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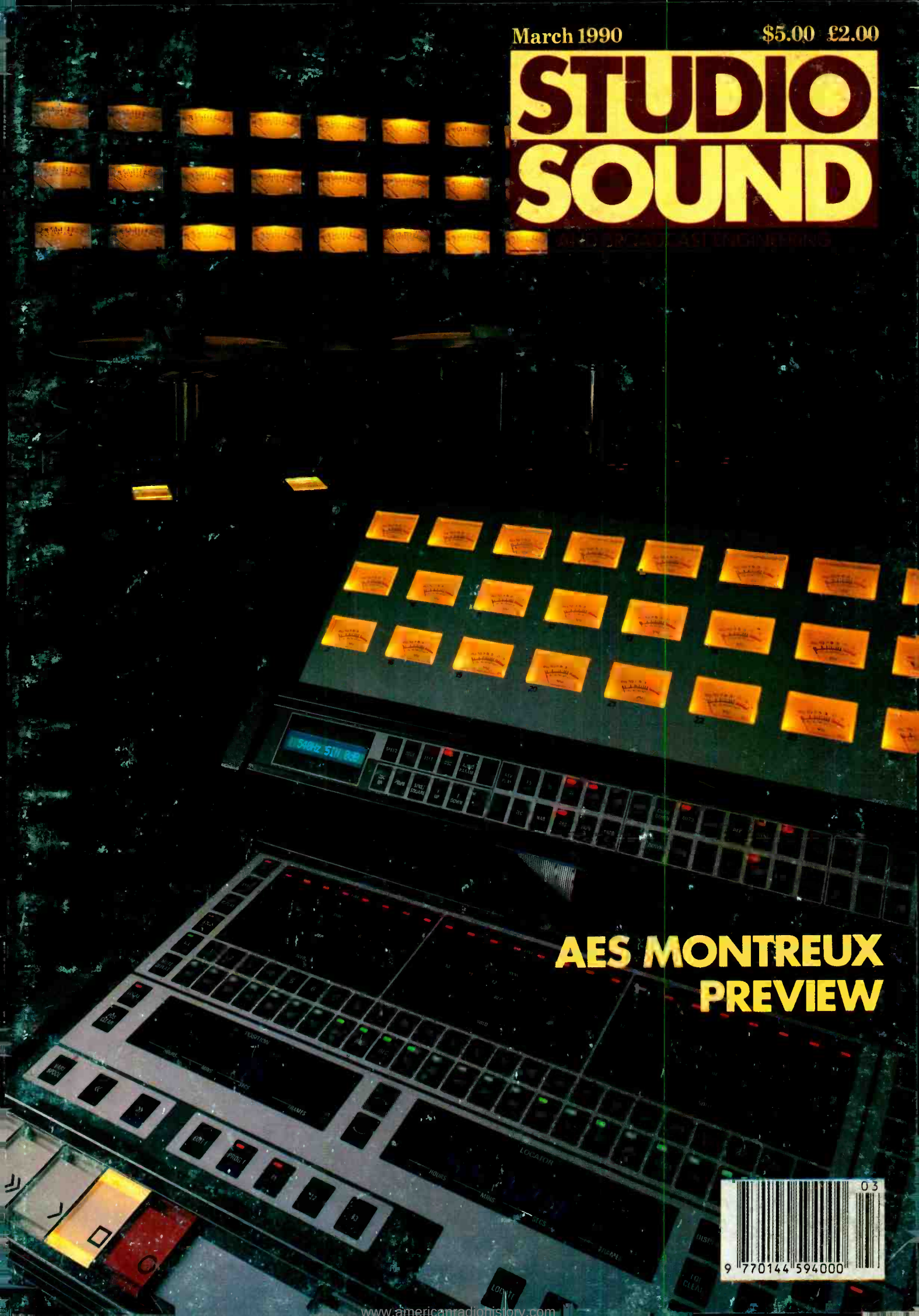

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Synclavier suite 3 at Full Sail, Florida, USA

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EDITORIAL & ADVERTISING OFFICES
Link House, Dingwall Avenue, Croydon CR9 2TA, UK. Tel: 01-686 2599. Telex: 947709. E-mail: 78:DGS1071. ESI: STUDIOSOUND-UK/US. Fax: 01-760 5154/0973.

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Studio Sound, 2 Park Avenue, 18th Floor, New York, NY 10016, USA. Tel: (212) 779-1212. Fax: (212) 213-3484.

JAPAN & FAR EAST AGENT
Contact: Mikio Tsuchiya, Media Sales Japan Inc, Tamuracho Bldg 3 3 14, Shimbashi, Minato-Ku, Tokyo, Japan. Tel: (03) 504-1925. Telex: J25666. Fax: (03) 595-1709.

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Where Do We Go From Here?

I would like to return to a subject I touched on a couple of years ago. At that time I remember being concerned about certain technological developments that looked poised to make a disproportionate impact on the recording process. I recall being most concerned that sampling techniques, sample libraries and sequenced triggering would homogenise our recording art. Viewed from my current perspective, this did not happen. Well I suppose it did among musicians but many engineers just adopted what they needed. This may have proved that the recording engineer is an adaptable creature but defining his character does not explain the beast and his future.

We have a fairly good idea of the readership profile of this magazine obtained from information supplied on subscription cards. You tell us that two-thirds of you are directly involved in the sound recording industry as equipment users or, as we specify, 'engineers,' which is back to this rather vague term that does not mean a great deal. It certainly used to in the days when the operator would have also built the equipment and needed a thorough understanding of its workings to produce a predictable result. My *Chambers's* desk dictionary defines *engineer* as one who designs or constructs machinery. It also adds the definition of management of machinery as in the role of maintenance. None of these descriptions fit the average recording engineer whose expertise now generally lies in other areas. But what areas *does* it encompass?

Returning to the opening paragraph, the recording engineer has proved a resilient if undefined position. It has not been chewed, swallowed and spat out by technology as easily as I feared. For instance, at a meeting hosted by a well known name in synthesis in the mid '80s a senior figure from the company stated that they saw their future direction as making the recording engineer redundant. Well in fact the subsequent complexity of their gear actually turned this statement on its head and they are now marketing to engineers! So I do not fear for the continued existence of that two-thirds of our readership but look forward with great interest to see precisely how their position changes as the next round of technology enters the arena.

The Montreux AES will contain a number of new developments that will reduce the skill needs of our recording engineer—not affect his skills but the need to acquire them. Much prized has been the ability to punch-in/out very tight passages on a reliable basis even after 18 hours solid work. Frame accurate and rehearsable programmable machines remove that need. Consoles that can automate all level and processing changes for a mix remove the need for memorisation, co-ordination and repeatability from the mix engineer. Hard disk systems allow salvaging of tracks that would previously have been rejected; placing the onus on the engineer to be the arbiter of artistic and financial limitations—balancing the ability of the musicians to improve on their performance against his own ability to correct the recording with the time processing powers of his own equipment. Software running on workstations will allow automated correction of double tracking and maybe far more—pulling wayward instruments back into tempo after recording. The ability to simulate alterations to mic positioning or ambience *after* recording relieves some of the pressures to get it right under extremes of pressure. All these things are here or are about to be although, admittedly, in some cases beyond current financial easy reach. But time will cure that.

This is not an anti-technology diatribe—in fact I look forward to these developments. It's not a thinly veiled assault on the skills of the current generation of recording engineers. I am just asking the question—how far can the job function of the engineer change in the future and still be able to use the increasingly tenuous term *engineer* for the role? We will have the position of 'systems engineer' whose job it will be to overcome the problems of making unlikely combinations of audio (and video) equipment work and talk together, simultaneously. But his role will stop short of using the gear.

What happens if the situation develops to the stage where the job requires just the ability to get along with your clients and manipulate the workstation software? No doubt you would have skills but nothing closer to our dictionary definition. If not an engineer what are you or does it even matter? Well it does to a degree. In Europe there is a flourishing bureaucratic demand for defining jobs and hence their training needs. There are moves to define the role of the recording engineer so that training needs for entrants to the profession may be determined. If defining an indeterminate role is difficult how will they fare with a moving target? We watch with interest—and from a distance!

Keith Spencer-Allen

Cover: Saturn 824

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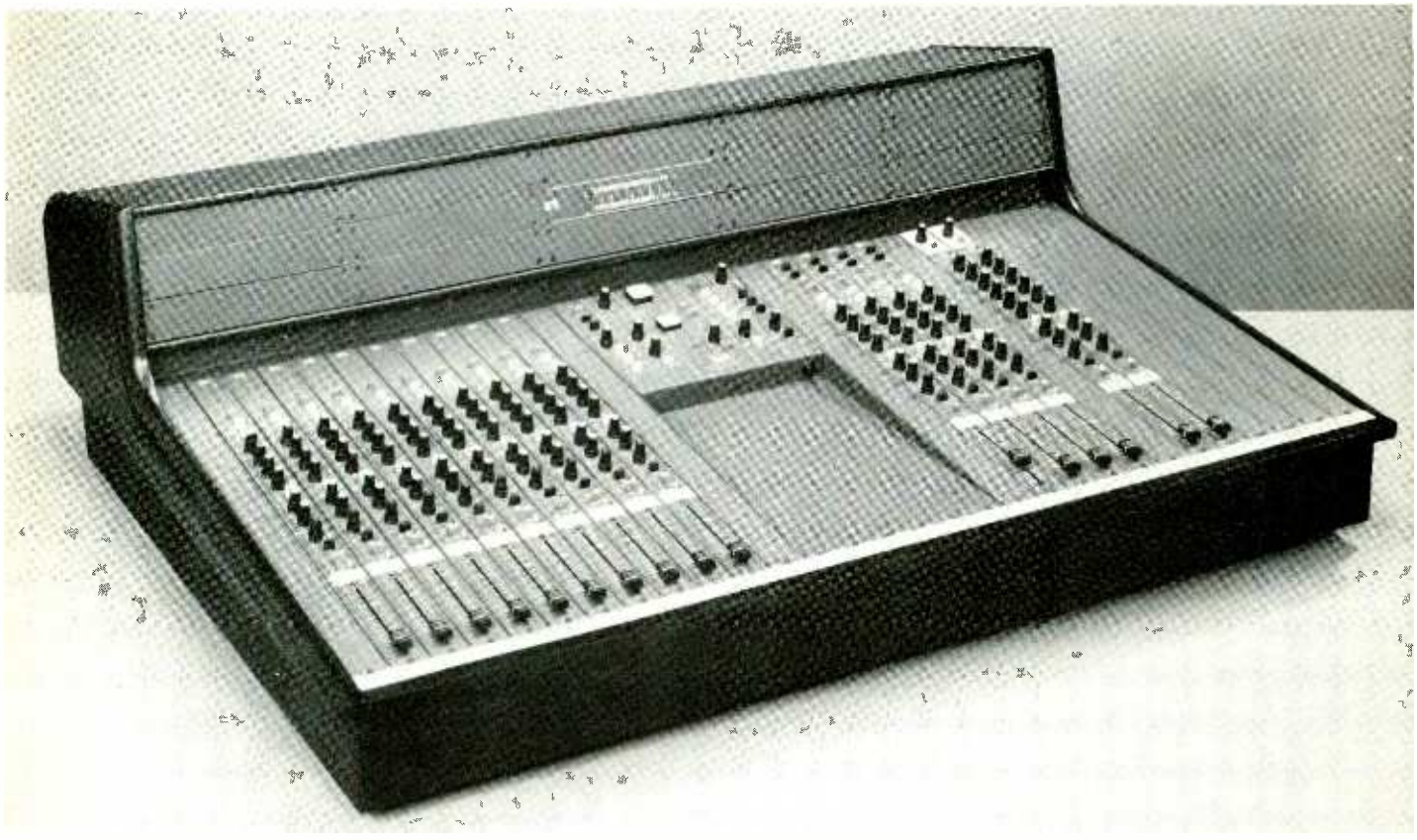

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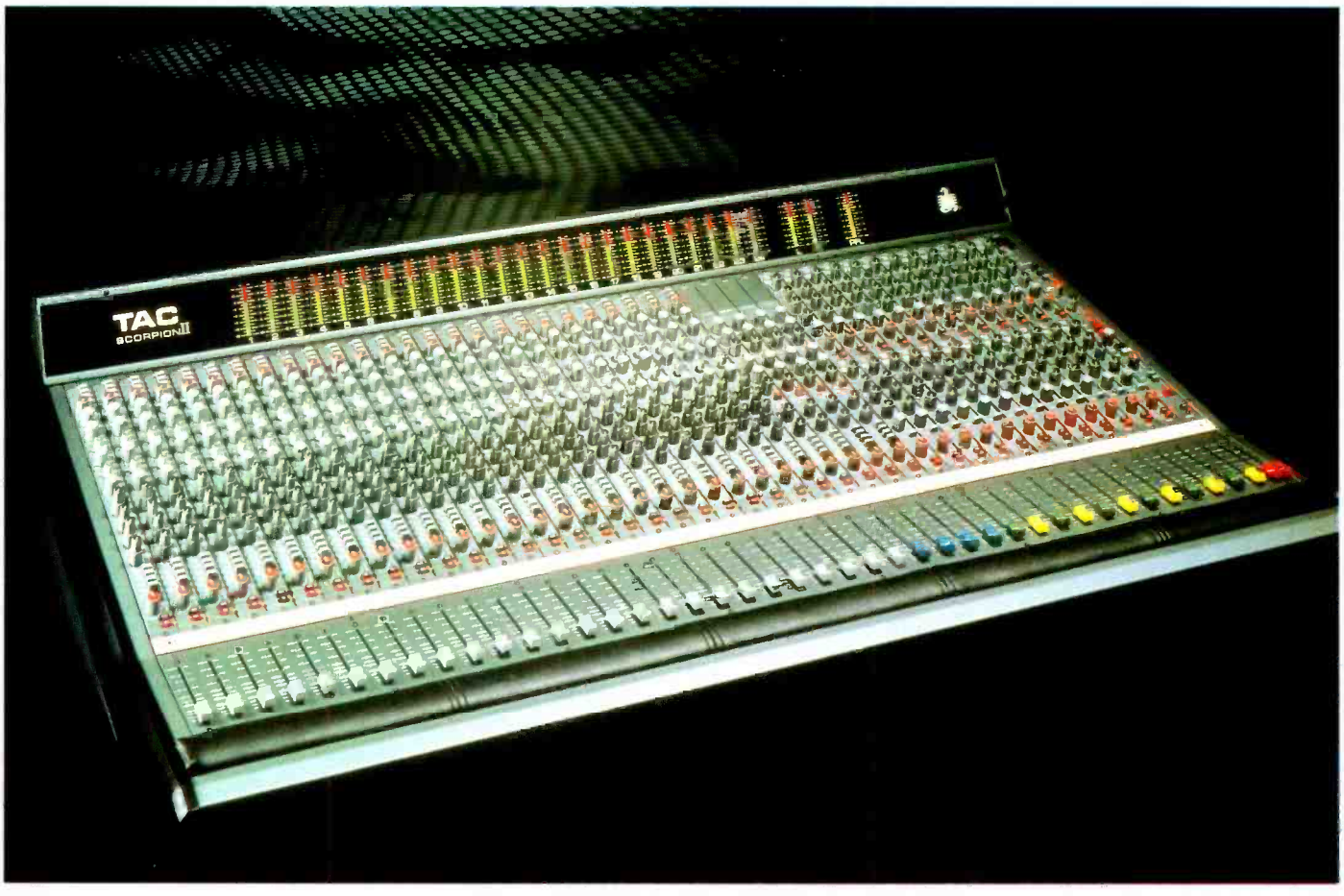

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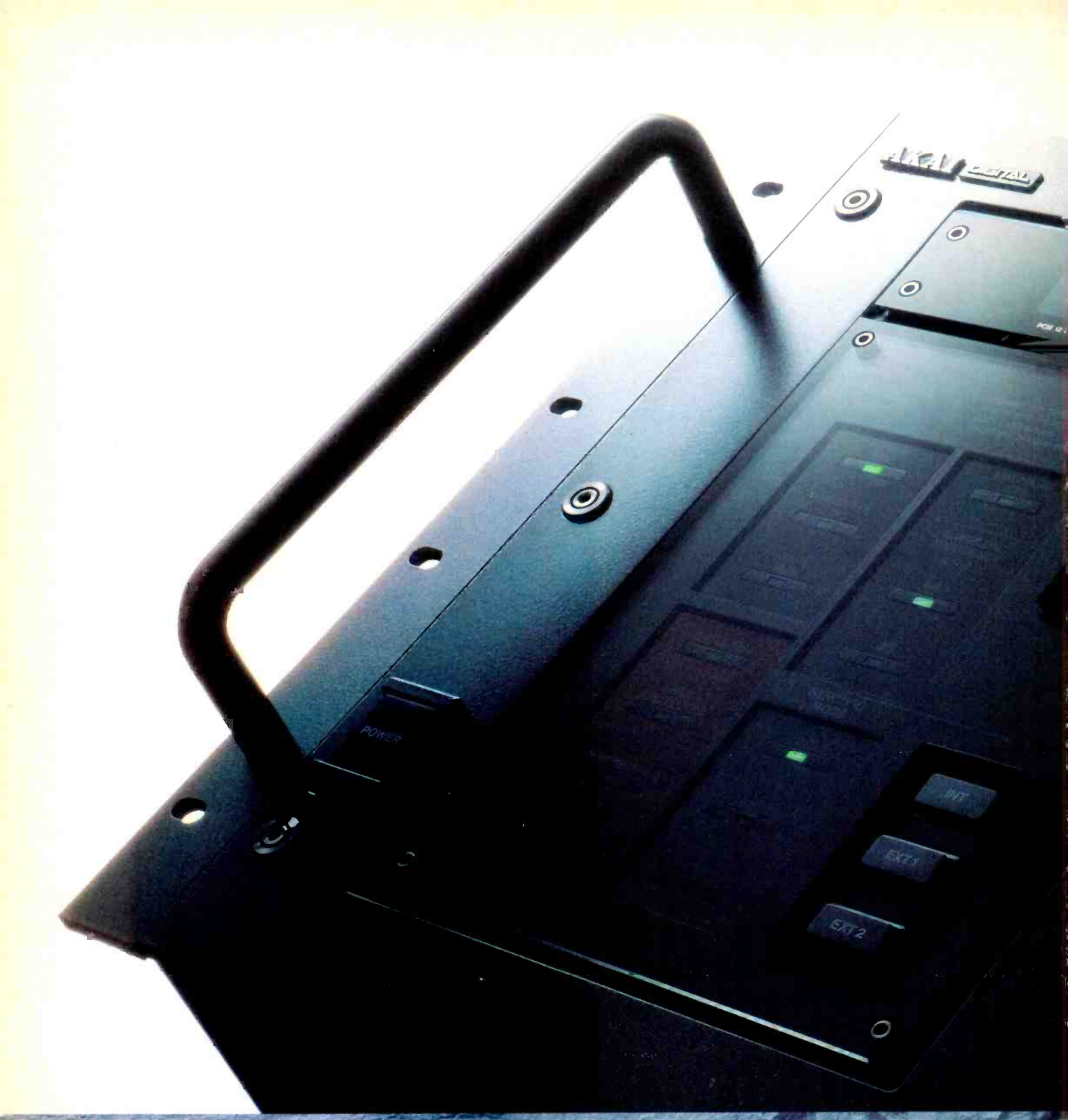

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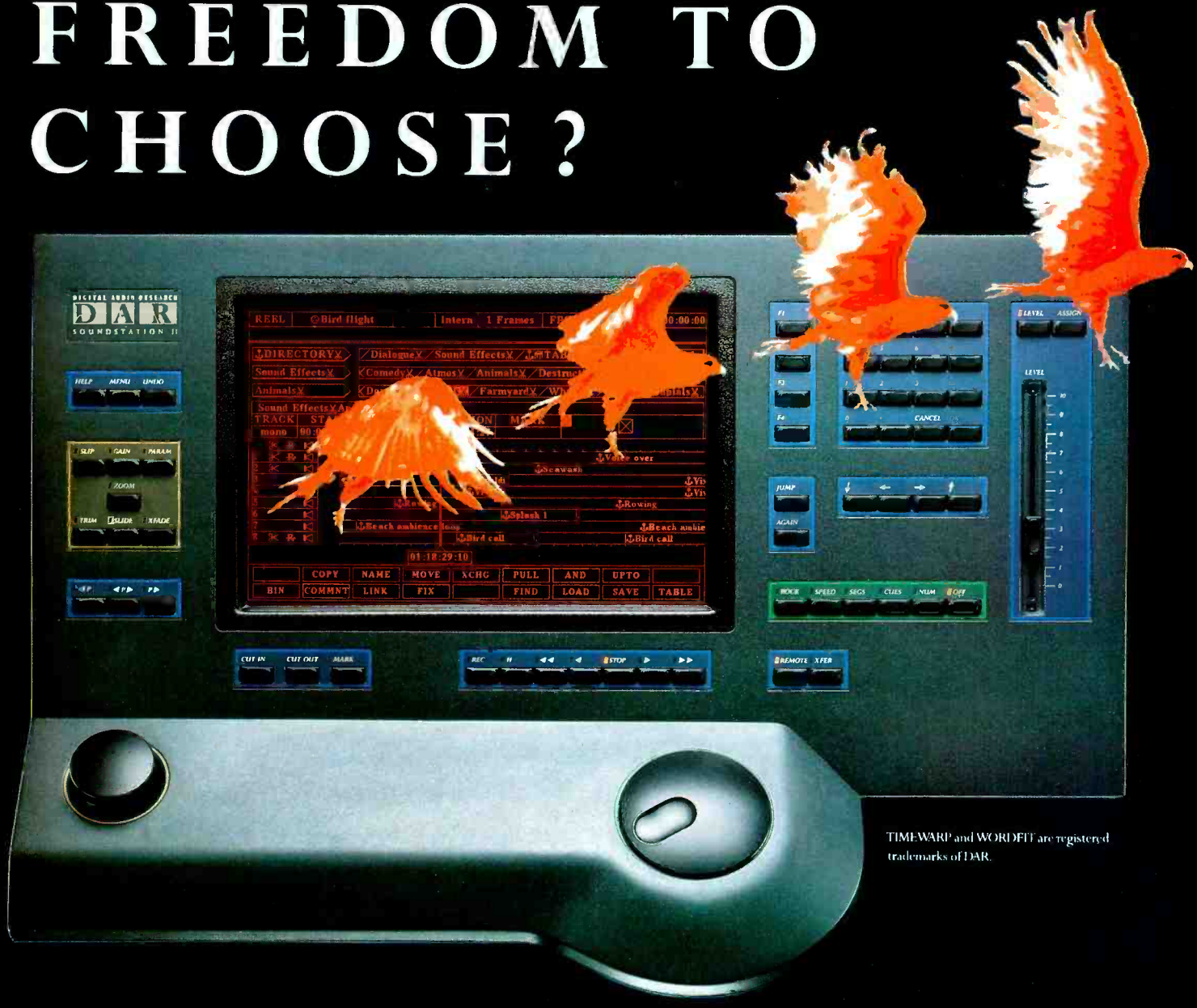

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March 1964 . . . Intended to retail at less than £200, a television recorder was shown recently in New York. The Fairchild Corporation are the second of several manufacturers, including 3M, Sony, CBS and Ampex to develop such equipment, which uses 11 inch spools of ¼ inch tape. Stationary tape heads, less than 1 micron in width and 50 silicon transistors combine to give a reasonably well-defined picture although the accompanying sound is said to leave something to be desired.

March 1966 . . . Take one studio tape recorder, marry it to a domestic record changer and the result is likely to be an automatic tape changer studio playback system. Just such a machine is now being produced by the Japanese Nippon Columbia Company and is designed to eliminate manual handling of tapes. The *DN 150P*, which costs £5,500 in Japan, takes up to 42 reels of 10 inch, 7 inch and 5 inch diameter tape.

March 1973 . . . No vacancies for BBC posts will be advertised as 'for men only' in future. Mr Maurice Tinswood, the corporation's personnel director, said that the BBC would also try to ensure that women were not kept out of senior management posts and that women would begin to take jobs they had not held until now. The BBC employed 15,913 men and 8,944 women at the end of March, 1972.

March 1973 . . . EMI have won the contract to build the IBA's commercial radio transmitters in London, Birmingham, Glasgow and Manchester. The two aerials for London and Birmingham will be the first of their type in the country, transmitting circular polarised VHF. Such systems have already been used in the United States to improve reception on hand and car radios.

PAEG seeks US support

The Pro-Audio Exhibitors Group's fourth meeting was held on January 15th at the London Zoo meeting rooms. Inevitably most of the allotted 3 hours booked at the meeting rooms were taken up by the Montreux boycott debate, although before that subject was breached there was concern voiced over the way PAEG was perceived in America. Apparently some US manufacturers see PAEG's causes as parochial ones and that the recent boycotts were just a case of European in-fighting. However, since the meeting, there has been a meeting of US manufacturers at the NAMM show in Anaheim to raise the question of creating an American PAEG.

The Montreux boycott was seen as a success, even before the show had started, by the simple comparison of last year's AES Hamburg exhibitors floor plan and this year's Montreux exhibitors list. This questionable practice shows that 47% of Hamburg's exhibitors aren't going to Montreux. Antony David, of SSL and Chairman of the PAEG, said a result of only 20% would have proved to him that they had successfully made their point.

The problem of the clash in dates of AES Los Angeles and IBC in Brighton this year although highlighted by an open letter of complaint to AES's Donald Plunkett from PAEG secretary Ken Walker was seen as beyond debate. The question now was one of duplication of equipment and more importantly personnel.

The International Association of Broadcast Manufacturers' (IABM) decision to host an alternative broadcast show to IBC and ITS was approved with a show of hands. The show is to be held in Stuttgart, West Germany, in October 1992. The PAEG fully endorsed the choice of venue and the possible merger of IBC and ITS, although the moving of ITS from Montreux and a future clash with a US AES were seen as possible problems.

The PAEG still hasn't made up its mind about the validity of Pro-Audio Asia as an exhibition. There was news of another show based in Singapore from a merger of two shows but PAEG agreed to disregard this until more was known. The relocation of InterBee 1990 was also raised and unanimously endorsed.

With time quickly running out, the meeting turned to APRS 1990 and the price increase for stand space. Antony David argued about the justification of the rise after last year's disappointing attendance figures. It was agreed that a letter be sent to Philip Vaughan of the APRS outlining the PAEG grievances.

The overall feeling of this PAEG meeting was positive but the need for better links with European trade associations before 1992 was seen as pivotal to the group's future.

B&K crowd control

Bruel & Kjaer have designed a system to be used at American football games, which allows crowd noise levels in stadia to be measured, interpreted and then displayed on TV screens during live broadcast.

The development of the system came about after a National Football League ruling which stated that home teams could be penalised during a game if crowd noise became so loud that it interfered with player communication.

In conjunction with Ken Michel, ABC TV's technology planning engineer and Jack Kestenbaum, audio production engineer, Adrian Weidmann, head of a special B&K projects team, initially specified a system using the B&K *2230* sound level meter mounted on the 'marketeer', a raised camera rostrum that moves along the line of scrimmage from end zone to end zone. One of the cameras on the marketeer was panned onto the *2230* meter and the results then shown on screen.

Unfortunately, having a dedicated camera trained on the meter for an entire game proved too costly, so Bruel & Kjaer simplified the system by mounting the *2230* meter on the marketeer with a cable fed from the *2230*'s output into a computer running a dedicated B&K software package in the ABC audio production vans outside the stadium. The measurement levels were then graphically displayed using a thermometer-type scale of 50 dB range, marked with noise level guidelines, such as Heavy Traffic (90 dB), Jackhammer (100 dB) and Rock Concert (110 dB). The graphic was then fed into the network's video switcher so that the image on the computer screen could be displayed to the viewer whenever the noise ruling came into being.

Exhibitions and conventions

March 13th to 16th AES 88th Convention, Centre de Congres, Montreux, Switzerland. Contact: AES Exhibition Director, Herman A O Wilms, Zevenbunderslaan 142/9–B-1190 Brussels, Belgium. Tel: (2) 345 7971. Fax: (2) 345 3419.
March 30th to April 3rd NAB, Atlanta, GA, USA.
April 22nd to 25th Vision and Audio International, Earls Court Exhibition Centre, UK. Tel: 01-776 0709.
May 8th to 10th ShowTech Berlin '90, Berlin Exhibition Hall, East Germany. Contact: AMK Berlin. Tel: (030) 30 38 0.
May 22nd to 24th CD-ROM Europe '90, Novotel Hotel, Hammersmith, London, UK. Contact: Elizabeth Beckett. Tel: 0733 60535.
May 29th to June 1st Broadcast Asia '90, World Trade Centre, Singapore. Contact: Joan Thompson, Electronic Engineering Association. Tel: 01-437 0678.
June 1st to 6th AV & Broadcast 90, China International Exhibition Centre, Beijing. Contact: Business & Industrial Trade Fairs, 28/F Harbour Centre, 25 Harbour Road, Wanchal, Hong Kong. Tel: 5-756333. Fax: 5-8341171.
June 6th to 8th APRS 90, Olympia 2, London, UK. Contact: APRS Secretariat. Tel: 0923 772907.
August 19th to 22nd Video Expo '90, Palacio Das Convencoes do Anhembi, Sao Paulo, Brazil. Contact: (UK) Ms Alison Carew-Cox. Tel: 021-455 9600. Fax: 021-456 1785. (Brazil) Para maiores informacoes. Tel: 021-220 3386.
August 24th to September 2nd Firato '90 Consumer Electronics, The RAI International Exhibition Centre, Amsterdam, The Netherlands. Contact: RAI. Tel: (020) 549 12 12.

News from the AES

We are delighted to announce that on Tuesday March 20th, the UK evening meeting will be presented by John Vanderkooy of the Audio Research Group, University of Waterloo, Ontario, Canada. The format will be different from our usual meetings in that John has agreed to give two talks on different subjects. Firstly, he will describe work he has done on **Minimally-Audible Noise Shaping**. He will show how, "by adopting a suitable weighting curve for low-level noise audibility, one can design dithered low-order requantising noise shapers to produce the approximate inverse of the audibility curve and hence achieve the least audible noise penalty. If Fielder's modified E-weighting curve is adopted as a model of the 15-phon audibility curve, reduction of 10.9 dB in perceived noise is possible by the use of a second-order noise shaper, a result within 0.6 dB of the theoretical minimum set by information theory, and almost a 2-bit gain in apparent signal-to-noise ratio. As ADCs get better than 16 bits, it will be possible to enjoy that quality with only 16 code bits."

Secondly, he will describe **A Simple Theory of Cabinet Edge Diffraction**. In this part he will show how, "Asymptotic diffraction results, valid at high frequencies for an infinite wedge, are used to derive an equivalent edge source strength, which can then be applied to the finite edges of a loudspeaker cabinet. Diffraction amplitudes are about 73% larger than earlier work, and display a strong dependence on observation angle. Computation of the diffraction is very efficient when carried out in the time domain, and second- and third-order effects can be included. Comparison with a boundary element calculation in the literature confirms the basic validity of the theory and experiments show the expected inversion of the diffracted sound on the two sides of the shadow boundary."

The meeting will start at 6.45pm with coffee served between the two lectures at about 7.30pm. It will be held at the IBA, 70 Brompton Road, London SW3. As with our other monthly meetings, members and visitors are most welcome to attend. To help future planning the dates, speakers and titles of our future monthly meetings are listed below (more details will be available on each nearer the time).

March 20th
As above

April 10th
Amplifier Differences
Paul Miller

May 15th
DAT Timecode
David Bush—Sony

May 16th to 17th
Hard Disk Recording
AES UK conference

June 12th
Active Acoustics
Philip Newell

July 10th
Digital Audio Components
Bob Stuart

Please note the new date for the May lecture. More information on the UK Hard Disk Recording Conference will be available next month.

Please also note that the next AES Convention, the first of the '90s, will be held in Montreux from March 13th to 16th, 1990. In addition to a full series of Papers and Workshops, there will be a large exhibition of international manufacturers with the latest technology on show. As usual we will have a stand at the Convention, so please drop by and have a chat. See you in Montreux!

For further details on any of the above or information on joining the AES, please contact: **Heather Lane, AES British Section, Lent Rise Road, Burnham, Slough SL1 7NY, UK. Tel: 0628 663725. Fax: 0628 667002.**

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• **AMS Industries Inc**, 1180 Holm Road, Suite C, Petaluma, CA 94954, USA. Tel: (707) 762-4840. Fax: (707) 762-4811.

The Classical Recording Company

A former BBC outside broadcast engineer, Simon Weir, has formed his own digital recording company specialising in classical music. The Classical Recording Company uses analogue mixing with digital mastering on R-DAT, *PCM701* and *1610* U-matic to produce digitally edited material for use by record companies making DDD spec compact discs.

Weir has an agreement with a couple of hire companies to supply extra equipment when the job demands it but intends to keep the operation small enough to be competitive. "Having worked with the BBC in outside broadcast I've got to know a lot of the venues that the record companies use. Even so I like to set a day aside before the actual recording to co-ordinate with the client and make sure I get the best possible result."

Weir wants to attract both amateur and professional musicians and hopes to be working at both ends of the recording spectrum, music students and major recordings. The **Classicial Recording Company, Farmhouse, St Luke's Road, Old Windsor, Berks SL4 2QJ, UK.**

People

●Colin Lane-Rowley has joined **FarrahSound**, UK, as sales manager for Anchor Products.

● **TAC**, UK, have announced the appointment of Anthony Hall as sales and marketing assistant.

●The **Hollywood Association of Recording Professionals** (HARP), USA, have elected Terry Williams, co-owner of Lion Share Studios, as the organisation's 1990 president.

● Doug Ford has joined **AMS**, UK, as senior customer liaison engineer. He was formerly audio facilities manager at Aspen Spafax Television.

● Ted Pine has been named as marketing manager of **New England Digital**, USA, assuming responsibility for the development and management of all NED marketing, advertising, direct mail and PR programmes. Pine was promoted from within the company.

● Geoff Calver joins the UK audio sales team at **Sony Broadcast & Communications** as sales engineer, post-production. Calver had been a freelance engineer before the appointment.

● Susan Planer has been named general manager of **BMG Studios** in New York, USA. Planer was, until recently, executive consultant to Sigma Sound. Hank Meyer has been appointed studio manager, he was previously general manager at Sigma Sound.

● The **Producers Association** which was formed from the merger of the AIP and the BFTPA have announced the appointment of John Woodward as Chief Executive.

Contracts

● Harris, Grant Associates, UK, have supplied **RPG** *Abffusor* systems to hire company Hilton Sound and mastering/duplication facility Chop 'Em out.

● Kiva studios, Memphis, TN, USA, have added a new suite designed by studio acoustician **Tom Hidley**. As part of the upgrade, the room features an **SSL** 56-input *SL 4000* series with *G* computer.

● The Sultanate of Oman have taken delivery of two OB vehicles constructed by **Sony Broadcast & Communications**, Basingstoke, UK. The basic design of the trucks was created on SBC's 3-dimensional CAD system. The contract came through Sony's associate in the Sultanate, Al-Yousef International Enterprises.

● Sky TV have bought an 8-channel *SoundStation II* disk based multichannel audio editing and production system from DAR distributor SSE Marketing. Sky will be using the *SoundStation* for general audio post-production work.

● Saunders and Gordon have recently opened a fifth studio at their West End, London, UK, location. Stirling Audio Systems have supplied the equipment, which includes an **Amek** *Mozart* desk, **AMS** *AudioFile* and **Otari** *MTR90*.

● DD Sound Design, Vienna, are using five **Audio Kinetics** *ES.Lock 1.11s* synchronising **Sony** U-matic and National Panasonic *M2* format video machines, two Studer *A807* 2-track audio machines and a chain of five **Albrecht** *MB51* film dubbing machines, all in the edit suite.

Neve *VR 72* mixing desk at Eel Pie Studios, UK, with owner

● **Amek** have sold a 48-input *Classic* mixing console to 021 Television, the independent outside Broadcast company subsidiary of Central Television in Birmingham. Amek have also sold three *BCII* mixing consoles to NBC, to be used as principal edit suite mixers at their Burbank facilities.

● A **Neve** *VR 72* mixing desk complete with *Instant Recall* facility and *Flying Faders* automation has now been installed at Eel Pie Studios, Twickenham, the studio owned by Who guitarist Pete Townshend.

● Clive Green and Co, UK, have recently exported two **Cadac** *E*-type audio consoles for *Phantom of the Opera* productions in Sweden and Canada. Gerr Electro Acoustics, distributors for Cadac in Canada, supplied the *E*-type for the Toronto production. Tal & Ton supplied the *E*-type to the Oscars Theatre in Stockholm.

● An order has been received from Norwegian Broadcasters NRK for a further **AMS** Virtual Console System. Worldwide *AudioFile* sales include a second unit for Waves Sound Recorders in Los Angeles, USA; Radio France; Auditel post-production studios in Paris, France; Estudios Abaira, an audio for video production company in Madrid, Spain; Atanor Videocentro, Madrid; TVE (Spanish State TV), Madrid; Kash Productions Digital editing studios, Madrid, for in-house CD mastering. Kash are also *AudioFile* distributors in Spain.

