the performance at a satisfactory level, acoustically hear the same as the people who are sitting close to it."

Results

There are many people for whom modern technology and opera just do not mix. I expect these people would be shocked to find out how much equipment (audio and video) is used at our major opera houses. The fact is that this sort of production is probably the most demanding for the sound designer and operator, because there is a known reference point against which their performance can be judged.

Aida at Earl's Court did not sound like *Aida* in a theatre. That is not surprising but the surprising fact is that it came so close. The principal problem was localisation of the sound sources. (My seat was fairly close to the stage, making both natural and reinforced sound audible.) That is only to be expected since the speaker clusters are so high above stage level. There is probably no answer to the localisation problem in amplified dramatic shows until someone invents see-through speakers!

What was pleasing was that the overall sound was not too much larger than life. The principals were slightly louder than you would normally expect (one may be tempted to say that they were more even in level too). The orchestra was certainly no louder than I have heard from unamplified theatre pits. Once accustomed to the amplified sound, one could persuade oneself to forget it and enjoy the performance.

Of course, there is always room for improvement. The offstage band and chorus were not well served by the sound system. This was made more obvious because only the amplified sound from the offstage performers was heard, and from my seat I could compare it with the sound coming from the stage and the orchestra pit.

Speaking as an occasional opera-goer (and an ex-operatic sound engineer) I judge *Aida* to be a fair success in both sound and production, considering the problems involved. It was certainly a success in attracting the public, probably many of whom had never experienced opera before.

There were difficulties, of course. Seen from close-up, the production lacked subtlety, some of the ballet sections were ludicrous, and the interaction between principals (who changed from night to night) was minimal. Any problems with the sound were very minor in comparison to these.□

(Thanks to Richard Lienard of Sound Hire for assistance with this article.)

Equipment list

Microphones:
4 Beyer *M160*
3 Neumann *KMR 82*
8 Neumann *U87*
8 Schoeps *BLM 3*
2 Schoeps *MK6*
13 Schoeps *MK4/5*
4 Sennheiser *MKH 416*
2 Sennheiser *MKH 816*

The Schoeps BLM *mic is mounted on a specially-made stand*

Mixing consoles:
1 Midas *PRO4* (32/8/2)
1 Yamaha *PM 3000* (40/8/2)

Ancillary equipment:
1 EMT *250* reverb
4 Klark-Teknik *DN 716* digital delay
3 Klark-Teknik *DN 360* equaliser
3 Klark-Teknik *DN 410* equaliser
1 Klark-Teknik *DN 780* reverb
1 Klark-Teknik *DN 60* spectrum analyser
8 Meyer Sound *CP10* equaliser
1 Yamaha *YDD2600* digital delay

Loudspeaker systems:
5 Meyer *UM-1A*
2 Meyer *UPM-1*
46 Meyer *UPA-1A*
14 Meyer *MSL-3*
4 Meyer *650-R2*

Meyer Sound controllers for the above. Power amplification by Crest.
Equipment supplied by Sound Hire.
Radio microphone equipment (detailed in text) supplied by Autograph.

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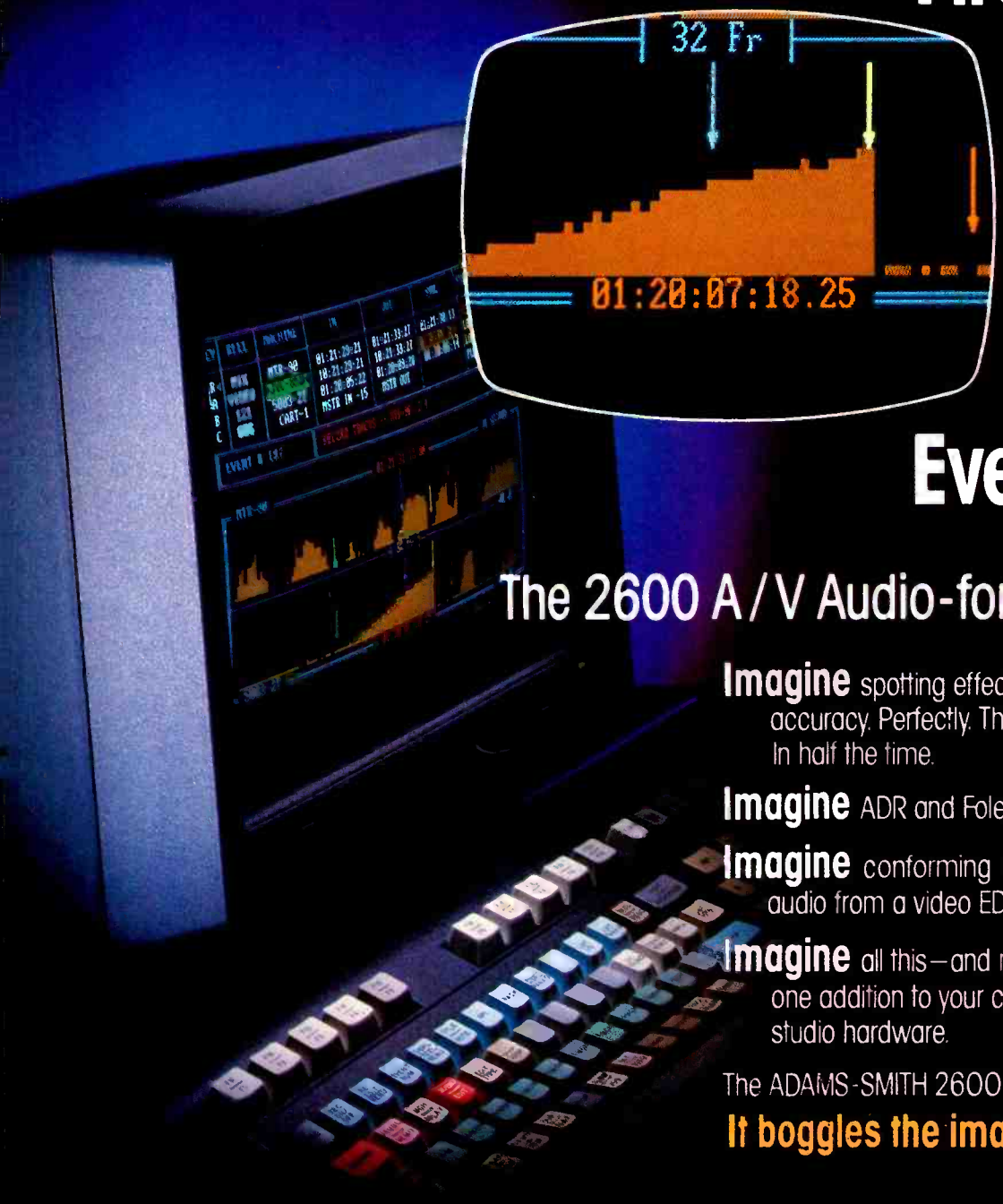

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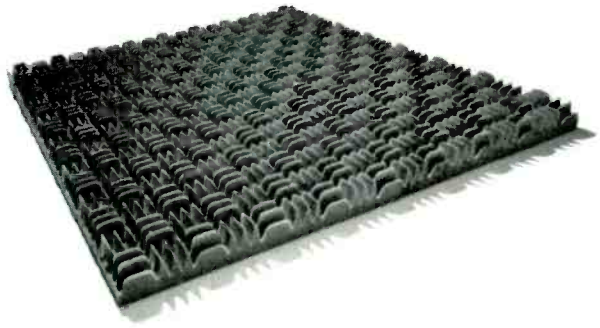