● Recent contracts for the **Soundtracs** *In-Line* series consoles include Radio 2MMM-FM, Sydney, Australia; Song Bird Studio, Kumamoto City, Japan; and the Singapore Broadcast Corporation.

● **Trident Audio**, USA, have recently taken an order for three of their new *Vector 432* consoles from the Nashville Network, a division of Gaylord Broadcasting. A 64-input *Vector 432* will replace a Soundcraft console in the Nashville Now studio at TNN, for live broadcast of the prime time television series *Nashville Now*.

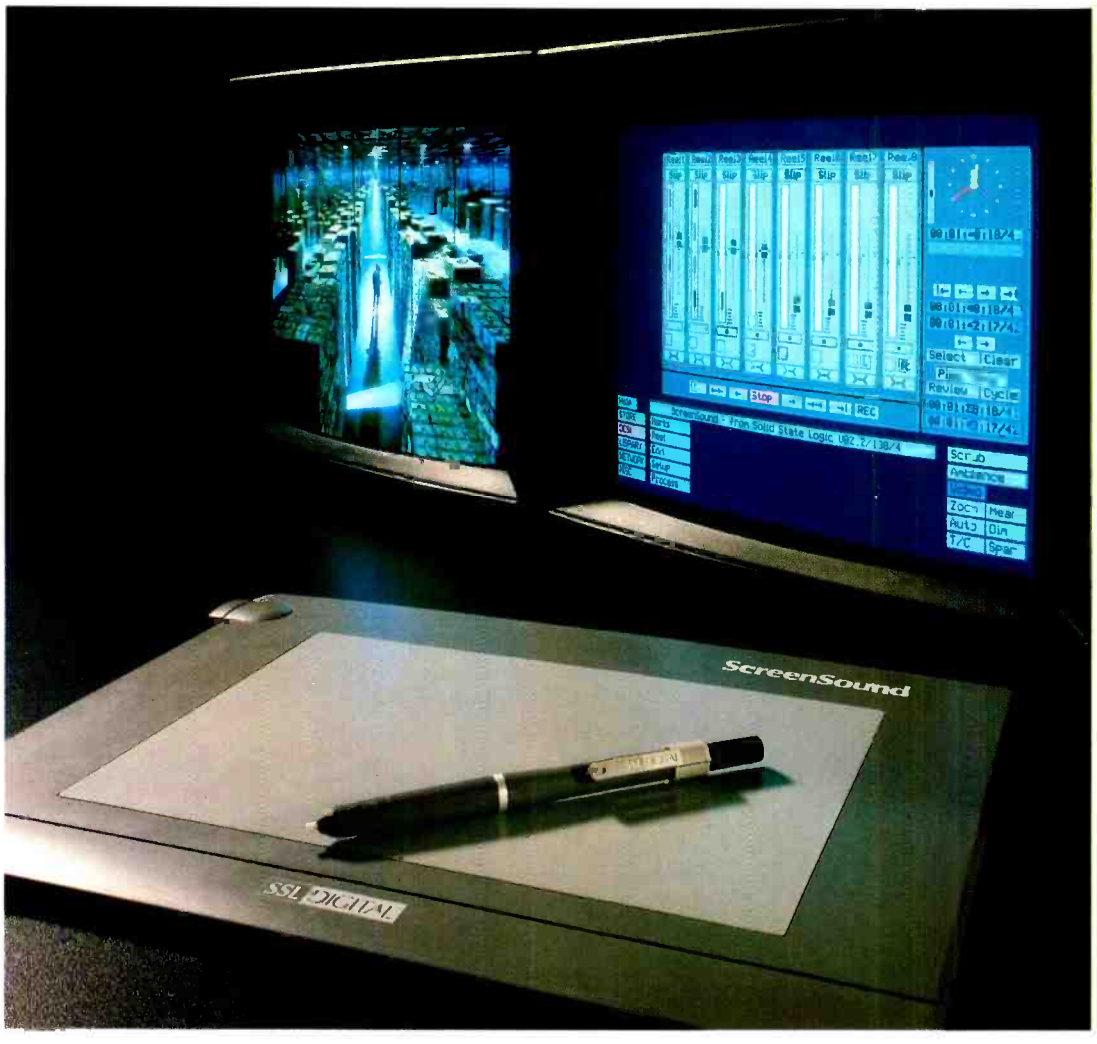
● Recent sales for the **Mitsubishi Pro-Audio Group** include a further two *X-850*s to Metropolis Studios, Chiswick, UK; an *X-880* at Virgin's Townhouse Studios, UK; and *X-880*'s at Kirios Studios, Madrid, Spain; Jet Studios, Brussels, Belgium; and Medicina studios, Milan, Italy.

● Scottish TV have become one of the first independent television customers for **DAR** following their purchase of a 16-channel *SoundStation II* with *WordFit* dialogue synchronisation and replacement software with erasable, optical disk back-up option.

● John Storyk together with Ed Montgomery have designed and built **Context Music**, a six-room rehearsal/recording facility on Manhattan's Lower East side. Storyk's design had to convert an empty 5000 ft² warehouse loft to create the facility.

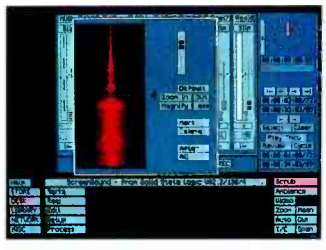
● A **Neve** *VR60* console with *Flying Faders* automation has been installed in BMG Studios, formerly RCA studios, in New York. BMG is now one of the largest studios in the Northeast United States, with 40 engineers on staff, six recording studios, nine digital tape mastering suites, two digital mastering suites, and a Soundstream digital editing system.

ScreenSound. A fully integrated audio for video editing suite



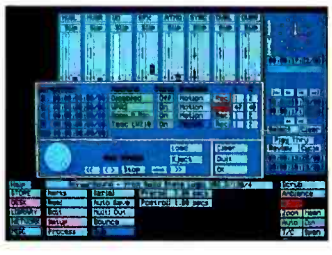
AUDIO STORE
The hard disk store of sound clips gives title and duration, in addition to powerful search and sort routines.

SCRUB EDITOR
Provides accurate edit marking and scrub of audio waveform.



OPTICAL LIBRARY
An off-line library of sound clips and effects can be compiled on a Write Once Read Many (WORM) optical disc.

MACHINE CONTROL
For control of multiple VTRs, laserdisc or film reproducers.



Post production facilities need to take advantage of the efficiency offered by today's technology. Speed and creative flexibility are essential to commercial success. Digital sound quality is no longer a luxury.

ScreenSound is a fully integrated audio for video editing suite. It combines digital audio storage and editing with machine control of multiple VTRs, Laserdisc or film reproducers. It also interfaces with Quantel's digital video editor, Harry.

Simple to learn and fast to use, a cordless pen, tablet and RGB monitor provide control of all ScreenSound functions.

Multiple sound reels enable music, dialogue and effects to be laid back to picture and synchronised to the exact video frame.

Edit, review, time offset, track slipping, cross fades and many other production techniques are available at the touch of a pen. Gain and stereo pan controls can be automated to timecode.

AES/EBU interfacing keeps digital audio transfers free of analogue distortions and losses, preserving the highest audio integrity through to the final format.

Above all, ScreenSound is a dedicated system - purpose-built to bring the advantages of hard disk sound manipulation to audio post production.

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Solid State Logic

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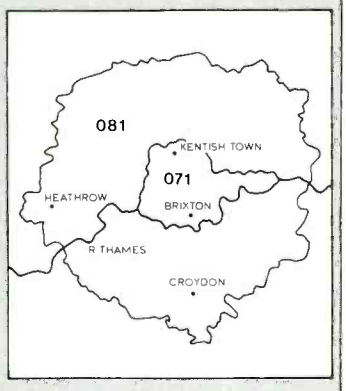
London (01) 706 4948 • **Paris** (1) 34 60 46 66 • **Milan** (2) 612 17 20 • **New York** (212) 315 1111 • **Los Angeles** (213) 463 4444
• **Toronto** (416) 363 0101 • **Tokyo** (03) 5474 1144

New London telephone codes

As from May 6th, 1990, the 01 area code used for dialling a London number is being split into two codes for two new areas (see map). The new number for *Studio Sound* will be 081-686 2599 if you're outside London or in the 071 area. From overseas the number will be +44-81-686 2599.



The Tapeless Directory

SYPHA, an independent consultancy specialising in tapeless recording systems, have recently completed The Tapeless Directory, which covers the tapeless digital audio recording/editing systems now available.

The aim of the Directory is to provide a one-stop source of information on all available systems, as well as those planned for release during this year. In addition the Directory provides background information on the technology and explains the terminology associated with these products.

The Tapeless Directory is available for £25 (add £2 post and package outside the UK) from **SYPHA, 216A Gipsy Road, London SE27 9RB, UK. Tel: 01-761 1042.**

In-brief

● Bracknell, UK: **3M** (UK) have been awarded the British Quality Award for their entire UK operation. Apparently this is the first time such an award has been presented to a company as a whole.

● London, UK: **Hilton Sound**, the European pro-audio rental company, have introduced a new post-production service to support their studio and video facility customers. The 'Elephant Suite' is an empty acoustically treated shell in which the company's rental customers can configure different products and systems.

● Gerrards Cross, UK: **British Forces Broadcasting Service** (BFBS) have opened a second English-language radio service, BFBS-2, for Forces listeners and their dependants in Germany. The new channel is expected to reach about 65% of the forces audience in Germany.

● Middlesex, UK: **Inovonics Inc**, based in Santa Cruz, CA, USA, manufacturer of audio processing equipment and stereo generators, have announced the opening of a London-based office to serve and support the needs of existing customers and dealers. Inovonics Europe Ltd, Unit 40, Sheraton Business Centre, 26/28 Wadsworth Road, Perivale, Middx UB6 7JD. Tel: 01-991 9152.

● Hammersmith, London: **Tapeworm** have recently opened a cassette duplication studio. The studio will specialise in duplicating from ¼ inch, DAT, and Betamax to cassettes. Tel: 01-741 3946.

● Panama, Central America: **IDB Broadcast** downlinked video feeds for NBC, ABC and CBS for their coverage of the US invasion of Panama. IDB also recently transmitted a remote broadcast from the Berlin Wall for radio station KOOL-Phoenix.

● Manchester, UK: BBC Manchester have recently used an **AMS** *Soundfield* microphone to record a tennis match for a Radio 3 play, *Joking Apart* by Alan Ayckbourn. A **DAR** *SoundStation* is being used to record and edit the rest of the play.

HIT receivership

As of January 16th, 1990, receivers were called in by the FennoScandia Bank to take over the running of Harrison Information Technology, a leading manufacturer of professional power amplifiers.

The receivers, Levy Gee & Partners, are confident that the company can be saved and sold as a going concern. But at this time it is still unclear about the future of HIT's sister company Novation International.

Audio aid for Romania

One of the problems emerging in Eastern Europe is that, although there is a very high level of technical education, lack of communication with the West has prevented these countries keeping abreast of technological developments. Romania is a case in point with a complete blackout on Western literature imposed by Ceausescu during the past decade leaving the recording and broadcast industries back in the dark ages.

Based in Bucharest, the Radiotelevizuonae Romana broadcasting company for example does not own a single VHS recorder. Radio reporters are working with domestic cassette recorders at least 15 years old. No catalogues, brochures or literature of Western origin have been allowed into the country and therefore they know nothing of the sophisticated equipment available in the West.

The broadcasting media have a crucial role to play in the country's preparations for a free election and they desperately need help in gearing up to cope with this new-found responsibility.

Danmarks Radio has taken an initiative to explore the needs of Romania specifically. They sent head of project design group (audio for radio and television), Dan Popescu, back to his native Romania and his old colleagues at Radiotelevizuonae to compile a report. Having left the country 25 years ago he had no idea what to expect. Although aware that they were desperately poor he was still staggered when on arrival he discovered that systems he installed back in the early '50s were still in use. Radio continuity still operates using Siemens *E80F* and *E80L* valves (tubes) in the audio consoles nearly 40 years on.

Undaunted Popescu requested a copy of a television programme in order to illustrate their needs on his return to Denmark. This was met with "Very sorry, we can't for we do not have a VHS machine."

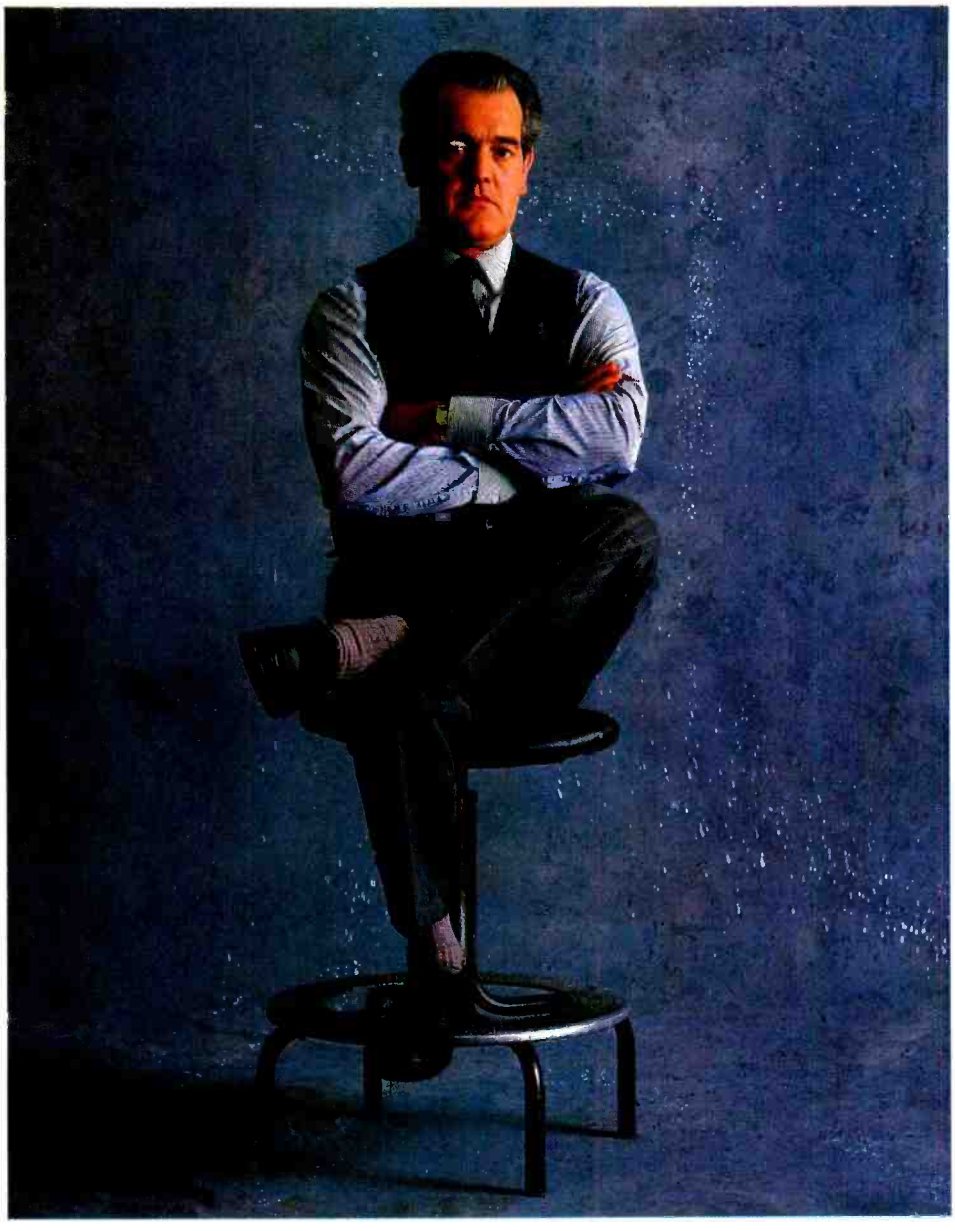
The one television channel for the last 2 or 3 years has been transmitting programmes 2 hours a day, mostly about Ceausescu. So self-obsessed was the dictator that when his age began to show on screen he complained to Radiotelevizuonae. Seizing a rare opportunity they quickly replied how sorry they were but their cameras were very old; if they were to have some money for the latest technology he could look 15 years younger. This brought instant results—three Betacam *SP*s and associated editor.

In addition to the one television channel there are three radio channels and the people do have access to receiver equipment. The novelty of freedom of information and ability to air different political ideas means that the Romanian people need help from the West in order to make the most of it. "Following the very heavy and bloody revolution Romania is preparing for the free election and they need help with radio and television reporting equipment," explained Popescu.

Danmarks Radio has instigated an action to provide assistance and is exploring the possibility of a combined effort from all the Scandinavian broadcasting companies. Manufacturers are already donating equipment—from Studer there have been two *A721* professional cartridge machines, two *A727* professional CD players and a complete Philips sound effects library; Neumann have sent a stereo microphone set and Lexicon a model *200* reverb, Lyrec have also helped out. "But everything is welcome; everyone can send things because these people do not have anything."

Radiotelevizuonae Romana's technical director Nicolae Stanciu may be contacted by telex on 11 251 TVR. If you need further information from Dan Popescu he may be contacted at Danmarks Radio on (31) 67 12 33.

Wild, reckless, exciting?



Because he isn't you can be.

The steely looking character above is 'Sergeant Major' Brian Pyke, Neve's Quality Control Manager. Flamboyant he is not, but when it comes to meticulous attention to detail Brian can't be beaten.

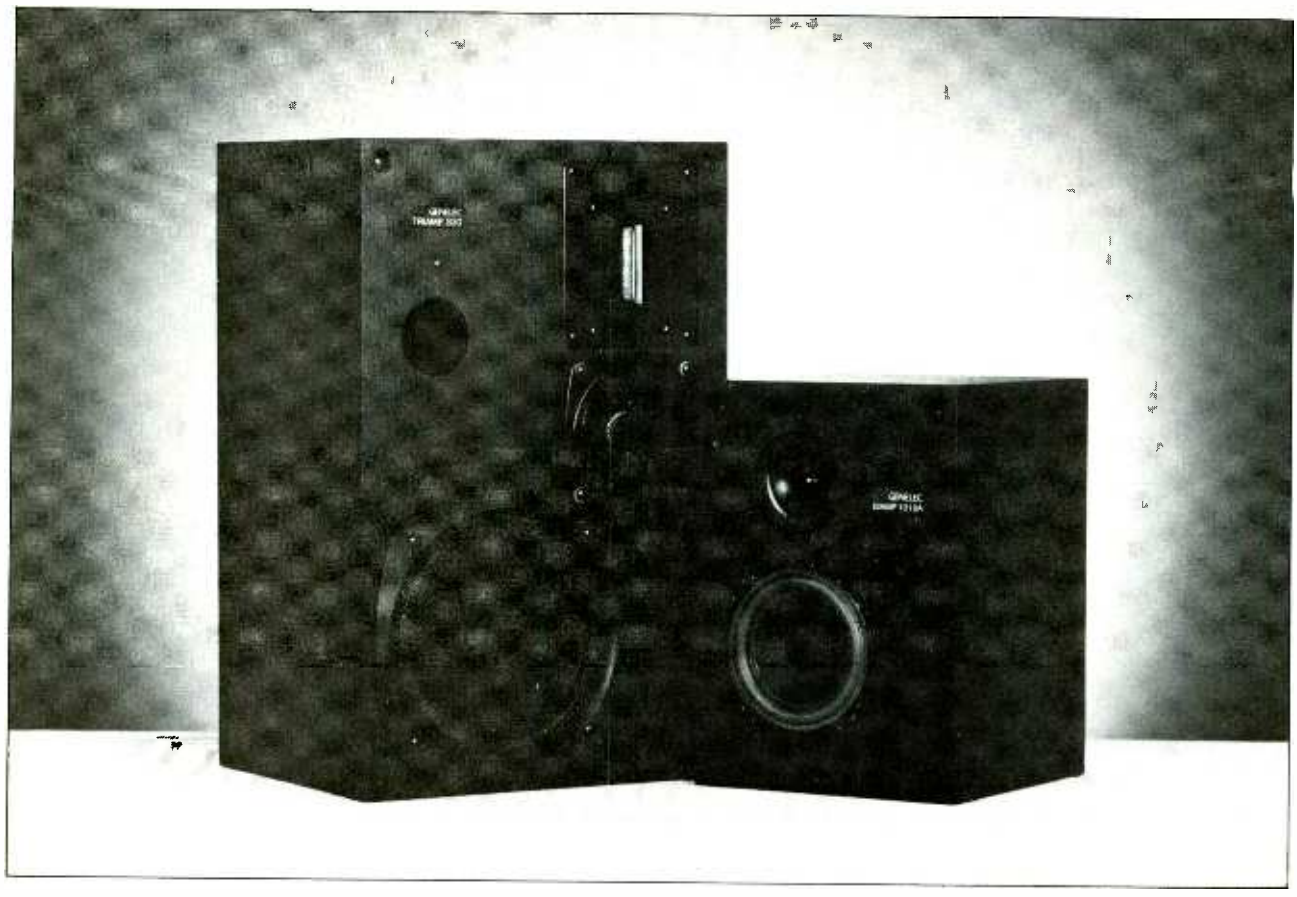
Every Neve console spends over one hundred hours in the company of either Brian or one of his team of 23 diligent scrutineers and some of the most powerful computers available as they test and re-test the sum of 217,000 component parts for performance and reliability.

But when a Neve product leaves Brian's tender care it is not forgotten. To ensure all users enjoy a long and happy life with their console, Neve's ten strong Technical Services Department provides a level of aftersales support unmatched in the industry.

With such loving care lavished on every Neve console, it's hardly surprising that so many are still in daily service after twenty years.

Neve

NEVE ELECTRONICS INTERNATIONAL, A Siemens Company. Cambridge House, Melbourn, Royston, Herts. SG8 6AU. Tel:0763 260776. Fax: 0763 261886. Telex: 81381



FREE FROM ARTIFICIAL COLOUR

Genelec Active Monitoring Systems are from Finland, a land blessed with natural beauty. So it's perhaps no coincidence that Genelec products possess an unrivalled purity, with an un-coloured sound that has set recording and broadcasting standards for over a decade.

Seen above are two speakers from the range. The Biamp 1019 A is ideal for OB-vans, video editing rooms and near-field applications.

It's bigger brother the S30 is perfect as a main monitor for small and medium-sized broadcast, drama and music studios – so too is the highly sought-after near-field version.

There is a Genelec to match the whole range of monitoring applications where pure un-coloured sound is desired.

Ring SSE Marketing for more information or a demonstration.

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Alpha Audio DR-2

Alpha Audio Automation Systems have introduced a 2-track digital hard disk recorder that they say has been designed to be 'no more expensive or difficult to use than an analogue 2-track'. The *DR-2* can record up to 60 min of 16 bit stereo audio at sampling rates of 44.1 kHz or 48 kHz. The unit uses 'tape recorder controls' and no computer interface is required. Dual RS422 serial ports allows direct connection to audio and video editing systems where the *DR-2* emulates a Sony *BVU-800* under serial control. The *DR-2* offers subframe-accurate jog and shuttle emulation with crossfade capabilities and one-key location logging.

The *DR-2* is housed in a 3U, 19 inch rack enclosure and the basic model stores 15 min of stereo audio with options for 30 and 60 min versions with the ability to operate in mono mode with double playing time. Further options will include digital I/O and low-cost remote for standalone use.

Alpha Audio Automation Systems, 2049 West Broad Street, Richmond, VA 23220, USA. Tel: (804) 358-3852.

UK: Stirling Audio, Kimberley Road, London NW6 7SF. Tel: 01-624 6000.

Digital Audio Desktop Recording Board

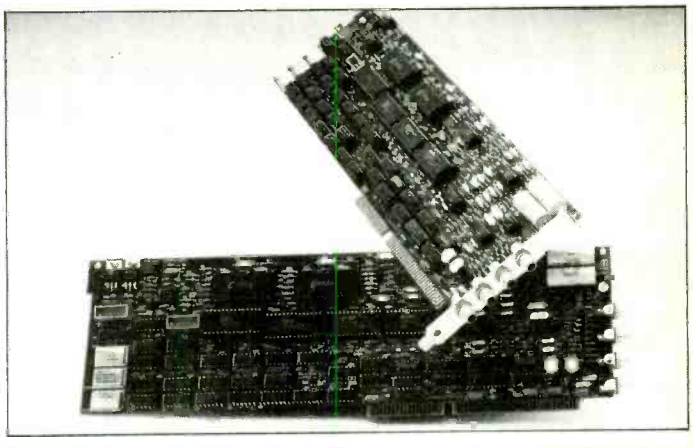
The *Desktop Recording Board* for *AT* or compatible computers provides pro-quality digital audio with selectable sampling rates of 32, 44.1 and 48 kHz and has an input for external clock. The audio data is also available on a serial data bus.

Recording is 2-channel with 2x oversampling, 16 bit resolution, linear phase analogue anti-aliasing filters and digital post-conversion filters. Playback is 2-channel simultaneous 8x oversampling with 18 bit resolution, output digital filters and linear phase analogue filters.

A C-language software toolkit is also provided.

Digital Audio Labs, 6311 Wayzata Boulevard, Suite 330, St Louis Park, MN 55416, USA. Tel: (612) 559-6104.

SSE Marketing, London, UK. Tel: 01-387 1262.



Letter: DAT's the difference

Dear Sir, First let me congratulate Sam Wise on his very thorough and detailed review of the Technics *SV-260* DAT. It is good to read a review where the reviewer has such high level and balanced skills. All too often the reviewer's technical expertise outweighs practical applications knowledge and a product review can end up misleading the reader.

Thank you also for the Editor's note on page 67 and your attempt at qualifying the differences between the Panasonic and Technics branded machines. However, I would like to take this opportunity to clarify the various differences and model numbers of the Panasonic/Technics DATs available now and in the past.

The original portable DAT introduced under the Technics brand was known as the *SV-MD1*. This was a consumer-targeted product where size was considered of primary importance, probably because of the portable cassette 'smaller is better' contest, in the consumer market.

Because of the potential performance benefits inherent in the DAT format, Panasonic began working on a 'Pro' version of the *SV-MD1*. The first professional version was known as the Panasonic *SV-250* or outside the US as the Technics *SV-260*. This is the machine reviewed in your January 1990 issue.

We felt that there was a considerable amount of potential as yet unrealised in the first version and proceeded to redesign the piece—particularly the mic/line pre-amp section. The mic pre-amps are now averaging 128 dB (plus) EIN—a significant improvement. Crosstalk, grounding, shielding and gain scaling were all considered upgraded. With the lowering of the EIN, certain other system noises were 'uncovered' forcing further review of such as the DC to DC converters, internal grounding and shielding, etc.

Another area that needed redesign was the gain/trim range of the pre-amps.

The *SV-250/260* and the 'Pro' version of the 'other' company's portable DAT all exhibit gaps in their trim range, forcing users to choose between clip-or-higher noise levels when faced with source levels of approximately −20 dB to −8 dB. Selecting between mic and line on these machines, also presents an impedance change to the microphone that results in a change in sound quality.

The noise contribution of the pre-amp in a system is related to system noise and gain structure. Pre-amps should not contribute noise to tape throughout the normal operating range.

A gain range of −70 dB to +24 dB was chosen as suiting the overwhelming majority of applications.

Overlapping the mic/line transition by 10 dB+ is desirable for ease of set up and use.

The outcome of the redesign effort has been very satisfactory. The noise, RFI, CMRR, gain range, grounding, and most importantly the sonic performance are much improved.

The Panasonic/Technics units all feature MASH A to D converters, that direct and indirect advantages of these Delta-Sigma type converters over conventional A-Ds are significant.

The sampling rate is effectively 64 times oversampling or 3.072 MHz. This allows the use of 'gentle' third order lowpass filter slopes. The resultant phase and frequency response offers improved sonic and measured performance. MASH also gives lower distortion and improved linearity.

The revised unit is marketed in the US as the Panasonic *SV-255* and in the rest of the world as the Technics *SV-260-A*. Note the 'A'.

Thank you again for this opportunity to comment. I hope this clarifies any misunderstandings that the choice of model numbers may have caused.

Steve Woolley, Panasonic Communications & Systems, 655 Kalella Avenue, Cypress, CA 90630, USA.

Lester Audio Fibre Optic

Lester Audio Laboratories have introduced a multichannel fibre optic transmission system with a soft patching ability. The *DAS-1016* can transmit 16 channels at 16 bit 48 kHz digital audio via a thin fibre optic cable at a transmission frequency of 20 MHz over a maximum fibre length of 3,000 feet. The system contains A/D and D/A converters together with mic inputs and is set for zero insertion loss with a selection of input and output levels. The soft patch system allows connection between inputs and outputs as well as multiplication of channels.

All controls are housed in a 19 inch rack chassis including the button controlled soft patch system and LCD display. There are 64 resident patch memories with battery back-up and possibilities for future software updates.

Claimed audio specification includes a frequency response of 10 Hz to 20 kHz; crosstalk of −90 dB over the full range; total harmonic distortion less than 0.05% and noise less than 0.03% independent of the cable length.

Lester Audio Laboratories, 1122 Windomere Avenue, Dallas, TX 75208, USA. Tel: (214) 946-8900. Fax: (214) 941-8800.

In brief

• **3M** have introduced *41A* general purpose splicing tape for quick temporary editing applications. The *41A* features an improved and easily tearable 1.50 mil acetate base film that is suited to making quick edits that will be transferred or copied for more permanent storage. Adhesion is quick but lifting of splices for remaking or moving edits is described as easy.

• **Thatched Cottage Audio** are manufacturing 2 Mbyte memory expansion cards for the Akai *S1000* and ¾ Mbyte cards for the *S950*. As each *S950* is capable of taking an extra two cards, this gives a possibility of 2¼ Mbyte memory in total. Thatched Cottage Audio. Tel: 0223 207979.

Dolby switchable SR/A units

Dolby have introduced two new noise reduction processing systems both of which offer switchable Dolby *SR* or *A*-type processing as well as rapid auto-alignment. Software controls all alignment and assignment functions with digital gain controllers with a resolution of over 0.1 dB over a wide range. Separate calibration settings can be stored for standard in-house alignment and temporary settings for incoming tapes. A hard bypass facility is available to override all software control.

The *MT* series switchable multitrack unit provides up to 24 channels in a 7U frame. All 24 tracks can be aligned for record and play in seven seconds with four keystrokes on the control unit. There is also provision for realigning nominated channels without affecting the remainder. The signal connections are the same as for the *XP/SP* series and requires no rewiring. The *400* series uses similar circuitry to the *MT* series but offers an alternative for facilities requiring up to eight processing channels. The unit is 1U high and can address up to four 2-channel frames.

Dolby Labs Inc, 100 Potrero Avenue, San Francisco, CA 94103-4813, USA. Tel: (415) 558-0200.

Dolby Labs, 346 Clapham Road, London SW9 9AP, UK. Tel: 01-720 1111.

High power FM

FM Acoustics have announced the *FM 1000-1* single-channel high power amplifier—the successor to the established *FM 1000*. They claim that this amplifier will drive any known loudspeaker to top performance. The design philosophy uses an internal computer that constantly surveys the operational stages of the amplifier, with sensors for all important parameters. These are analysed in realtime and if anything exceeds the safe limits the output of the amplifier is instantly disconnected, a red indicator illuminates and the mains light flashes. The internal computer keeps measuring parameters 20 times/sec and when conditions reach normal, switch back on. FM Acoustics say this type of protection method eliminates any negative effects on the audio signal. The amplifier is described as capable of driving loads below 1 Ω, supplying peak power levels of up to 2500 WRMS with corresponding peak output currents in excess of 100 A.

FM Acoustics Ltd, Tiefenhofstrasse 17, CH-8820 Wadenswil, Switzerland. Tel: 1 780 64 44.

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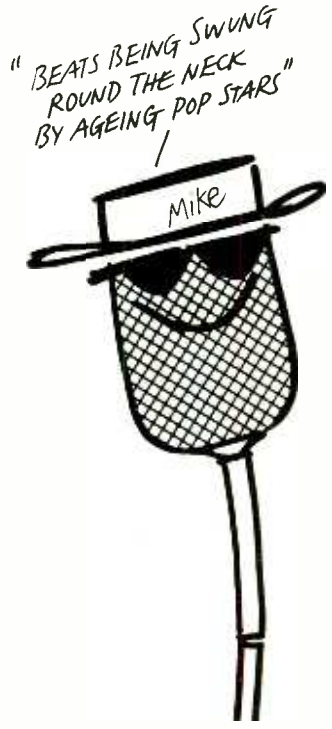
And we think you'll be delighted to hear from us.



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Soundtracs PC Midi 24/16/2	£3,995
MCI 500B JH50 auto	£12,500
Soundtracs CMX 32	£12,000
Soundtracs Trackmix	£5,000
Soundtracs CP6800 32/12/24	£16,000
Soundtracs MRX 24/8/16 patchbay	£5,250
Soundtracs FME 16/4/8/2	£1,995
Soundtracs 'T' 20/4/2	£1,395
Soundcraft TS24 28 patchbay	£12,900
Soundcraft 200B 8/4/8/2 new	£1,195
Soundcraft 200 16/4/8/2 fc	£1,395
Soundcraft 800B 32/8/2 FOH in fc	£6,995
Studiomaster II 32/16/2	£2,750
DDA AMR 36	£25,000
TAC Matchless 26 patchbay	£8,500
TAC Scorpion L (No.19) 32/16	£4,500
AHB CMC 16 inc computer	£1,150
AHB CMC 24 inc. computer	£1,700
AHB System 8 12/8/2	£600
Cadac 28/24	£12,000
Harrison MR4 32.36F + Mastermix	£24,000
SECK 12/8/2	£695
SECK 18/8/2	£800

Recorders

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WINDINGS

This residential 24-track studio sits in a Welsh valley above disused coal mine workings. Mike Lethby reports

The corner of Wales bordered by the Dee estuary to the north, the Cheshire plain in the east and the rolling countryside around Wrexham is a classic story of industrial decline and renaissance.

The site chosen by Max and Elizabeth Rooks, Rob Jones and Glenys Griffiths for their new 24-track residential recording facility is uncannily appropriate. The Windings, in a beautiful valley a few miles north of Wrexham, sits on top of a labyrinth of mine workings in what was once the heart of Wales's industrial revolution.

Beginnings

Jones and Max Rooks came together through an appropriately musical coincidence.

Rooks: "We'd both been playing in bands since we were, respectively, 10 and 12 years old. Both bands—they were rivals in North Wales—decided to call it a day at exactly the same time. Rob was drummer in the other band and I'd known him on and off for about 10 years.

"When the bands split, my lead guitarist, Rob and I got a three-piece together. We did some recording and really hit the business in 1981. Then Rob and I got into the audio side; we started with the usual 4-track Teac; then an 8-track and a 16-track.

"But I always had this personal ambition to have a place in the country and when Elizabeth, my wife, came into the scenario she had similar ideas. So while Rob and I were developing our 8-track in 1982, Elizabeth went out to look for a property. It took her 2 years, by which time we'd opened up a commercial 16-track facility—above Rob's travel agency business in Wrexham—called RPM.

"We wanted a big house with outbuildings, in any condition, with a lot of acreage; green fields, trees, the whole thing. And that's exactly what she found.

"One of the first things I did when we got this property was to walk round singing, which was very disconcerting for Elizabeth—but she'd told me 'you must see this place!' We'd seen zillions—the struggle we had to get this property.

"Our ambition was to go right in at the top end with a residential 24-track facility for professional artists. Twenty-four-track, of course, is a totally different concept from 16; we learned that very quickly. It was always meant to be a kind of musical hotel because we'd recorded at places many times where we'd had to stay in hotels, which just wasn't conducive to creating an atmosphere.

"Eventually it won't just be a studio, but a place to record and have a holiday. The best combined residential, musical, travel and financial facility in the north west..."

Building a dream

Rooks: "It took us 2 years to get planning permission, because the local authority were so delighted to talk about recording studios that we had meeting after meeting after meeting. But that's OK: they loved it. A recording studio! They're having so many meetings about us it's unbelievable. We finally started building in October 1988 and it took us slightly more than a year to build.

"And as for the locals—we've brought a lot of business to the Red Lion pub: 'Excuse me, I don't know if I'm in the right valley but I'm looking for a recording studio...'"

Elizabeth Rooks chips in with some history. "The valley used to be an industrial site, though you wouldn't know it now. Until 1904 there were mine workings here with over 200 men working underground, hence the name 'The Windings'. Now, though, there's a rebirth around us with Chester industrial park and lots of things happening on the North Wales coast. It's not a parochial environment; people are well into the tune of what's going on in the world. They have a goal and want to make it happen."

Max Rooks: "We already have established businesses, which obviously influences what we do here. And it's an investment for me as well as a labour of love. But we wanted to live in the country; it was part of the dream, the concept. Financing the equipment was more difficult, because the market's in a trough, and it may not have bottomed out yet because of a myriad of things that are affecting the music business.

"I'm an optimist because I see a trend back towards integrity. We've had a swing to making records by computers, and now there's a move back to natural sounds; I expect bands will be setting up out here in the valley, on the lawn. Pete Coleman, the engineer, has been out recording the valley, and it has got an ambience you can hear, a natural delay."

How resonant is my valley?

Rooks explained the design of the studio—formerly a barn—and their determination to retain its natural acoustics. ▷

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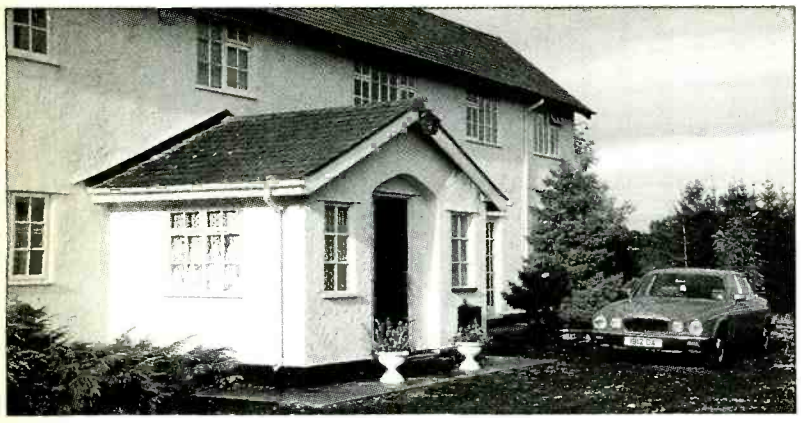


◁ "We have a very good relationship with Jeremy Lewis, from Amazon Studios in Liverpool, who helped design our studio. Jerry's talented as a studio designer because although studio design still isn't an exact science, he came here with Roger Quested and Andy Munro experiences in his mind, sat down with Michael Balle, the architect from Chester and made it work.

"I've known Jeremy for 15 years. I was one of the first guys to sing in his 24-track studio in the '70s. He's always been a source of good advice to me."

Even as potential competition?

"Yeah; he's accepted the fact that we're here; but then again we're not really in competition because we're residential.

"I started by asking his advice on who should design the studio. And eventually he said 'I could do it for you', so we asked him for his services.

"The first time he came over he said 'it's got a great sound'. I said 'yes, and you're the man for the job'—because I knew the place itself was an acoustic dream. Jerry didn't complicate things; we both liked the natural sound of the barn and he kept it simple and acoustically honest.

"I've been out in the valley in the summer and there must be every conceivable bird on the planet. You hear them as if they're bouncing off some sort of acoustic spectrum here. It's gorgeous."

What was the architect's contribution to all this?

"Well, I was flabbergasted when the architect who designed the basic building told me he was the grandson of a Hungarian baron who'd lost his property to the Germans, so he's got blue blood in his veins.

"But I digress. . .he designed it to have its own ambience. This was his first studio job. But he quickly developed his experience as we got into the project, because he has a good ear for music himself.

"With the advice we had from the experts, including Roger Quested and Andy Munro, we knew this wasn't a complex idea; we had a good sound already and when you walked in and sang it sounded good. It was immediate. That's how a very experienced engineer who's worked at Rockfield and with Pink Floyd, put it: 'this sounds immediate—it's right there'."

Thus the rebuilt barn houses a studio and control room which retain the original internal shape and space. A 'skin within a skin' outside of which, Rooks says, "you wouldn't hear Motorhead or Iron Maiden". It also isolates sensitive clients from the occasional training sortie by RAF jets over the valley.

Rooks laughs: "If someone's recording on the lawn they might have to wait a few moments. But you can't hear a whisper inside."

Choosing the hardware

The Windings control room reflects its primary function as a high quality track laying facility. At the centre is a 32-channel Amek *Mozart* console, recording to a Studer *A820* with Dolby *SR*. Main monitors are Westlake *BBSM-12*s, while the outboard line-up is more or less any engineer's standard 'wish list'. There's also a comprehensive array of mics and MIDI keyboards, the latter being a natural complement to Amek's Steinberg-

based automation system.

Most of the hardware was supplied by Britannia Row Sales in London. Jones explains why. "I only rang them to ask about a multitrack and I ended up with a whole studio system. They offered us a complete package, a lot of help—and they wouldn't take 'no' for an answer.

"We knew roughly what we'd like ourselves and listened to advice on the essential pieces of equipment, especially the desk and the multitrack. When you're starting with a scenario of 'what shall we get for our studio?', there's tremendous scope: speakers, desks, effects, etc.

"We needed that personal contact when we started up because if we had any technical problems we were able to get straight through to Britannia Row for support. Their service has been totally professional, a great help in getting the studio running so well so quickly.

"Many opinions besides Britannia Row's pointed us towards *BBSM-12*s. And I haven't heard a single criticism of the system; a lot of people have tested the system and everyone's said the Westlakes sound great, they're totally amazed with the honesty of it. I'd defy anyone to say what is the right system for any particular place but as soon as we switched it on we said 'that's fabulous'. I'm used to Tannoys, I like them, but these are perfect for this room.

"Likewise, we wanted a desk that would honestly record the room and the environment. We originally had a DDA *AMR24* in mind but while we were negotiating finances the *Mozart* became available. We looked at it and thought, 'that's the desk for the '90s', and I still believe that's the case.

"We listened to both desks and felt they were equally 'the business' sonically but that the *Mozart* offered amazing technology for the '90s. With the automation system, I think it'll be a very commercial desk from an artist's point of view and I get the same reaction from engineers. I don't want it to be in every 24-track studio in the world—but I do love it.

"Amek have stuck their necks out somewhat; it isn't the easiest of desks to work on simply because they've tried to anticipate what facilities will be required in the '90s. It has facilities that aren't even available on an SSL. I've taken engineers who work with SSLs onto it and they say 'does it do that? That's amazing!'

"What they like most is the EQ. And the automation is superb. Steinberg is commonly perceived as a bedroom-type product but nevertheless they've produced something that does more than an SSL in many respects. And now Amek have their own system, I think it's unbeatable. We'll be going for full automation very soon."

The choice of Studer and Dolby *SR* derived, again with Britannia Row's advice, from the owners' gut feeling that they made a very effective combination for a facility geared towards clean natural sound.

Jones: "At least half the industry finds analogue and *SR* at 15 in/s preferable to digital—an honest appraisal of what's being recorded. I've experienced digital recording and mastering myself, which had the accuracy but not the feel; I felt it lost something and to me that immediately started warning signs. Analogue might add a touch of noise but it makes it warm.

Resident competitors

The UK residential recording market is already well served. But both Rooks and Jones are calmly realistic and optimistic about their chances of success.

Geography is one factor: if it's isolation you're after a secluded Welsh valley (albeit just an hour from Birmingham or Manchester) takes some beating. The unique acoustic environment should bring plenty of repeat business too.

Rooks: "Apart from the suicidal business of rate cutting, it's a people business—you have to relate to your clients in the way you provide a service. It depends on our talents, our integrity and our willingness to work hard. And we're all in tune with those things."□

The Windings, Ffrwd Valley, Wrexham, Clwyd LL12 9TH, UK. Tel: 0978 758211.

AES PREVIEW

The 88th Convention of the Audio Engineering Society will be held at the Centre des Congrès, Montreux, Switzerland March 13th to 16th, 1990. As usual the Convention will consist of a wide range of technical papers with an associated exhibition. We have compiled this preview from details available to us at the time of writing.

Studio Sound will be exhibiting on stand B-8 where you will find the latest issue together with sister publications *Broadcast Systems International, Live Sound International* and *One To One*. Editorial and advertising staff will be in attendance at the stand or around the Convention and we look forward to meeting anyone who wishes to drop by.

A

● **AB Systems:** no information received. ● **AD Systeme:** no information received. ● **Adams-Smith:** synchronising products and software updates. ● **ADT:** no information received. ● **Adyton:** featuring their range of sound reinforcement systems including power amplifiers, audio processors and controlled directive loudspeaker equipment. ● **AEG Olympia:** range of analogue tape machines as well as peripheral equipment. ● **AEQ:** range of mixing consoles and ancillary equipment. ● **Agfa:** audio, video and duplicating tape and cassette products. ● **Akai:** featuring European debut of the *DD1000* magneto optical disk recorder/editor. The *DD1000* offers stereo recording of up to 50 mins at a maximum of 48 kHz. 4-track playback is also featured making the *DD1000* suitable for audio-visual applications. Also featured will be the *DL1000* a remote controller for the *DD1000*. ● **AKG:** full range of products including microphones, headphones, reverb units and signal processing equipment. ● **Alcatel:** exhibiting the radio and TV studio intercom systems *ODICOM* and *ODINET* and recently launched software package OCU for PC control of the routing system *ODILOG*. ● **Alphaton:** full range of transformers and transformer-based products. ● **Altec Lansing:** full range of sound-reinforcement products. ● **Amix-Etelac:** no information received. ● **Ampex:** exhibiting their full range of audio tapes including *456* Grand Master, *467* digital open reel and the *467* DAT products. ● **ANT:** ANT Nachrichtentechnik, now Bosch Telecom, will display the full range of telcom *C4* noise reduction units for use with analogue and digital recorders. The new *Soundwich* PA loudspeakers and the *Petra* CAAD program will also be shown. ● **Apex:** exhibiting the Rotoscreen Printer capable of printing on audio, video or R-DAT cassettes as well as floppy disks. Also featured will be the *CA-15* Semi-Automatic Cassette Printer with ultraviolet drying system. The *CA-15* now offers increased speed, with a production capability of up to 55 parts per minute. ● **APRS:** Association of Professional Recording Studios. ● **ArSonic:** signal processing products and mic and power amps. ● **Ashly:** wide range of signal processing equipment and power amplifiers. ● **ATB:** details of their audio and video cassette components for the duplicating industry. ● **Audio Developments:** portable mixers, portable processors and a digitally based editing system. ● **Audio Digital:** range of audio delay lines. ● **Audiomatic:** Concept Design products including DAAD solid state duplication master. ● **Audiopak:** featuring their range of broadcast tape cartridges. ● **Audio Performance:** no information received. ● **Audio Precision:** featuring the *System One* audio test set. ● **Audioscope:** featuring model *9000* modular audio measurement set. ● **Audio Technica:** new products include the *AT4462* ENG mixer; the *AT877* shotgun mic; the *AT851a* and *AT841a* boundary mics. Established products include the *AT-MX52* mixer and the *AT-MA50* compact mic mixing amp. ● **Audix:** featuring their range of telephone hybrids using digital signal techniques and consoles.

B

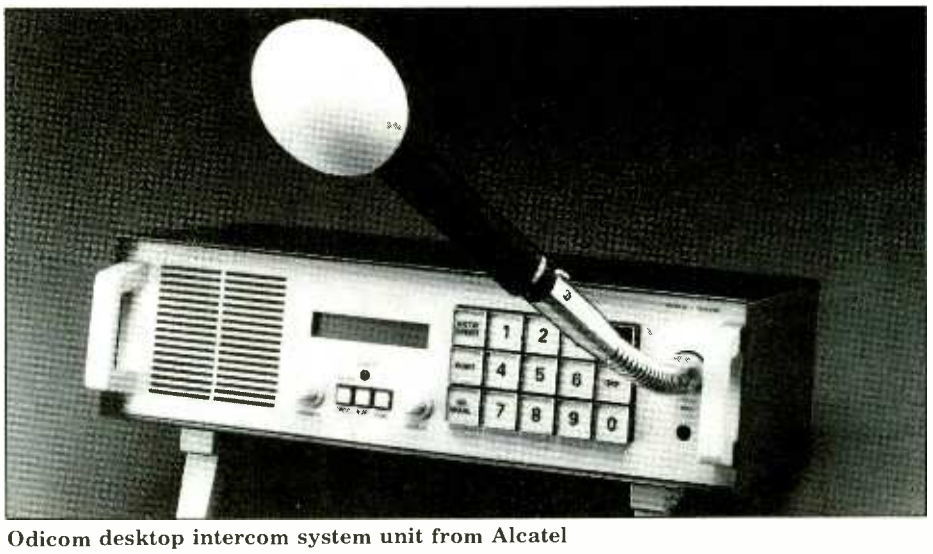
● **Barco-EMT:** featuring the EMT *442* digital PA processor for electronic suppression of feedback disturbances in PA systems; the EMT *246* digital reverb and the EMT *445* delay line; the EMT *266 X* transient limiter; and the EMT *981* professional CD player. ● **BASF:** professional audio and video tapes, cassettes and calibration test tapes. ● **Beyer Dynamic:** wide range of microphones and headphones. ● **BNS:** studio monitor systems including active systems. ● **Broadcast Electronics:** range of cartridge machines; stereo generators; and FM exciters. ● **Bruel & Kjaer:** appearing for the first time at a European AES are the cardioid mic type *4012*, a pre-polarised condenser mic powered from B&K's 2-channel power supply *2812*; the portable R-DAT Recording Set which when launched at AES New York featured the Panasonic *SV-255* portable DAT recorder and two B&K *4006* omnidirectional; and the type *5930* head & torso simulator consisting of a mannequin known as HATS with mathematically describable surfaces replicating the geometry of a medium adult human head and torso. The simulator has specialist applications for binaural recording, subjective testing, ambient recording and sound effect compilation for film and broadcast.

C

● **C-Mix:** no information received. ● **Cabasse:** their range of monitors and speaker systems. ● **Canford Audio:** new products from Canford comprehensive range include the *Alice* radio studio and transmitter switchers and monitoring control units, the MB range of studio microphones, the Time Calculator, and the full range of the TechPro intercom system. ● **Clearcom:** wide range of intercom systems. ● **Concept Design:** products for the cassette duplicator. ● **Crest Audio:** will be showing for the first time in Europe the Gamble series *EX* professional mixing console and their full range of power amplifiers. ● **CST:** products for cassette tape duplication including printers and labellers.

D

● **dbx:** noise reduction and signal processing. ● **DIC:** range of digital audio tape and 8 mm video tape. ● **DigiDesign:** featuring the *Sound Tools* hard disk recorder/editor. ● **Digital Audio Technology:** exhibiting the Stellavox *Stelladat* ▷



Odicom desktop intercom system unit from Alcatel

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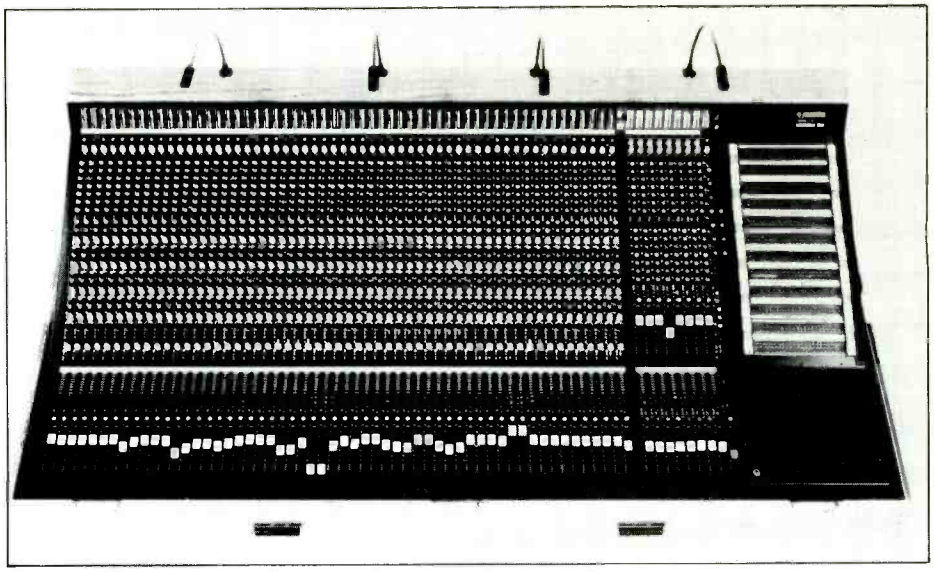


Gamble EX series console to be shown by Crest Audio

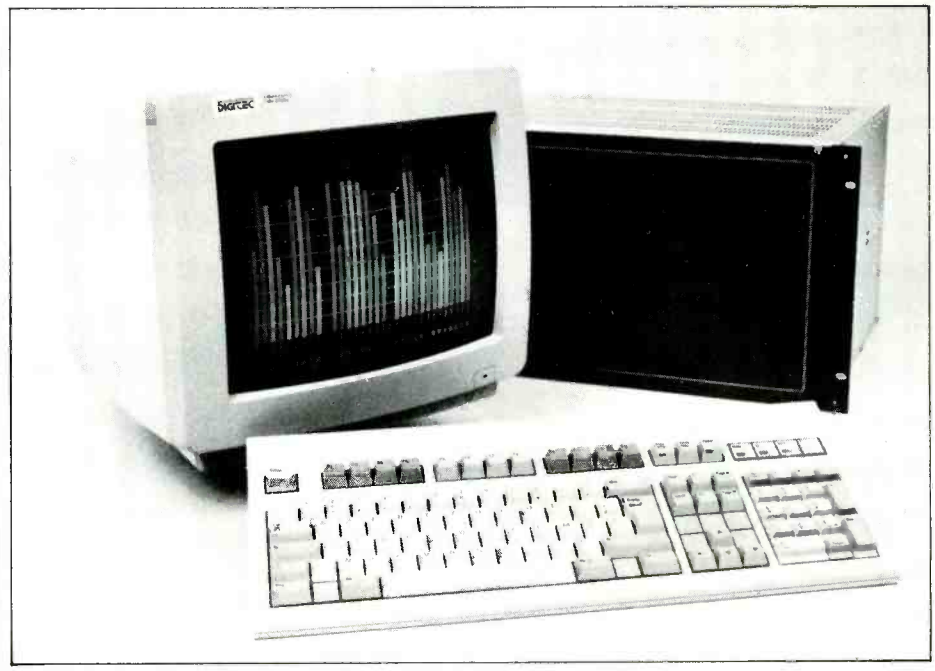
with a workshop demonstration of the *Goldbus*. The *Goldbus* is a new digital measurement interface developed by Stellavox. The new Stellavox *III* timecode synchroniser will also be presented. • **Digitec:** will be exhibiting the *DS-M 1616* AES/EBU switching matrix; the *DS-C2* AD/DA and the *DS-C16* analogue-to-AES/EBU digital and AES/EBU digital-to-analogue converters; the *DS-PPM 32* digital multipeakmeter; the *DS-FC 8* sampling frequency converter. • **DOD Electronics:** range of sound processing products. • **Dolby:** products for music recording, film and TV post-production, cassette duplication and tranmission systems. • **Dorrough:** audio processors for AM, FM stereo, shortwave and TV sound applications. Also featured will be the stereo Signal Test Set Model *1200* offering the ability to measure stereo programme levels in L/R and sum/diff formats.

E

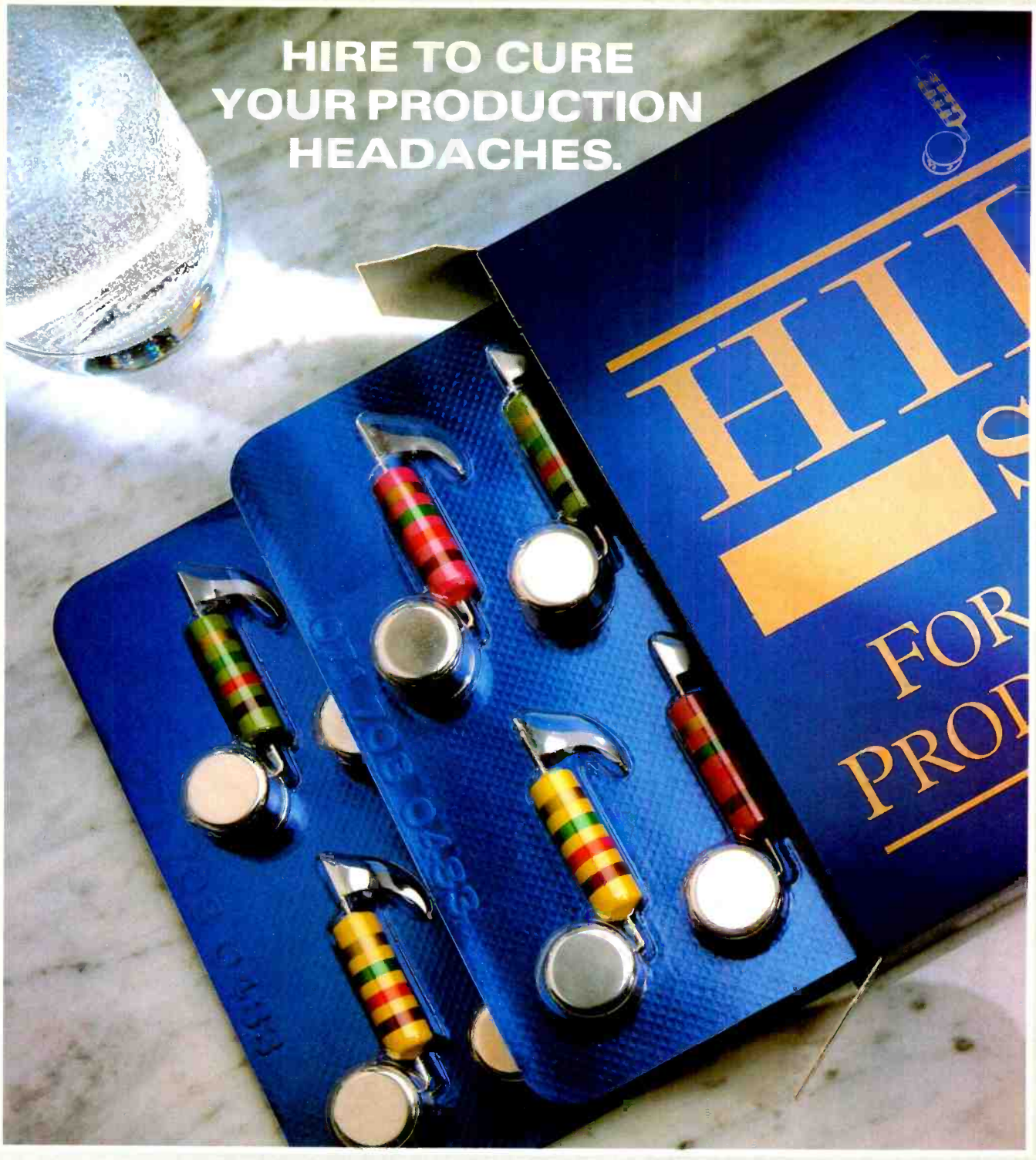
• **Eela Audio:** new products include the new *Reportophone S20-A* with pushbutton dialling and a mix function; and the *Broadcast Control Center S-240*; the *S-90* series has been expanded with a new radio console. Existing products include the *800* series of audio accessories. • **Electro Sound:** range of duplication equipment. • **Electro-Voice:** will be showing their full range of speakers, concert monitors and wireless guitar and vocal systems. • **EMU Systems:** *Emulator Three*

Eela Audio S20A Reportophone

digital sound production system including *EIII*, *HD300* and *EIII RM45* sound storage systems. New products are *EIII* remote controller/librarian ▷



Digitec digital multipeakmeter PPM 32



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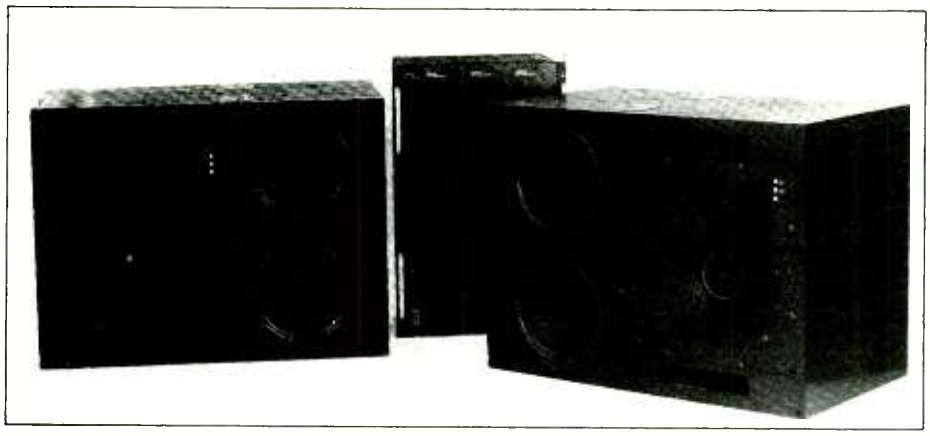
PIONEERS IN AUDIO ACCESSIBLITY



Genelec 1034A active monitor range

◁ for the *Macintosh* computer and *EMAX II* digital sound system. • **Estemac Electronic:** no information received. • **Estudios Gema:** no information received. • **Eventide:** full range of sound processing products including the *H3000* and *H3000B UltraHarmonizers.*

F

• **Fairlight:** updated versions of *CMI* and accessories. • **Fidelipac:** complete line of broadcast studio products. • **FM Acoustics:** featuring the *FM 801A* power amplifier and the *FM 1000-1* power amp. • **For.A:** exhibit features *Sirius-100* digital audio memory designed for radio station applications. • **Fostex:** the launch of an addition to the series *4000* synchronisation range. The *4020* event controller can be run to both SMPTE and MIDI commands and can be operated as a standalone unit. Also on display will be the *D-20* DAT machine and some of the latest developments for this product. • **Fougerolle:** will be featuring *Melody*, a digital mono/stereo recorder/player with removeable disk; and *Picot 1500* magnetic perfo recorder. • **Full Sail Center:** full details of the new Full Sail complex in Winterpark, FL, USA, and music technology/recording courses held there.

G

• **Gauss:** high speed duplicating systems and test equipment. • **Genelec:** will be displaying seven models in their active monitor range including the European debut of the models *1034A* and *S30B*. • **Ghielmetti:** audio and video routing systems. • **Giese Electronic:** range of synchronisation and timecode equipment. • **Gorgy Timing:** timing and display clocks. • **Gotham:** will be showing their full range of audio cables. New for the show is the *GAC-1*, a double-shielded unbalanced single conductor audio cable.

H

• **Harmonia Mundi:** will be displaying for the first time its Graphic User Interface, a high resolution integrated graphics system providing SMPTE timecode control of all functions. Also on show will be the *CDR 90* recordable CD system from Gotham Audio. • **Harrison/GLW:** range of mixing consoles. • **Hauffe:** range of compact active input and output modules. • **HES Electronics:** will be exhibiting the HES Integrated Telephone Broadcast System for PABX lines and the HES Audio Engineering Modules, a modular building block system for broadcast applications. • **Heyna:** range of duplication equipment. • **HH Electronic:** exhibiting their full range of products including power amplifiers, signals processors and loudspeakers. HH Acoustics will be showing a complete line-up of chassis loudspeakers, the *B18*, *HF 300* and *CD500* compression driver.

I

• **ICM:** C-0 shells including coloured and transparent sonic welded, screwed coloured and transparent. Also details of CD production capabilities. • **Ilsemann:** range of labelling, packaging, and foil wrapping machines for compact and video cassettes. • **Industrial Research Products:** exhibiting their System *41* modular signal processing unit for sound reinforcement systems; TEQ Transversal Equaliser *DG-4021/4022/4023*; and the Voice-matic microphone mixing system *DE-4018* incorporating 10 channels of automatic microphone mixing, the *DE-208* Transversal Equaliser module and the *DE-206* Level-Matic Automatic gain control. ▷

Microphones from Milab

◁ • **Ivo Lola Ribar:** range of sound mixers, music recording and sound reinforcement products.

J

• **JBL:** examples from their series of loudspeaker systems.

K

• **King Instrument:** range of DAT cassette loaders and fully automated audio cassette loaders. • **Klein & Hummel:** self-powered monitors, equaliser products and headphones amplifiers.

L

• **Lafont Audio:** range of in-line and split audio mixing consoles. • **Lemo:** no information received. • **Lexicon:** full range of products including the *Opus* digital audio workstation and processing equipment. • **Loughborough Sound Images:** exhibiting the *DSP32C* Digital Audio Processor Board combined with an on-board digital interface allowing direct digital connection between the DSP and any digital audio equipment supporting the AES/EBU or Sony PCM formats. • **Lydkraft:** new products on show include the *NLE 1000 W* mono power amplifier; and the *LS1* loudspeaker selector using high quality relays and logic control routing the output of one amplifier to one of three sets of loudspeakers. Existing products include the Tube-Tech product line. • **Lyrec:** will be exhibiting the *FRIDA* and *FRED* ¼ inch tape recorders; the *TR-533* analogue multitrack recorder offering 16/24 tracks; and their complete line of duplication equipment, including the new master model *P-4409* running 480 in/s.

M

• **Master Audio Design:** no information received. • **MB Quart Electronic:** will be showing the *MBC-603* interchangeable capsule microphone. Available capsules include two different omnidirectional; two undirectional cardioid capsules; and a new hypercardioid capsule. • **Media Touch Systems:** featuring a fully operational Media Touch control system working with the *DAMS*, digital audio storage system, *RSDAT* players, Sony *DTC* RDAT players, Sony *CDK006* CD players and associated broadcast equipment. Media Touch will be broadcasting live from their booth once an hour using their Media Touch remote software to control all the equipment located in the studios of Radio Grischa at Chur in Switzerland over 250 km from Montreux. • **Meyer Sound:** sound reinforcement systems and studio monitors. • **Milab:** featuring their full range of studio microphones including the transformerless *VM-44* and the dual membrane capsules of the *VIP-50* and *DC-96B*. • **Minim:** showing their range of Ambisonic Surround Sound equipment for recording and playback in professional and enthusiast situations. Clock systems will also be exhibited. • **Mitsubishi Pro-Audio:** on show for the first time at a European AES will be the Mitsubishi 20-bit ready *X-86* 2-track digital recorder fitted with digital interface cards (*DIF-2*) as standard allowing interface to an outboard converter and the *CS-1* Chase Synchroniser. Established products include the *X-880* multitrack recorder; the *X-E2* Digital Editor; and the *X-400* 16-track recorder. • **Mogami:** range of audio cables. • **Montarbo:** no information received. • **Mosses and Mitchell:** jack patchfield systems and jack plugs. • **Musicbox:** C-0 shells, library cases, boxes and blank cassette tapes.

N

• **Nagra Kudelski:** featuring the Nagra *D* 4-track digital audio recorder. • **NED:** digital audio workstations and *Direct-to-Disk* hard disk recording system in all its various forms. • **Neutrik:** range of patchbays, test sets, connectors and modules. • **Neumann:** showing the complete range of studio condenser microphones with two new developments; a new pressure capsule *AK 31* omnidirectional for the *KM 100* variable miniature condenser microphone system; and a new type of boundary layer microphone *GFM 132* which provides regular polar pattern and flat frequency response in the entire pick-up area. The *5000* series fully automated computer controlled mixing system will be shown with a newly designed and modified operating panel. • **Neve:** range of mixing consoles and mastering consoles. • **NTP Electronic:** will feature the True Digital Communication Switcher Series *525*. The *525* features 24 kHz sampling frequency and a 12 bit resolution. Also on display will be a broad range of ppm, In-vision ppms, compressors/limiters, telephone hybrids and special purpose instruments.

O

• **Optical Disc Corp:** optical disc mastering products. • **OD & ME:** no information received. • **Orban:** processing systems for radio broadcast and studio applications. • **Otari:** European debut of *MTR-15* ¼ inch 2-track analogue tape recorder with auto-alignment. Established products include *DTR900B*, 1 inch 32-channel PD format digital tape recorder; *MTR-100A*, 2 inch 24-channel analogue multitrack recorder; and *MX-70*, 1 inch 16-channel analogue multitrack.

P

• **Platinum:** no information received. • **Prefer:** no information received. • **Pro-Sound News:** European pro-audio news magazine. • **PSI:** no information received. • **Publison:** signal processing systems featuring the *IM90* with latest hardware and software updates.

Q

• **Quad Electroacoustics:** will be introducing the Quad *240* 1U rackmounting amplifier, intended for use in video-edit suites and dubbing rooms and suitable for all areas where relatively low power monitor loudspeakers need driving. Also on show is the *520f* series amplifiers. • **Quantec:** signal processing products. ▷

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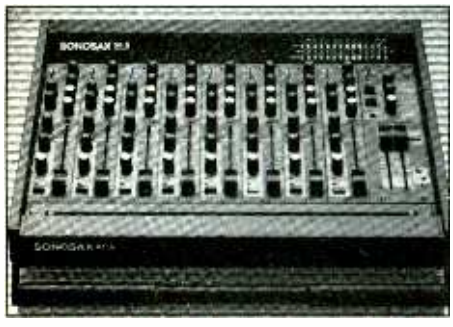
R

● **RCA Tapes:** range of test tapes for use in audio production, machine repair and in the laboratory. ● **Rebis:** range of rackmount signal processing equipment. ● **Renkus-Heinz:** featuring processor controlled speaker systems; HF compression drivers; horns; woofers; active crossovers; processors and amplifiers. ● **Revox:** range of tape machines, CD players etc. ● **Rood Megatronics:** will be presenting for the first time Radio Link products specifically dedicated to sound radio link activities. This equipment combines an audio feed transmitter link with a talkback cue receiver and an off-air station monitor providing a transportable reporter link. Models on display include the *PMRL-030-2* Portable Reporter System. ● **RTS Systems:** intercom systems and peripheral equipment. New is *MRT327* modular intercom user station. ● **RTW:** full range of meter systems.

S

● **Saki Magnetics:** range of long life ferrite heads for Ampex, MCI, Otari, Scully, Sony and Studer. ● **Sanken Magnetics:** featuring two miniature microphones developed jointly with NHK, the Japanese Broadcast Corporation, the *COS-11* tube type and the *COS-12* flat lavalier type. ● **Schneider:** showing their range of audio C-0 cassettes; audio and video reels; and video hubs. ● **Schoeps:** will be featuring new products *VMS 02 IB* and *KCY 51*. The *VMS 02 IB*



Sonosax SX-S mixer

combines the features of a stereo microphone preamplifier, an M/S-matrix and a power supply for the active Y-cable *KCY 51*. Schoeps will also introduce a sphere boundary microphone, a binaural stereo microphone for simple recording methods. ● **Seem Audio:** will be introducing the *Seeport* 8-input portable mixer for use in mobile broadcast as well as music recording. *Seeport* will operate on battery as well as mains power. Also new is the Seem *EH108* remote recording control system for remotely controlling a tape recording from a normal telephone set. Established products include amplifiers, effects units and audio patch panels. ● **Sennheiser:** condenser, pre-polarised condenser and dynamic microphones, wireless mic systems, headphones, infra-red systems and portable mixing consoles. ● **Sescom:** accessory and interconnection boxes. ● **Shure:** range of professional microphones and mixers. ● **Siemens:** broadcast audio products. ● **Sonosax:** showing their full range of mixers including the new version of the *SX-S* mixer which comes with a new frame to stand up to harsh treatment and conditions. ● **Sony:** new products include the *MXP-210* and *MXP-290* mixing consoles for video post-production; and the *DAE-3000* now fitted with *Version 3* software with enhanced editing features for CD mastering systems. Established products on display include the *APR-24* analogue multitrack recorder shown with *RS-422* 9-pin serial control interface for use in video post-production applications; the DASH format recorders; the complete range of Sony DAT machines; and the range of mics.

● **Soundsphere:** no information received. ● **Steinberg:** featuring *Topaz*, a hard disk digital audio recorder/editor. ● **Strand Magnetics:** audio and video cassette products. ● **Studer:** European debut of the 48-channel DASH recorder *D820-48* and the hard disk based *Dyaxis* workstations from Studer Editech, providing two simultaneous channels of hard disk recording and four simultaneous channels of playback, a systems synchroniser, a DAT back-up system, a *Dyaxis EX-cellerator* card, a time scaling software option and additional storage media. Also new are the digitally controlled mixer series *990* which features extensive control possibilities as well as data storage and reset procedures; the *A729* modular CD system controller; and the small *A779* mixer. ● **Studio:** monthly studio news magazine. ● **Sunkyong:** audio duplicating cassette tapes including *UCR* pure chrome, *SKX* super ferric and *SH* standard ferric. ● **Switchcraft:** examples from their range of interconnection products. ● **Symetrix:** noise reduction system, headphone amplifiers, microphone amplifiers and parametric equalisers.

T

● **Tape Automation:** tape duplicating equipment including master transport, slaves and loaders. ● **Tapematic:** will be displaying their range of tape loading and duplication equipment including the *2002* Audio Loader; *3003* Video Loader and Conveyer; and *8300* Data Control System. ● **Tascam:** new products include the *DA-800-24* DASH format multitrack; the *MSR-24* 1 inch multitrack; and the *M-3500* mixing console series. Established products include the *M-700* console; the *ATR-80* multitrack and the *CD-701* Pro-CD system. ● **tc Electronic:** signal processing equipment. ● **TFT:** solid state microwave link products. ● **3M:** full range of magnetic tape products for broadcast. ● **TOA:** wide range of products from mics to speaker systems.

V

● **Valentino Music:** selections from their music library. ● **VDT:** no information received. ● **VKB Elektronic:** no information received.