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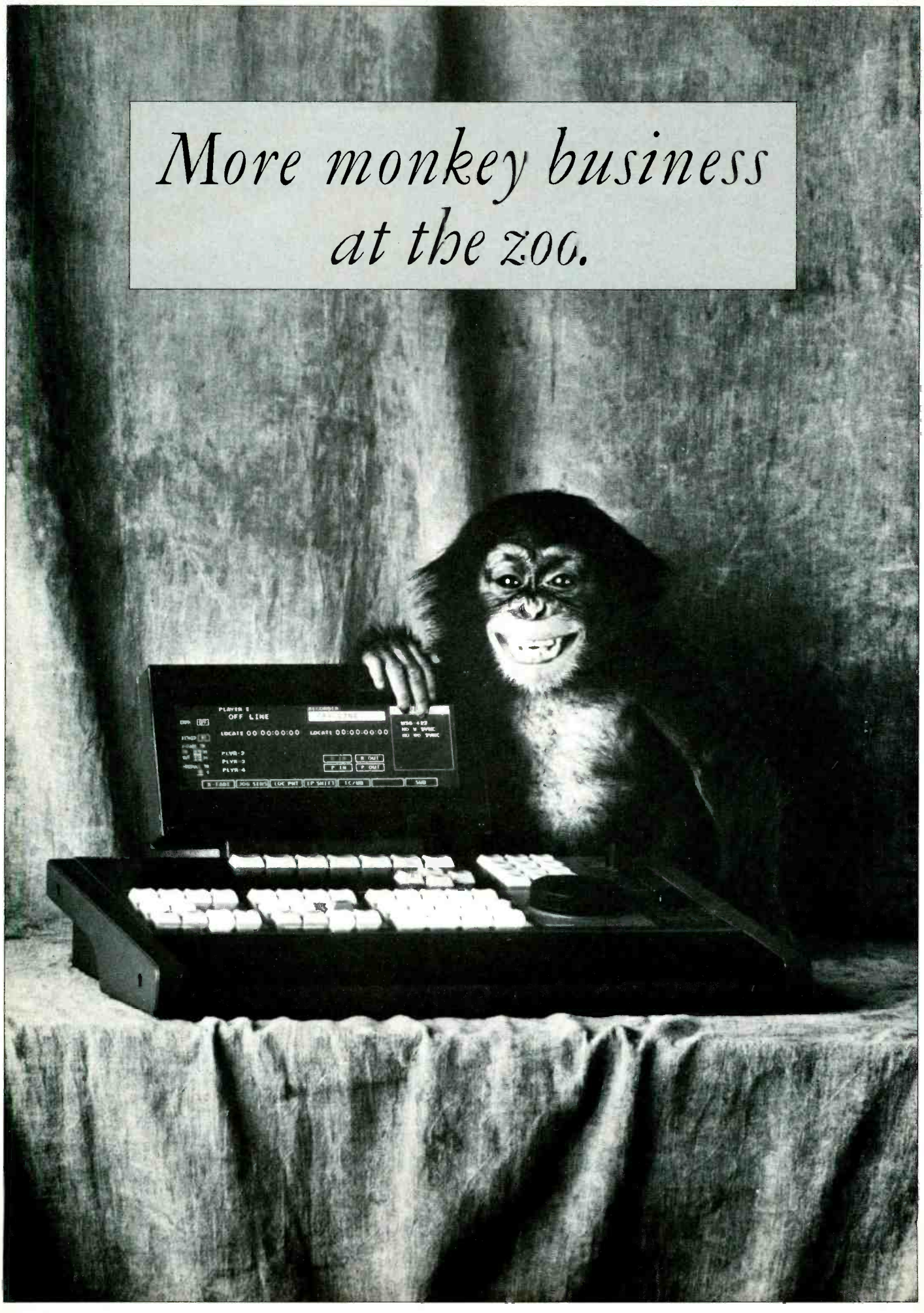

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The Digital Information Exchange is back in London Zoo this November, offering the audio professional a unique perspective of new and emerging digital technology.

The organisers are committed to providing a comfortable environment. One where equipment can be demonstrated and in which professionals drawn from the allied fields of broadcast engineering, video production, studio recording and leisure industry marketing, can assess it objectively. At the same time, delegates gain a special opportunity to discuss the application of hardware options with experts and those responsible for their design and manufacture.

Just a glance at the three day event confirms that the 1988 Digital Information Exchange has its most powerful programme yet. The enthusiastic participation of the major international organisations that shape the future of professional audio and video, including Sony, Studer, Quantel and BBC Research. Entertaining and informative presentations from leading industry names like Roger Lagadec, Jeff 'Skunk' Baxter, Roger Cameron and John Watkinson. And not least, the opportunity to appraise the hardware itself, be it digital VTR, the 'Audio Tablet', innovative DSP developments, the 'Tapeless Studio' and new digital multi-track technology.

Supported by 'hands-on' sessions and spiced with lively debate from delegates and presenters alike, The Digital Information Exchange is now a key event in the pro-audio calender. Held on November 22, 23 & 24, it once again takes place in The Private Member's Suite at London Zoo. As ever, delegate places are strictly limited, but the cost of attending – thanks to the continued sponsorship from Sony Broadcast and leading pro-audio supplier HHB Hire & Sales – has been reduced. Including lunch and refreshments, just £75 (inc VAT) per day and only £200 (inc VAT) for a special ticket covering all three days.

Day One (Tuesday, November 22nd 1988) Digital Audio in Broadcast, Film & Video

(Welcome & Introduction) – Ian Jones, HHB Hire & Sales.

Stereo TV: Digital in Action – Neil Gilchrist, BBC Research

Digital in Feature Film Production –
Al Hart, Modern Videofilm, Los Angeles

Digital Glasnost – Eastern Broadcasters Equip –
Mike Bennett, Sony Broadcast

Digital VTR in Practice – John Watkinson, Consultant

The HarrySound System – Bill Aitken, Quantel/SSL

Digital Audio & HDVS in Production – Phil Wilton, Sony Broadcast

Day Two (Wednesday 23rd November 1988) Recording Industry 1

(The CD Market/Digital Media Overview) –
Nick Hopewell-Smith, Consultant

The Prodigi Perspective – David Ward, Mitsubishi

12 Channel Low-Cost Digital Recording – Jeff 'Skunk' Baxter

Hard Disk Systems – 'How, Why & What' – John Watkinson

'The Audio Tablet' Random Access Editor –
Carl Schofield, Real World Research

Digital Editing – New Approaches – David Walstra, Willi Studer

Digital Mixing – 'Logic One' & Music Recording –
Peter Billington, AMS/Calrec

Day Three (Thursday, November 24th 1988) Recording Industry 2

(The Return of Dr LeCoq) – Roger Lagadec, Sony Corporation

New Multi-Track Technology – Cary Fischer, Sonam

The MADI Interface Standard – Alan Jubb, MADI Group, (Neve)

Pro-Audio Japan: A Personal Status Report –
Sam Toyashima *(to be confirmed)*

A Producer's View – 'The New Way' – Soundtracs/Synclavier

D.S.P. – The Sony Philosophy – Roger Lagadec, Sony Corporation

New Developments in Digital Audio Processing –
Roger Cameron, Neve Electronics

DIGITAL
INFORMATION EXCHANGE

The above programme is correct at the time of going to press. Although unlikely, it is possible that minor changes may occur. Registration enquiries should be made to Frances Sharp on 01-381 4624. Any delegate requiring hotel accomodation is advised to contact Expotel (a free booking service) on 01-741 4411, quoting 'Digital Information Exchange'.

Snip off or photocopy the form below and post it to: Frances Sharp, Digital Information Exchange, FREEPOST, London SW6 7BR. (No stamp is necessary). Enclose a cheque payable to 'Digital Information Exchange'. State clearly which day(s) you wish to attend. Should you wish to register more than one delegate, please send their details on a separate sheet of paper, along with the cut-off form. Tickets and finalised programme details will be sent at least two weeks prior to the event.

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REVIEW

Davie Foister tries out the Micro Enchancer signal processor from Alesis

The Alesis *Micro Enhancer* joins the growing number of small, simple, 'pile-em-high and sell-em-cheap' signal processors apparently aimed at the budget studio or the home user but claiming sufficiently high quality to find use in good professional facilities. Prices are so low that if the performance is genuinely up to the mark it can be worth installing racks full of the things alongside the bigger more versatile units to reduce the risk of running out of effects on a heavy mix.

Alesis' *Micro* range comprises the usual selection of a gate, a limiter and a digital reverb but the inclusion of an enhancer is perhaps less conventional, particularly as this enhancer uses a different approach from most.

Most psycho-acoustic enhancers work by generating harmonics to be mixed in with the original signal, which is basically controlled distortion. Alesis call this method 'ultimately objectionable'—although it hasn't hindered the success of certain products—and have decided instead to use the under-explored process of dynamic equalisation. The idea of dynamic HF attenuation or filtering is familiar from various single-ended noise reduction systems, where in the absence of a strong signal a lowpass filter comes into effect to reduce the HF response. The *Micro Enhancer* uses the same process in reverse; that is, it boosts high frequencies in the presence of a signal and does nothing in the quiet bits. The boost takes the form of a shelving equaliser whose turnover point can be adjusted between 2 kHz and 12 kHz with a response extending to 20 kHz. The unit has only three controls—one marked Bandwidth for adjusting this turnover frequency, a Threshold control for setting the signal level at which the HF boost comes into play, and a Mix knob for balancing the HF enhancement component with the original signal. Setting the threshold is assisted by a simple meter display of four LEDs—best results are obtained when signal peaks regularly light the top (red) LED, although the manual gives no idea of what levels these represent, how the enhancement gain responds to increased input level over the threshold, or any details of this sort. The meter LEDs still operate when the unit is in bypass (a front panel switch is provided for this) so the threshold can be set up blind. Ins and outs are unbalanced ¼ in jacks and work happily at nominal levels of −10 to +4 dB.

The effect produced by the *Micro Enhancer* is not dissimilar to that created by more familiar harmonic-generating processors, although if anything it is slightly more subtle and possibly sounds cleaner. Like other enhancers it must be used with care, as on many signals an excess of enhanced signal in the mix can produce a shrill and thin end result, although despite its dynamic action no side-effects such as pumping and breathing are apparent. Time constants for the equaliser dynamic action are not specified; it may be that attack and release times are programme-dependent but it seems more likely that they are not particularly critical in this application and are fixed at reasonable general-purpose values.

It comes as no surprise that on some signals, particularly clean, constant-level sounds, the effect of the *Enhancer* is very similar to that of straight HF boosting EQ. On most, however, the signal's own dynamics produces variations in the effect, generating extra transient impact without a blanket treble lift. This clearly applies particularly to percussive sounds—drum machines benefit from the extra bite, for example—but also works with less obvious signals such as vocals, guitars and electronic keyboards, which can be made to sound less bland without becoming painfully toppy. Reverberation acquires additional early sparkle while retaining its original decay. The process particularly comes into its own where a signal contains an element of unwanted noise; while treble lift alone could raise the subjective level of the noise so that a gate would be required, the *Enhancer* brightens the wanted signal while leaving the unmasked noise untouched. The potential for the 'portastudio' brigade to tart up their outpourings is obvious, and it could also be the answer to the occasional noisy track, such as a guitar recorded via a noisy amp, which might need some top but is tricky to gate.

While the obvious place to use the *Enhancer* is patched into a channel's insert points, the provision of a dry/effect mix control means it can alternatively be fed from an auxiliary send with just the enhancement component returned to the desk, so that different instruments can have different amounts of treatment added, still in the correct stereo position if a stereo aux is used. I found this configuration worked best of all, allowing, for instance, a small amount of enhancement on drum overheads with considerably more on lead vocals, sax solos and rhythm guitars. Soloing the *Enhancer* returns showed the position of a panned mono source to be shifting slightly in the image as its level varied but in context this had a negligible effect on the apparent position of the original signal.

The fact that the two channels are fully stereo linked means that the unit will happily process stereo signals, including complete mixes, and this also worked well but made settings a little more critical. In the absence of signal the *Enhancer* introduces no noticeable noise, and indeed with a quoted dynamic range of 100 dB it should handle most signals cleanly. Distortion was not found to be a problem either, which is perhaps just as well since the unit's metering never shows the actual signal level present.

The concept of dynamic equalisation has yet to be properly exploited; if it were to be, important new areas of signal processing could be opened up. In the meantime, the Alesis *Micro Enhancer* puts the technique to use effectively in a simple and obvious manner. Its effect is subtly but significantly different from straight treble or presence boost; whatever the application, it works and should be worth trying.□

Alesis, PO Box 3908, Los Angeles, CA 90078, USA. UK: Sound Technology plc, 6 Letchworth Business Centre, Avenue One, Letchworth, Herts SG6 2HR.

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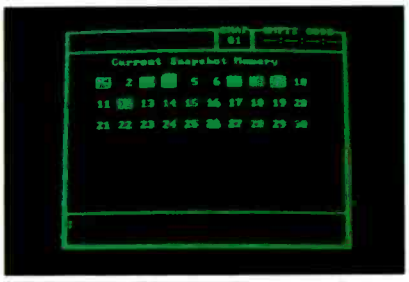

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REVIEW

A technical report by Sam Wise on Sony's PCM-2500 and DTC-1000ES digital audio tape recorders

The Sony *DTC-1000ES* domestic and *PCM-2500* professional digital audio tape recorders are the first in a series of reports on rapidly emerging DAT products. In evaluating digital products, new measurement problems have been encountered in the quest to uncover the differences between machines, and relate these to their practical use. In the end, some of the measurements may prove to be irrelevant, while new ones are introduced. We will attempt to explain our conclusions and decisions as we go. Comments in this review will apply to both models unless specifically noted.

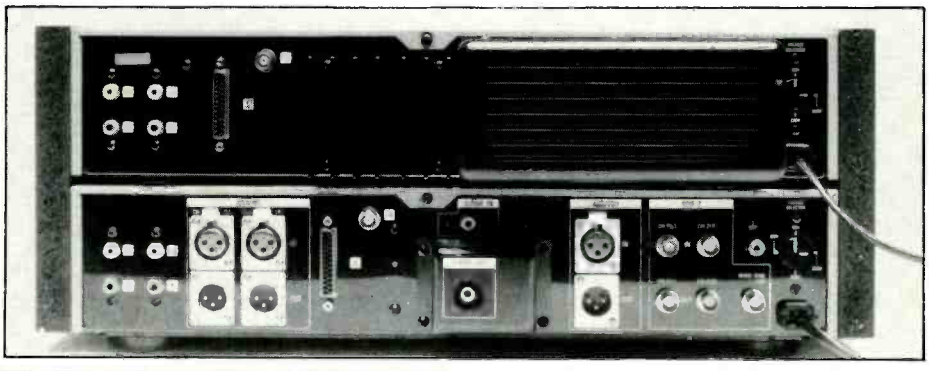
First impressions

WOW! A digital recorder for the price of a Revox? In terms of recorded quality, background noise and dropouts, there seems to be little comparison. And, as a look at the technical details of DAT technology shows, there is capability in the system to accomplish most of the tasks undertaken by conventional machines. But the trusty reel-to-reel workhorses will not succumb yet. All seems to depend on the priority manufacturers place on the development of the system potential into real products. The products as reviewed were generally easy to operate with the exception of a few of the special features, which required some practice to appreciate.

Both models are intended for fixed table-top or rackmount use. Visually the machines are attractive, with an extruded aluminium front panel and a steel chassis and covers. The *1000* is black with clearly printed pale grey legends, while the *2500* is medium grey with white legends. Many of the pushbuttons are internally illuminated, or contain built-in indicators related to their function. Central on the panel is an easy to read fluorescent display containing the level meter, counter/time function and indexing/locating information. The important parts of this display are easily visible up to 3 m away. The machines are 17 in wide without the easily removable wooden side cheeks, 18½ in with them. This, with an overall height of 3½ in (*1000*), makes rackmounting easy. The *2500* professional model adds an interface unit beneath of the same height. This provides balanced audio inputs and outputs along with a variety of digital interfaces and the option to record at different sampling rates with or without pre-emphasis.

Externally, the construction is to a high visual standard and seems adequately robust for its intended use. Internally they are very Japanese, with a variety of large and small PCBs all connected by large bundles of wire. This said, everything is tidy, reliably colour-coded and accessible should repair be necessary. The electronics are highly integrated into a very few ICs and transistors.

Connectors on the *1000* are gold-plated phonos (Cinch) for both audio and digital purposes. The two boxes that make up the *2500* are externally interconnected, allowing access to either the balanced *XLR*-type audio connectors on the bottom unit, or the gold-plated phonos on the top. The remaining connectors on the *2500* are digital interfaces to various standards. Both models have fixed mains leads. The *1000* has only one operating voltage supplied to local requirements, while the *2500* incorporates an external voltage selector. No fuses are fitted, all internal protection is in the form of fusible resistors, which are not user repairable. Available with the products were service manuals in the superb Sony fashion.



Manufacturer's specification

Recording method: Rotary Digital Audio Tape (R-DAT)
Recording time: up to 120 minutes
Tape speed: 8.15 mm/s
Drum speed: approx 2,000 RPM
Error correction: Double Reed Solomon Code
D/A conversion: independent 16-bit linear
Frequency response: 2 Hz to 22 kHz, ±0.5 dB (48 kHz sampling)
Signal to noise ratio: ≥92 dB
Dynamic range: >90 dB
Total Harmonic Distortion: ≤0.05% @ +4 dBu
Wow and flutter: not measurable
Playback sampling rates: *DTC-1000ES* and *PCM-2500*—32 kHz, 44.1 kHz, 48 kHz
Record sampling rates: *DTC-1000ES*—48 kHz; *PCM-2500*—32 kHz (digital only), 44.1 kHz, 48 Hz
Pre-emphasis: 50 μs/15 μs: *DIC-1000ES* automatically selected on playback, not on record; *PCM-2500* automatically selected on playback, switchable on record
Cable length: AES/EBU digital format 300 m (with ECD-30C)
Sony Corp, PO Box 10, Tokyo AP, Tokyo 149, Japan. Tel: 03 448-2111.
UK: Sony Broadcast Ltd, Belgrave House, Basing View, Basingstoke, Hants RG21 2CA. Tel: 0256 55011.
UK: HHB Ltd, 73-75 Scrubs Lane, London NW10 6QU. Tel: 01-960 2144.
USA: Sony Corp of America, Professional Audio Division, Sony Drive, Park Ridge, NJ 07656. Tel: (201) 930-1000.

Operational controls

The fundamental operations: play, stop, fast forward, rewind, load/unload are easy to use. RECORD differs from its conventional counterpart in that it is impossible to drop-in, the machine must first be stopped or put on PAUSE before Record can be activated. This is one direct result of rotary head technology, which records discontinuously. Recording on one of the stereo tracks at a time is

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also impossible on current machines, however, subcode information can be recorded after the event without altering the quality of the audio in any way. During play mode, the FF and REW functions double up as forward and reverse cue controls, allowing the tape to be cued to position at about 3× normal speed while monitoring an albeit quite distorted signal. The speed of spooling is quite phenomenal, only taking 40 s from one end of a 2 hr tape to the other. This can actually cause problems when trying to locate a nearby section manually. However, while spooling, the system can locate any START ID and any of up to 99 program start locations. All this is inherent in the small linear tape speed and the thought that went into data storage and recovery during the design of the R-DAT system.

The last transport controls are PAUSE, which is active in play or record modes, and RECORD MUTE. This last is necessary in order to force the machine to write digital zeros to the tape and is useful for inserting absolute silence between recorded pieces. It records a mute to the tape for 4 s each time it is depressed. Record Mute can be entered directly from Pause, or while recording, but always ends in activating Pause–waiting for the next item to be ready to record.

Subcode functions

Next we have the controls that use the DAT subcode system. AMS (Automatic Music Search) is located above the FF/REW switch. Each depression in the forward or reverse direction causes the machine to spool forward or backward to the next Start ID on the tape. The Start ID marks the beginning of a recorded piece or section of a piece. Punching AMS once in the backwards direction returns you to the beginning of the piece you are in. This is actually the best way to FF or REW to nearby locations.