W

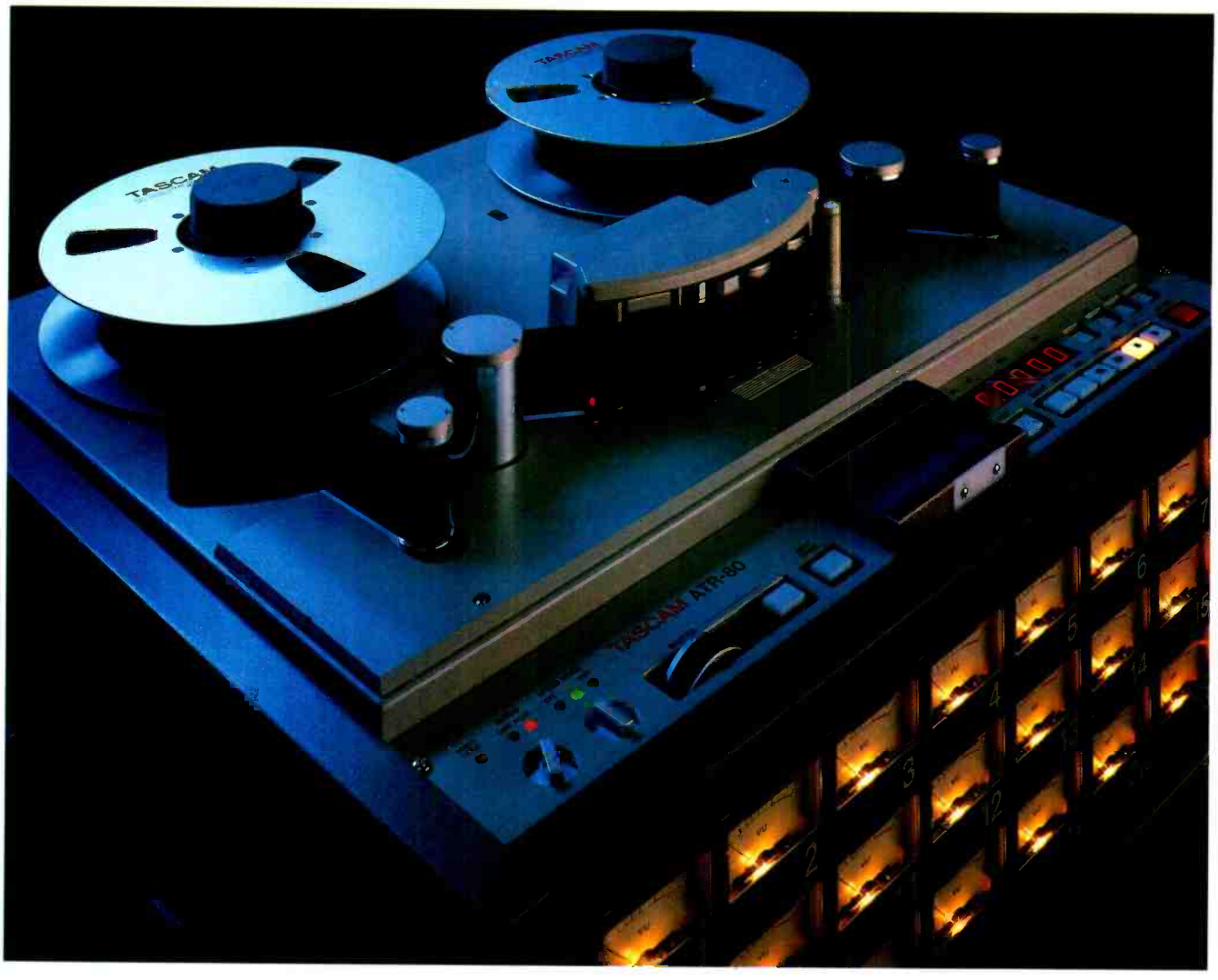
● **Westlake Audio:** range of studio monitors. ● **Woelke:** professional audio heads and test equipment.

Y

● **Yamaha:** exhibiting the new *DMR8X* integrated all digital system for audio recording and mixing, with an 8-track digital recorder, digital mixer, locator and mixing automation integrated into a single unit. All signals inside the unit are handled as 24-bit and on tape as 20-bit digital audio. Also featured is the *DRU8X* digital recording unit for use as a slave or tape backup unit.

Z

● **Zonal:** full range of magnetic recording products for broadcast and film application, including cassette tape and magnetic sound recording film. All 16 mm film is now available with the option of printed frame numbering.□



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ADR WITH TEF

Barry McKinnon describes how the TEF audio measurement system can be of help in ADR audio post processing

Those great old movies from the mid '60s are such fun to watch. Italian movies like *The Seven Voyages of Sinbad*, where not only did the words and the lips never match but all the dialogue sounded the same no matter where the action took place. When was the last time you were on a beach with a reverb problem! Thankfully the process of ADR (Automated Dialogue Replacement) has come a long way in 20 years. The advent of digital delays and reverbs combined with comprehensive equalisation allows the mix engineer to simulate virtually any type of location recording. Those two aspects of ADR, equalisation and reverb/delay, are critical to the invisibility of the inserted dialogue.

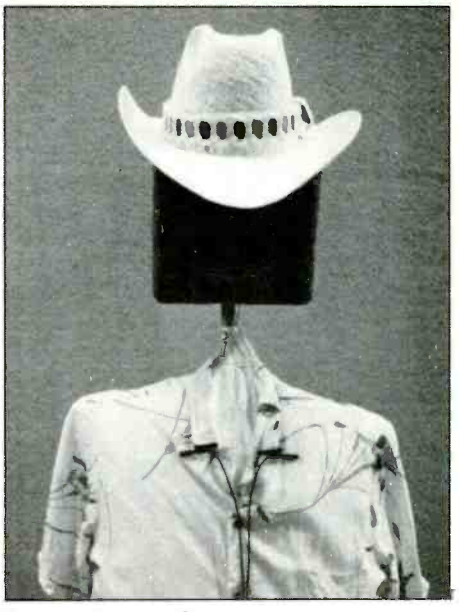
The difficulty lies in the time necessary to accomplish that match. With the complexity of film and TV projects increasing, the demand for faster post-production has also been increasing. More and more productions are done on location, which puts a higher demand on audio post-production for sound effects and ADR work. Every mic technique has a unique pickup character, its resultant frequency response and the amount of room pickup are a part of that characteristic.

An experienced audio engineer can sort out the required EQ and reverb settings pretty quickly by ear, with only the occasional difficult pickup to deal with. Often the most difficult locations to duplicate are the most commonplace. A hospital corridor is a good example, there is no reverb but rather a family of reflexions, which contribute to response variations at the microphone due to cancellation from multiple arrivals. Wouldn't it be handy if you could just take a picture of the reflexion and reverberation characteristics of the location, capturing any response anomalies of that pickup, so you could just look at it later and know how to set your EQ, delays and reverb.

Just such a 'camera' exists in the form of the Techron *TEF* analyser, the device that has brought Time Delay Spectrometry (TDS) to the masses, and in doing so, has revolutionised sound system installation, studio and control room design, loudspeaker design and even electronic design and measurement. The *TEF* is a two-port measurement system, that is, it sends its own test signal, then looks for that test signal at the output of the system under test. This gives you an indication of how the system has changed the test signal. The signal is a swept sinewave, with a user-selectable bandwidth for the swept range. The *TEF* can give you information in the frequency domain, and the time domain, using Fourier transform from the frequency domain. What this means is, the *TEF* can tell you how the frequency response of the system under test has altered the test signal, and can tell you how the time response of the system under test (how long it takes the system to pass the signal) has altered the test signal.

The system under test can be purely electronic such as an equaliser or amplifier, or an electro-acoustic system such as a speaker system or a microphone. Anything that can have a test signal applied at one end, and have a related output at the other end, can be tested. This has led to the *TEF*'s acceptance in testing sound systems, speaker systems and especially studio monitor installations. With time and frequency data you can derive all phase information as well.

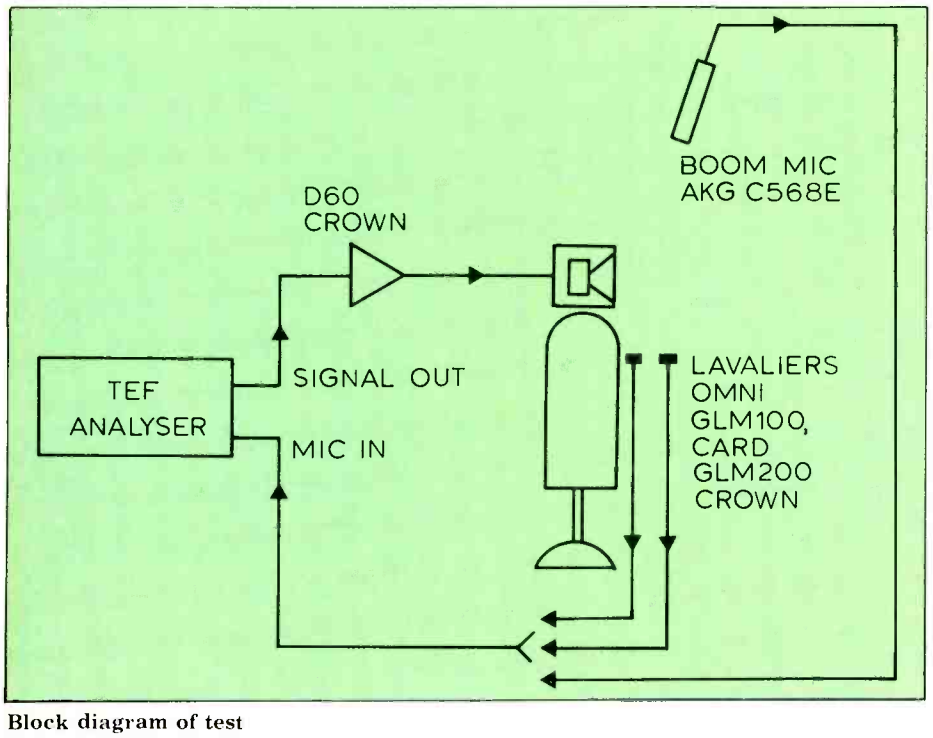
There are *TEF* applications for the film and TV audio industry beyond designing better studios, control rooms and microphones. Using the ETC (Energy Time Curve) mode, it is possible to look at the time of arrivals of sound at the microphone used in dialogue pickup. The relative levels of the direct sound, early arrivals, late reflexions and reverberant energy are directly represented on the screen. Using the TDS mode, the frequency response effects of early arrivals can be viewed. All this can be done without the need for silence in the environment to be measured and the measurements can be done quickly. Imagine using these two measurements on a location recording or a sound stage to see what is happening to the system comprised of the actor's mouth and the microphone picking up speech. Imagine how this may benefit the often difficult task of ADR.



Leroy—the test dummy

Recent extensive research has been done in the field of psychoacoustics, how we perceive spaciousness and directional cues, and how frequency response changes relate to spatial location. As has been pointed out in studio control room design and concert hall design, early reflexions play a large role in our sense of spaciousness and spatial position. If you placed someone in the centre of a huge reverberant hall, blindfolded them, then put up reflective surfaces near them, they would be able to identify that there were surfaces close to them, even if they were in the midst of a reverberant field with an RT60 of several seconds. The importance of early reflexions in matching ADR is paramount in the duplication of the original pickup environment. Response anomalies generated by the early arrivals at the microphone in the location pickup itself, when combined with the relative level and density of early reflexions and room decay give a pretty thorough aural picture of the scene.

We can measure all those factors using a *TEF* but we can't easily generate the test tone required by the *TEF* by directly stimulating an actor, at least not comfortably. A reasonably accurate substitute test source must be found, preferably one that doesn't have an agent. The test dummy (complete with cowboy hat and loud Hawaiian shirt) was nicknamed Leroy. He ▷



Block diagram of test

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◁ consists of a small speaker enclosure, with a 5 inch loudspeaker, mounted on a microphone stand, with a pillow to simulate the torso surface area (if not exactly its density) and wrapped in a shirt to provide lapels for attaching microphones to. Small speakers, such as the one in use here, have similar directional characteristics to the human voice, providing a convenient method of examining the pickup characteristics without involving live actors.

Fig 1 shows a sample TEF-ETC display. The time axis runs horizontally and the energy axis is vertical. Time zero is on the left. The display shows the direct arrival, early arrivals and diffuse late arrivals. Note that this display is frequency blind, that is, we are unable to tell what frequency is arriving at what time. The swept range is 150 Hz to 5 kHz, and any one of the arrivals represented by a vertical bar could be any or all frequencies contained in the sweep. Each arrival indicates the total energy that is arriving at that time. To view the frequency content, we would have to run a TDS sweep at a specified time. A bit later, using this method, we will look at response anomalies created by mic technique.

The *TEF* analyser is a very convenient tool for looking at these characteristics. To see what information it will give us, three test examples are presented. The first is with the test source in a small warehouse environment with concrete floor and walls, steel roof trusses and roof deck and many diffuse surfaces. Measurements were made using a short shotgun microphone, an omni lavalier and a cardioid lavalier. The second example has the test source in a seated position at an office desk, with office dividers present and typical acoustical tile ceiling overhead. Measured here using the shotgun, two lavaliers and a *PZM*. The third example has the test source in the driver's seat of a small automobile, measured using two lavaliers and a *PZM* microphone.

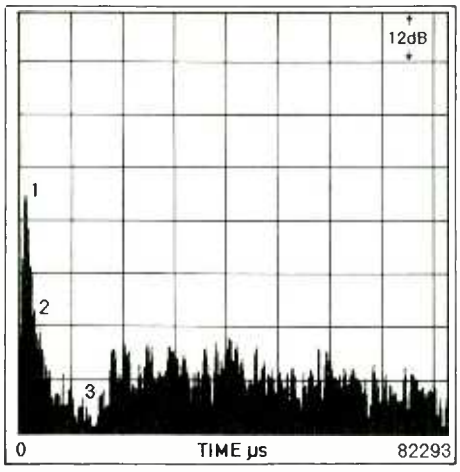

Fig 1: Sample ETC curve
1 Direct arrival 1031 µs
2-3 Early arrivals 2887 to 14849 µs
3 Diffuse or late arrivals 14849+ µs

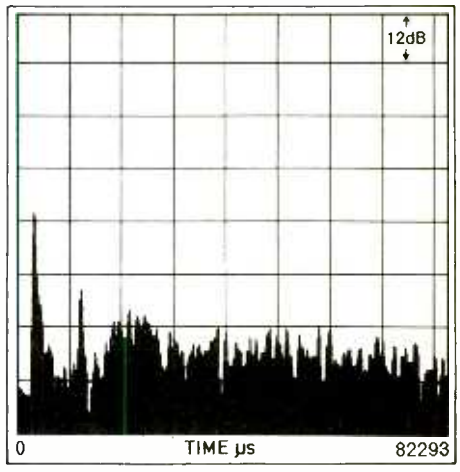

Fig 2: ETC of short shotgun mic approx 1 metre above test source, in small warehouse environment

The first example is shown in **Fig 2**, here the short shotgun is approximately 1 metre above the test source (without the hat), typical of a boom' pickup. The cursor (the crosshairs) on the display marks the arrival of the direct sound. The levels of the direct arrivals, early reflexions and the major reflexion from the floor can be read directly from the display. The room is technically too small to have a reverberant field, it is actually a dense field of reflexions, and the fairly regular spacing of them can be seen.

Fig 3 shows another handy feature of the *TEF* program. In the *TEF* software *TEF 2.0*, the E cursor program allows you to do an RT60 measurement, actually measuring the reverb as 'heard' by that microphone position. The sloping line is the Schroeder Integration Curve, which defines the amount of energy contained in the sound field. If you remember any calculus, here is a real world application for it, luckily it is all done by the *TEF*. By locating two points on the integration line in the reverberant field, the *TEF* will calculate the slope of the line connecting ▷

◁ them and determine the RT60. Ideally you would want at least 10 dB of level difference between the two points to ensure accuracy. The downward curvature of the line, just past our second RT60 point, does not indicate that the reverberant field suddenly disappears. What it means is, to get an accurate picture of the reverberant field right to the edge of the display, we would require a slower sweep rate. The one chosen did not allow time for all the energy in the sweep to get back to the microphone. By slowing the sweep rate from 1000 Hz to 500 Hz in this example we could have obtained more data on the right side of the display. In this case, our primary interest is in the early arrivals, and having a quick sweep. You can check your two reverb calculation points for curve fitting by using the 'D' command, which draws the regression line shown.

In **Fig 4**, we have installed the cowboy hat. You can see the direct sound is a couple of dB lower in level. There are some changes in the early arrivals, from refraction and diffraction around the hat. You can see that there are a couple of arrivals close to the direct sound that have increased in level and the reflexion from the floor is a bit broader in time. In **Fig 5**, the test source, sans hat, is in the same position but we have switched to an omni lavalier microphone. You can see a major difference in the early arrivals, they are all much lower in level when compared to the direct signal. Also note the difference in density of the reverberant field. Much of the pickup of the reflexion is being blocked by the torso. Now in **Fig 6**, Leroy is wearing his hat again and you can see two distinct arrivals very close together, one a reflexion from the hat brim. To see the effect of this second arrival, look at **Fig 7**. Here you can see the notch created by cancellation at approximately 2800 Hz and the bump at 2100 Hz. You can expect the location of the notches to change with hat position too. If the actor pushes his hat back that will sweep the filter down.

In **Fig 8** we doff our hat and use the cardioid lavalier. There is an increase in the direct sound pickup and a substantial reduction of early arrivals is apparent. The initial portion of the reverberant field is less dense as well. It is picking up reflexions from the ceiling area now, which do not seem to decay as fast as those picked up with the omni. This would still be audibly interpreted as a very 'dry' pickup, with very little room character.

The second example is one that would crop up regularly in office scenes, dinner table scenes, restaurants and so on. In **Fig 9**, we have the office desk position, this time using the omni lavalier for pickup. The direct sound has only 14 dB advantage over the first group of reflexions. Note that the bulk of the energy arrives in the first 20 ms and the decay is rather fast. This is quite a dead space. All these early arrivals will play havoc with the frequency response just like the cowboy hat did. And they will change with the actor's position.

Fig 10 shows the cardioid lavalier and its attendant drop in early reflexion pickup. Oddly enough it has a higher level in the late arrivals but they are more diffuse and spread over a greater time. **Fig 11** shows the *PZM* on the desk surface, overall its pickup looks like the omni lavalier but with a lower, more uniform level of early arrivals spread over a greater time. **Fig 12** shows the short shotgun pickup, again approximately 1 metre overhead. A substantial change in the direct to reverberant energy is visible, with barely 12 dB of advantage for the direct sound. The greater reverberant field would make this a very 'distant' pickup.

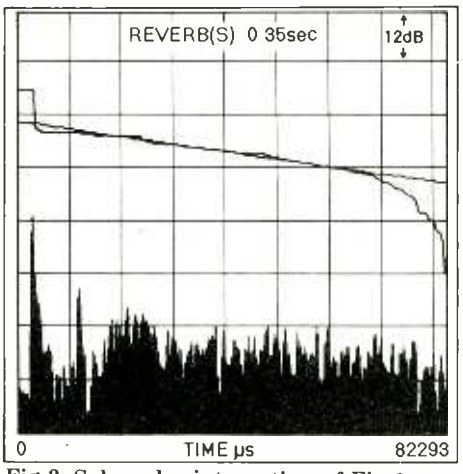

Fig 3: Schroeder integration of Fig 2 setup showing very short reverb time. Regression line for reverb shown

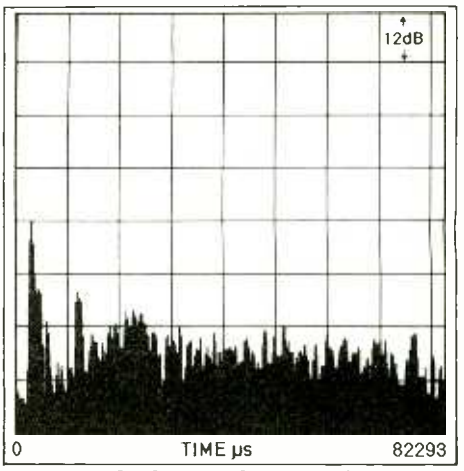

Fig 4: ETC of short shotgun mic approx 1 metre above test source, test source now wearing a cowboy hat. Some changes in early arrivals are visible

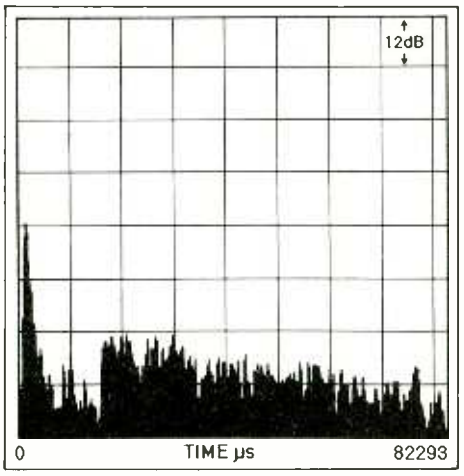

Fig 5: ETC with test source as Fig 2 ('bareheaded') but pickup with omni lavalier on lapel. Visible differences in direct to reverberant energy

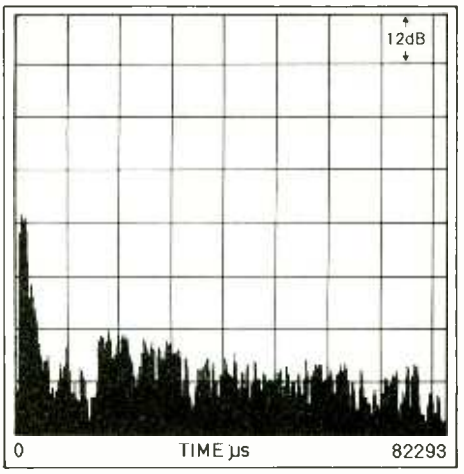

Fig 6: ETC of same omni lavalier pickup as Fig 5 but with the cowboy hat re-installed. Note two distinct arrivals very close together

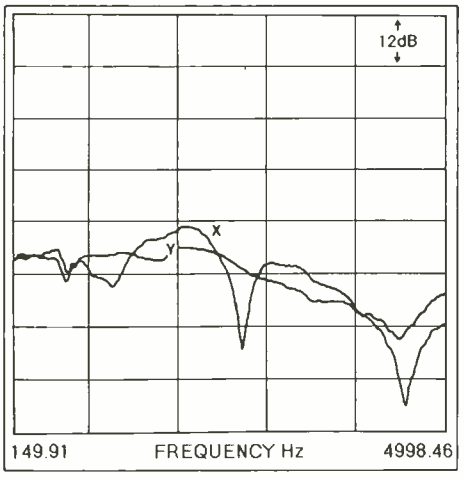

Fig 7: EFC of omni lavalier pickup
X Curve with cowboy hat
Y Curve without cowboy hat

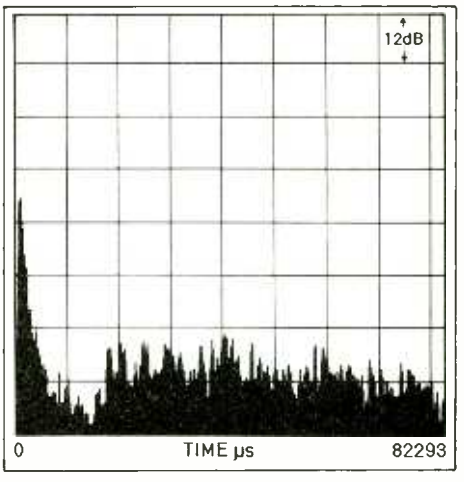

Fig 8: ETC of cardioid lavalier pickup, same environment as shotgun and omni lavalier

The third example, the front seat of an automobile, required changing the band of frequencies swept by the *TEF*. This changes the total display width from 82 ms to 26 ms. This allows more detail of the early arrivals to be seen, an important concern since all the surfaces are so close. The time domain and frequency domain are inverses of each other, so as you acquire more time resolution, you lose frequency resolution and *vice versa*. In this case, broadening our frequency content has shortened the time scale of the display. At the 1 kHz sweep rate, this raised the total sweep time from 5 to 15 sec.

The omni lavalier used in **Fig 13** shows a very high level of reflected energy due to all the hard surfaces close to the source. The omni lavalier produces a pickup with a very even decay, even though the decay is incredibly short, as shown in **Fig 14**. All the arrivals of any significant level in the front seat of an automobile will have more impact on response than on perceived reflexions. All the reflective surfaces are a few inches to a few feet away. The notches created in the pickup itself cannot be fixed through equalisation since ▷

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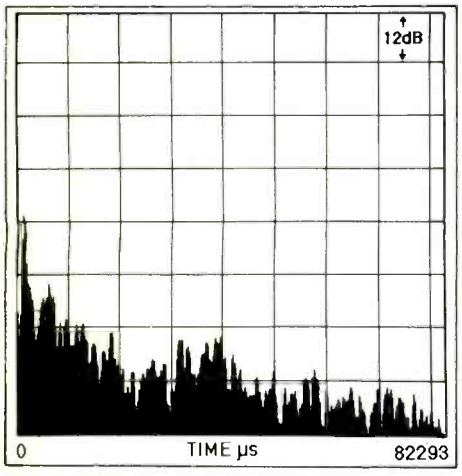

Fig 9: ETC of omni lavalier pickup with test source at seated office desk position, low acoustical tile ceiling and office dividers present

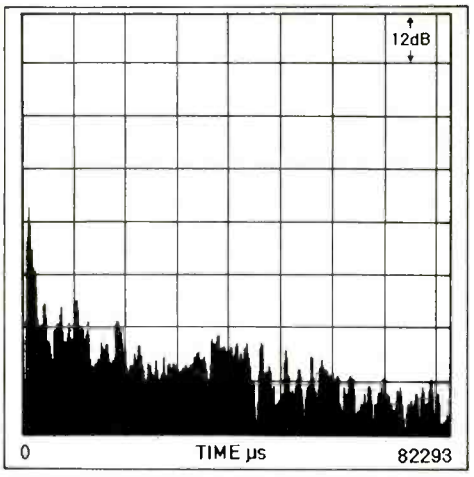

Fig 10: ETC of test setup as Fig 9 but using cardioid lavalier. Note drop in early arrival pickup, yet overall reverberant character relatively unchanged

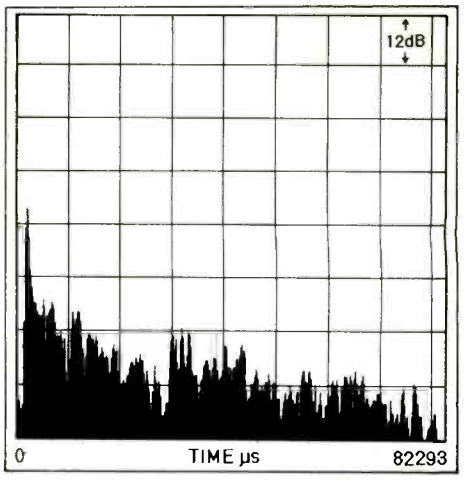

Fig 11: ETC of test setup as Fig 9 measured with *PZM* on desk surface. Note change in early arrivals

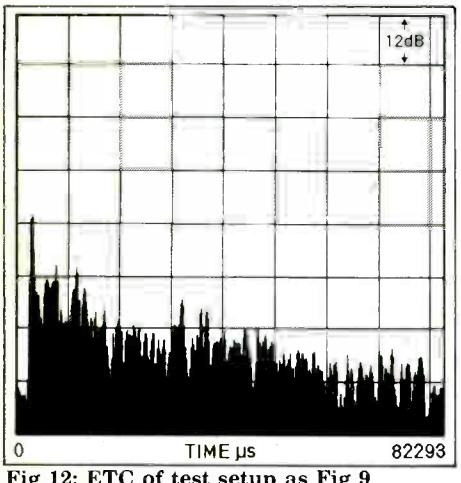

Fig 12: ETC of test setup as Fig 9 measured with short shotgun mic approx 1 metre above test source. Note significant change in direct to reverberant energy

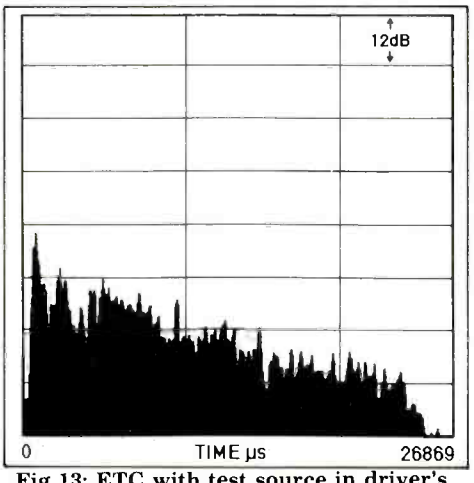

Fig 13: ETC with test source in driver's seat of automobile measured with omni lavalier. Timescale has been reduced to show more detail in early arrivals

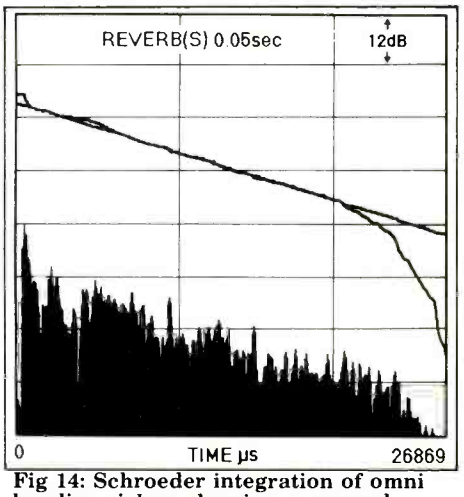

Fig 14: Schroeder integration of omni lavalier pickup showing measured 'reverb' as being very short. In fact it is more like closely spaced reflexions and not truly reverb

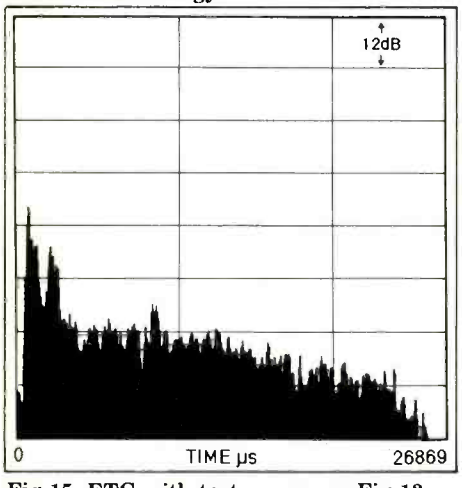

Fig 15: ETC with test source as Fig 13 but with cardioid lavalier pickup. Different early arrival character is visible

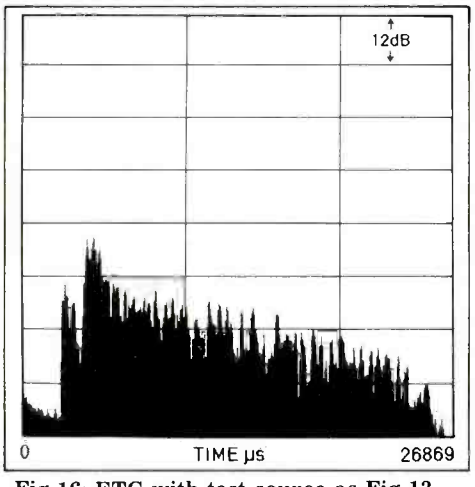

Fig 16: ETC with test source as Fig 13 using a *PZM* on the seat between the driver and passenger

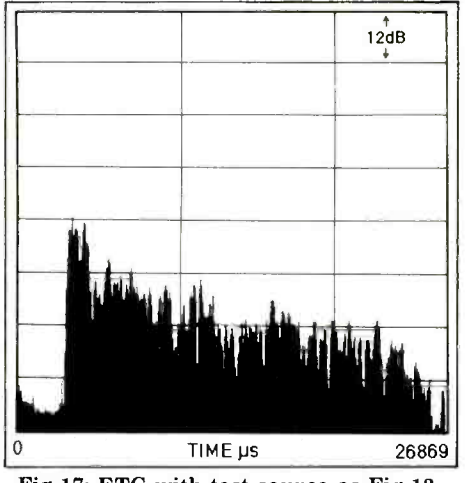

Fig 17: ETC with test source as Fig 13 this time using the *PZM* on the top of the instrument panel close to the windshield

◁ they are the result of phase cancellation at the microphone diaphragm, there is no sound left to equalise.

Fig 15 is the same test source with a cardioid lavalier. A strong reflexion from the roof and windshield is visible, and you might expect this will cause some response irregularities. **Fig 16** shows the result of a *PZM* on the seat between the driver and passenger. The direct signal is actually lower in level than the combined reflexions that arrive 2 ms later, there are a lot of reflective surfaces in an automobile. **Fig 17** again shows the *PZM* but this time on top of the instrument panel, close to the base of the windshield. We have a much higher direct arrival and the early arrivals are bunched closer together but the effect of spreading them over almost 2 ms is visible when we look at the resultant response in **Fig 18**. It makes you wonder why you spent all that money on a flat response microphone.

When performing ETCs where you need to measure very long reverb times in large rooms, you will run into conflict. If you actually display a full 6 sec (6,000,000 µs) on the screen, you will lose detail in the early arrivals that are most critical for ADR work. In these instances, two sweeps would be made, one to cover the long period for RT60 measurements and one with a short time period to measure early arrivals in detail. As long as you keep the swept frequencies ▷

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◁ in the voice range, you will get relevant data.

When it becomes necessary to look at frequency response, you can limit the bandwidth to the voice range, approximately 150 Hz to 5 kHz. In the frequency response displays in these examples, the resolution was chosen to be 100 Hz, allowing the display of major comb filtering and the use of a relatively fast sweep rate of 1 kHz. It would be possible to get a frequency resolution of approximately 32 Hz with this sweep rate but the additional detail can be distracting as it begins to show variations that will change with the actor's head position, his arms, eyeglasses and other minor, short term influences.

Once you know the approximate distance

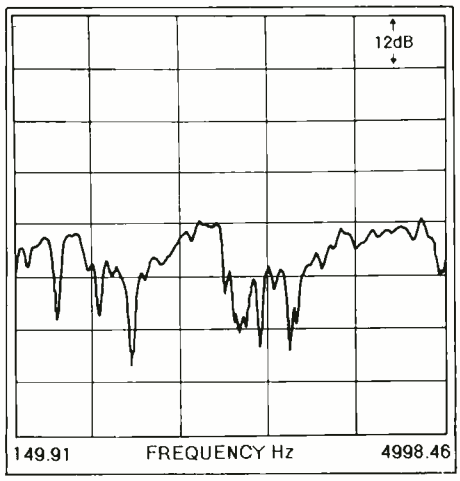

Fig 18: EFC with *PZM* near windshield on top of instrument panel

around the actor in which the action will occur, you can optimise the bandwidth setting. By choosing the optimum bandwidth you can select the size of the 'sphere of interest' around the actor. Along with resolution information the bandwidth specification will give a distance in feet. This describes the total pathlength from the test speaker to the microphone that will be accepted by the *TEF*. In the usual application of TDS measurement, this describes the measurement ellipse (see **Fig 19**). If you took a string of the length given, tied one end to the speaker and one end to the microphone, any point you could stretch the string to would be on the surface of the ellipse. With the source and the receiver so close to each other, as on our test dummy, the ellipse is nearly spherical (see **Fig 20**). If you choose a bandwidth that gives a distance of 32 ft, the measurement will include all sound paths within a sphere of 16 ft radius about the actor. If you choose a bandwidth that gives you a distance of 2 ft, the measurement will include all sound paths within a 1 ft radius.

The application of the *TEF* in film and TV sound has to begin on location. Once a microphone technique for a given scene has been chosen, a test dummy similar to Leroy would be placed on the set, equipped with the same type of microphone and wardrobe as the actors will have. A test sweep would be done and stored. If there were a number of locations on the set where dialogue would take place, especially if some of those locations will have different acoustical characteristics, a number of test sweeps may be required. The sweeps only take a few seconds each, and since the *TEF* does not require silence to work in, it would be done while cameras and lights are being prepared—long before the director would start tearing his hair out about delays.

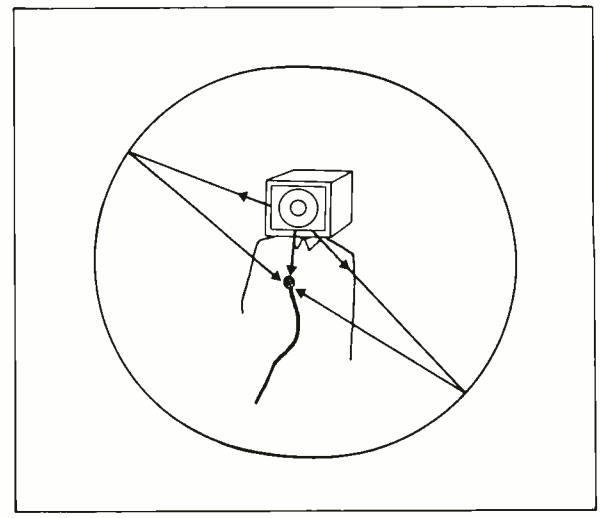

Fig 20: TEF-ADR measurement ellipse nearly spherical since source and microphone are so close. Measurements that include reflexions with a 10 ft (3 metre) path length will show the most significant effects of the surroundings on the pickup response

The new *TEF 12 Plus* is especially useful here, due to its faster operating system, giving quicker access to various command menus. The equipment could be streamlined by using a powered speaker for Leroy's head and it could be attached to a mannequin torso to provide an easier-to-handle assembly. At the end of the shoot the disk containing the data could be kept with the audio tape from the shoot and so travel together to the audio-post house for appropriate changes and additions.