Putting Start IDs on the tape can be very easy. When the machines are first turned on, the button marked START ID AUTO is illuminated. When this is active, the machine records a new Start ID (if in Record mode) each time the audio input rises above a preset level after having been below it for 3 s or more. The Start ID can be altered later without affecting the audio recording. Alternatively, depressing START ID MANUAL allows the ID to be put (nearly) anywhere. If the machine is in record mode, depressing MANUAL immediately writes a new Start ID, assuming you are about to begin a new recorded section. If the machine is in Playback mode, a new Start ID can still be written. In this case, the machine will play forward for 3 s from where MANUAL was pressed to allow the start point to be monitored, then rewind and play again. The operation is

similar to a trial edit. The ID beginning position can be inched forward or backward by steps of 300 ms using the FF/REW control until the result is acceptable. Depressing MANUAL again records the ID on to the tape but even then it can be changed or erased if required. The Start ID is written for 9 s, necessary to allow reliable reading at spooling speeds.

Program numbers allow indexing of tape locations. Due to the nature of DAT, these have no correspondence with SMPTE/EBU timecode. Normally, they will be written automatically together with the Start ID when the tape is initially recorded. Since they are intended to be sequential, it is not possible to change only one program number during playback mode, for example if a new Start ID is inserted on the tape. Instead, depressing RENUMBER rewinds the tape and numbers completely through from the beginning. This takes reasonable time and is something to do during a coffee break, not with a client looking over the shoulder. During Record, program numbers can be started at any number by entry on the keypad while in Record/Pause mode and will be written with the next start ID. Locating the beginning of any recorded portion is then as easy as entering the 2-digit program number on the keypad and then pressing START, which is also on that keypad.

While trying to use program numbers to index a digital copy of a test CD, it became clear that a 15 s gap is about the minimum between adjacent numbers for reliable operation, unlike CD where they can be almost as close together as you like. This means that for some types of operation such as sound effects archiving, theatre effects playback, or short spots on radio, extra space will need to be inserted deliberately between items to allow sensible indexing access later on.

The last subcode facility available on these machines is the SKIP ID. This, once again, is written separately from the other IDs. It can be put anywhere on the tape at any time. Its purpose is to allow a portion of material to be skipped over during playback. It is recorded during Playback or Record mode by pressing SKIP ID WRITE, when it is immediately written on the tape. These two machines allow Skip mode to be on or off. If it is on and the tape is rewound to a point before the Skip ID before entering Play mode, when a Skip ID is encountered, the machine will mute and immediately spool forward to the next Start ID and re-enter Play mode. If Skip mode is off, then Skip IDs are ignored on playback except for being signalled on the front panel display. Thus it is possible by writing Skip IDs and Start IDs in appropriate places to jump past unwanted material while leaving all the audio untouched. This might be an advantage for instance where several versions of a mix were laid down using the DAT machine as a master recorder. Sections could then be selected for easy playback while leaving one's options open and keeping all versions on the tape. Skip IDs are erased by playing past one then pressing SKIP ID ERASE. The machine will backtrack to the last Skip ID and erase it while leaving all other information intact.

The last available facility is called MUSIC SCAN. This causes the tape to be rewound to the beginning, then 8 s of audio are automatically replayed each time a Start ID is encountered with fast forward spooling in between. This provides a convenient way to scan through a tape, useful if the engineer has been careless with his take list.

All the above facilities are available on remote controls. The *DTC-1000ES* comes with an infra-red control, while the *PCM-2500* has both wired and infra-red controls.

At the far right of the front panel is a dual-concentric Record Level control. On the *1000*, this is the only way to adjust record level, and playback level is fixed. The concentric set is tightly coupled mechanically and would normally function as a stereo control. The *PCM-2500* incorporates additional Record and Playback Level Control screwdriver-adjustable presets as would be found on conventional studio machines. Beneath this is a stereo Phone Level control. The headphone output can deliver up to 28 mW into a 32 Ω minimum load.

Digital to digital recording

Just to the left of the headphone level control is an INPUT SELECT switch to select analogue or digital inputs. The *DTC-1000ES* domestic model is fitted only with a S/P DIF (Sony/Philips Digital InterFace). This allows digital-to-digital transfers at 48 kHz and 32 kHz only, thus preventing direct copying of CDs.

The *PCM-2500* professional model incorporates the S/P DIF with the same restrictions but is also fitted with a *SDIF-2* interface. This allows recordings at 48 kHz and 44.1 kHz but will detect copy inhibit signals from a CD player and thus refuse to record CDs so labelled. In addition an AES/EBU digital interface is installed, which allows recording at all three sampling rates. This again senses the CD copy inhibit signal. All three interfaces have connectors conforming to their appropriate standards. A selector switch to choose among the available inputs is located on the front of the interface unit.

In order to allow testing of D/A converters and filters, HHB Hire and Sales copied a test CD for

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me over the digital interface. This was the only test this part of the system got since no compatible equipment was available.

Analogue to digital recording

The *DTC-1000ES* has a fixed output gain giving a level of 2.0 VRMS (+8.24 dBu) for a peak (0 dB) digital tape signal. The record level is variable using the dual gang Record Level control, giving a useful input signal range from >3.0 V (+12.0 dBu) down to 260 mV (−9.5 dBu). The gain structure does seem peculiar though, since the Record Level control must be set at position 3, out of 10, to provide unity gain record to playback. The unbalanced outputs of the *1000* should not be loaded with less than 10 kΩ.

The *PCM-2500* provides electronically-balanced inputs on *XLR*s mounted on the lower interface unit. In addition to the Record Level control, Record and Playback presets are provided. Peak playback level can be set in the range from +5.1 to +23.5 dBu, which in theory should provide a useful range of studio operating levels from +6 to +16 dBu while leaving a margin in hand to prevent clipping. However, if the Record Level Control is set to its only calibrated position of maximum, the peak input level is within the range −9.8 to +8.0 dBu using the preset adjustment. A maximum peak input level of +8.0 dBu is not high enough. Obviously this can be increased by turning down the Record Level control but calibration is lost. This anomaly can be readily overcome by changing two resistors within the recorder unit.

The Record Level pot itself has excellent stereo tracking as shown in **Fig 1**. This pot is a Noble Electronics *AP25*-type and incorporates a multi-fingered wiper just like a P&G fader. In the search for pots with reliable laws, good matching and consistent performance, this particular type is the best I have ever found. Unfortunately it is a bit large for most uses. The *1000* had a fixed record gain error between channels of 0.5 dB with no apparent means of adjustment. Offsetting the Record Level control can compensate at one level but only results in mistracking as the setting is changed.

Common mode rejection ratio of the *2500* inputs, as shown in **Fig 2**, is an acceptable though not inspiring performance. Input impedance is 44 kΩ and output impedance about 100 Ω, both suitable for professional use.

Noise

The broadband output noise from both units is given in **Table 1** and compared with published specification of a standard ¼ in stereo master recorder with and without noise reduction. These measurements were taken with the machine inputs terminated with 50 Ω, record to playback. There is obviously a significant improvement over the conventional recorder used on its own. The ⅓-octave noise spectrum is given in **Fig 3**, showing the absence of any mains-related components, the result being nearly pure white noise. The two machines were nearly identical. **Fig 4** shows the improvement in noise at the higher frequencies when emphasis is used on recording, a benefit of about 5 dB is obtained above 5 kHz.

Modulation noise was measured by recording a low frequency tone (20 Hz) at levels ranging from −100 dBr to −40 dBr (below peak) in 10 dB steps. The recorded tone was then removed by a highpass filter and a ⅓-octave sweep made from 500 Hz upward. The results are plotted with respect to the fixed peak level of the system and are shown in **Fig 5**. The difference between the top and bottom curves represents the worst case modulation noise of 6 dB generated by the recording process due to the varying levels of low frequency tone. When a signal is recorded, the S/N ratio can degrade by up to this amount depending on the input signal level. In many cases the audibility of the noise will be reduced by masking effects of the wanted signal but this depends greatly on the type of material being recorded. This noise is generated in digital

TABLE 1 Broadband noise measurements
dB below peak level

	Review machines	Conventional without NR	Conventional with NR
22 Hz to 22 kHz RMS	−90.5	−63	−90/−95
400 Hz to 22 kHz RMS	−91.5		
CCIR 468-3 unwtd	−86.5		
CCIR 468-3 wtd	−80.0	−54	

Conventional machines data taken from professional stereo ¼ inch master recording @ 15 in/s
Noise reduction Dolby *SR* (taken from data sheets—not confirmed)

FIG.1
TRACKING ERROR BETWEEN LEFT AND RIGHT OUTPUTS OF RECORD LEVEL POT AS IT IS TURNED DOWN

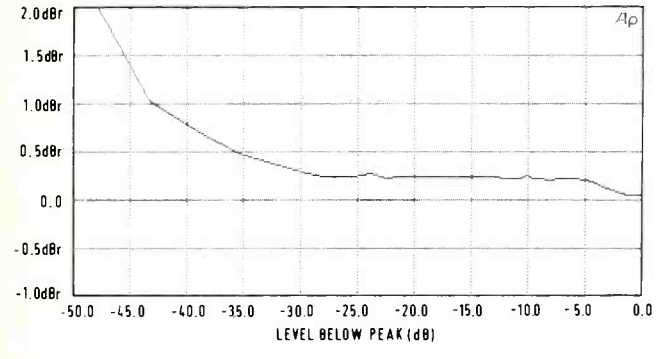


FIG.2 PCM-2500
COMMON MODE REJECTION RATIO

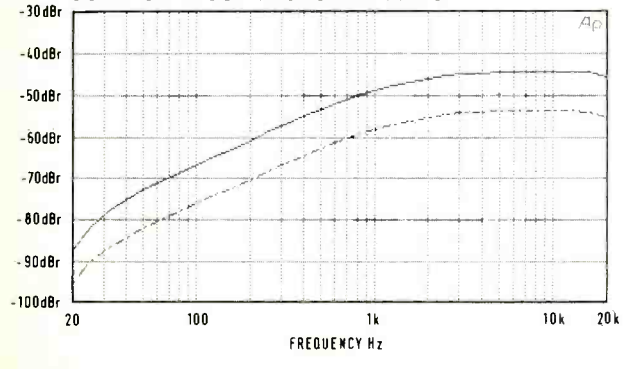


FIG.3 DTC-1000ES
NOISE IN A 1/3-OCTAVE BANDWIDTH REFERRED TO PEAK RECORDING LEVEL. THE RESULT IS NEARLY PURE WHITE NOISE

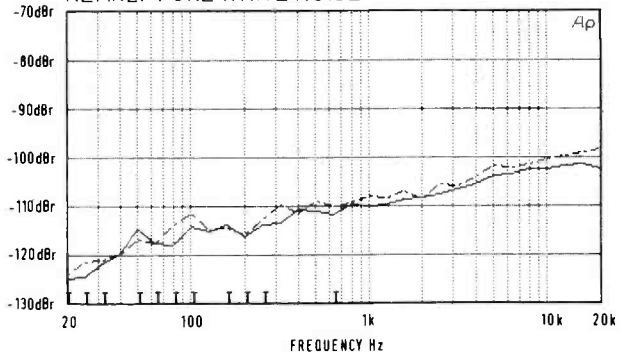
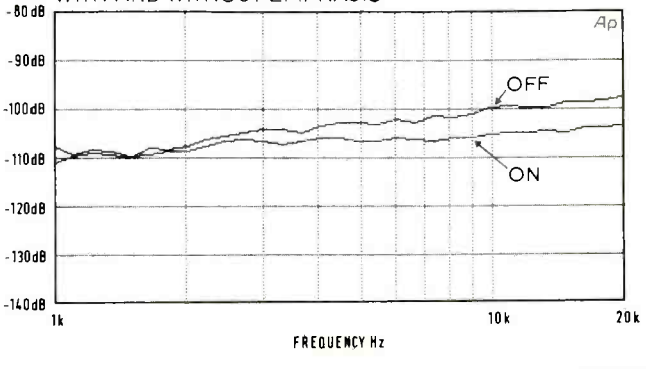


FIG.4 PCM-2500
RESIDUAL NOISE BELOW PEAK LEVEL WITH AND WITHOUT EMPHASIS



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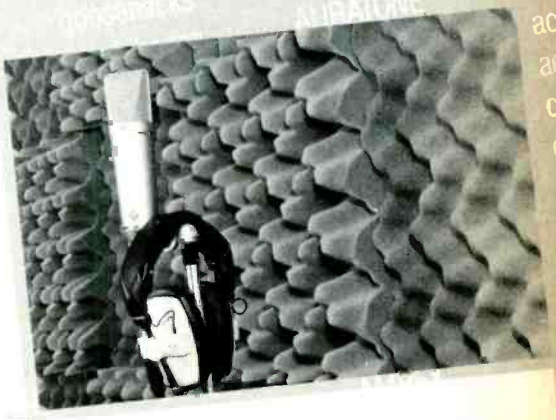
WE DIDN'T REACH No.1 BY BEING OUT OF STOCK OR EXPENSIVE!



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machines by errors in the A/D and D/A converters and in the digital filters.

Frequency response and linearity errors

Using a digitally-created test tape, playback-only frequency response was measured as shown in **Fig 6**. Both machines exhibited nearly identical responses that are nearly ruler flat, rising by only 0.2 dB between 10 kHz and 20 kHz. **Fig 7** shows the *PCM-2500* record/playback response at 44.1 kHz with emphasis switched on and off. When off, the response measures within ±0.1 dB to 20 kHz. With emphasis on, a peak is introduced at 7 kHz of 0.4 dB. At 48 kHz the record to playback response is almost ruler flat. In all cases the match between channels is within about 0.05 dB.

Fig 8 is a plot of the level error in dB versus the absolute level in dBr below peak for the *DTC-1000ES*. Measurements were taken with a 200 Hz signal. The ideal is a straight line. It can be seen that down to −70 dBr the error is negligible. Below this deviations of up to 1 dB exist down to −100 dBr. On the *PCM-2500*, which has identical converters, **Fig 9** shows much greater errors of up to 5 dB beginning at −60 dBr. The cause of these errors was not investigated.

Interestingly, quantisation distortion measurements taken on this same machine show a likely bit weighting error at about −55 dBr. Notice the step in the curve of **Fig 10** at this point. This set of measurements uses a fixed frequency 1 kHz tone, which is gradually reduced from peak level to 110 dB below peak level. The THD+N is referenced to peak level, giving a reading related to errors in the quantising levels of the A/D and D/A converters. As the signal gets smaller, fewer and fewer quantising levels are crossed. A step in the curve indicates that a particular bit that was in error is no longer being activated by the signal.

Distortion

In this case we are measuring classical distortion parameters. **Fig 11** taken on the *PCM-2500* with emphasis off, shows four types of distortion measurements: THD+N at 1 kHz, SMPTE IMD using 60 Hz and 7 kHz tones in a 4:1 ratio, CCIF