The *TEF* has other applications here as well. By augmenting the ear, the TV and film sound person could fine tune microphone technique. By listening to, then measuring, various pickup techniques, troubleshooting certain pickup problems can be done quickly and accurately. You could take a detailed look at the comb filtering that occurs when two actors with lavalier mics approach to within a few inches of each other. A catalogue of typical pickup methods could be made and then stored in memory in digital delay/reverb units. This would be applicable for a TV show that used a number of standard sets on a sound stage. The *TEF* can be used to measure the combined equaliser/delay/reverb electronic chain, to view its time response and frequency response. Hundreds of aspects of microphone technique could be examined in detail, from the effects of microphone position to the effects of cowboy hats as shown here.

There is no reason to stop at ADR, virtually the entire post processing chain is *TEF*'able, starting in the voiceover studio, right through to the tape recorders. The *TEF* can be the audio lie detector, usable anywhere a two-port measurement can be devised.

While the cost of a *TEF 12 Plus* may seem high for a single box of equipment that does not directly produce revenue, it can reduce time spent on many types of projects and increase accuracy. It costs about the same as a good synchroniser and could smooth post-production work as effectively. Its applications are limited by the imagination and need of the user; those seem like minimal limitations in the recording industry.□

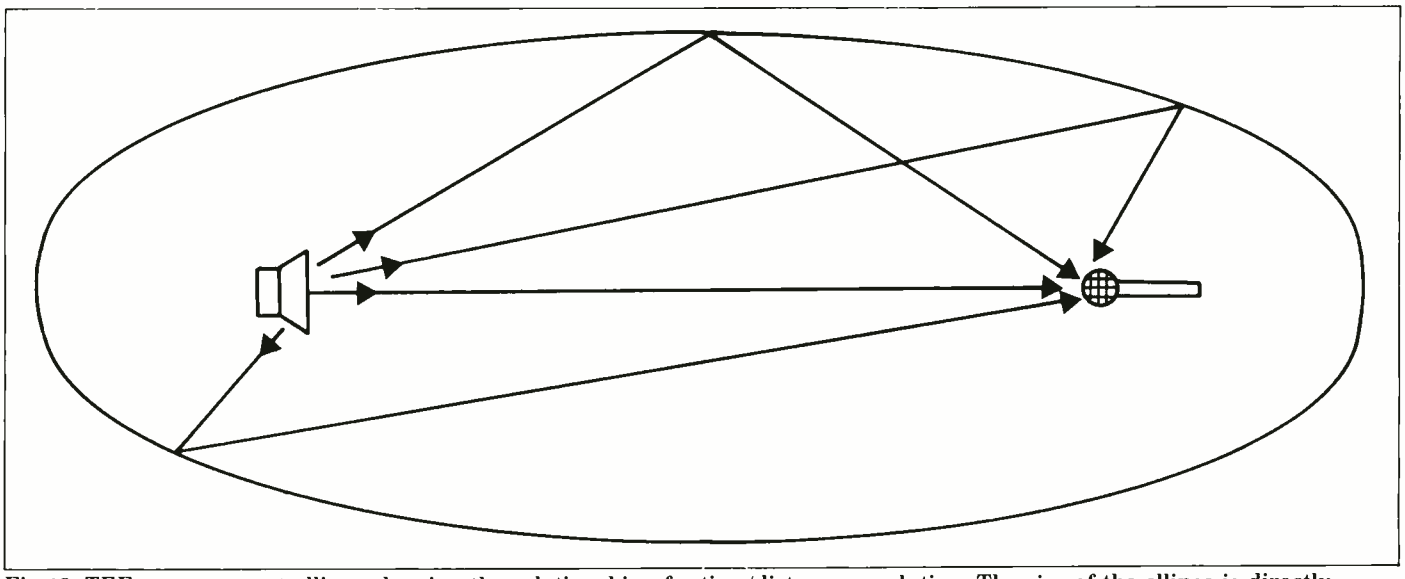

Fig 19: TEF measurement ellipse showing the relationship of a time/distance resolution. The size of the ellipse is directly related to the acceptance time of the filter. The longer the acceptance time, the greater the path length of reflexions that will be included in the measurement

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NOISE OR MUSIC?

With the growing concern about noise levels Ken Dibble analyses the relationship between music and noise

Among the many problems faced by the music industry is the emotive and often irrational media reportage of sound levels of 100 kilowatts here and ¼ million watts somewhere else, leading the uninformed observer to conclude that everyone coming anywhere near a rock concert or discotheque will immediately be struck deaf. Often surprise is expressed[1] when research fails to confirm this. At every opportunity, when a reporter is seeking comparison with something loud, or an industrialist is looking for a scapegoat for increasing occurrences of hearing problems within his workforce, it is always rock and roll, discotheques, hi-fi or personal stereos that take the brunt. What about fire-arm sports, motor sports, the noise level in a ballgame stadium or at a power boat race meeting, or the host of other noisy leisure activities? Why must it always be music? Small wonder that the music business has been so earnestly drawn into the net of the Noise at Work Regulations.

An introductory article to the 1989 Noise at Work Regulations ('Volume Controls Pending' *Studio Sound* December 1988) questioned the justification for the inclusion of music within the scope of legislation whose structure rests upon NIHL (Noise Induced Hearing Loss) predictions, which are based upon exposure to unpleasant noise in an industrial environment for 40 hours per week and for a 40 year working life.

I like to listen to music played at relatively high volume levels. I have attended rock concerts and discotheques on a fairly regular basis over many years and now and again find myself in a recording studio or control room. Sometimes I am there in a professional capacity, sometimes as a leisure activity. I have played guitar in a 1960s pop group, run a mobile discotheque and toured as a sound engineer with a number of bands over the years. I like to attend West End musicals and 'classical' concerts. I find that provided the sound quality is of an acceptable standard—ie reasonably free from peak clipping or excessive colouration—I am not under stress at SPLs of up to, say 110 dBA L10 or, say, 105 dB LAeq.

> **noise** (-z), n, & vt & i. Loud outcry, clamour, shouting, din of voices and movements; any sound—especially loud or harsh or undesired one.
> **mu'sic** (-z-), n. Art of combining sounds with a view to beauty of form and expression of emotion; sounds so produced; pleasant sound.
> *Concise Oxford Dictionary*

Rock and roll (for want of a better term) just does not work below a certain threshold level. I call this the 'adrenalin level' which seems to sit somewhere around the 95 dBA mark provided there is sufficient low frequency energy present. **Fig 1** shows typical discotheque and live performance music spectra and there needs to be at least a 10 dB differential between the mean mid-band energy level and those peaks in the 50 to 100 Hz octave. If this is missing because of insufficient headroom on the playback system, then the 'adrenalin level' will be higher.

By comparison, when my work takes me into a noisy industrial environment, say a power station turbine hall where noise levels are typically in the region of 92/96 dBA of virtually broadband pink noise, I find this highly disturbing and stressful. I would not dream of entering such an environment without my site helmet and hearing protectors in place and with the ear muffs carefully positioned for maximum effect.

So, along with a growing body of opinion it seems, it is my view that there must be a difference between the NIHL risk associated with exposure to loud music and that associated with traditional industry and upon which the new regulations are based. After many years of intending to do something about it, and prompted by the noise exposure studies being carried out as part of the BEDA Discotheque Survey project in 1988[2], I finally got around to investigating the available work in this field during last year and presented my findings to the Institute of Acoustics' 'Reproduced Sound' conference last November in a paper with the intentionally provocative title *Disco Deafness—The Myth?* This article is based on that paper and references are given at the end to provide further information for study.

The object

The object here is not to show that exposure to loud music will not ultimately be harmful or that it will not lead to hearing impairment. If the playback levels are too high and the accumulated duration of exposure too long, it almost certainly will result in NIHL. Nor is it intended to question the current DRC (Damage Risk Criteria) when applied to traditional industry. It is, however, designed to show that research has failed to substantiate the widely held belief that all rock musicians and all who attend rock music performances and discotheques, along with all studio engineers and session musicians will be deaf by the time they reach the age of 30, and to question the validity of the exposure level values presently assigned to Damage Risk Criteria or Equal Energy Concept methods of assessment after Burns and Robinson[3], Robinson & Shipton[4] or *BS5330*[5] for this application.

Overview

The hypothesis is put that while for exposure to industrial noise audiometry has been able to substantiate the criteria used, this is not the case ▷

TABLE 1a Sound levels from live pop/rock groups using amplification

Authors	Year	Country	Comments	LIN	dBA
Lebo & Oliphant	1968	USA	Hall 'A'	109	106
			Hall 'B'	118	111
Rintleman & Borus	1968	USA	5 groups	106	100
			5-20 ft from stage	106	102
				108	103
				104	97
				107	104
			group 40-60 ft from stage	98	90
Flugrath	1968		10 groups	108	106
				98	97
				102	99
				103	102
			1 ft from stage	98	95
				105	104
				105	103
				105	104
				99	99
				105	104
Lipscomb	1969	USA		122	114
Rice	1969	UK	Dance floor	–	105
Dey	1970	USA	30 ft from loudspeakers	108	100
Abrol, Nath Sahai	1970	New Dehli		104	100
				106	101
Hickling	1970	NZ		104	99
Speaks, Nelson, Ward	1970	USA	10 groups, 15 measures each, table shows max and min values	116	111
				101	95
Fearn	1972	UK		112	109
Flottorp	1973	Norway		113	111
				112	110
				110	106
				115	110
Rupp, Banachowski, Kiselwich	1974	USA			102
					116
					104
Ulrich, Pinheiro	1974	USA	Figures read off small chart		90/95
Barry, Thomas	1972	USA	Figures inconsistent		105
Bickerdike, Gregory	1980	UK	Unlicensed:	119-121	116
			Licensed:	95-126	89-119

◁ in studies carried out on those who engage in, or are spectators to, modern music making. The situation is aptly stated by Fletcher[1] who, following an audiometric study in which the pure tone thresholds of 100 rock musicians and 100 rock music spectators were compared with that of 400 normal hearing control subjects, concluded:

"Knowing the levels and durations of exposure these persons receive in that pastime, it is almost unbelievable that no clearly observable losses could be found."

Simply stated, the concern is that any new Code of Practice proposals aimed at volume regulation in this arena and any industry sector agreements[6,7] that might be entered into with the Health & Safety Commission regarding the implementation of EEC Directive 86/188[8] should be based on substantive criteria rather than on an assumed relationship, which on present evidence, does not stand up to objective measurement.

Bickerdike, in a paper based on the results of an earlier study[9] and presented to the 89th Environmental Health Congress 1982[10] concluded:

"The tentative estimate of risk attempted in this paper shows that the overall problem is significantly less than that of workers in industry; probably by a factor of four or five...the problem is not...well enough researched and defined in all its aspects to warrant specific proposals being made...it is considered that specific legislative control is unwarranted."

And the Medical Research Council[11] commenting on the Bickerdike and Gregory study[9], summarised:

"...Bickerdike and Gregory's estimate of the numbers regularly exposed to discotheque noise implies that this is an important source of noise exposure. However, we have argued that this estimate may be a three- to seven-fold overestimate and conclude that the importance of this noise source is less than they imply."

And Lutman, in a paper presented to the British Society of Audiology in 1987[12] concludes:

"...leisure noise does not constitute a major source of noise-induced hearing loss in the UK, given hearing conservation programmes geared to 90 dBA. Our interpretations would be more certain if we had reliable data on a sufficiently large and representative population sample."

So it would seem that Bickerdike considers the problem to be of such small proportions that legislative provision is not warranted, the MRC consider that even this conclusion may be based on a seven-fold overestimate and Lutman categorically states that it is not a problem. So why are we here?

The subjective element

How many times has a fraught parent yelled at a teenage son or daughter "turn that X#$?&!* television set down—it's too loud—I can't hear myself think!" often during a music-based programme. Yet this is clearly an impossibility. The average television set's loudspeaker has a sensitivity rating of about 88 dB and an amplifier rated at little over 2 watts. Thus the maximum possible SPL at 1 metre from the loudspeaker will be little over 90 dBA. So it is not the fact that the sound is too loud that is the cause of the parental distress, it is the high level of distortion inherent in most domestic audio/video equipment coupled with a subjective dislike of the programme content that will have offended mum's auditory senses.

The former symptom can be further tested by listening to a piece of music at a fairly high volume level—say 90 dBA—through a typical domestic audio system and then listening to the same piece of music played through a sound system with sufficient headroom to handle the transient information without peak clipping. Not only will one's reaction to the programme content be completely altered but the two sensations of loudness will be quite different.

Now test the latter symptom by listening to broad band pink noise at 90 dBA and then listen to music at the same SPL. Which is louder? Which is the more unpleasant?

Such observations are not entirely without foundation, scant though this may be at the present time. The discussion on the subject to be found in the MRC Review Report[11] clearly recognises the stress element in unwanted sound and observes:

"...loud music appears to be somewhat less damaging than noise of a supposedly equivalent energy..."

In a study intended to test this hypothesis Barry & Thomas[13] subjected 10 volunteer students to 60 minutes exposure to music and 60 minutes of noise at similar levels, measuring the effects of TTS (Temporary Threshold Shift) after each exposure. The results show that the noise-induced TTS exceeded music-induced TTS by about 9 dB over the midrange, whilst Chuden & Strauss[14] found:

"...disc jockeys developed less TTS after exposure to music than to noise of equal intensity and spectral form."

Clearly then, subjectivity is not be be dismissed lightly.

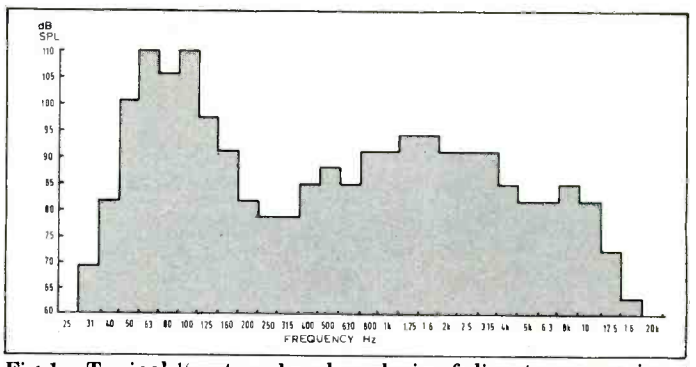

Fig 1a: Typical ⅓-octave band analysis of discoteque music; measured level 96 dBA (Dance floor—1987)

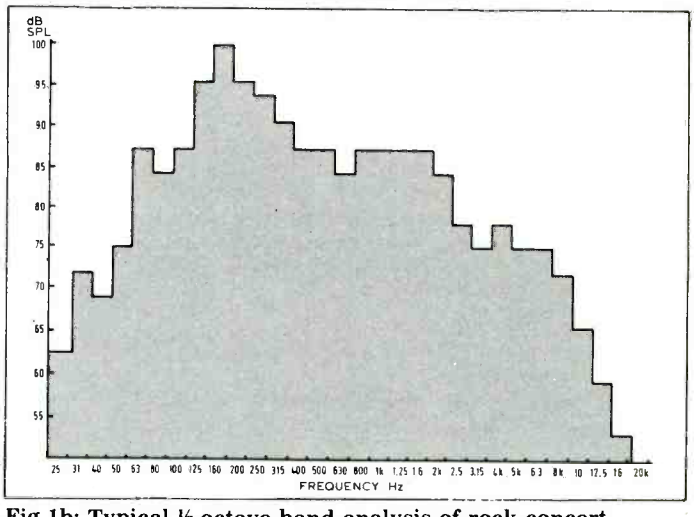

Fig 1b: Typical ⅓-octave band analysis of rock concert performance; measured level 96 dBA (Theatre circle front—1986)

TABLE 1b Sound levels in discotheques 1970-79

Authors	Year	Country	Comments	LIN	dBA
Abrol, Nath Sahai	1970	New Delhi	Original paper inacessible; data taken from Whittle & Robinson	89	84
				88	83
				100	95
				94	88
				83	79
				93	89
				89	88
				92	90
Fearn	1972	UK	Room centre	94	92
			Near loudspeaker	108	100
Rupp, Banachowski, Kiselwich	1974	USA	Means of many readings		100
Shirreffs	1974	USA	Means of several readings		107
Cabot, Genter, Lucke	1979	USA	Disco 02: 4 times	98	95
				96	91
				93	90
				93	87
				94	82
			Disco 15: once	94	87
			Disco 17: 4 times	95	92
				94	86
				94	86
Bickerdike & Gregory	1980	UK	Disco 11: unlicensed	108	101
				110	105
			Disco 18: licensed	110	103
				108	102
			Disco 29: licensed	106	99
				109	101
			Disco 30: licensed	117	113
				117	113
			Disco 31: licensed	94	88
				95	87

▷

On sound levels and spectra

Much work has been carried out to study the volume levels at which rock music is played, in live performances and discotheque situations, much of which (up to 1980) is summarised in **Table 1** taken from the MRC Literature Review[11]. Comparison with more recent data recorded by myself during the BEDA Discotheque Survey[2] during 1988 as shown in **Table 2** confirms that not much has changed during the 20 year period for which data is available.

What has changed, however, is the spectral distribution. The MRC Literature Review[11] gives the bargraph chart **Fig 2** based on Bickerdike & Gregory 1979[9] and Cabot, Genter & Lucke[15]. However this data is very different from that recorded by the author[2,16] as shown by the ⅓-octave RTA plot of **Fig 1**, the general pattern of which can be verified by many similar RTA plots taken in venues throughout the UK over an 8 year period[17].

The principal studies

The subject of NIHL vs music has clearly interested researchers for many years, and of the earlier studies undertaken in the wake of the Burns and Robinson report[3], the outstanding work in terms of its quantity and zeal is by Fearn[18-25]. Based on the results of his investigations, Fearn submitted a report to Leeds City Council in 1973 recommending that volume limits of 90 dBA and 93 dBA be imposed as a condition of licence. As a result a limit of 96 dBA peak was accepted and predictably, popular music in Leeds died on its feet.

To protect their interests the Association of Ballrooms retained consultants to investigate the matter and as a result of a report by Burd[26], coupled with a public outcry, the restrictions were eventually revised in 1975 by a new condition of licence:

"During any period of time in which music is played...the equivalent continuous noise level, Leq, shall not exceed a reasonable level. An interim code of practice will be sent in the near future...this will be based on the industrial code and will permit an Leq of 90 dBA or the equivalent noise emission level."

As a result of this furoré the Acoustics Group at the National Physical Laboratory were asked by the Department of the Environment to:

"Review the various studies...to collate the available information...and to produce a best estimate of the probability and extent of damage to hearing using the latest methods of assessment[4]."

Therefore the ensuing report by Whittle & Robinson[27] remains firmly based on Robinson & Shipton's DRC method but does introduce a 3 dB correction to the recorded LAeq level to take into account the variability and intermittency of music. This study concluded that one group of 'live pop' attendees exposed to a corrected LAeq of 104 dB for 4 hours a week would be unlikely to reach the low fence impairment level after 8 years exposure but that 5% of musicians exposed to 108 dB corrected LAeq for 10 hours a week would reach the low fence level after just 2 years.

The Whittle & Robinson report provided the starting line for what is probably the most extensive study of the subject yet undertaken, in which the sound levels in 49 discotheques were monitored and the habits of 4,166 attendees studied. The survey was carried out as a course project at Leeds Polytechnic's School of Constructional Studies with John Bickerdike as project leader. Again the conclusions reached[9] are based on DRC after Burns & Robinson[3] and Robinson & Shipton[4]:

"...Although the range of possible exposure to sound levels in discotheques is large, the risk of noise-induced hearing loss...is small. Out of an estimated 6 million regular attendees some 0.025% might be expected to reach the low fence impairment level...at the end of their attendance period."

Yet the MRC consider this to be a seven-fold overestimate!

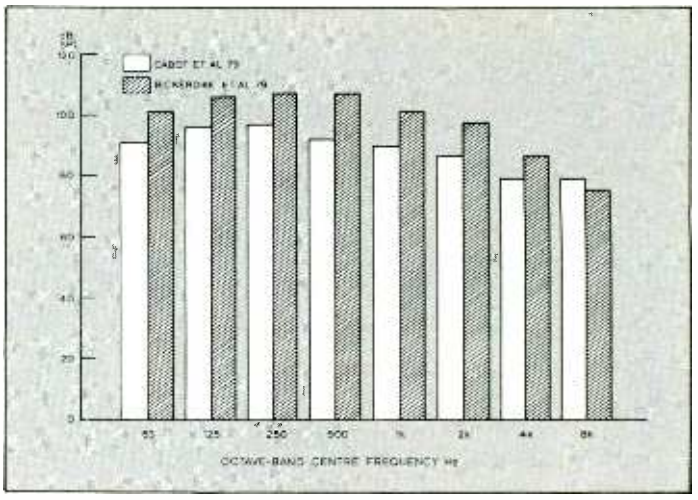

Fig 2: Spectral distribution of rock music volume levels

TABLE 2 Venue volume levels

Measurement location	Mean SPL	Mean Devn	Max SPL	Min SPL	No Smpls
Dance Floor	103 dBA	1.5	107	99	12
DJ console	98 dBA	1.6	104	98	12
Bar serveries	90 dBA	4.2	100	73	36
Lounges	90 dBA	4.5	98	75	32
Restaurants	84 dBA	6.1	89	70	10

Audiometric evidence

Turning then to the available audiometric evidence of NIHL due to exposure to loud music, in a study carried out in the USA by Rintelmann & Borus in 1968[28] it was found that of 42 otologically screened rock and roll musicians aged between 16 and 23 years, exposed on average to 105 dB (Lin) for 11.4 hours a week for 2.9 years, only 5% showed any symptom that could be diagnosed as NIHL when tested by conventional pure tone air conduction and by bone conduction audiometry. Four years later 10 of the original subjects were still actively playing in rock and roll bands and follow-up tests showed that their hearing thresholds had not changed. Three and a half years later—ie 7½ years from the date of the original study—six of these were still playing and further tests showed no substantial differences between the 1968, 1971 and 1974 results. The findings are shown in **Fig 3**, from which it can be ▷

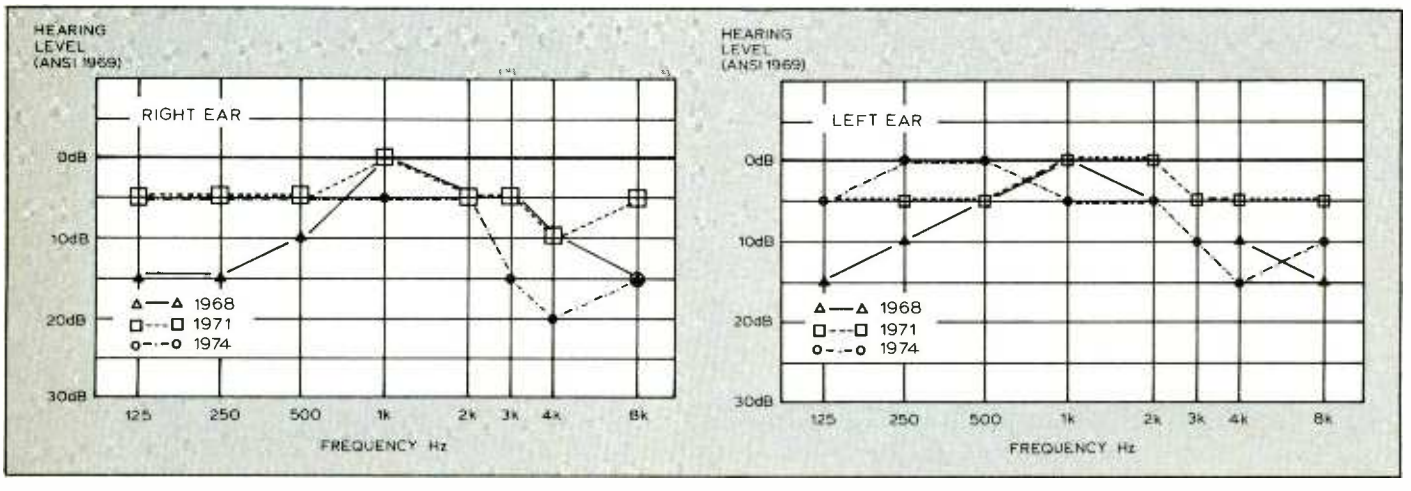

Fig 3: Comparison of the mean pure-tone air-conduction audiograms from 1968 to 1974 for six musicians

TABLE 3 Number of instances by frequency (kHz) in which thresholds among the four groups of rock music audience members exceeded limits of normal hearing* (N=120)

	26 to 35 dB HTL Frequency (kHz)					36 dB HTL or Poorer** Frequency (kHz)				
Group Exposure Time	**2**	**3**	**4**	**6**	**8**	**2**	**3**	**4**	**6**	**8**
Less than 2 hours										
Males	1		1	2	3	1	2	1	1	2
Females				1				1	3	2
More than 2 hours										
Males				2	1					
Females				1	3					

*Poorer than 25 dB Hearing Threshold Level (re AMSI 1969 Norm)
** = total by group

◁ seen that the thresholds are within normal limits on each occasion. One musician from this group, however, following 9 years as a rock and roll drummer, suffered a 35 dB loss at 3 kHz and although this one case was not considered typical it was concluded[29]:

"Since one musician demonstrated a loss in hearing it can be said that our findings to date support the notion that there are some individuals who are seemingly susceptible to noise-induced hearing loss when exposed to levels of music commonly encountered today. However, the majority of individuals in this study could be exposed to high levels of rock music without suffering substantial changes in their auditory thresholds."

In another pure tone air conduction study, this time involving attendees rather than musicians[30] 120 college students with an average age of 20 years were divided into two groups, each group comprising 30 males and 30 females. The first group comprised those who listened to rock music for less than 2 hours a week, the second, for more than 2 hours a week. The actual exposure periods average out at 41 minutes for Group 1 and 5 hours for Group 2. The results showed that out of the total sample of 120 subjects, only five showed a loss of hearing, and that the occurrences of low fence impairment were equally divided between the two groups with all the 36 dB hearing threshold loss subjects in Group 1, as shown in **Table 3**. The authors conclude:

"...There was no evidence to suggest that audience members who listen to rock music frequently had poorer pure-tone thresholds than audience members who listen to rock music infrequently."

And then of course we have the study carried out for the National Institute for Occupational Safety & Health, US Dept of Health, Education & Welfare, by Fletcher in 1972[1] as earlier cited. To fill in some of the details, the 400 control subjects, 100 rock musicians and 100 attendees were all aged between 18 and 21 and were tested using both high frequency and conventional air conduction audiology. While no change was noticed between the two groups overall, either as a function of age or of exposure to rock music, in the 20-year-old group the rock musicians showed slightly lower thresholds than the control subjects, while for the 18-, 19- and 21-year-old groups the position was reversed. The rock music attendees are reported as attending two to three performances a month as well as listening to loud recorded music played over hi-fi stereo equipment at home for "several hours per day". Thus the conclusions quoted earlier under Overview appear justified and because of the importance of this work I must express some surprise that this study is not more widely known.

To return to the UK, Fearn [18-25] has been active in this sphere for many years, his work apparently motivated by an earnest concern that young people should not suffer premature hearing loss from exposure to leisure activities. Along with Hanson[31] he carried out a well structured study in 1975 in which otologic history, otologic examination and reliable audiometric serial examinations were used to select 29 control subjects and 50 young adults who attended rock concerts or discotheques regularly from a total of 505 volunteers. Although the results of pure tone audiometric testing showed little difference between the two groups—typically less than 5 dB, the authors nevertheless concluded that exposure to rock music is associated with sensorineural hearing impairment.

In two more recent studies[32,33], again following

rigorous otological screening and careful age matching, the hearing thresholds of 83 9- to 12-year-old children who do not attend discotheques or pop concerts were compared to those of 61 children of the same age group who do. In the same study 135 teenagers aged between 13 and 16 who do attend such activities were compared with 88 who don't. The merged results of the two studies, taken from a summary in the MRC Literature Review[11], are shown in **Table 4** and again it can be seen that the differences between the two groups are of marginal significance. Yet the authors conclude that amplified music is the cause of hearing loss in children.

Given a low fence impairment level of 30 dB and a minimum audiometer step of 5 dB Fearn's results seem almost insignificant and certainly do not appear to support the conclusions being drawn. This scepticism is supported by Rintelmann & Bienvenue[34], the MRC Literature Review[11] and by Knight[35] and a study of Fearn's titles[18-25, 31, 32] suggest increasing fervour bordering on obsession, even though his motives are not in doubt.

The final study to be considered was conducted by Martinez & Gilman at the 83rd AES Convention in 1986 on the basis that many AES members would be exposed to high levels of reproduced sound in their occupations[36]. A random sample of 229 volunteers was given pure tone air conduction audiometry to establish hearing thresholds. The volunteers were divided into five age groups and four occupational groups and the results analysed accordingly. **Table 5a** shows the tabulated results of the survey, **Table 5b** the associated table of standard deviations and **Fig 4a** the mean results by age group. **Fig 4b** shows the results after the application of Spoor's Correction[37] and **Fig 4c** the corrected results by occupation.

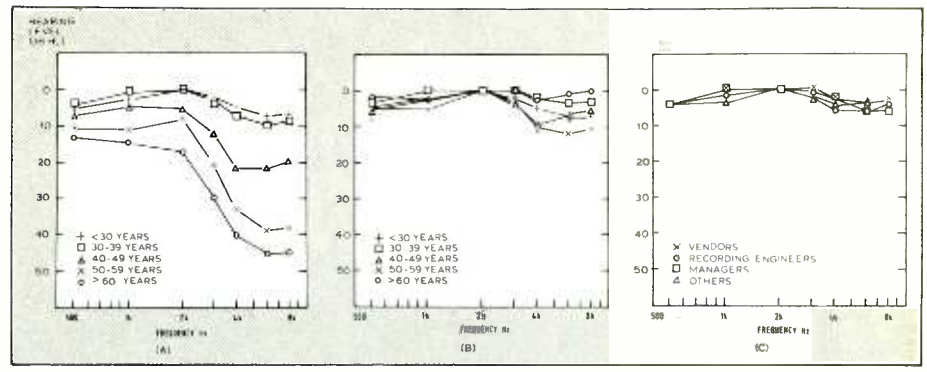

Fig 4a: Mean results of 1986 AES audiometric survey

Fig 4b: Mean results of 1986 AES audiometric survey after application of Spoor's correction for aging

Fig 4c: Age-corrected results of survey grouped according occupation

From **Fig 4a** the authors conclude that as the Spoor Correction has failed to normalise the curves, the residual 4 kHz dip shown in respect of the 40 to 49 year group in particular and the 10 dB or so loss at higher frequencies

TABLE 4 Hearing thresholds of various groups of otologically normal young people

Ages	No	dB HL 500 Hz	1 kHz	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz
Those who do not attend discotheques/pop concerts:								
9-12	83	4.2	3.0	0.8	1.3	2.1	3.8	2.5
13-16	135	6.8	1.3	0.9	0.1	2.4	6.8	5.3
Those who attend discotheques/pop concerts (same sources):								
9-12	61	7.9	4.8	1.6	2.8	4.8	8.1	7.2
13-16	88	8.2	3.8	1.7	2.0	4.2	7.9	7.0
Differences between above two sets of data:								
9-12		3.7	1.8	0.8	1.5	2.7	4.3	4.7
13-16		1.4	2.5	0.8	1.9	1.8	1.1	1.7

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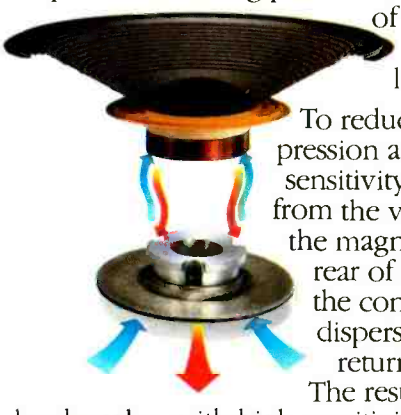

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TABLE 5a Mean hearing thresholds (dB re: ANSI, 1969), uncorrected for age

	Number in group	Frequency (Hz) 500	1k	2k	3k	4k	6k	8k
Occupation								
Recording engineer	100	5.3	2.7	0.9	7.1	12.3	14.0	11.5
Manager	34	5.0	1.5	−1.4	5.1	9.3	13.6	12.7
Vendor	49	7.3	3.8	3.1	8.3	16.1	19.5	19.3
Other	46	6.8	6.5	3.7	10.7	14.8	17.1	17.0
Age								
<30	53	5.2	2.6	−0.6	2.3	4.9	7.2	6.4
30-39	107	4.2	0.7	−2.3	3.1	7.2	9.7	8.4
40-49	37	7.1	4.7	5.4	12.9	21.8	21.8	19.8
50-59	12	10.6	11.0	8.1	20.8	33.3	39.2	38.5
>60	20	13.3	14.8	17.3	30.0	40.5	45.2	45.0

TABLE 5b Standard deviations from threshold

	Frequency (Hz) 500	1k	2k	3k	4k	6k	8k
Occupation							
Recording engineer	4.5	5.4	7.5	9.4	11.8	11.6	11.9
Manager	4.8	5.3	7.3	9.1	11.3	16.6	16.6
Vendor	6.8	6.2	7.9	10.8	12.4	13.6	15.8
Other	5.2	9.7	10.3	12.6	13.8	12.7	12.0
Age							
<30	4.1	4.1	5.9	7.0	8.5	8.1	7.7
30-39	4.1	4.5	6.1	8.3	9.9	10.3	10.5
40-49	4.7	5.9	8.3	13.3	15.3	18.5	19.3
50-59	9.2	10.2	13.0	18.1	20.6	20.4	18.5
>60	9.5	15.0	14.8	15.1	16.6	17.1	20.4

shown for the 50 to 59 year group demonstrates NIHL at a level beyond that to be expected in a normal population. They also express concern over the wide variability in the results as shown in the Standard Deviation in **Table 5b** and the trend towards greater deviation at the higher frequency test tones and upper age groups.

Yet this conclusion appears to be contradicted by the results in **Fig 4c**. Surely, if occupational noise were the cause then the recording engineers group would show greater NIHL than the other groups with managers the least affected but this is not the case and the authors do not address this discrepancy at all in the formulation of their conclusions.

Other studies

There have been many further studies carried out and those of uncertain reliability or not directly relevant have been omitted. Also, those study methods based on histology have been omitted partly because I am sceptical of the relationship between the hearing characteristics of animals with those of human beings and partly because of a general disapproval of the practice *per sé*.

Also those studies whose predictions are based on a relationship between TTS (Temporary Threshold Shift) and PTS (Permanent Threshold Shift) have been omitted because it is considered that the assumed relationship between temporary and permanent changes in hearing threshold is not proven[11,34]. So, while all the available evidence as summarised in **Table 6**, coupled with subjective experience, confirms that TTS is certain to result after exposure to loud music for any significant period of time, its relevance to PTS and NIHL is at present unclear.

Conclusions

For each study that might be cited to support the case for the inclusion of 'music' within the scope of the 1989 Noise at Work Regulations, there is another that will suggest otherwise with equal conviction. Also, conclusions reached by certain authors do not always stand up to scrutiny and it is suggested that a number of papers appearing to support the case for assessment based on the present DRC values can equally be interpreted to make a better case the other way. There also appears to be some evidence to support the widely held supposition that pleasing sounds are less stressful and therefore less damaging, than unwanted noise.

No one wishes to see the hearing of future generations being eroded through exposure to dangerous levels of noise or music, and at the same time, there is no virtue in regulation for its own sake. Most responsible people will react positively to regulation that is seen to be necessary and accepted as reasonable, otherwise opposition is certain and enforcement becomes impossible—as, for example, the outdated UK 70 mph speed limit on the motorway.