FIG.5
WORST CASE MODULATION NOISE IS THE DIFFERENCE BETWEEN THE UPPER AND LOWER CURVES

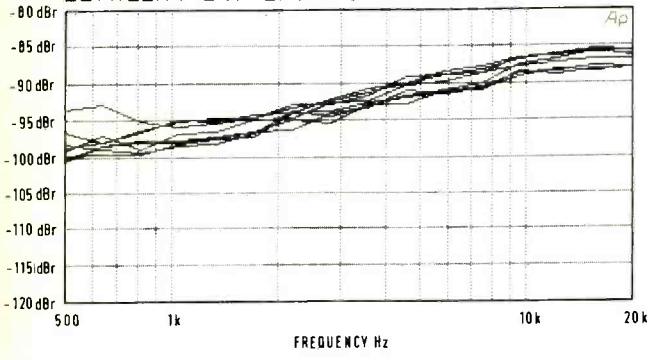


FIG.6 DTC-1000ES
PLAYBACK ONLY RESPONSE OF A -20 dB TONE STEPPED IN 1/3 - OCTAVE INTERVALS

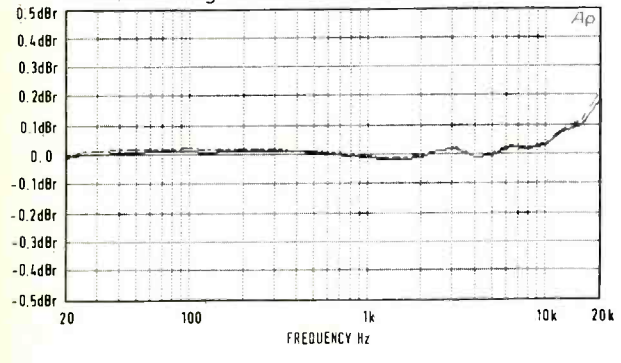


FIG.7 PCM-2500
RECORD TO PLAYBACK FREQUENCY RESPONSE, 44.1 kHz SAMPLING RATE

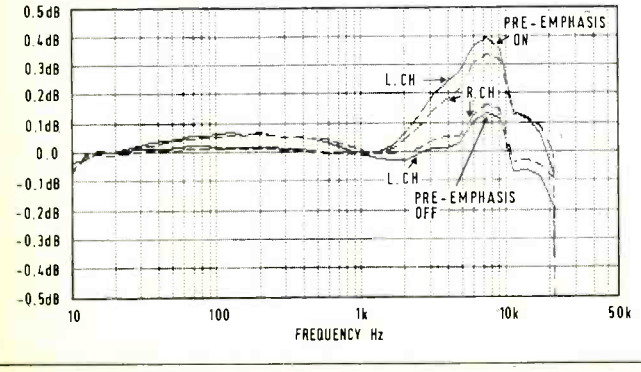


FIG.8 DTC-1000ES
INPUT/OUTPUT LINEARITY, 200 Hz

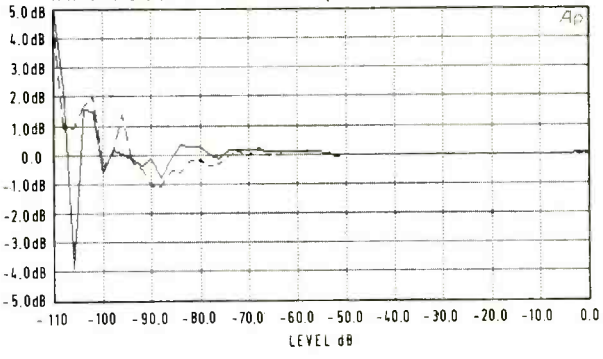


FIG.9 PCM-2500
INPUT/OUTPUT LINEARITY, 200 Hz

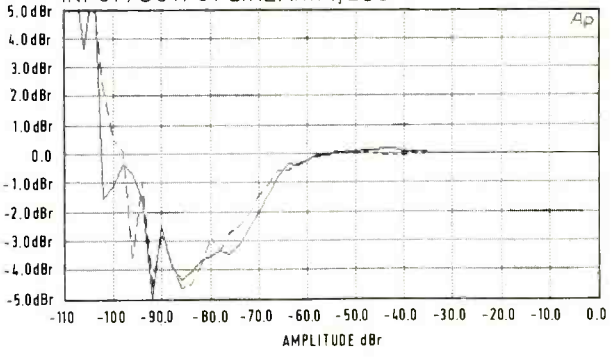
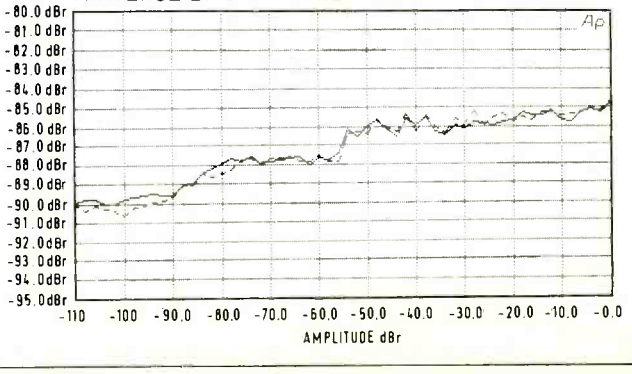


FIG.10 PCM-2500
RDAT THD+N vs AMPLITUDE (QUANTISATION DISTORTION) AT 1kHz. DISTORTION EXPRESSED IN dB BELOW MAXIMUM OUTPUT. STEPS IN DISTORTION OCCUR WHEN SIGNAL PEAKS NO LONGER TRAVERSE BITS WITH HIGH WEIGHTING ERRORS



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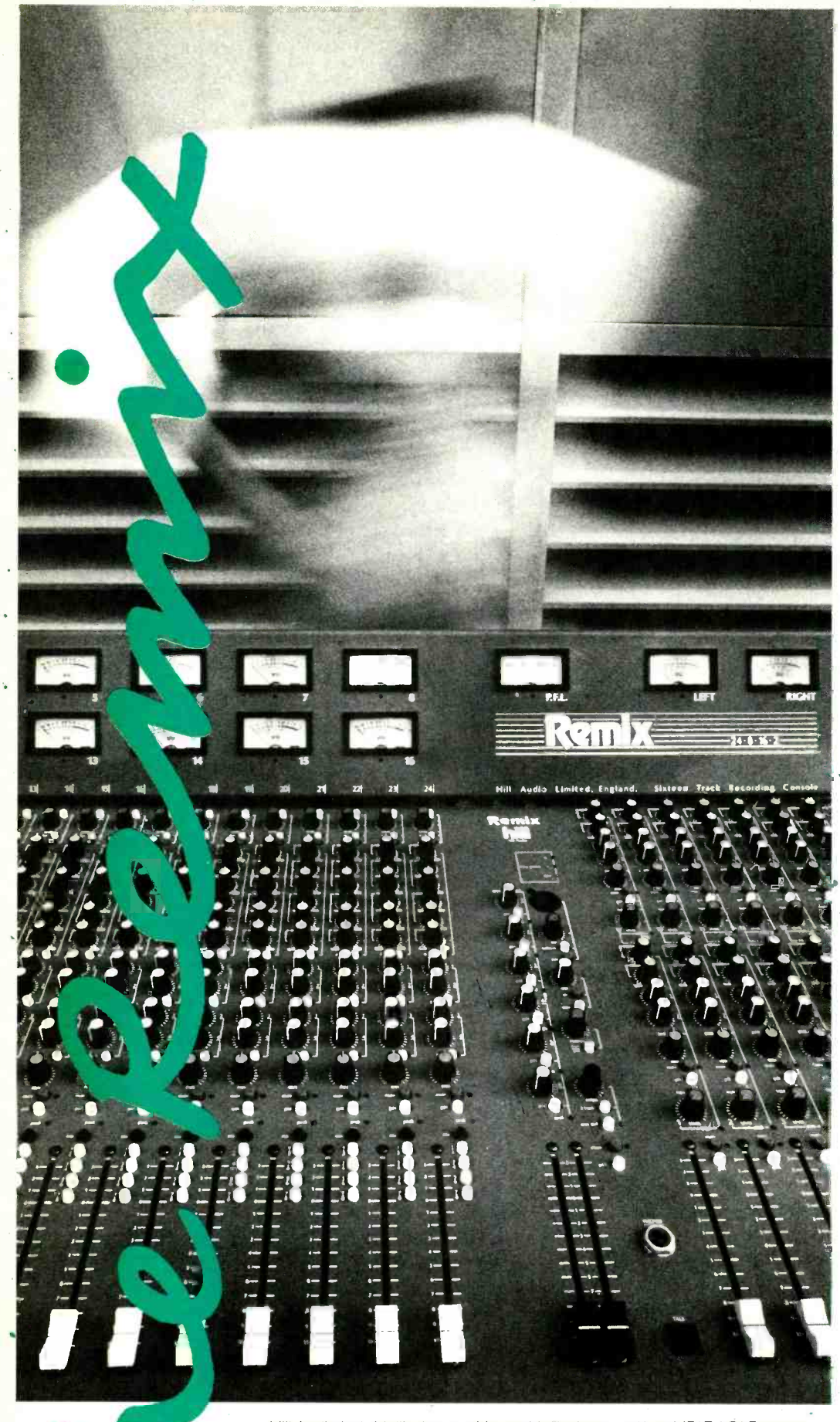

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IMD using 19 and 20 kHz tones in a 1:1 ratio, and DIM-30 which combines a 3.15 kHz square wave with a 15 kHz probe tone. The measurements are taken while increasing the signal level from −30 dB to 0 dB referenced to 2 dB below peak level as indicated on the DAT machine's meter. As expected, the results generally decline as signal level increases, since they are all relative to the signal level, and at low levels are limited by background noise. **Fig 12** shows the same curves with emphasis on. Note that there is a severe rise in distortion in the CCIF and DIM-30 curves as they approach peak level. Both these signals contain high frequency tones which, due to pre-emphasis, are clearly entering overload, probably in the final filter stage. Yet on the machine's meters they have been set to reach a maximum of 2 dB below overload. The meters are obviously missing the point, so care should be taken when recording material having high level/high frequency content. Generally the metering system should be used as a guide only since it does not seem to correspond to any known standard.

Fig 13 shows the relative overload level of the machine with and without emphasis. Note that near 20 kHz there is 8 dB less headroom with emphasis on. This should not be a problem with most material but may show up on cymbals and some synthesiser settings.

FIG.11 PCM-2500
DISTORTION MEASUREMENTS-MAXIMUM LEVEL SET 2dB BELOW INDICATION OF OVERLOAD FOR EACH SIGNAL EMPHASIS OFF
1 - THD+N@1kHz
2 - SMPTE, 60Hz & 7kHz @4:1
3 - CCIF, 19kHz & 20kHz @1:1
4 - DIM-30, 15kHz PROBE TONE

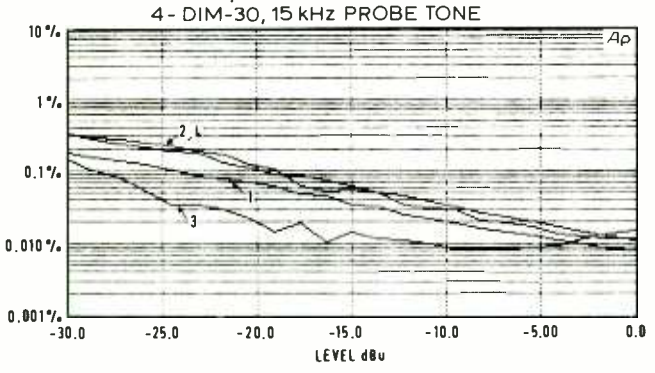


FIG.12 PCM-2500
DISTORTION MEASUREMENTS-MAXIMUM LEVEL SET 2dB BELOW INDICATION OF OVERLOAD FOR EACH SIGNAL EMPHASIS ON
1 - THD+N@1kHz
2 - SMPTE, 60Hz & 7kHz @4:1
3 - CCIF, 19kHz & 20kHz @1:1
4 - DIM-30, 15kHz PROBE TONE

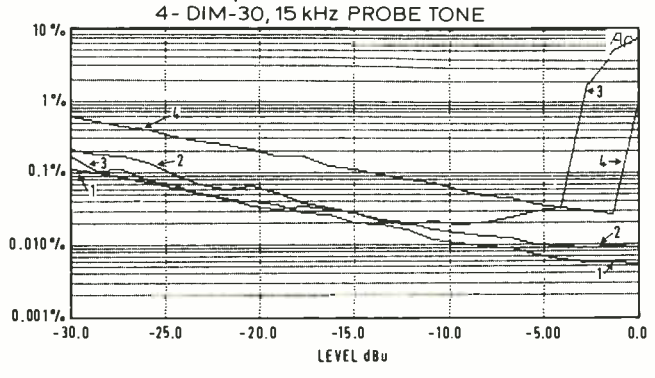


FIG.13 PCM-2500
COMPARISON OF RELATIVE MAXIMUM INPUT LEVEL VERSUS FREQUENCY WITH PRE-EMPHASIS ON OR OFF. 0dB REPRESENTS THE LOW FREQUENCY OVERLOAD POINT

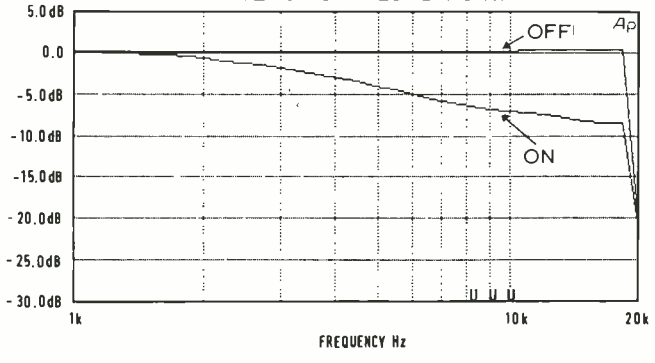


FIG.14 PCM-2500
STEREO SEPARATION AT MAXIMUM RECORDING LEVEL DAT MACHINE. SOLID LINE LEFT-TO-RIGHT, DASHED LINE RIGHT-TO-LEFT. COMB FILTER EFFECT AT HIGH FREQUENCIES DUE TO TIME DELAY IN DAT MACHINE

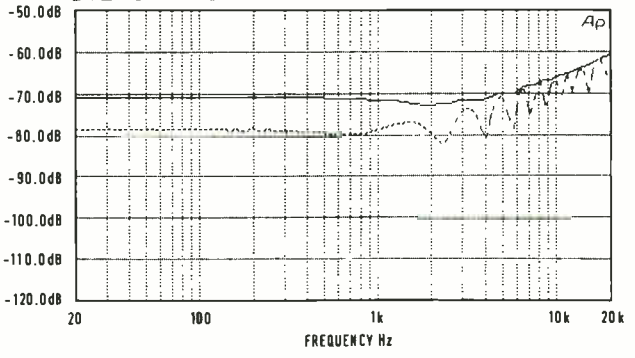


FIG.15 PCM-2500
CHANGE IN GROUP DELAY WITH FREQENCY, CREATED BY SUBTRACTING THE FIXED DELAY DUE TO DIGITAL SAMPLING FROM AN OVERALL DELAY MEASUREMENT

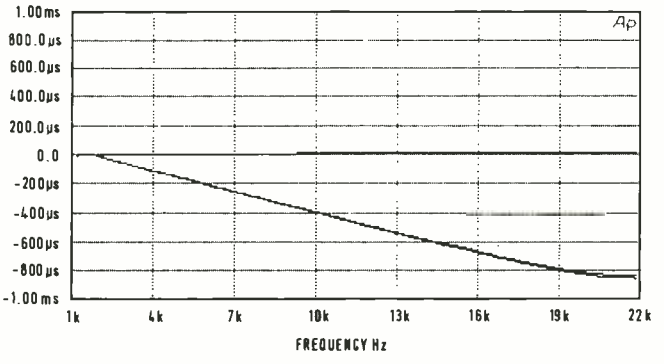
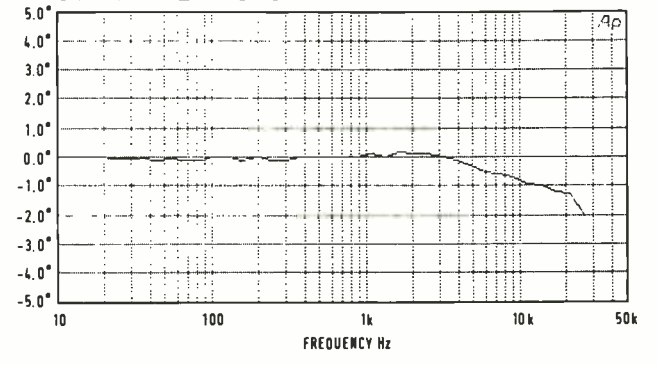


FIG.16 PCM-2500
PHASE DIFFERENCE BETWEEN LEFT AND RIGHT OUTPUTS-RECORD TO PLAYBACK



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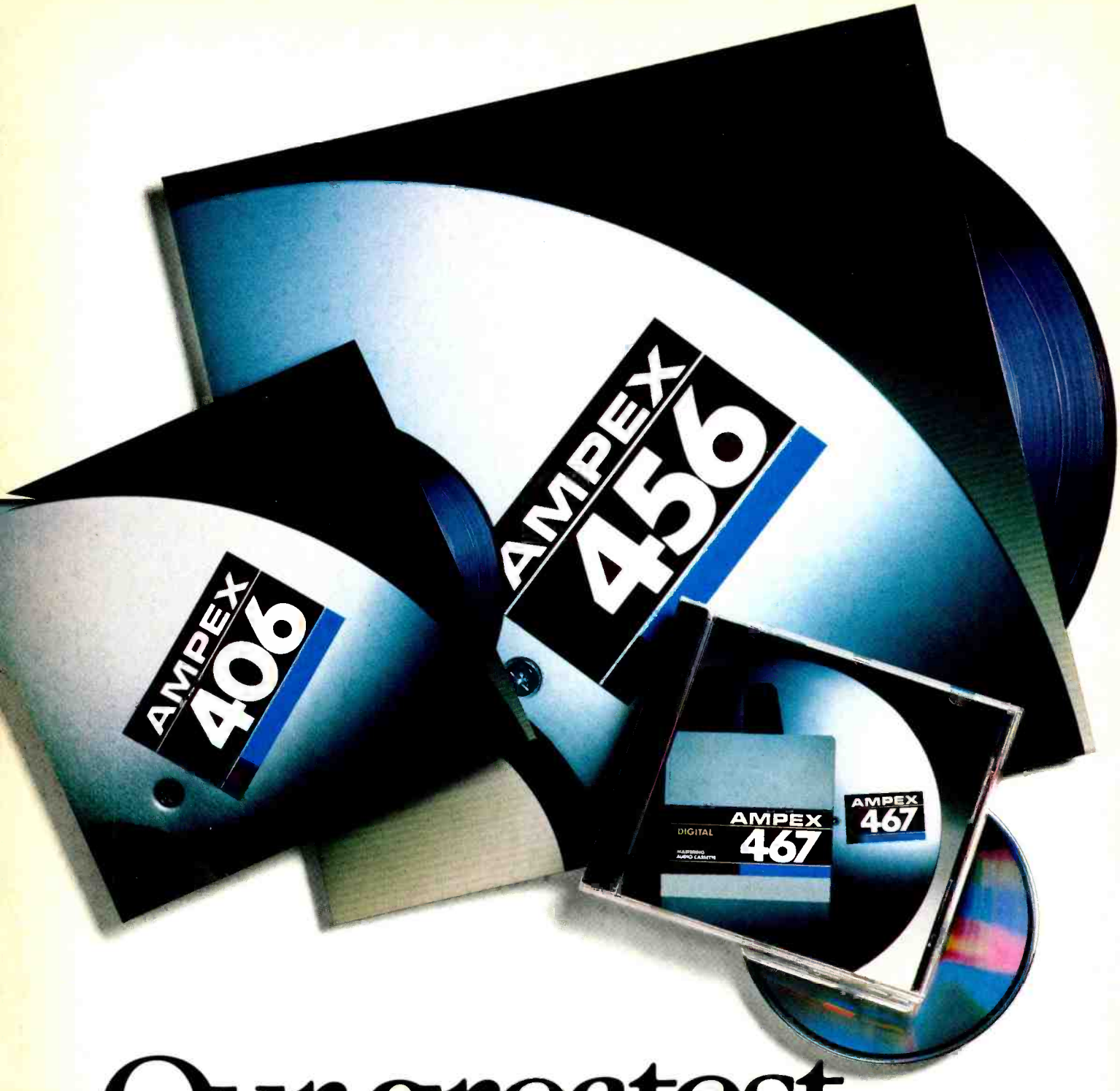

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Crosstalk, group delay and phase error

Fig 14 shows record to playback crosstalk from left input to right output and right input to left output. These figures, while acceptable, are not as good as they might be, being only marginally better than a 2-channel conventional recorder. Certainly crosstalk could be the largest error present on the replayed signal. As long as the machine is used for real stereo no problem will occur but what about those requiring synchronised but independent channels?

The concept of group delay comes originally from high frequency applications such as radio, TV, and broadband telecommunications. It can be thought of referring to a band of frequencies (a group) being time delayed with respect to signals in other frequency bands. It first became relevant in audio when one loudspeaker carrying a band of frequencies (the tweeter) was physically mounted out of line with another loudspeaker carrying other frequencies (the woofer). One lot of frequencies then arrives at the ear after the other one even though they left the amplifier in unison. Some people could hear this, so time-aligned monitors came into being. Group delay is directly related to phase, being the slope of the phase response curve. In fact linear phase just means that the slope is constant with frequency, therefore the group delay is also constant.