TABLE 6 Temporary threshold shift reported after exposure to rock/pop music

Reported by	Year	No of subjects	Age range	Noise level	Exposure time	Freq of max shift	TTS dB	TTS statistic	Time of start of testing after exposure
Rupp & Koch	1969	5 musicians	19-20	120-130 dBC	2½ hrs	4 kHz	25	median	'immediate'
Hickling	1970	4 lab subjects	?	107 dBC	20 mins	4 kHz	8	mean	2 mins
Speaks, Nelson, Ward	1970	25 musicians	?	90-110 dBA	2½ hrs	4 kHz	8	mean	20-40 mins
Dey	1970	15 male	18-25	range 100 dBA	30 mins	2 kHz	14	mean	up to 10 mins or longer. Corrected to TTS,
Jerger & Jerger	1970	5 musicians	17-23	104-124 (dB, octave band)	4 hrs	3 kHz	22	mean	within 60 mins
		4 musicians	14-15	108-116 dBC	4 hrs	6 kHz	15	mean	
Cohen, Anticaglia, Jones	1970	6	teenage	112 dBA	3 hrs	3 & 4 kHz	17	mean	immediate
(quoted in Whittle & Robinson 1974: 128)		5	high school	105 dBA	1½ hrs	4 kHz	6	mean	
Smitley & Rintelmann	1971	40	18-24	110 dB average peak SPL	1 hr (continuous) 1 hr (with 12×30 sec off periods)	4 kHz	27	mean	2 mins
							25		
Flugrath, Irwin, Wolfe Krone & Parnell	1971	7M	13-20	96-113 dBA	10 mins	6 kHz	4		
		19F				6 kHz	12		
		6M			20 mins	6 kHz	7		
		18F				6 kHz	5		
		8M			30 mins	6 kHz	4		
		13F				6 kHz	15	mean	2-5 mins
		6M			40 mins	6 kHz	10		
		9F				6 kHz	15		
		6M			50 mins	6 kHz	3		
		10F				6 kHz	3		
		7M			60 mins	6 kHz	11		
		2F				6 kHz	5		
Rintelmann, Lindberg & Smitley	1971	20 female	20-22	110 dBC continuous 3 mins on, 1 min off	60 mins	4 kHz	26	mean	2 mins
						4 kHz	23		
Redell & Lebo (quoted from Whittle & Robinson 1974:128)	1972	7	22	108 dBA 1 hr estimated		6 kHz	21	mean, at 6 kHz	'immediate'
Ulrich & Pinheiro	1974	14	teens	110-115 dB SPL	3½ hrs	4 kHz	18 (R)	mean, at 4 kHz	30 mins
						4 kHz	15 (L)		
Axelsson & Lindgren	1978	30 musicians		95-110 dBA	50-240 mins	4 kHz	1 to 22	range for 1-8 kHz aver	mostly 2-15 mins
		18 audience		88-110 dBA	45-180 mins	4 kHz	−6 to 21		

◁ The following conclusions are thus drawn from this report:

- The application of current risk criteria (DRC) values to music cannot be justified on the present evidence.
- There is a clear need for further properly conducted and rigorously controlled research on a much larger scale and on all fronts, sufficient to allow new, realistic, risk criteria for music to be determined.
- Based on a balance of the presently available data an interim value for LEP,d should be established to be used in the enforcement of the 1989 Noise at Work Regulations where the principle exposure is to 'music' rather than to 'noise'. The study by Whittle & Shipton[27] has already recommended an intermittency correction of +3 dB, which has not been implemented, although my own suggestion would be +6 dB. This would move the 1st Action Level up to 91 dB LAeq/8 hours and the 2nd Action Level up to 96 dB LAeq/8 hours and would, in my own view, be far more realistic.□

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Barry Fox

The CD player bit race, sound and video engineers clash over tape formats, mic tricks

While recording engineers worry about the upgrade path to 20 bit recording, the people who play the end product are worrying about the upgrade path to one bit decoding.

Until recently CD players did the logical thing and used digital-to-analogue converters to construct a stepped waveform from the 16 bit digital words on disc. Filters smooth the steps. The technique known as 'oversampling' processes each digital sample several times, to spread step noise over a wider frequency range and allow the use of a more lazy filter curve.

But the 16 bit DAC still has to process some bits with an accuracy 65,536 times greater than other bits. However carefully the DACs are made and adjusted at the factory, and however many times they oversample the digital signal, they are still working with 16 bit binary code words. And in any digital system that relies on binary code words, some bits in each word will be much more important or 'significant' than others. Any errors in these Most Significant Bits (MSBs) can make the stepped output signal jump wildly up or down, introducing nasty random noises into the music.

The new idea is to break down the 16 bit words into a much faster serial stream. Because all bits have the same 'significance', errors are never catastrophic—they just steer the signal slightly off course and the mistake is easily corrected. Needless to say, no-one can agree on the best way to do the conversion.

In March 1989 Philips unveiled Bitstream. This prompted Technics (hi-fi division of Japanese giant Matsushita) to announce its rival system, MASH, at a European seminar in May.

Tadashi Abe, the man in charge of CD development at Technics, admitted: "MASH is very difficult to explain—especially after so much talk about oversampling and 20 bit decoding. We started using MASH last October (1988) but did not tell anyone. Now we are using it in all but two of our new CD players. Actually, we wanted to introduce MASH 1½ years ago but we were fighting the 18 and 20 bit battles. But the idea was opposed. The sales force did not understand the system. Now, thanks to Philips, who have started to promote the idea of one bit processing, we can join in."

MASH, short for Multi-stAge noise SHaping was a joint development between Technics and Japanese telephone authority NTT, Nippon Telephone and Telegraph Corporation.

Whereas Bitstream groups the bits into bunches, which vary in density, MASH varies the bits in width. Hence, while conventional DACs are referred to as Pulse Code Modulation devices, Bitstream is a Pulse Density Modulation system and MASH relies on Pulse Width Modulation. Both use shapers to push residual noise towards the high frequency end of the range, leaving less noise in the audible band.

In September 1989 Sony announced a variation on the Philips theme—called the High Density Linear Converter System. HDLCS was developed by Sony in co-operation with NTT, separately from NTT's work on MASH. Later the same month, JVC introduced Pulse Edge Modulation.

JVC offers a crystallised distinction between PEM, Bitstream and MASH: Bitstream samples at 256 times the CD sampling frequency and uses two noise shapers to give a final bit rate of 11 29 MHz; MASH effectively samples at 768 times, with three noise shapers to give a 33.869 MHz stream; PEM samples at 384 times, and uses four noise shapers to give a bit stream running at 16.934 MHz.

So it looks as if the bit race has now become a race to use more noise shapers. It can only be a question of time before this nonsense spills over into the studio world.

While the satellite broadcasters standardise on the Betacam *SP* format, Anglia and Thames TV have opted for Panasonic's *MII*. And while the video engineers enthuse over the picture quality available from the ½ inch metal cassettes used by both these formats, and the freedom it gives to dub through at least three generations for editing, sound engineers are bitching about the sound.

The video signal is, for both *MII* and *SP*, recorded in component format, with luma and chroma on separate helical tracks. But both formats use the same sound system as domestic VHS. Stationary heads lay linear tracks down the tape edge and extra heads on the video drum lay down a two-layer 'depth multiplex' sandwich of FM sound and video recording. So the sound and picture signals are inextricably linked and the sound has to be dubbed to a separate carrier for editing. The sound will not survive as many generations of dubbing as the picture.

The linear sound heads can also suffer from a build-up of clear binder shed from the metal powder tape. This creates an invisible barrier to the head gaps and muffles high frequency response. The solution is regular head cleaning, even if the heads look clean.

If the linear soundtracks are used to record timecode pulses, for synchronising a separate audio tape recorder they often do not survive copying.

> 'What we want,' engineers say, 'is a format that keeps high quality sound separate from the pictures.'

The new Super VHS system suffers from exactly the same limitations. The audio circuitry is essentially domestic and the sound quickly degrades if it is dubbed through several generations for editing.

"What we want," engineers say, "is a format that keeps high quality sound separate from the pictures." Video 8 has PCM sound but picture quality is not good enough for broadcast use. The new Hi 8 format could fit the bill, with greatly improved picture quality and PCM sound separated from the picture signal at the ends of the helical scan tracks. But the code is heavily compressed (by analogue and digital processing) into non-linear 8 bit words. "What we want," say sound engineers, "is 16 bit linear PCM."

Both Sony and Panasonic are working secretly on modifications of Betacam *SP* and *MII*, which use a technique similar to that adopted by Sony's *2800* 1 inch C-format recorder. This sacrifices the linear tracks and uses their small area for helically scanned 16 bit PCM.

The VHS family are working on two ways of putting PCM on VHS (either Standard or Super VHS). One works like the *2800*, by sacrificing the linear audio tracks and extending the video tracks into the released tape area. The other uses extra heads on the drum to lay down a three layer depth-multiplex sandwich of video, FM stereo and PCM. Each is a compromise that either sacrifices compatibility or locks the sound and picture together at the time of recording.

JVC's biggest mistake was to ignore Panasonic's recommendation that the PCM option be introduced along with *S-VHS*, which compromised compatibility anyway.

The hi-fi industry has fads for demonstration discs. It used to be an LP of the *1812* that no cartridge known to man could track. Then *Hi-fi News* magazine put out a CD recording of Mike Skeet's garage door closing. Simply Red, Donald Fagen and Jazz at the Pawnshop have all been favourites. My bet is that Cliff Richard's CD *Stronger* will be the next.

Whether or not you like Cliff Richard, Try Track 5, 'Lean on You'.

I was turned on to it by Capital Radio and BFBS presenter Richard Allinson who was wondering what 'they' had done to Cliff's voice. It's cleaner and closer than anything else I've ever heard. It's as if the microphone is right between his teeth. But there's not a trace of popping.

Curious, I phoned Gerry Kitchingham, who had recorded most of the album at R G Jones in South London.

The trick, if you can call it that, was to use an old valve mic, a Neumann *M49*. R G Jones were lucky and got hold of a nice quiet one.

Cliff Richard sang just 1 inch away, across the mic, with no shield. His voice was pretty breathy that day, anyway.

The album was digitally recorded on Mitsubishi 32-track, and mixed direct to a Sony DAT. A case of old meets new.□

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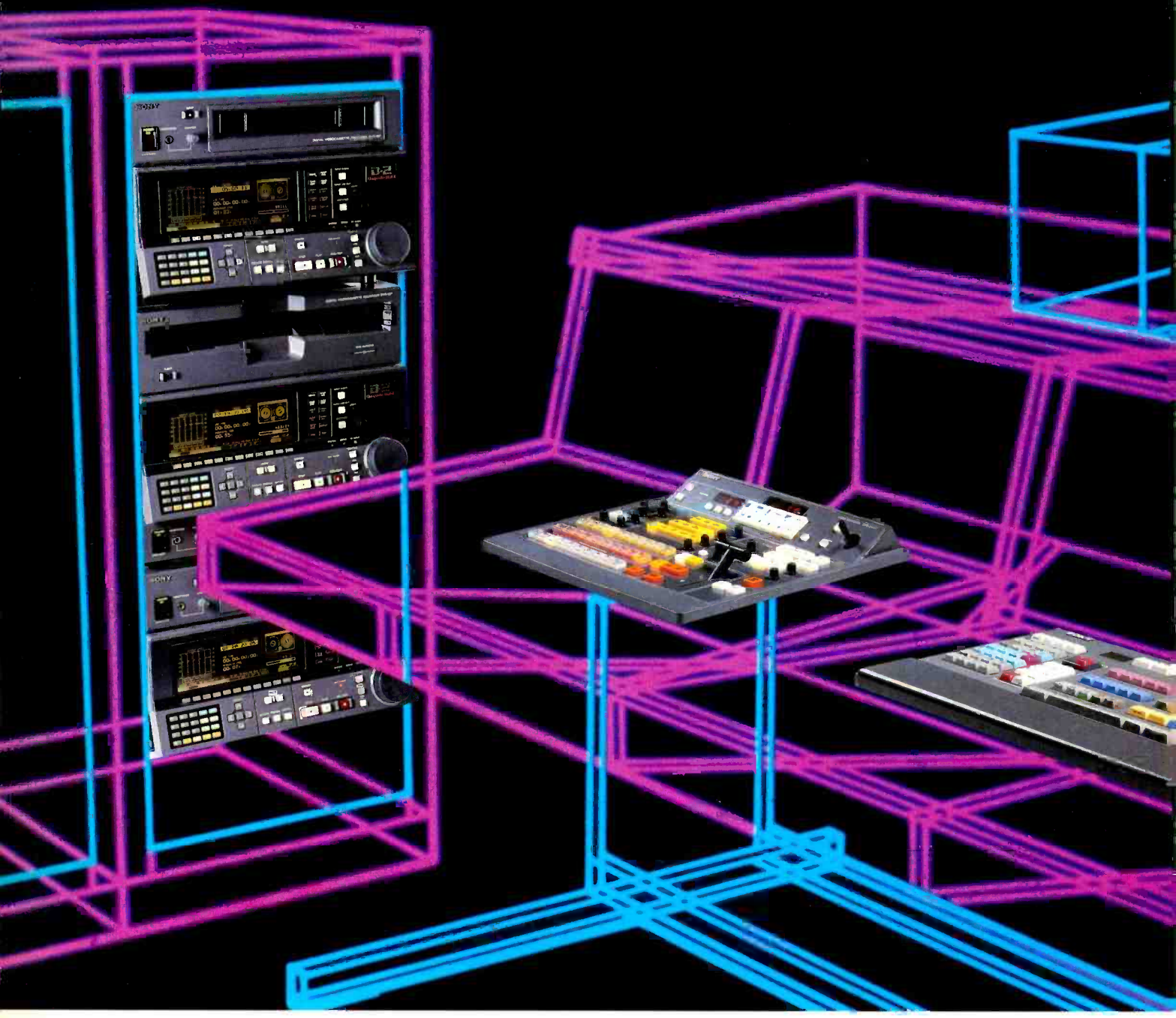

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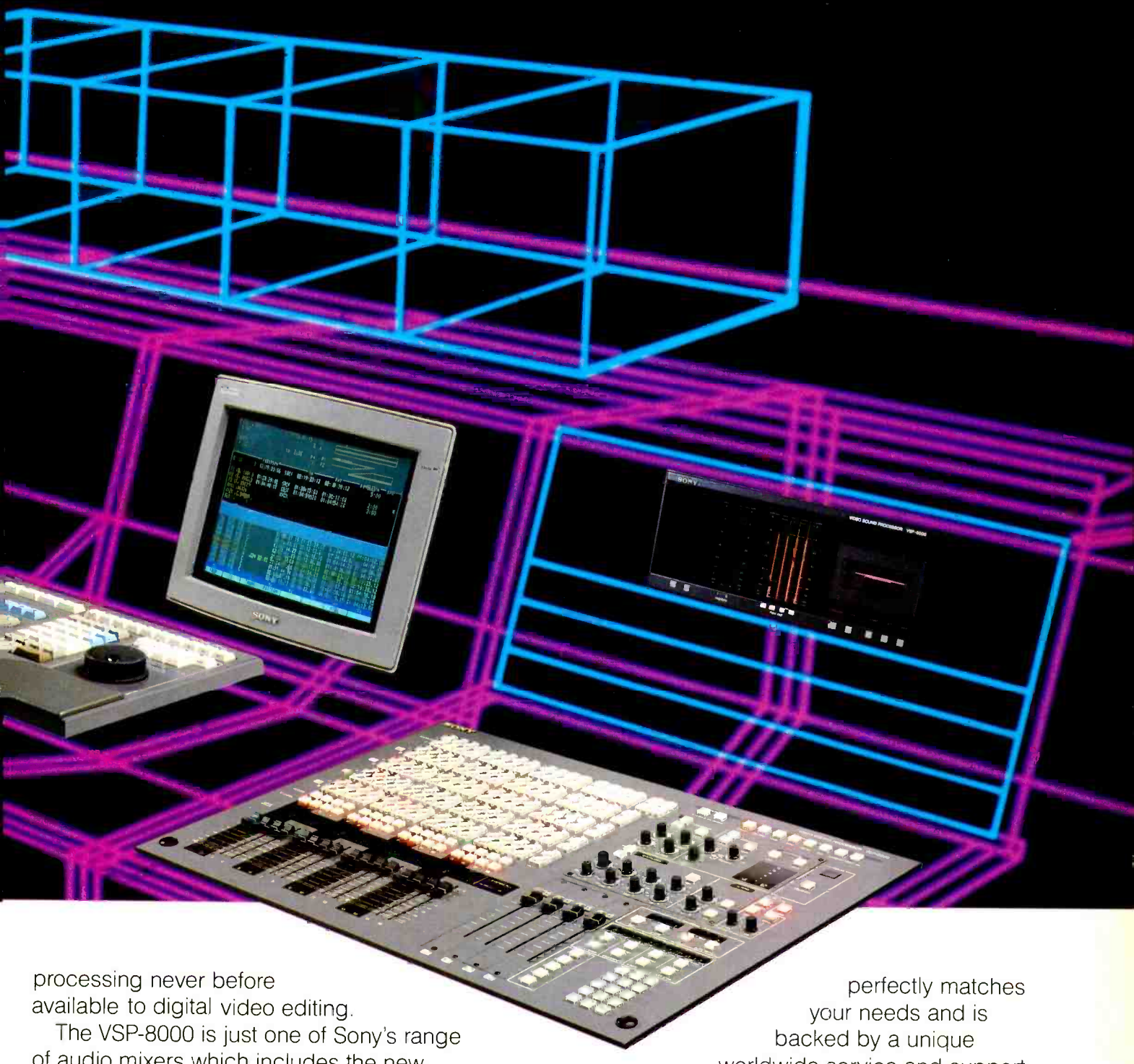

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Sony Broadcast & Communications

Martin Polon

Random thoughts from conventions past and yet to come. Comment from our US columnist

It all started so innocently. The flight had been perfect. The cabin staff were so friendly. The 'surf and turf' had been just that; fillet steak and lobster tail, rather than shrimp caught in a tuna drag net and cow hit by a car, as so often found in airline meals. But I should have known it was going to be difficult when my baggage failed to turn up. After 40 minutes at baggage control, it seemed that my bags had gone on to the West Indies—to the island of Montserrat. Despite my protests that I would have preferred to visit the Caribbean while my bags went to the big city, I was left with an airline kit of disposable pre-applicated toothbrush, disposable soap, disposable paper towels, disposable paper underwear, etc. Armed with this non-permanent bounty, I charged out to the taxi area of the terminal, only to find that the rain had denuded the airport of yellow cabs or those of any other colour, for that matter. Searching the grounds in vain for stabs of yellow pigment on the pavement indicating a yellow cab meltdown, it appeared unavoidable to find some other mode of transport. Having heard that the intellectual giants of the transit board were moving to abandon the bus-linked subway service, that option was not considered available. So the only thing to do was to wait for an airport bus or hope for a taxi.

Indeed a taxi came but the driver immediately began a bidding process for the privilege of sharing the cab with some of the other passengers equally stranded in the airport's industrial ghetto. At $50 per head, the 'Let's Make A Deal' taxi service did not seem a good idea although several fellow sufferers did opt for that choice. 'Investment bankers racing to close a leveraged buyout (LBO),' I thought. Every so often the other passengers or I would spot the airport bus in the distance; like some illusory vessel that beckons falsely to survivors of a shipwreck. Unfortunately, the airport bus never did make it ashore—not at least to our piece of land. I was to find out later that the availability of taxis ceases during violent weather as they tend to stay in the city. The airport bus would fill each time at its earlier stops since there were almost no taxis available. Thus we were forced into the hands of the private limo drivers.

The private limousines and their drivers always gave one the feeling of being summoned to one last meeting with Big Al, with Louis (Icepick) Caponnata driving. This rather childish fear borne of watching the movies *Godfather I* and *II* 17 times on TV had left me with an aversion to such modes of transport. I really had no choice, however, and when the driver solicited me and I noticed his Hispanic accent I felt it was not such a bad deal. Four of us would travel together in a capacious Lincoln limo. Kind of neat. The other three were obviously business types equally stranded as I.

I will never forget that ride as long as I live. It seemed the driver had just been sent to a Defensive Driving school by the limousine company to learn escape and evasion for important customers. To us, however, it seemed the only lesson that had mattered to the driver was that of speed. We left the airport with afterburners flaring and managed to do several wheelies getting on and off the hysterically and humorously named 'expressway'. Every time the traffic slowed, our driver speeded up. He would detour through surface streets broaching residential neighbourhoods at nearly the speed of sound. I avoided looking at the hood ornament, afraid I would find an equal assortment of small children, housewives and grandmothers skewered on that automotive sculpture atop the front of the vehicle. Finally we approached a tunnel under the river, I didn't know its name and it didn't matter—since our driver plunged in at over 60 miles per hour. Finally, we reached the show hotel and after copious apologies from our driver for how much time it had taken getting from the airport, I was ready for the really dangerous part of my mission—the audio convention.

Well, friends, you can tell from my subtle story above how much I enjoy travel in general and audio shows in particular. There are too many meetings that one must attend. Start with the AES US Convention in LA or New York, add the rotating AES European meeting, the rotating AES US Conference, the winter and summer NAMM shows in Anaheim and Chicago, the annual SMPTE Conference in New York or LA, the winter and summer Consumer Electronic Shows in Las Vegas and Chicago, the yearly NAB meeting in Atlanta or Las Vegas, the Festival Du Son in Paris, the Sound Contractors Show in Reno, APRS in London, ITS in Montreux or IBC in Brighton, and you have a show every month of the year. Except that this is not all of them, just the most important ones and these are generally pushed together during the spring and fall 'prime time' for such meetings rather than being stretched out over a full 12 months.

Which brings us to the question of which audio shows are really important? "The definition of which audio show is 'really important' is easy," opted one veteran pro-audio rep. "The really important show is always the one that you miss. Every show you attend will end up being about as fascinating as Sominex. Sleep will come easily. Nothing new, nothing much going on. But if you decide to pass on one meeting or another because of your child's graduation, or your mother's visit—you will discover that you missed the most important professional audio meeting since the invention of the LP record and magnetic tape recording. There will be new product releases of cosmic importance, professional papers so revelational of new technology that showgoers will respond on their knees in tears, and workshops offering near divine guidance. Or so the reports from your compatriots who were there, will lead you to believe."

Does a united Europe want to call its own shots show-wise? One wag suggested that 1992 really meant '19 trade shows a year in 92 European backwaters.' Welcome to the 'Audio Cable Show' in Slough. A stunning Scotch Egg is to be had at the Plough and Skull's 'member' bar. How about the 'Audio Connector Convention' in Blois. Swell chocolate factory there, anyway. And now we have Berlin, quite aside from any humour, as 'the' hot new destination for trade show activity for quite some time to come. In fact, Eastern Europe promises to offer some important venues for the coming decade with the breaking down of the Communist Wall between East and West. Berlin, and Vienna certainly promise to be the most exciting exhibition centres to cross-pollinate audio products into a somewhat reunited Europe.

The question of convention dining raises its caloric head every year at every venue. So does the issue of convention accommodation. It was fascinating to venture out of the show hotel in the Big Apple, in search of affordable sustenance. Having found a pizzeria and having selected two slices of clearly indigenous pizza, I was appalled to hear the cashier announce "11 dollars and 77 cents, please." I commented that I could buy two whole large pizzas back home in Boston, let alone two pieces for that price. After being told that if I wanted to do so, I certainly should—it was dutifully explained to me that the toppings were charged out at 75 cents each and since the two pieces I had selected had onions, peppers, olives and extra tomatoes and extra cheese plus the basic $1.75 charge for the pizza shell—the whole thing came to $5.50 per slice. Times two that was $11 plus tax so "Mayor Koch could have a little taste." Never before having been confronted with needing a bank loan to buy two pieces of pizza, I nevertheless decided to opt for this extravaganza of mozzarella, oregano and tomato since it was obvious that the New York pizza industry had copied common recording industry practice and was 'four-walling' their pizza. The basic price bought you the shell—anything else was extra.

So much for pizza. As to hotel accommodation, one fellow remarked that staying in New York was to "spend more money than you ever thought possible for a room that you never thought possible that you would set foot into."

Security and safety have become very real concerns for both audio convention goers and exhibitors. Several solutions can be offered for problems in various cities. In New York for example, the Paisley Kevlar bulletproof vest coupled with the decorator quilted stocks for the silver-plated Uzzi SMG (sub machine gun) with the inlaid trigger guard provides tasteful solutions to those most minor daily problems of life in New York City. But it is also clear that audio manufacturers have been guilty themselves of not using enough force to control the problems of modern exhibition life worldwide. The two following news bulletins could certainly indicate a trend in solving future show problems.

Dateline: London, March 14, 1995
Authorities announced today that the remains of two suspected audio equipment thieves were removed from the demonstration suite of Audio Audio Audio Ltd, at the luxe Elephant and Castle Palace hotel. The E & C Palace, the new home of the bi-monthly London professional audio salon, had been plagued with minor 'problems' in recent months. Hy Price, managing director of the audio firm commented, "It's not as though we didn't try to feed the dogs. We kept requesting cheeseburgers from room service but the dogs wouldn't touch them. I suppose not enough real meat. But the big problem was that the dogs had 'ahhmm' marked the *EDVR-2000*. You know, the way dogs claim post boxes and the odd such thing. Anyway, the *2000* was marked. If those guys had just taken the *1000*, I think it would have been alright. We were going to have to sell the *2000* to the Bulgarians anyway, since they wouldn't notice the different."

Dateline: Los Angeles, October 22, 1996
The US Nuclear Regulatory Commission announced today that the demonstration suite floor of the newly-built Hotel Savoy East Los Angeles will be usable again in the year 2396. A Commission spokesperson pointed out that the British tactical nuclear weapon used was 'smallish and really quite clean'. Lieutenant-Colonel Anthony Black-White EM (formerly RM) temporarily assigned to the European Trade Show Protective Force (ETSPF), defended his decision to use the tactical nuke.

Recent budget cuts at home had reduced our range of weaponry to a choice between an air rifle and the 'bomb', and it seemed that it was the only way to protect the British exhibits. After all, since 1992, so little that is British is sacred anymore. In addition, the Labour Government has ordered our stock of nuclear devices to be used outside the walls of the United Europe if possible, since our encompassing peace and trade agreement with the Eastern Bloc. And one thing is certain: that audio equipment is safe. I have done my job. Nobody but nobody unauthorised is going to touch it.

Finally, unconfirmed reports of glowing home recording studios have been denied by local Los Angeles authorities. The City agencies responsible for zoning have stated for the record that such uses are in neighbourhoods normally zoned for home nuclear activity. That would make it not a violation of the city's stringent control of home recording activities for that part of Los Angeles.

All humour aside, crime has become a big city issue wherever you are. The recent New York AES show has received a great deal of notice in that department but the SMPTE show in Los Angeles had its reports of problems as well. No one is ever going to depict New York City as being crime free. The drug-gang infested neighbourhoods around the Los Angeles Convention Centre boast a reputation for fear that transcends similar areas at other major convention neighbourhoods in the US. London has become a 'dangerous' city, according to recent Home Office pronouncements. Toronto has become the scene of a 'major crime wave' according to local newspapers. Yet this is where the 'action' is in the audio business. There are over 10,000 professional audio practitioners in the New York Metropolitan Area. Los Angeles boasts over 15,000 pro-audio specialists. London and Toronto are the centre of their own regional audio industries as well as being international centres. But the reality of crime is that it has much less effect in fact than it does in fiction. That is, the news media have created a sense of fear far out of proportion to any reality. Crime numbers in the US have dropped in recent years and the numbers in Canada, the UK and Europe are really quite low relatively speaking. However, if you want to be completely insulated, one must go to certain small towns in Switzerland.

Now, somehow, isolation brings us to the supposed root of 'L'Affaire Montreux'. This controversy certainly does expose the Swiss to a rather darker light than their carefully painted-on smile of commercial affability would otherwise indicate. Many exhibitors have charged that the Swiss are unyielding on issues of customs clearance, facilities access and loading, building safety and proximity of hotel accommodation. In fact, these cynics are missing the fact that the Swiss are really in the business of providing a truly therapeutic locale for professional meetings.

Some experts claim that attendance at Swiss venues, and especially Montreux, reduces the stress normally found with such professional meetings. In winter, there is no nightlife and no daylife. With absolutely nothing to distract you, all of your useful time is channelled into the meeting that brought you to town in the first place. It is the only site in the world other than perhaps Irkutsk, Siberia, that can state 'absolutely no distractions'. For example, if Swiss customs blocks your convention shipment, there is absolutely nothing else to do about it and so you are relieved of your stress. If your hotel is 30 miles away, you will not be distracted by unnecessary contact with other showgoers and will probably have fewer alcoholic beverages and will certainly be twice as productive at the show. And any reports that the Swiss have no sense of humour are just not accurate. After all, clearly, they got you to Montreux in the first place!

On a lighter note, the discussion of convention or show 'parties' becomes paramount, or perhaps that is 'universal'. It is impossible to attend any trade show, be it AES, SMPTE, NAB, CES or APRS without noticing the profusion of show 'parties'. Some of these are events planned by such groups as SPARS or awards ceremonies of specific magazines, while others are receptions of various equipment makers or trade organisations. One of the hazards of such events is the numerous small titbits that are passed around for attendee consumption by the staff of the various hotels that house such events. This column strongly recommends avoiding such unidentifiable repasts. However, if you must indulge and hope to avoid squandering valuable show time on polishing up your digital two-step in your hotel commode, the following guide may help.

In New York, the morsel that looks like red leather on a piece of old shoe sole is actually sun dried tomatoes on pumpernickel bread. Similarly, the red patent plastic on plywood is actually smoked salmon on yellow egg bread. In Los Angeles, the old small plastic pipe dripping with adhesive is actually a Vietnamese spring roll with sauce. This noodle wrapper with vegetables and ground mystery meat can be very good but it is usually best to command the titbit to 'fetch' or 'rollover' to verify its origin. In the Nevada desert, Las Vegas hotel snacks that look like 'roadkill', probably are. Vegas hotels are also not supposed to lower the lighting completely at receptions so that certain food items would be seen to glow in the dark. This helps to explain current US policy for waste disposal at the adjacent nuclear test site. In London, confer with a board-registered gastroenterologist before trying miniature Scotch Eggs or Pork Pies. Remember that many think that these items were invented to torment the English conquerors by the Scots and the Welsh. In short, look before you eat!

Overlaps with other shows is one of the elements of audio industry planning or the lack of it that further adds the spice of life to the rigours experienced by convention goers. One can only imagine that municipal road construction planners, after a lifetime of carefully co-ordinating the virtually continuous blockage of major traffic arteries around the world, have retired to a second career of scheduling audio and audio/video conventions simultaneously. No other excuse could justify the incredible log jam of meetings in 1989 and 1990. It is not the province of just one organisation; many hands are stirring this foul brew of convention confusion.

Where do we go from here? There is much that is wrong with convention going in the audio and audio/video industries. But mark these words. These conditions of malaise are not exclusively the province of the wonderful world of audio. Industry wags have commented recently that maladroit convention planning seemed to be limited to the audio arena with computer, aerospace and video shows being held up as paragons of planning efficiency with only four 'major' events per year. In fact, these industries all have more than four important events per month—let alone per year. The computer industry is faced with at least two Comdex shows every year (Las Vegas and Atlanta), a West Coast Computer Faire, Interface (Dallas), Northeast Computer Show, Unix Solutions, Government Computing, several Macintosh-based shows, Interex, graphic shows, artificial intelligence shows, software shows, etc. Component shows such as Wescon and Electro also are computer industry must-do's. Aerospace shows are so numerous that a detailed listing had to be discontinued by a major aerospace industry publication since it consumed so much space. Video shows include NAB, SMPTE conference and convention, SBE, IBC, BKSTS, ITS, Video Expo, several European conferences, NCTA, military electronics expositions, regional cable shows, audio-visual shows, etc. The point here is not to engage in a piscatorial pissing match about show body counts but to accept the fact that societally we have succumbed to an unprecedented information explosion in the form of industrial expositions. If we are not to go the way of Imperial Rome, we had better learn to control our show-going environment. *Et tu, Brute.*□

FULL SAIL

Michael Fay traces the 10-year growth of this audio school and describes their facilities and philosophies

Recording studio engineering first became glamorous in the mid '60s, with the advent of 4-track recording and the British invasion of the American pop music scene. Since then, thousands of aspiring engineers and producers have attempted success and fame. For most, the road to even marginal prosperity has been long and arduous—10 years being the average gestation period for freelancers.

In the late 1970s a new audio niche was beginning to form, partly born out of need, partly of greed. These were 'schools' offering classes in engineering and production. Many of these schools were fronts for studios that couldn't keep their doors open without the cash infusion that unwary or starry-eyed students could regularly supply. The value and reputation of such programmes was clearly in doubt.

By 1977, Jon Phelps had made up his mind to make engineering his career. But Phelps lived in Dayton, Ohio, which was not exactly a hotbed of recording activity. His efforts to find an acceptable audio engineering school proved unsuccessful.

Recognising that there might be a real need for a good audio engineering school in that part of the country, Phelps started the Full Sail Recording Course in 1979. In April 1980, after a brief period when classes were held in Illinois and Florida, Full Sail moved to its first permanent headquarters in Orlando, Florida.

In the beginning Phelps initiated a three-point philosophy that still guides the school today: provide the students with access to the most contemporary technology available; hire experienced professionals to teach and allow them to 'moonlight' so they can stay current with their professional skills; position the school central to the industry—the school and its graduates must be an active part of the industry, not just fringe players.

From 1980 to 1982 the company had just five full-time employees. The staff was augmented using freelance engineers and guest lecturers. This is a practice that continues today. From 1982 to 1985 the staff grew slightly, averaging seven employees.

Synclavier Suite 3

In 1986 Full Sail became an accredited school, initiating a sudden surge in enrolment. The real growth began in the summer of 1987 and took them from a staff of about 10, to around 85 today. Earning accreditation involved many steps. The school went through 18 months of preparation, aligning such things as their accounting and record keeping systems, to suit the National Association of Technical Trade Schools (NATTS) accreditation committee. (In the US, NATTS accreditation is the most sought-after stamp of approval for trade schools.) The programme is also licensed by the State of Florida and established as an accredited programme with the University of Central Florida and Middle Tennessee State University.

In September 1987, the school became eligible to offer PELL grants (financial aid based on the need for assistance), guaranteed student loans and two other government-endorsed, low-interest loans. "The accreditation opened the door for us to apply for financial aid for our students," says Garry Jones, senior vice-president and director of admissions. "Up to that point, we had only 'cash' students."

As the student population went up, so did the need for additional facilities. In July 1989, Full Sail and its sister companies Platinum Post and Platinum Creative, moved into their new 23,000 ft^2, six-studio complex in Winter Park, Florida.

Enrolment

As part of the pre-registration process, prospective students take a short 20-question enquiry. This serves the dual purpose of evaluating the prospective student's level of understanding and giving them a taste of the type and level of education they might expect before enrolling.

"We tell the prospective student that this is not a scored test," says Jones. "It gives everyone involved some perspective. There are very few prerequisites for enrolment, the Recording Arts Program is designed to start at the very beginning."

The most complete courses are the Recording Arts Comprehensive Program and the Video and Film Production Comprehensive Program. Each lasts about 9 months. Students can enrol in either or both but they cannot be taken simultaneously. Tuition for the Recording Arts Comprehensive Program costs $13,700.

The Recording Arts Comprehensive Program consists of 10 modules, each dealing with a specific subject. For example, there are modules for recording engineering, music video and music business. As an alternative to the complete Comprehensive Program a student can take almost any combination of individual modules. The audio modules run from 8 days, which is an introduction to the recording arts, up to 4 weeks. Individual modules range in price from $420 to $2,500.

"Today probably 90% of our students choose the Comprehensive Programs," says Jones. "That has changed over the history of the company. When we offered our first Comprehensive Program in 1984, the roles were reversed."

In the recording engineering module, a student's typical day consists of 4½ hours of lecture/theory classes, and an additional 3 hours a day in labs—the hands-on training. The students enter each module and 'live' there until they either complete it, walk away from it or graduate to the next module. According to Jones, 88% of the students that start a comprehensive course, finish it.

There are currently 263 students enrolled at the school. The new facility allows that number to increase to 576 per year. In spite of these numbers, the school maintains a self-imposed maximum limit of six students per lab instructor.

Curriculum

The students leave Full Sail having basic skills. They encounter everything from signal processing to tape machine calibration. They know about automated mixing but not before they learn non-automated mixing. "A lot of them are very good but we don't try to make any of them think they are experts," says Jones. "We are very real with the students."

The instructors tell their students that even after completing ▷

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The Recording Arts Comprehensive Program

	Contact hours	Weeks of training
Introduction to the Recording Arts	42	1
Music History	62	1
Tapeless Studio	80	2
Recording Engineering	184	4
Advanced Recording and Production	180	4
Sound Reinforcement and Concert Lighting	144	4
Studio Maintenance and Troubleshooting	144	3
Music Business	80	2
Music Video	188	4
MIDI Music	80	2
Internship	240	6
Totals	1,424	33

Many of these courses are divided into several classes. For example, the 4 week Recording Engineering course outline breaks down as follows:

- Basic audio engineering, 69 hours

Topics include acoustic design, the recording chain, principles of sound, studio management, disc mastering and studio terminology. Use of outboard equipment, the recording console, magnetic tape, multitrack tape machines, microphones (types, characteristic, placement) and power amplifiers are also studied.

- In-studio engineering, 72 hours

Focus is on the recording console and multitrack tape machines. Recording live tracks and the use of outboard gear is emphasised along with session setup procedures, microphone placement, and client relations. Ear training, getting basic sounds, overdubbing, sweetening, sub-mixing, editing, the care and handling of master tapes, the cue system and cue mixing are learned

The Advanced Recording and Production course is also 4 weeks and includes the following subsections:

- Advanced recording/engineering (108 hours)
- Calibration (5)
- Job market (6)
- Studio management (2)
- Psychology of engineering (4)
- Digital recording (8)
- Music production (22)
- History (8)
- Automated mixing (10)
- MIDI (4)

Other classes

- Introduction to music production (17 hours)
- Introduction to live sound (2)
- Synchronisation and MIDI (4)
- Career planning (8)
- Studio instrumentation (8)
- Introduction to music business (4)

Video

In October 1988 Full Sail began their new Video and Film Production Program. The comprehensive programme consists of 41 weeks of study covering virtually every phase of film and video recording. Like the audio courses, this programme is designed in modular format and covers areas such as: Television production and post-production, lighting, special effects, set design and construction, creative writing, recording engineering and working with talent. The programme director is Elizabeth Railey.

◁ the Comprehensive Program they are typically not prepared to walk into a studio and be recording engineers. As Jones puts it, "We tell all our students and (potential students) right up front, in their face, hard core, that they should not expect to walk out of this school and into an engineering job."

The theme throughout the Program is, "We're going to give you the basic skills you need to be ready for an entry-level job in your chosen area," says Jones. "If the students want to work in sound reinforcement, it probably means being a roadie. In a studio they'll be a 'gofer', on the video side they'll be grips. That's probably the level at which they'll start, regardless of how much training they have."

Also, the curriculum is constantly updated. "We place a lot of value on the student comment sheets and on what our guest lecturers say. We don't wait until the end of the year to make changes," says Jones. "For example, when we first added tape machine calibration to the Comprehensive Program, one of the comments was, 'I didn't get enough hands-on exposure to tape machine calibration.' Since then we have nearly tripled the number of hours that the students spend learning this procedure."

Along with the expected priority toward the operational aspects of the hardware, the school places a very heavy emphasis on attitude, personality and communication skills—areas that many studio owners consider the most important. Often, the biggest mistake made by novice engineers is saying the wrong thing at the wrong time.

Attitude, personality and communication skills are taught in a studio etiquette class and continually stressed throughout all the modules. The message is, "You go in with a humble attitude and you work your butt off," says Jones. "The students are told over and over that the industry owes them nothing just because they graduate."

Evaluations

Before moving on to a new module, certain basic requirements must be satisfactorily completed. Grading for most modules is based on the instructor's comment sheets, lab scores, quizzes, midterms and a final exam. To prevent cheating, three tests are rotated so the students never know which one they are going to get. The following examples are from one of the exams:

1 Diagram the hookup of a three-machine SMPTE sync session. Machine 1 is a ¾ inch VTR; machine 2 is 24-track audio; machine 3 is a mixdown machine with your choice of formats and SMPTE. Show the relationship of the console, video monitor, audio mix, SMPTE code, and all control cabling.

2 An engineer brings in his own mic preamp and EQ, and says he'd like to avoid all electronics of the console going to tape. What patch points would you look for to make his connections work?

The main areas of evaluation are: technical, practical, people management and applications. The grading system uses the standard A, B, C, D, F letters, with a numerical grade of 96% to 100% being an 'A', and 0% to 74% an 'F'.

Graduates of Full Sail's Comprehensive Program do not receive a degree, they get a diploma. The diploma simply states the courses the student has taken and how many hours they have successfully completed. At graduation the student's diplomas are withheld until their internship has been successfully completed.

Placement

All education programmes of merit point to their ability to place their graduates into the workforce. Full Sail is no exception. A 240-hour intern programme has been established to bridge the gap between Comprehensive Program graduates and their prospective employers.

After completing their academics in Florida, students are asked to choose six studios—anywhere in the world—where they would like to do their internship. "The students do the research with the help of our placement department. They pick and prioritise six studios for their wish list," says Jones. "There are no guarantees that the chosen studios will agree to participate but as the programme grows in respect, more and more studios are accepting our interns."

From there, the placement department calls, makes the ▷

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Maintenance lab class at Full Sail

◁ introductions, handles the correspondence with the studio managers or whoever is in charge, and actually supports and services the intern programme. Using professional administrators takes a lot of pressure off the students, who may not be fully confident of their skills or how to approach a potential employer. "Having a full-time placement department has proven to be a very great door opener for jobs," says Jones.

The responsibility for determining the successful completion of an internship lies with both the student and his supervisor. To receive credit, the student must maintain a daily log of his primary duties, which must be submitted to the placement department at the end of the intern period. "It is also the responsibility of the studio manager or immediate supervisor to fill out a questionnaire that we supply," says Jones. "This is a pass/fail situation. We are looking for a favourable report from the supervisor."

According to Jones, Full Sail tracks and fully documents the placement statistics of their students. "In the academic year of 1987 our placement statistic was 92%. In 1988 we went just a fraction higher, to 92.8%. When asked to define placement, Jones said, "To us, placement means that the student got his or her desired, paying job." All in all, Jones estimates that the majority of their grads go into studio recording, another 25% go into sound reinforcement and about 10% opt for broadcast work.

There are no statistics to indicate how long the students stay in those jobs but, if needed, Full Sail stands ready to help them find another job. The placement service is available for an indefinite period of time—weeks, months, even years.

Continuing education is another of their value-added services: "Our school is open to any graduate who wants to come back and audit any class," says Jones. "There is no cost or time limit." While in Florida, I talked to one student who was part of the school's class of 1979. She had recently moved back to Orlando and was taking the Tapeless Studio course as an adjunct to her singing career.

Degree programmes

Jones speaks for the entire staff when he says that Full Sail has a lot of respect for 4-year degree schools. "Certain programmes cater to a section of the student market wanting a double major with a strong emphasis on music theory or electronics, and audio engineering. Those students are looking for programmes such as the ones at the University of Miami and Berkeley's School of Music."

Full Sail caters to a different segment of the market. "Instead, our students want to concentrate on equipment operation and how to understand the industry," says Jones. "Do it quickly, concisely and get out and get a job." Interestingly, some of their current students had previously completed audio-oriented, 4-year degree programmes—only to enrol at Full Sail to get more hands-on experience.

Facilities

Of particular importance in the design of the new complex is the fact that Full Sail also caters to a professional clientele through Platinum Post, the commercial arm of the company. Platinum Post puts a considerable effort into servicing their clients and it is critically important that the student population and the professional clients be kept separate. For this reason the facility design has to work for students and instructors as well as for engineers, producers, artists, and film and television clients.

With that objective in mind, Jon Phelps selected studio designer/architect John Storyk to orchestrate the complex needs of the new facility.

There is a variety of classrooms, lecture halls and labs/studios in the new facility. Each floor of the two-storey structure has a lecture hall that holds up to 80 students, and two sets of small classrooms that can each be opened into a medium-sized room. Studio A, Studio V and the three *Synclavier* suites are all labs/studios—each has the dual function of serving both student and professional needs.

Studio A is the main multitrack room. Connected to it are three live recording areas and Studio V's sound stage. The main recording area has a 26-ft ceiling and a tiled floor. Studio V's 35×30 ft sound stage ties directly into Studio A and because of its very live acoustic, is becoming a favourite room in which to record drums. There are also two small overdub rooms that adjoin either side of Studio A's main room. They are 60 ft² and 75 ft² respectively.

At the moment Studio V serves as a video editing suite, a post room and a lab for class camera shoots. "Studio V is an audio studio waiting to happen," says Gary Platt, director of advanced studies at Full Sail, and vice-president/chief engineer for Platinum Post. "We built it thinking that for the first couple of years it would be a video studio but the way things are going, it's going to be an audio studio much sooner than that."

Sync 3 is the most elaborate of the three *Synclavier* suites. It features a 36-input Neotek *Elite* console, two sets of Tannoy *SMG10B* monitors and a Fostex *SW12* sub-woofer for each set of *10B*s. One sub-woofer is located under the console, the other under the *Synclavier*.

"This allows a single operator to sit in front of the same monitoring configuration when working at the axe or the console," Platt says. "This arrangement is working well to overcome the typical, single monitoring system problems where the guy sitting at the axe isn't able to hear what he is supposed to." All three *Synclavier* suites are structurally the same and have essentially the same hardware. The finished work is what varies.

There is yet another large classroom at another location. It's actually an auditorium that serves as a classroom for the sound reinforcement module. There, rigging, lighting and full-scale concert sound system setup and operation is taught under the direction of Dana Roun. ▷

Equipment

Full Sail/Platinum Post facilities partial equipment list

Consoles

Neve 60-input V series with *Flying Faders*, *SSL 6000E* with *Total Recall*, Sony *3036* with automation, Neotek *Elites*, Sphere *Eclipse*, Yamaha *1608*.

Tape machines

NED *Direct-to-Disk* digital 8-tracks, Mitsubishi *X-880* digital 32-track, Studer *A-800* 24-track, Otari *MTR-100* 24-tracks, Otari *MX-80* 24-tracks, NED *Synclavier* digital audio workstations.

Monitoring

Tannoy *FSM-U*, Meyer *833/834* system, Fostex *LS 2B*, Hafler power amps

Outboard

Adams-Smith, AMS, Aphex, BBE, dbx, Dolby, Drawmer, Eventide, Lexicon, Roland, tc Electronics, Timeline, Yamaha

Microphones

AKG, Sennheiser, Shure, Neumann, E-V, Audio Technica, Sony, Crown

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Control Room A

◁ In addition to the new facilities, the old Altamont location is still home to Platinum Recorders and Parc Studios. Platinum Recorders is Full Sail's mobile truck, which also serves double-duty as a classroom and professional facility. Parc Studios, serves as yet another hands-on training lab.

Security

Because it is essential to keep the student population and the professional clients from interfering with each other, an access-limiting system had to be devised. The problem: how to elegantly limit access to some while admitting others.

Storyk found the solution in the Sielox Threshold *4100* security system. This system allows employees, clients and students access to specific studios or areas at specific times by scanning electronic signature cards via infra-red proximity readers. The access codes are fed to a central computer that controls magnetic door locks in all areas, with all card activity being logged for security reports.

The system also controls lighting and heating, as well as keeping track of the students' daily attendance. There is also a CCTV system that monitors the halls. The CCTV network is fed into the maintenance shop for monitoring.

"Another of the complexities of having a school and a professional studio together in the same building is the need to give tours," says Platt. "That is really difficult to do when you have clients in. One of the things we've done is put two conference rooms on the second floor, overlooking Studio V's sound stage."

The conference rooms are set above Studio A and have triple plate-glass windows. "There are two, 28 ft. sand-filled, solid concrete-block walls between the studio and those conference rooms," says Platt, "and there is absolutely no leakage. I've had rock 'n' roll bands with Marshall stacks on the sound stage, and you can't hear a thing when you're in the conference rooms. It has to be like that, we can't have the sound bleeding into the school."

The CMR

The central machine room ties together everything in the building and is critical to the effective operation of the complex. In each classroom and control room there are 24-pin Elco connectors, a *Synclavier* connector for complete *Synclavier* and *Direct-to-Disk* control, and video tie lines. A two-way camera/monitor link can be established between Studio A and one of the classrooms, and with an audio patch from the control room to the classroom through the CMR, two-way interactive in-studio demonstrations can be given.

"If we are doing a mix demonstration, all the sound can be played back in the classroom over the large Fostex or Tannoy monitors," says Platt. "That way the students can get good sound and see what's happening. When we have guest instructors such as Bruce Swedien or Tony Bongiovi, they can go into the studio, do a mix, and the students can ask questions about what's being done and how the console is being used. This allows us to have the equivalent of 80 people in the control room."

Other routing available through the CMR includes telephone patching to anywhere in the building. Also, there are microphone and audio tie lines in the lounges, halls, offices and classrooms.

Another handy feature is the custom guitar jacks in the patchbays of the Sync suites. These jacks, labelled 'guitar' and 'guitar X', were installed specifically for routing low-level instrument signals to other studios. The 'guitar' jack is a straight line to the CMR, 'guitar X' goes through a Jensen transformer that steps down the signal before it leaves the control room. When the signal arrives where it is needed, it goes through another transformer and is stepped back up to its original level. This solves the inherent problems of recording an amp in one room while the player is in another.

The CMR's air conditioning system incorporates a unique energy-saving feature. "All the air is ducted to come up through the floor and cool the equipment racks first," says Platt. "This has proven to be an effective alternative to cooling the room first. Once the air leaves the racks, it spills into the room itself, cooling the people working there."

The facility's wiring scheme was designed by Ted Rothstein of New York. Twenty-six-pair Gepco snakes were used for all the audio applications. "We felt the Gepco represented a happy medium between esoteric cable and the least expensive cable available," says Platt. "We ran lengths and did tests, and to be honest with you, we couldn't tell any difference. For the video lines we used Belden *8281*, which is a very high grade cable—we couldn't get away with anything less." The facility adopts the following guidelines for balanced connections: Pin 2 is high for mic-level connections.

Their biggest concerns were with the *Synclavier* data lines. Problems started cropping up in runs over 75 ft. "What normally happened was that the 'velocity' data got lost," says Platt. "We discussed our needs with NED and their engineers designed some extended distance boards. We have data runs of up to 160 ft, and with the extended distance boards, everything works perfectly."

For the MIDI runs they opted for another very high-grade wire, Global *C4-223*, which is a four-conductor, extended distance cable that has less capacitance than most MIDI cables. They haven't had any problems with MIDI data losses over long runs. When needed, they are using DA-type boosters to get MIDI from the *Synclavier* suites to other rooms.

Market saturation

With the opening of their new facility, Full Sail may now have the most sophisticated training facilities of any audio school in the world. While all this is obviously designed to attract as many students as possible, at what point is there concern about market saturation?

"If you had asked me that 5 years ago," says Jones, "I would have said that we may be approaching the saturation point. But that doesn't seem to be the case. There seems to be endless possibilities for a graduate who's willing to work hard. The proof is that our placement statistic keeps getting higher and higher."

With today's placement statistic at slightly under 93%, compared to 33% in 1985, the placement department has obviously built up a large list of satisfied contacts. These contacts are in all disciplines of audio—from radio to sound contractors, recording studios to theatre. They try and leave no stone unturned.

As further proof of a growing market for pretrained, entry-level engineers, Jones said that in 1985, when they did their first placement measurement, there were about 12 competing schools. Today there are about 80.

Income potential

Income potential, lifestyle and job security are at the back of everyone's mind but not often expressed at the student level. These topics are covered in a lecture called Careers in Audio. In

this class an instructor explains what jobs are available, what the titles are and what those people do.

They talk about positions in sound reinforcement; mix engineer, monitor mix engineer, roadie. Recording engineer, studio manager, maintenance technician, assistant engineer and gofer are the in-studio job descriptions covered. "We look at things such as salaries, glory and life expectancy—meaning how long can you do the job and remain happy."

The students are told that the life of a recording engineer involves a non-fixed schedule, and that they had better think about that if they also want a spouse and children in their lives. They talk about a schedule that might involve working all days one week and all nights the next. They then pose questions such as, "How long will you be happy working like that?" This process is intended to make the students think, not give them every answer.

"As for salaries, we take averages from the information that has come back to us through our grads," says Jones. Most of our people that become assistant engineers start at $5/hr, regardless of the city. The cost of living doesn't seem to have any bearing on the rate." But, as the instructors point out, the money that 'first' engineers make does vary from city to city. In Orlando the average is around $11.50/hr. In California, it's more like $20 to $25/hr.

"Our feedback tells us that it takes between 6 months and a year for a graduate to move from gofer up to assistant engineer. Assistants usually work 1 to 2 years before they are cutting tracks."

Jones emphasises that the students are told there is no demand for entry level jobs—that they have got to find a place for themselves. "We tell them not to look for ads and not to send out resumés, because it's a total waste of time."

To get a job it is suggested that the graduates pack their bags, go to the city where they want to work and set up interviews. Call up the studios, get a tour and do whatever's possible to get their faces in front of the people they may eventually be working for. This also gives the student a chance to check out the place before asking for a job.

Full Sail acts as official training centre

In June 1989 Full Sail completed their first year as New England Digital's official training centre for the *Synclavier* and *Direct-to-Disk* systems. An intermediate Tapeless Studio course is now offered and is specifically designed to provide maximum hands-on training for professional *Synclavier* and *Direct-to-Disk* operators. The course lasts 1 week (40 hrs) and is limited to two people per lab. In addition, the school offers a similar, on-site training programme.

Rupert Neve Inc also use Full Sail as their official training centre for their *V* series consoles and *Flying Faders* automation. As part of the agreement between Neve and Full Sail, Platinum Post and its creative team, Platinum Creative, are producing educational and promotional videos for Neve.

Conclusion

When I took this assignment I was very sceptical of recording schools. I went in with the idea of exposing some of the chronic shortcomings of such programmes. My visit to Full Sail caused a 180° turnaround in that opinion.

I spent 3 days at the school; interviewing and taking tours about half that time. The other half I was allowed to roam freely. I sat in on several of the classes—actively participating in one. In every case the classes were well structured and the information provided was fundamentally sound.

This is truly a dynamic programme. What impressed me most was the unambiguous policy of telling the students exactly how difficult life is for most aspiring engineers.

Special mention must be given to the management team. It is rare to find a company with so many dedicated and focused managers, each exerting positive energy toward a unified goal: the success of their school and its graduates.□

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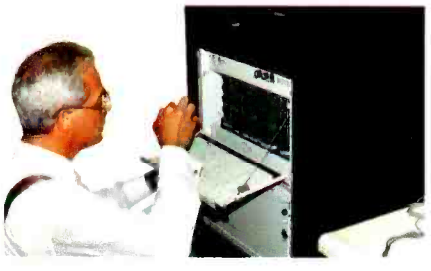

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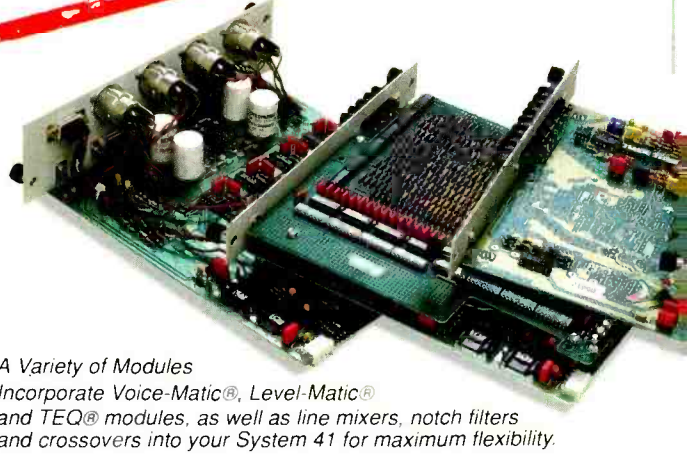

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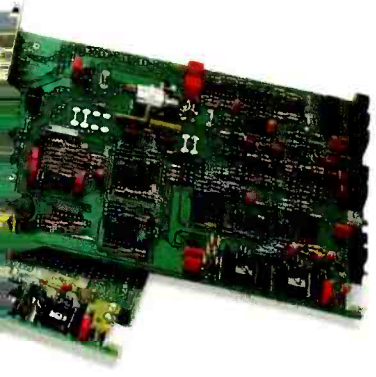

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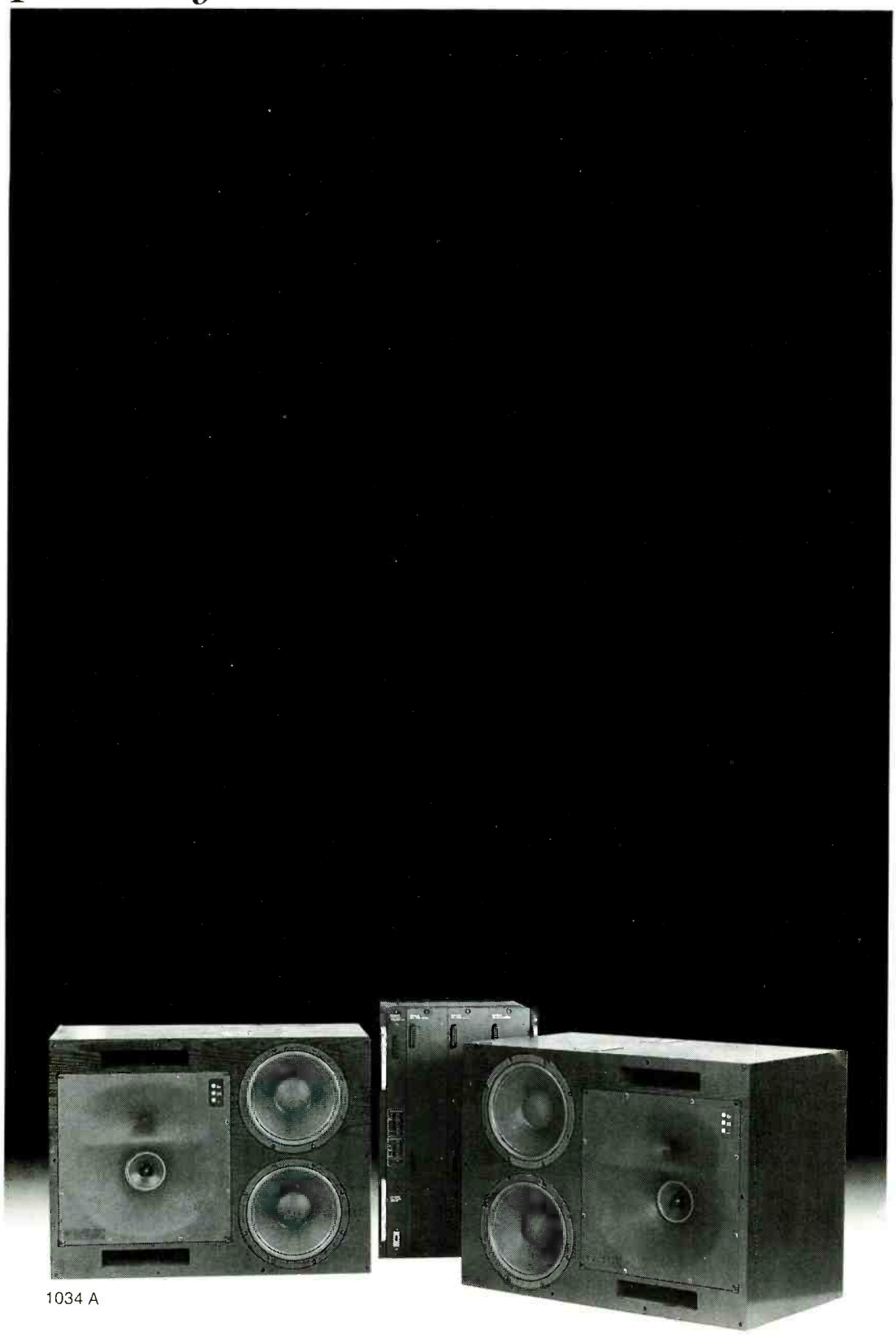

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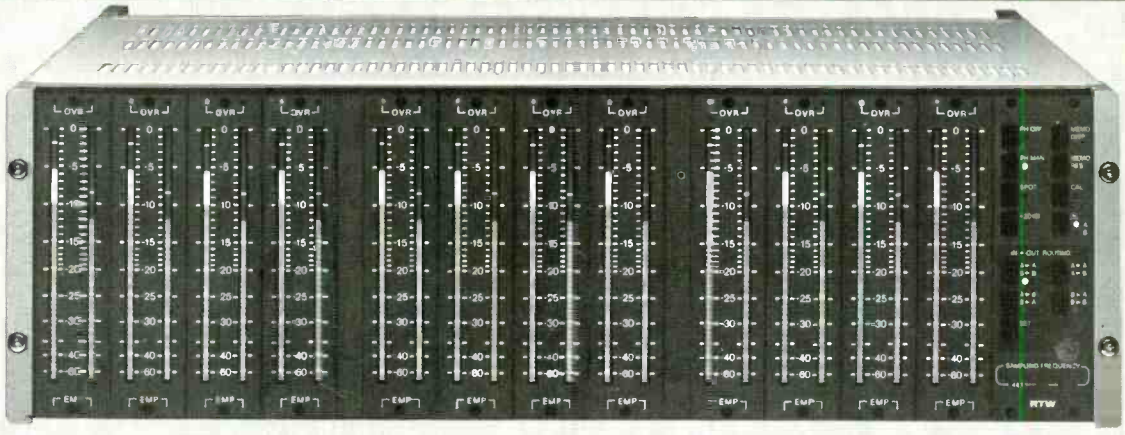

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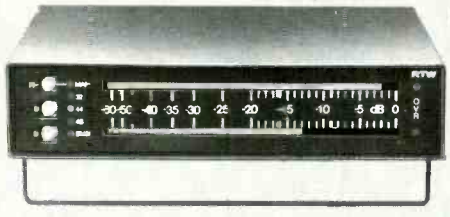

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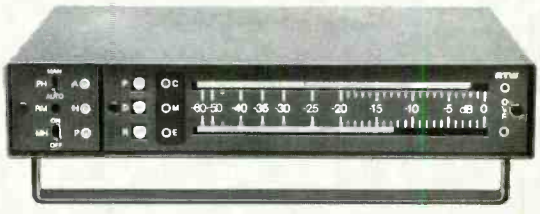

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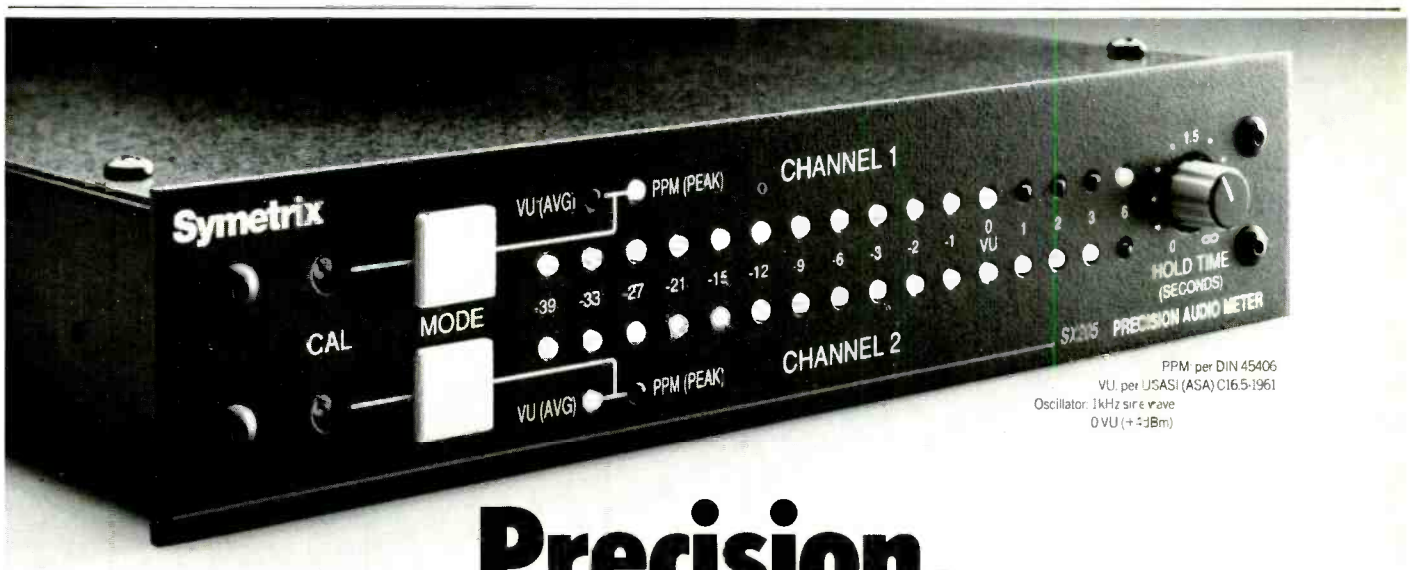

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SOFTWARE FOR THE YAMAHA C1

Following his review last month Mike Collins summarises some of the wide range of software available for the C1 computer

The *C1* is well-supported with a good range of music software from a variety of manufacturers and, being IBM-compatible, with an enormous range of other programs of every imaginable type.

Yamaha supply two other programs along with the *C1* and *CSQ1* sequencer—the MIDI Monitor and the Bulk Manager. These could be very useful in any studio situation where there are a large number of MIDI devices being used: A MIDI Monitor for fault-finding, or 'debugging' and a Bulk Manager for storing all the memory data in one convenient place.

Many IBM-compatible music programs have been ported to the *C1*, several of which have been in existence for a number of years, and have proven their worth. There is also a large number of popular business programs available for IBM compatibles, which can be run on the *C1*.

Bulk Manager

A Bulk Manager program supplied with the *C1*, aims to provide a convenient method of storing all the data (other than sequencer data) for a piece of music onto a single disk. Many MIDI devices are able to store their settings in internal memories and then transmit the information via MIDI system exclusive Bulk Dumps to a computer. Such devices include not only synthesisers, which memorise their patches, but also drum machines with their rhythm patterns, digital effect units their program data, MIDI/SMPTE units their setup data, and so on.

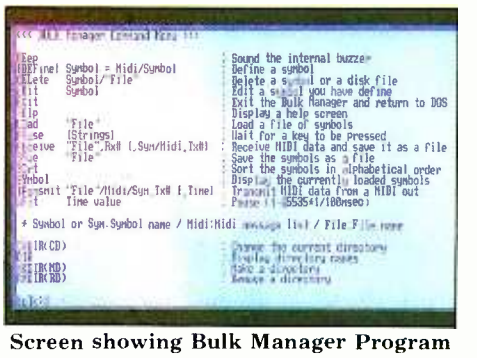
Using the Bulk Manager, you may request bulk data to be input via either or both inputs and output through all, or any combination of, the eight outputs of the *C1*. You often need to transmit setup messages to the various pieces of equipment to prepare them to transmit or receive MIDI data. Sometimes a simple Bulk Dump Request message is sufficient to access data, which is then sent back to the unit when you wish to work on the piece again. At other times you will need to send a message to the receiving device to put the patches into a memory bank. A list of such instructions, known as a Command File may easily be constructed, eg when using a Yamaha *TX802*, you would enter a message to switch the *TX802* to receive banks 1-32 or 33-64 before sending the appropriate bank of voices. Another useful feature will save a series of Bulk Dumps from various MIDI devices as one file. These may then be loaded automatically before starting a sequence.

To load Bulk Manager, you type 'bulk' from the MS-DOS command level. When you press ENTER, the prompt BULK appears at the top left-hand corner of an otherwise blank screen, then you type in the instructions you wish to give. These are fairly cryptic and are similar to MS-DOS style commands. This is not the most user-friendly piece of software but there is a HELP screen available to explain the available commands.

Command Files are for frequently-performed tasks, such as setting up all the synths in your rig with their appropriate patches. You must use a word processor or text editor to create a file containing the appropriate commands for the Bulk Manager, however, a Bulk Symbol file containing useful pre-defined Symbols (or Words) for frequently used MIDI messages is provided for many popular Yamaha devices (including the *DX7, DX711, TX81Z, TX816, QX5, QX7, RX5, RX7, DX11, TX802*) and these may be added to, changed, or deleted as necessary.

A Bulk Manager symbol may be thought of as a shorthand version of a MIDI message, which you may include in your command file. Symbols may contain other symbols within them: a symbol for a standard Yamaha SysEx bulk dump header might be included with extra information to form a new Symbol to represent the complete Bulk Dump request.

Setting up the Bulk Manager to communicate with all your MIDI gear could be quite a task. You would need to know all the correct Bulk Dump Request data for all the MIDI devices. These are not always printed in the equipment manuals and, when they are, can sometimes contain mistakes. Also, the documentation is often poorly presented, so it can be difficult to interpret any information correctly. Assuming you had all the necessary information, it would still take some time to set the system up to work correctly and you would need to be very knowledgable about MIDI. The Bulk Manager could be a powerful piece of software in the hands of someone who has all the necessary information at their fingertips and knows their MIDI gear well.



Screen showing Bulk Manager Program

Bulk Manager commands

To give you a feel for how the Bulk Manager works, here is a run down on some of the commands:

The **Define** command allows you to define a Symbol to represent a string of MIDI data, eg dx7 voice=f0 43 20 09 f7 defines the word 'dx7voice' to represent the Bulk Dump Request for *DX7* 32-voice bulk data.

When the **Receive** command is entered, the *C1* will wait for a SysEx message to arrive at the 'MIDI In' you specify. After the data has come in, reception stops automatically and the data is automatically saved to disk with a filename you specify in the receive command. You may embed a dump request to a MIDI device in this receive command, so that your synth or whatever will send the correct data for you to capture.

Via the **Transmit** command you can transmit either a file (eg 'dxbrass2'), or a Symbol (eg dxvoicereq), or a MIDI message in hex (eg to tell a *TF1* module in a *TX816* rack to turn its memory protect off so that you can prepare it to accept bulk data).

The **Pause** command is used within a command file to prompt the user to perform some necessary action the computer cannot. For instance, to say 'set the correct MIDI Channel on your device', or whatever. A message up to a line in length may be displayed, followed by the instruction 'Strike a key when ready . . .' upon which, the next command will be executed.

The **Wait** command is used also in command files. It makes the *C1* wait for the length of time specified in units of 10 ms from 1 to 65535. It is used to insert short wait times between successive transmit commands to allow the receiving device time to process incoming data.

The **Beep** command makes the *C1*'s internal buzzer sound for a short time. For instance, you may place it in a command file to tell you when a task is completed, or to prompt you to make a setting or perform an action.

Conclusions

The Bulk Manager could play an important role in your MIDI setup. Although many sequencer programs have similar capabilities, as do many patch editor/librarians, not all provide such comprehensive facilities. Some do provide better or more user-friendly facilities than this Bulk Manager but if your sequencer or patch editor/librarians do not include these functions the Bulk Manager will provide a virtually indispensible addition to your MIDI facilities. It is a shame that Yamaha have not provided pre-defined symbols for communication with non-Yamaha devices, as do sequencers like the Voyetra. This does seem to be an unfortunate omission, as most users have devices from several manufacturers.

MIDI Monitor Program

This may be used as a MIDI trouble-shooting tool. Just as the recording engineer needs meters to indicate signal levels, the MIDI Programmer needs MIDI Monitor to let him know what is happening with his bytes. If you want to check exactly the output of any MIDI device, just connect MIDI Out to the monitor's MIDI In and you can see everything displayed on the screen. You may simply wish to play one note on a keyboard to check the signal quality and levels. A more complex task may involve analysing a voice data dump to ascertain the sequence and number of bytes.

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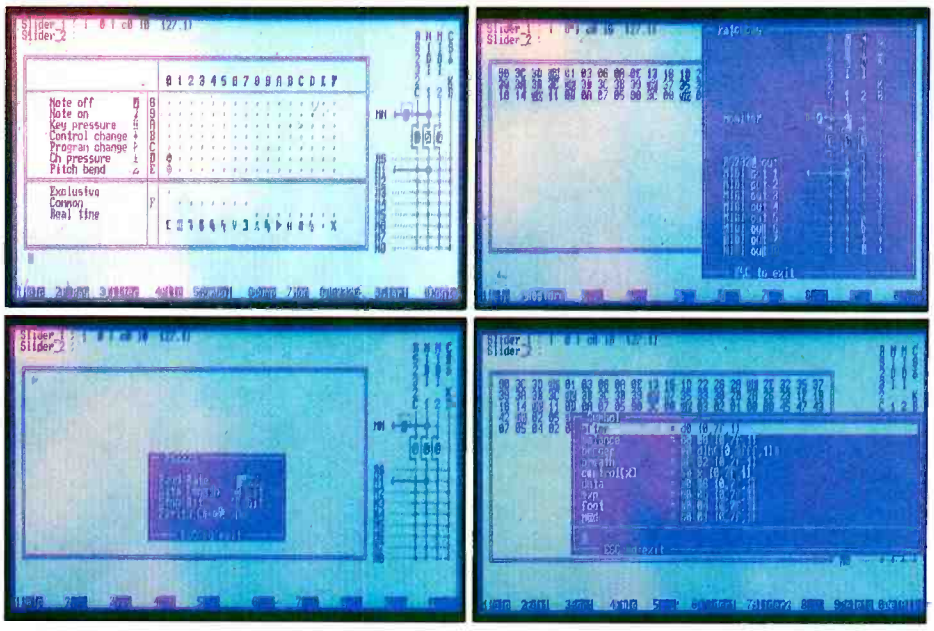


Displays from the MIDI Monitor Program

The Yamaha MIDI Monitor records all incoming data into a buffer and you can view up to the last 16 kbytes (eg one *DX7* voice uses about 4 kbytes of data). This data may be saved as a text file on a word processor and printed out later. The data normally appear as hexadecimal numbers that represent the binary bytes of raw MIDI data. Once you get used to it, this is quite easy to read and is the most useful for professional users. Two alternative displays are provided—ASCII or map—which as they are easier to read in some ways, may be of more use to MIDI newcomers.

The *C1*'s data sliders are programmable from within the program to send a variety of MIDI messages, including timing data, patch changes, etc. These functions allow quite a degree of remote control over your MIDI setup, directly from the *C1*. There is also a built-in patchbay control section, whereby any input can be assigned to any outputs, or to the *RS232* output.

Basic functions

The MIDI Monitor software can monitor incoming data, transmit data and route data through the two MIDI In and eight MIDI Out terminals. Incoming MIDI messages can be viewed as a stream of data (ASCII) or as a blinking indicator on a grid (map). From the monitor display, which appears when you run the monitor program, function keys F1 to F8 open the various windows. The mouse is not used at all in this program.