Group delay problems occur in digital systems if the samples are not synchronised between the left and right channels, or are caused by the very steep filters used to prevent aliasing or to reconstruct the digitised output signal. If everything is time delayed together, we will be unaware unless we can hear the original source signal, but the audibility of time delay, which varies with frequency, is still under discussion. In **Fig 15**, a measurement of absolute group delay with respect to the input signal has been made, then the constant delay due to digital sampling has been subtracted so that only the change in delay with frequency is plotted. Both channels are plotted and are essentially identical (so nearly so that I pulled the plugs to check). The difference between the delays of the two channels was then plotted on the same graph and in this case shows up as an almost straight line along 0.

At 19 kHz the group delay is 800 μs. This is equivalent to starting off a 1 kHz signal, then waiting 15 cycles of 19 kHz before starting it off as well. Another comparison is that the same delay would occur if the tweeter and midrange unit of your loudspeaker were out of line by 275 mm (nearly 12 in) but only at that frequency. As the frequency goes down it is as if the two units get closer and closer together until they line up at 2 kHz. Can we hear this delay? Many people believe that we can and companies are offering alternative filters to reduce the group delay error but they are not yet available to try in these machines.

As far as phase error is concerned, the absolute phase is almost meaningless with such long delays as shown above. What is interesting is that, like the consistency of group delay, the interchannel phase difference is almost zero, see **Fig 16**. Thus, although we may or may not hear the delay, the stereo image will be absolutely right due to such good accuracy between channels in both level and phase.

Summary

The Sony *DTC-1000ES* is an excellent recorder at a modest price, and will in many ways outperform professional master recorders for mixdown purposes. The *PCM-2500* version offers versatility, particularly with its digital I/O facilities, while also providing professional balanced audio I/O. Other companies are currently launching their own professionalised versions of the *DTC-1000*, which we hope to look at in the future.

The full potential of R-DAT technology is still to be realised, allowing the recording of individual channels, editing, etc. Fostex have proposed a standard for integrating SMPTE/EBU timecode into a DAT machine, which can be slaved to other machines. One of the new Sony DAT portables has timecode but can only be used as a master. The technology seems to allow for varispeed operation, editing and many other applications still left to conventional or much more expensive digital machinery.

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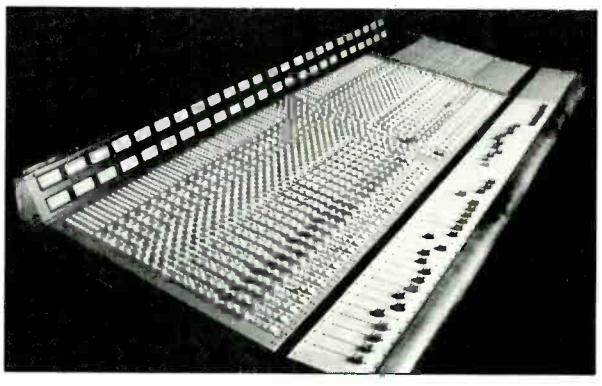

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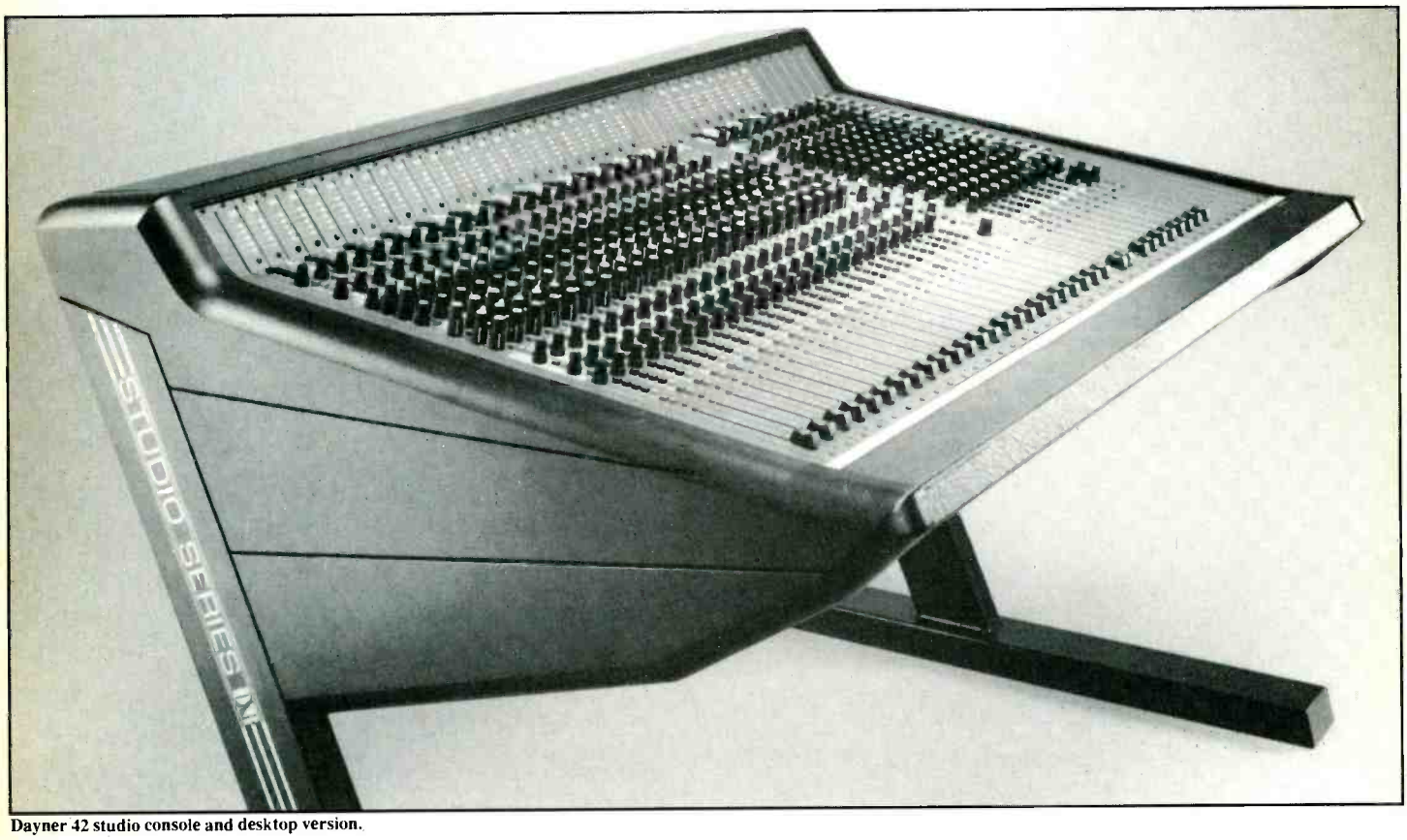

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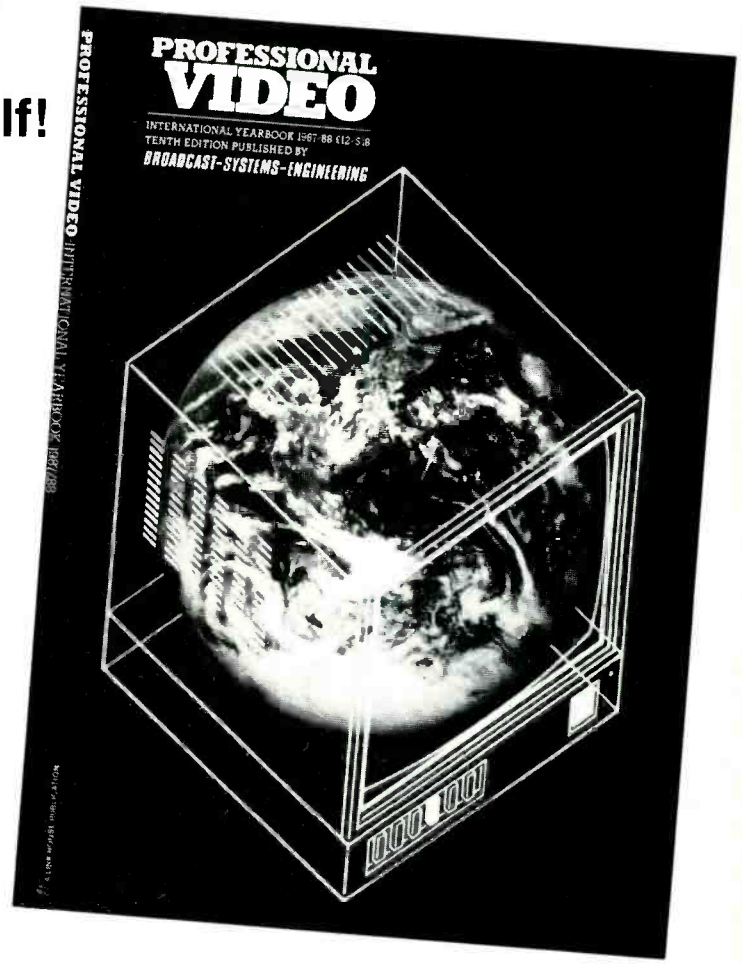

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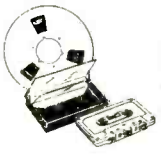

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For full specifications and details of the Roland System House network contact:

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Roland (UK) Ltd
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Worldwide: Studer International AG, Regensdorf, Switzerland, +41 840 29 60.

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