The 'command line', which appears when the program is booted up, may be used to issue commands to control the program instead of using the function keys—able typists may prefer this. Numbers typed into the command line in decimal or hex will immediately be transmitted from MIDI Out as MIDI data bytes. Alternatively, a Word or Symbol can be defined to stand for a string of MIDI data.

While in the Monitor display, you can transmit numbers or symbols. You can also transmit MIDI Start, Stop or Continue messages to drum machines or external sequencers using function keys F9 and F10. In such cases, you would probably find it very convenient to use a *C1* slider to control the tempo of the external device.

Any time there is a command line (in the Monitor display, Dump window, or Symbol window) you may enter MIDI data from the keyboard (or move the two sliders). The data will immediately be transmitted from the output specified by the Patch Bay setting. You can enter 'raw' MIDI data in hex, or define a Word (up to 12 characters long) to represent a string of data (eg 'keyon=90 60 40'). This lets you output a long and complex message, or messages, by typing a short Symbol. There is no limit to the number of Symbols you can define. You can nest as many Symbols as you like to define longer Symbols. And you can type Symbols and data in any combination: for instance, if you define volume as 'vol=BO 07', then you would just use 'vol 127' to transmit BO 07 7F (the Monitor program makes the conversion from the decimal value, 127, into the equivalent hexadecimal value, 7F, automatically for you). The symbols may also use variables, so if you define a Symbol this way: 'on (x)=90×40', then type 'on (3C)', the program would transmit '90 3C 40'.

The *C1*'s two front panel sliders can be assigned to transmit any type of data, (eg define 'slider1)=BO 07 [0 127, 2]' to make slider 1 transmit Control Change 7 (MIDI Volume) with only even numbered data, like 0, 2, 4, 6 to thin out transmitted data). The current definitions of the sliders are displayed at the top of the screen. Various preset slider definitions are available for quick setup. Yamaha System Exclusive parameter changes may be transmitted from the sliders. If the slider is defined as 'slider=tempo', MIDI Timing clocks bytes (F8 in hex) will be transmitted at a rate determined by the slider position. When a slider is defined as 'slider=channel', the slider will determine the MIDI channel on which data will be input from the *C1* keyboard and on which data from the sliders will be transmitted. Symbols may be edited in the Symbol window, accessed by pressing F5 or typing SYMBOL. Symbol definitions can be stored as files in standard ASCII format, which could then be edited in a word processor.

F-keys

At any time in any mode or window, you can press **F1** or type 'help' to get an on-screen explanation. This is an excellent feature all the better-designed computer programs are starting to include.

To adjust the patchbay, you press **F2**. Messages from the two MIDI inputs and the *C1* keyboard and sliders and the *RS232C* (when used as an input) can be transmitted to any combination of the 8×MIDI and 1×*RS232C* (when used as an output) outputs. A useful grid on-screen indicates the connections. When an output is receiving data from more than one input, the incoming data will be merged. (SysEx given priority, other messages held up.)

F3 allows you to access a data filter which prevents unwanted data from being displayed or output. The display, the *RS232C* input and either of the two MIDI inputs, each have their own data filter. There is also a 'channeliser' to convert any incoming channel into a different outgoing channel.

F4 accesses the File window where you can save and load MIDI data Symbols (which you have previously defined) onto a disk file.

F5 accesses the Symbol edit window where you can edit your defined MIDI data symbols.

F6 accesses the Dump window where you can examine the last 16 kbytes of displayed data. You may switch between hex and ASCII displays. You can search for a specified string of data. You can print out data, or you may save the data to a file. You can also transmit data while in the dump window.

F7 is the Monitor Mode switch. The Data Monitor displays incoming data as two-digit hexadecimal numbers, with status bytes reversed. Alternatively you may switch to a special symbolic display in which each MIDI byte is shown as a graphic character. (These graphic characters are also available in the Map Monitor mode.) The channel number is not displayed in the symbol, and the data bytes are displayed as the corresponding ASCII character. This can be especially useful when examining bulk data dumps of voice data, as the voice name will be shown as ASCII characters.

The Map Monitor briefly displays a '0' to indicate the type of data which has been received, in its main data display area. In a lower display line, graphic data symbols are displayed. There is also a command line underneath the data display areas which allows you to define symbols as MIDI data, or to directly enter MIDI data, or symbols, for immediate transmission.

F8 opens a window where you can make the setting for the *RS232C* port. The *RS232C* is a standard interface found on most personal computers. This may be used to transfer MIDI data between computers which do not have MIDI interfaces. Different Baud rates, data lengths, stop bits and parity checks may be selected.

Conclusions

This MIDI Monitor program is one of the most comprehensive I have seen for any computer and such a program is an essential tool in any MIDI studio for trouble-shooting and general utility purposes. Every studio should have one—along with someone who knows how to use it. The user interface on this program is very good and I have found the program to be extremely useful—so much so that I have kept it 'on-line' in my programming room for the last 3 months.

Other music software

Sample Vision: This runs under GEM, and is probably the most popular sample editing program for IBM-compatibles.

MasterTracks Pro Sequencer: This runs under windows, and is a very popular sequencer program which is also available for the *Mac* and the Atari.

Coda Finale: This program also runs under windows and is the latest, and one of the most comprehensive, programs available, for score-writing and music printing. It is also available on the *Macintosh*.

Bacchus TX802 editor/librarian: This runs under Meta-windows, like the Yamaha sequencer. It features comprehensive graphic editing facilities for the Yamaha *TX802* synthesiser and is a well-designed product I would recommend to anyone with a *TX802* in their rig.

Playroom Software DMP7 editor: A new *DMP7* editor/librarian program is being developed by Playroom Software in the USA. There was a prototype of this on the Yamaha stand at the 1989 APRS exhibition in London, and it should be available from the end of July this year. This program allows realtime control of the *DMP7*'s parameters from the *C1* and is somewhat similar to the *DMP7* editor section in the 'Q-sheet' program available on the *Macintosh*, where on-screen representations of knobs and sliders may be manipulated using the mouse to output control data to a *DMP7* or a *DMP11*. The program works through the multitasking windows environment, so you can have your Playroom Software synth editors (or any other programs which will run under windows) available for use at the click of a mouse button.

Voyetra sequencer for the C1: The Voyetra sequencer is probably the most well-established package available for IBM-compatible sequencers, having been around for about 5 years now. It is often regarded as the industry-standard sequencer package for IBM-compatibles, ie the one by which all others may be judged! It runs in MS-DOS Text Mode, so screens may be changed virtually instantly. This is because MS-DOS does not use the large amounts of code necessary to support a graphical user-interface such as Windows or Meta-Windows. As a result, any activities that involve redrawing the screen are carried out much more quickly on the Voyetra sequencer than on the Yamaha *CSQ1* sequencer or any other sequencer on the *C1* (or on the *Mac* or Atari) that uses a graphical user-interface. And the program itself is very fast to load compared with a *Macintosh* program, for instance. This kind of speed advantage may well appeal to users who find no difficulty in using keyboard commands as opposed to a Mouse/Icons/Windows approach.

There are three main screens, whose functions are as follows:

OVERVIEW Here you have a display of 14 of the 64 available tracks, showing the track names and their respective output channels. The display also allows you to set Transposition intervals, non-destructive Quantisation values, Loops, Metres and timing Offsets for each track. You can have any time signature you like within a track, and have any other time signatures on any other tracks—great for polyrhythms.

VIEW PAGE Here you get an overview of the whole song and you can cut and paste sections as you please. This is a very useful feature not found on every other sequencer, although it should be.

EDITING SCREEN A grid is provided with piano-roll style notation—horizontal blocks whose length indicates the note length and whose vertical position on the grid indicates pitch. This is a very visual way of editing, and is great for step-writing and individual note-editing.

The program allows you to make a number of useful adjustments while running the sequence. You can make notes in a notepad, adjust the metronome, show a large display with the bar numbers in giant letters that may easily be seen across a room by musicians, and so on. This latter feature is a neat idea I have not seen on other sequencers.

There is a built-in SysEx librarian feature with bulk request information supplied for about 100 popular MIDI devices from all the manufacturers—in contrast to Yamaha who only provide bulk dump information for Yamaha devices. These dumps are typically used to put the appropriate memory data into all your MIDI devices prior to running your sequence.

This sequencer deserves to be considered a viable alternative to those running under graphical operating environments. The advantages being speed of use and its own set of useful features such as the ability to cope with polyrhythms.

Score music typesetting program for the C1: Score was developed over a number of years by Leland Smith at Stanford University in America. It is one of the most comprehensive score-writing programs available and is intended as a music typesetting program, as opposed to a music

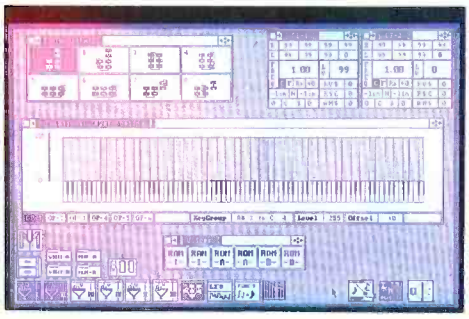
composition program using conventional music notation.

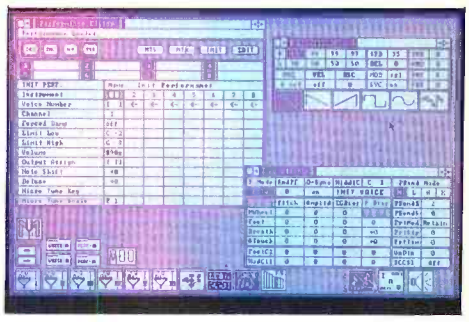
It is now available on the *C1* and runs very well on the standard model, although a maths co-processor is essential for serious uses, such as part-extraction, transposition, or creating Postscript files for printing purposes.

There are lots of neat features: the printed output is so good that the Associated Boards of the Royal Schools of Music are currently using the program for their exam papers. Lots of 'intelligent' features are available, including part-extraction with page turn decisions. Standard formats create extremely useful layouts as defaults, and these may easily be customised. Everything from the thickness of slurs to the placing of staccato dots may be over-ridden at will. A CAD drawing package is included to allow you to create your own notational symbols, although a geat number of unusual ones are included as well as all the conventional ones. The output files may be imported into Pagemaker on the *PC* or on a *Mac*, and Postscript files allow for easy interfacing with professional printing bureaux equipment such as the Linotronic printers.

All-in-all, Score is a most comprehensive package, worthy of consideration by anyone seriously interested in printing out music for a wide variety of purposes. Its availability on the *C1* is a bonus for potential *C1* users who need music printing capabilities.

Business software: A larger selection of business (and general) software is available for IBM-compatibles than for any other personal computer. From Pagemaker desktop publishing, To Microsoft Word wordprocessor, to Lotus 1-2-3 spreadsheet,





Bacchus *TX802* displays

you can get the best of everything. So, if you need to use these types of programs, for business or various musical purposes (such as printing musical books, writing lyric sheets or information sheets, and so on) then the *C1* will run these programs very conscientiously.

Summary

The MIDI Monitor program should find itself in regular use wherever a *C1* is used in a professional situation. The Bulk Manager may find some afficionados but most people will opt for the more user-friendly approaches to SysEx storage adopted by the Synthesiser Editor/Librarian packages, or the more capable MIDI Sequencer packages.

The free MIDI Monitor is a good bonus, because it works well. The Bulk Manager is potentially very useful, although it could present some practical difficulties.

The Voyetra sequencer is a viable, and faster, alternative to WIMP graphical user interfaces for those who don't mind memorising keyboard commands. The Score program is aimed at professionals who need the comprehensive facilities it has to offer. Turtle Beach Sample Vision is virtually an industry standard in the IBM-compatible world. Likewise the Bacchus Synthesiser editor/librarians. The Playroom software is reasonably priced and versatile. Coda Finale and Mastertracks sequencer are very popular programs on the *Mac* and should prove to be equally popular now that they are available on the *C1* and IBM-compatibles.

This all adds up to the fact that there is an excellent choice of software available whatever your preferences are. The fact that so many music programs have been ported to the *C1* (they have to be partially rewritten to work with the MIDI interface and 3.25 inch floppy disk drive) means that all the software suppliers are confident that it will take off in a big way.□

Are you 20 Bit Ready?

Up until now, many two-track digital recorders have had difficulty in storing a true 16 bit signal, let alone a 20 bit signal. But the advent of high quality outboard A-D/D-A Converters means that it is now possible for digital recorders to capture sound more precisely than ever before.
And as the only available two-track tape machine capable of storing a 20 bit signal, the Mitsubishi X-86 has the vital edge in the continuing battle for better sound quality.
Offering exceptional performance and reliability, the 20 bit ready X-86 also costs little more than the price of a top analogue two-track mastering machine.
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- Dedicated time code track and built-in generator offering 24 frame or 30 frame (drop or non drop) code.
- AES/EBU interface allows communication in the digital domain with all other digital equipment fitted with a similar interface (DAT, 1610/1630, hard disk etc).
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- Recording time up to 2 hours with 14" spools.

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MONITOR SYSTEMS-
MONITORS AURAL GUIDELINES PART 8

In his search for the perfect monitoring system Philip Newell comes to terms with an imperfect world and lays down some guidelines for dealing with it

Loudspeakers fall into four general categories: sound reinforcement, domestic hi-fi, studio monitoring and special purposes. In the first group, SR Systems, we can include all installations intended for entertaining a mass audience—cinemas, theatres, at music events or in audio visual presentations. The second group covers all units for attentive listening to music within the domestic environment, possibly extending to better quality background music systems. The studio monitoring group includes all quality control applications, including radio and television studios, disc cutting rooms, transfer suites and copying rooms, as well as conventional, control room monitoring. The fourth category, special purposes, includes loudspeakers for televisions, radios, intercoms, paging systems and all purposes where intelligibility or cost, as opposed to overall sound quality, are the fundamental requirements.

The four categories exist in their own right and have been developed within their own set of criteria. There is no 'league table' of quality or prestige; no one category is superior to the other. Attempts to compare them would be like trying to assess the relative merits of a Volvo *F10* truck, a Massey Ferguson tractor, a Rolls Royce *Silver Spur*, and a formula one grand-prix racing car. It is true to say that discoveries and developments in one field may spill over into, or influence another area. Tyre technology passes from the formula one car to the road car but the transfer is accompanied by modifications and adaptation. The crossover of loudspeaker technology from one category to another is by similar links. The four categories still exist in isolation, and for fundamentally different purposes.

Purposes

Loudspeakers developed for sound reinforcement in general are created to excite the audience—, punchy bass, exciting highs and a controlled penetration of the mid-range. The loudspeakers are designed to deliver the greatest intelligibility above the ambient noise of maybe several thousand people and create the most entertaining sound for the entire audience. Similarly with cinemas and other auditoria, flattery of the sound source is a valid and worthy aim.

Special purpose loudspeakers usually have one sole aim in mind for each application. A system for making announcements over the noise of a busy factory, of necessity is designed to be most effective over the range of greatest intelligibility. Outputs over an area of the response that contributed nothing to the message would only serve to add unwanted noise. Though such a loudspeaker may sound very nasal on full-range music, it is not necessarily an inferior loudspeaker. It may indeed be a very fine loudspeaker for the purpose it was intended.

Hi-fi loudspeakers for domestic use are in a very contentious area. The prime function is to give the most pleasure to the person listening to them, and extract the best from that person's choice of music programme. The choice is extremely personal, just like the choice of the music iteslf.

. Studio monitoring loudspeakers have often been approached on a 'big hi-fi' basis, but I believe that their sole aim is accuracy over a wide range of frequency and volume levels, together with faithful adherence to the fidelity of many different types of music.

Let us look at the motor vehicle analogy once again.

Sound reinforcement loudspeakers/large Volvo truck.
Aim: Possibly to travel great distances, give reliable service under arduous conditions and, above all, to deliver the goods to those for whom they are intended.

Special purpose loudspeakers/Massey Ferguson Tractor.
Aim: To do one, specific job very well, ie the job for which each was designed.

Domestic hi-fi loudspeaker/Rolls Royce *Silver Spur*.
Aim: To achieve the most comfortable, and enjoyable performance in a domestic, family or personal environment. However, just as some people may well prefer a Mercedes, or a Cadillac in place of the Rolls Royce a different choice of domestic hi-fi speaker may be chosen for a multitude of different reasons.

Studio monitoring loudspeakers/Formula one grand prix cars.

Aim: There is no reason to assume that these are the ultimate in either case, as they could both very well fall into a sub-division of the special purpose category. Both seek to achieve the ultimate in 'precision' and the pushing ahead of new frontiers, yet neither may be comfortable in daily domestic use. I doubt that too many people would use a racing car in which to go shopping—no room for the bags, you get wet when it rains, and they are by no means particularly comfortable. Similarly with studio monitors, certain criteria may make them less suitable for domestic use than units designed for that purpose. Before looking at these criteria in detail, we must look at the domestic hi-fi situation to establish some of the differences and define things we are not looking for.

Why does any person like any particular thing? Why does one person prefer cabbage to cauliflower while another person prefers cauliflower to cabbage? Why are there so many cars to choose from in any given price range, with partisan groups supporting each and every model? The answer lies in the fact that we did most certainly not all come out of the same mould. Our DNA structures are as individual as fingerprints. This means our sensory organs and brains are all peculiar to ourselves. The information arriving at our sensory receivers—eyes, ears, nose, tongues, fingertips and so forth—may well be the same but how our brains interpret this information is different in probably every case. It is the brain's interpretation of any stimulus that determines our own emotional reactions.

Auditory perception is no different, and is no less unique to each of us. The lynch-pin of our chain of hearing is the basilar membrane. This is a cluster of 30,000 to 40,000 fibres, vibrating in response to the sounds impinging on the ear drum. There is also a certain amount of random activity that can be set off by the interaction of certain mechanical components of the ear. This mechanical stimulation of spurious product generation can cause the brain to believe that certain frequencies are present, which were not part of the original signal arriving at the ear drum. Hair cells detect the motion of travelling waves passing down the basilar membrane in response to 'sounds', and nerve endings transmit these signals to the brain.

It would also appear that some of the component parts have 'gated' responses, not causing any sensation in the brain until a pre-determined threshold of vibration is reached. Any sound levels below this threshold will cause no sensation whatsoever to be produced. There are numerous people in whom the random responses of the inner ear can cause unpleasant clattering, or sounds, sometimes triggered by specific frequency bands and sometimes above certain sound pressure levels. This can cause people to have an inbuilt bias against 'loud music' or certain types of musical sounds. These are more extreme cases but in the instance of the selection of hi-fi loudspeakers, these factors can be of influence. In general, it can be seen that even minor changes from person to person in the make up of their inner ear, can create wide variations in their opinions of what sounds 'good'.

As we live in the real world and not in a hypothetical Utopia, size, cost, decorative appearance and many other peripheral factors influence hi-fi loudspeaker choice. One great obstacle in the way of selling Quad electrostatic ▷

loudspeakers has been the typical response from an enthusiast's wife: "Bring those radiator things in here and I'm moving out!" Faced with this choice, most men, quite rightly in my opinion, choose to keep the wife and buy smaller loudspeakers. (Incidentally, the above is not a sexist statement; I have never heard a man object to his wife bringing in larger loudspeakers.)

Can individual differences go some way to explain why certain people have strong preferences for certain instruments? This could explain why one person finds one instrument, combination of instruments, or style of musical score, exhilarating, while the same stimuli leave another person cold. Resonances in a certain frequency band may be exciting to one person, or distasteful to another. Psychological factors can also play a part. Why should a series of notes when played in one sequence, bring a person to tears, yet the same notes in a different order, produce in the same person a great uplifting of the spirit? There are just so many emotional, psychological and physiological differences from one person to another, that personal taste *must* be both accepted and allowed for. One cannot generalise or be dogmatic about matters of individual taste. Following this path, would a person with a strong liking for, say, saxophones, select for him/herself a loudspeaker that appeared to emphasise the saxophone's characteristics. Recording engineers do this all the time, selecting microphones for individual instruments to highlight the essence of that instrument. If professional engineers can use this principle to achieve what they want, it would be rather arrogant to suggest that people buying hi-fi, should not be allowed to use the same principle in selecting their home loudspeakers.

If all hi-fi loudspeakers met a common standard, life would indeed be dull. The acoustics of people's homes certainly do not conform to any standard. Should a person decide to buy a new three-piece suite, new curtains and generally re-arrange the lounge, it's quite conceivable that that person's much loved loudspeakers will no longer sound the same. Room positioning, size and furnishing make huge differences to the listening environment. There is no reason whatsoever why this person should not go out and buy a new pair of different loudspeakers. If that change restores the accustomed and well-loved sound to the lounge, then all is well. In general, houses are not built with acoustics as a primary consideration, nor under most domestic circumstances are the layout and choice of furniture secondary to acoustics. As long as there is variation in the human household, there is justification for differences in the sound of any loudspeakers designed for the home.

Any person paying their own money for their own loudspeakers has a right to choose those that give them the greatest enjoyment from the music which they choose to listen to. Entertainment and personal pleasure is the *raison d'etre* for home hi-fi. A deficiency, or prominence, of a particular characteristic in a loudspeaker, is entirely acceptable as a countermeasure to differing listening conditions, physiology of a person's ears, personal emotional reactions or purely personal preference. In the home, the pleasure and entertainment values cannot be over-stressed. This makes something of a mockery of the 'audiophile' hi-fi system with ¼ dB accuracy to equalisation curves and no tone controls. To expect that this will give more accurate sound in the average lounge is ridiculous.

The belief that the sound recorded on a disc or tape is sacrosanct is absurd. Record producers and engineers merely make their own interpretations of how a certain instrument or voice should sound. That is a personal decision and is not inviolate. Put the same people in a different studio on a different day with the same music and musicians, and they may come out with a different recording . . . sometimes radically so. This can be affected by the weather, too much alcohol the night before, or the fact that the baby had been crying all night. This may appear somewhat facetious but it is a deadly serious statement of reality.

Even if the master tape were sacrosanct, what happens in the transfer to disc, tape cassette or compact disc. Anybody who thinks they are all transferred flat is in for a shock. They are frequently adjusted at the transfer stage to suit the particular medium somewhat arbitrarily. Furthermore, many producers and engineers adjust controls when playing one of their own recordings at home. After 9 months working on one album, it is surprising how far off the beaten track a professional can find his or her own judgment. Familiarity can lead to overlooking the obvious. Two months later, that same professional may well be found at home, listening to the recording with 3 dB of bass boost, or the treble down, or whatever, wishing it had been incorporated in the original music. Oh for the benefit of hindsight!

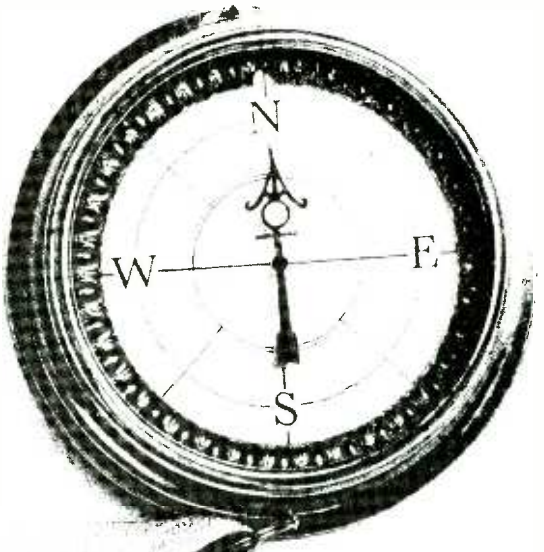
Any person in their own home has the right to juggle whatever controls they wish, in order to achieve maximum enjoyment, To paraphrase a well known saying 'Beauty is in the ear of the beholder'. In terms of home hi-fi, that statement is just about all that is sacrosanct.

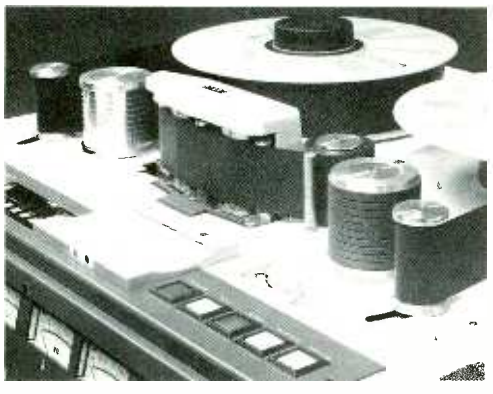
A vast number of records are completed in studios with which the engineers and producers are not familiar—they make mistakes. The above statement has a two-pronged thrust. Firstly, that recordings are not made to a fixed reference, hence the absolute necessity of providing tone controls on the home hi-fi. That is if you want to attempt to hear it as it really should have been, given listening room discrepancies at both ends of the record/reproduce process. Secondly, studio monitoring criteria require some considerable further investigation. Currently, studio monitors seem to run the full gamut from the proverbial chalk to cheese. Perhaps a few words in defence of producers and engineers would be appropriate here. Their lives are not all plain sailing by any stretch of the imagination. Music is still an art form, thank goodness, and as such the recording staff may be arbitrarily keeping 20 or 30 variables, artistic and technical, on the boil at any given time. Sound quality is not of absolute, paramount importance. In certain circumstances, it may have to be compromised for the benefit of other, musical or artistic considerations. The true goal is the best: achievable, overall compromise. Perfection and the arts rarely mix. Art is an interpretation of an imperfect society.

Objectives

After having attempted to justify acceptable non-linearities in the SR system, special purpose and domestic hi-fi categories, we now have to argue the very antithesis in the domain of studio monitoring. First, we must outline our objectives then establish our standards of reference. The first task is relatively straightforward; the subsequent task rather more contentious. The general requirements for a studio monitor are: very wide frequency response (even more so recently with the advent of computer musical ▷

THE NORTHERN ALTERNATIVE





ANALOGUE or DIGITAL?

In a rapidly changing recording environment the choice between analogue or digital isn't easy. Both formats now bear a similar price tag.

However, as the only Northern appointed agent for Otari and Akai digital products we can highlight the advantages of both recording formats in a "side by side" demonstration to make that decision a little easier.

With a manufacturer trained service department and sixteen years experience in professional audio sales we can offer the best in before and after sales service.

Whether you're in the market for a complete studio package or just the latest in signal processing – we'd like to talk to you.

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◁ instruments and digital recording); low distortion; low colouration; large dynamic range; consistency over a long period of use; and, in the event of component failure, simplicity of maintenance in order to restore it to original performance.

On the subject of frequency response, we would be looking at 20 Hz to 20 kHz. Monitors designed for smaller control rooms may, however, only respond down to 35 or 40 Hz as the smaller rooms themselves would preclude the natural reproduction of extreme bottom end. This subjective low frequency degradation would occur around the point where the front to back dimension of the room became less than a half wavelength. Distortion and colouration, due to resonances, non-linearities and reflexions should affect the sound quality to an absolute minimum degree; even when producing 120 dB in the control room. The dynamic range should allow peaks of 125 dB in the control room. Throughout the entire usable range, the essential character of the monitor should remain unchanged. Poor designs can give a noticeable change in timbre at high levels, as voice coils heat up and suspension non-linearities become apparent. Voice coil heating produces both mechanical and electro-magnetic changes, as resistance increases with temperature, and physical distortions take place.

Subjective standards of reference

The variables involved are multitudinous. It is not inconceivable that the future will isolate and define the major criteria in a numerical qualification but the past 100 years or so have, as yet, failed to do so. Two different loudspeakers of similar performance may well, under analysis, show their differences in measurable, quantifiable ways. It is very doubtful, however, that any manufacturer, given the tabulated data from the measurements, could contrive to produce a loudspeaker from the data alone, which actually sounded like either of the originals. It seems that wherever you look in terms of quantification, for every new parameter that is isolated another 10 become apparent and await investigation.

Currently, there seems to be only one instrument truly capable of assessing the performance of any loudspeaker—the ear. Having already established that all ears are different, we must look for an average of a cross-section of ears. But whose ears, and what are they listening for? The only reference point we have to compare with any loudspeaker, is a series of 'live' voices, instruments, or everyday sounds. Recorded signal sources are of no value, as the recorded quality depends largely on the monitoring system used for that recording. To minimise room effects, it would also seem preferable to have the sound source in the open air and the monitors under test in a relatively dead environment. Microphones used for the test, would tend to be the instrumentation types, not normally used in recording precisely because of their 'blandness'. In other words, engineers usually find them uninspiring for music recording, as their lack of colouration is no help to an engineer looking to highlight the characteristics of a particular instrument.

Microphone positioning should be such that as much of the sound of the instrument as possible is picked up in equilibrium. Microphones on, say, an oboe should be placed at a distance and not in such a position as would favour the mouth of the instrument, the 'reed' or 'keying' noise. A position too close to the 'reed' would produce a sound balance that could only be heard with the ear in close proximity to the instrument. This would not sound natural listening at some distance from a loudspeaker. Indeed an oboist may well not be the person most suitable to make a judgement on this. Despite listening to 'live' oboes for much of their career, oboists listen mainly from a position at the reed end of the instrument. Furthermore, the preconditioning of the expectation of the sound, may be further affected by bias towards certain aspects of that sound. This can be connected with whatever aspect of the instrument first drew the musician to that particular instrument. A loudspeaker highlighting those aspects may rate highly with that oboist, making judgement on taste, and not on accuracy.

This potential problem, pertaining to musicians as judges, was graphically described many years ago by GA Briggs in his book *Sound Reproduction*. Briggs described a BBC programme, *Records I Like*, which, on one occasion, featured the choice of Sir Thomas Beecham. After selecting a pre-electric recording, Sir Thomas remarked how little the recording of the human voice had progressed over the previous 40 years. Reading between the lines, on hearing this, Briggs all but fell off his chair. The recording sounded exactly like a person bellowing down a horn—which was, of course, exactly what it was. The only reasonable conclusion to be drawn from this, is that Sir Thomas, despite his lifetime in the presence of live music, tended to hear not the sound quality, but the performance, the emotion, the phrasing, the overall musicianship and the delivery. The implication here is not that musicians are unsuitable jurors on loudspeaker selection but that great care should be taken to make extremely clear just what the exercise seeks to achieve.

Studio staff, engineers and producers, are also, by no means, an automatic choice. Again care and attention to detail is called for. Many times in the past, a new 'revolutionary' driver has been fitted into a monitor system with initial, universal acclaim from all concerned. Unfortunately, this has all too frequently been followed, some months later, by the request for the return of the old ▷

◁ drivers, with the comment, "The mixes are disappointing." The new driver often produced comments such as, "I've never heard such detail and definition." This frequently turned out to be a characteristic of the driver that subtly, and almost unmeasurably, emphasised certain details of the sound. Closer attention to the 'live' source, in many instances revealed that the new 'detail and definition' was not to be heard in such predominance on the instrument itself. If it is not on the instrument in that proportion, it has no place on the monitors. It must be said, however, that should the engineer or producer choose to highlight these details by recording technique, it is well within their artistic licence to do so. Under no circumstances, however, must it be unsolicitedly emphasised by the monitors alone. In contrast, the driver may well be excellent for sound reinforcement, where an exciting sound is often a very desirable attribute.

The reason for the 'disappointment' in the resultant mixes, stems from the fact that monitor loudspeakers sounding 'exciting' in themselves, can flatter an otherwise uninspired mix. When the tapes are played back elsewhere, what is heard is something more akin to the disappointing truth. A somewhat moot point arises here, in the instance of monitors being used during the recording, as opposed to the mixing process. Control rooms are now being used for much of the recording; that is, musicians playing electric instruments in the control room. Under such circumstances, a little extra 'excitement' in the sound, may inspire the musicians to greater heights of performance than would be achieved using 'neutral' monitors. I suppose this could conceivably portend a requirement for separate recording and mixing monitors, but at this point in time, that would surely seem impractical as a general rule. It must be admitted that to some degree, this situation already exists, with *NS10*s and the like, being used more and more frequently on mixdown. This, however, is probably a consequence of a lack of trust in unfamiliar, larger systems, rather than as a function of the main monitors having been designed specifically for recording. The unfamiliarity is an inevitable consequence of the current mobility of recording staff, from room to room, and system to system.

Returning to the monitor assessment criteria level, it is imperative, in controlled tests that the volume level perceived from the monitor system be identical to that emanating from the 'live' instrument at the appropriate listening distance. There are two main reasons for this. Firstly, should a flute be used as the subject, it would be obvious that it was a loudspeaker being listened to, were it to be heard at 120 dB at 10 ft. The instrument itself could not produce such sound levels and the distinction between 'live' and 'monitored' would then be plain for all to hear. Secondly, consider the effect of the Fletcher-Munson curves. Different sound pressure levels, produce differences in perceived overall frequency response. The perception of the frequency extremes increase by a greater degree than to the middle frequencies as the overall level increases. Hence a flute, louder than a natural level, would be perceived to have extra highs and lows compared to the natural flute.

Realistically, only 'dummy head' or 'sound field' microphones should be used for such an assessment. Basic microphones of other sorts are simple, pressure-detecting transducers. The microphone diaphragm is capable of moving in one plane only—in and out. A guitar string, when plucked, vibrates in the plane along the face of the instrument, it vibrates in and out, towards and away from the face of the instrument, and longitudinal waves travel up and down, along the length of the strings. The complexity of the phase relationships of all the component vibrations, is enormous. The human ears, in their own extreme complexity, detect far more information than a simple, single plane, microphone diaphragm. The conventional microphone can detect only a pressure change at the diaphragm, a gross over simplification of the complete pattern. At least the 'dummy head' and 'sound field' microphones go some way further in retaining the integrity of the highly complex phase patterns so necessary in our perception and recognition of realistic sound reproduction.

Yes, loudspeakers also move in one single plane only, don't they! There is still a long way to go to the audiophile's Utopia. These restrictions in a loudspeaker's capabilities, are, however, no justification for allowing a compounding of the problem from the microphone end of the system. A further consequence of the profound importance of phase in realism, is that it is probably only fair to compare or assess loudspeakers in stereo pairs in order that appropriate use of realistic, phase sensitive microphones is used to maximum potential. A single loudspeaker would not be a fair assessment as spatial sensations are of great importance to overall realism. The stereo imaging potential can also, obviously, only be realised and assessed in pairs.

The panel of jurors

The jurors must be selected from people who, while being familiar with live sound, know what they are listening for. To the best of their ability, preconception and bias must be set aside, being replaced by a ruthless concentration on facts. A

monitor loudspeaker which either adds to or detracts from the original sound, is not on course to achieve the stated goals.

Bland neutrality and accuracy are the objectives; a neutrality which dictates that an exciting sound going in, produces an exciting sound going out and a dull sound going in, produces a similarly dull result. If the original sound is lifeless, and is clearly heard to be lifeless, the engineer and producer are in no doubt that, something must be done to change the sound at source, if that effect is not wanted. Flattery at this stage will only lead to subsequent disappointment. Jurors should not be overworked and frequent cross reference to the original sound must be made. Probably no more than two sets of loudspeakers can be compared with the original 'live' sound at any one time, as the positioning of many stereo pairs of large monitors could prove extremely difficult. A very wide range of source material is essential, as certain subtle defects may only become apparent on a limited range of programme material.

The statistical analysis of the jurors' perceptions is itself quite a complex subject. Figures will at best only provide a consensus, no absolutes. This may, however, need not be as bad as it seems. The ultimate purpose of loudspeakers is to be listened to, so, should they pass a critical, orderly listening test, the results are just as valid as any printout. On the subject of printouts, repeatability is still a problem, as in most instances, microphone positioning is hypercritical. It is extremely difficult to repeat exactly the reading from one day, when setting up the equipment, as carefully as possible, on another day. Although the readings may vary with slight microphone position changes, the loudspeaker would almost certainly show no perceivable difference in sound quality.

Assessment rooms

While the previously mentioned proposal for assessment in 'dead' rooms probably holds true for precise, subjective, neutrality tests, the ultimate acceptance tests must be carried out in a variety of typical control room environments. Subjective and objective testing do not always go hand-in-hand. One day, we *will* get to the bottom of all this!

In the Autumn of 1989, at the Institute of Sound and Vibration Research, 3 months were spent testing for certain loudspeaker characteristics. Initially, the test was intended to assess whether horns had a definable property that set them exclusively apart from direct radiators. We set up an arrangement of four archetypes labelled A, B, C and D, which were an electrostatic, a direct radiator, a typical horn/compression driver combination and a dual concentric. The main thrust was on midrange characteristics, so the signals were band limited at 24 dB/octave from 1.2 kHz to 6 kHz. The tests were performed in the large anechoic chamber at the ISVR with the loudspeakers hidden from view behind an acoustically transparent, visually opaque screen. A to D were arranged in an arc around the listener and between B and C, a sample loudspeaker could be positioned.

Nine different sounds were recorded digitally, some computer generated and others recorded either anechoically or outside, using measuring microphones of very low colouration. The axial responses in the 40 ft square anechoic chamber were very revealing. Long after we had achieved our primary goal and concluded that though the bad ones were bad, there was not a specific characteristic horn sound; we were left analysing the other observations made during the tests. The test had been conducted by switching in a sequence of Sample 1, A; Sample 1, B; Sample 1, C; Sample 1, D; Sample 1, A; Sample 1 . . . and so forth. The levels were set on the comparator by means of both measurement and listening while reproducing a noise signal. When listening to a sound such as a flute, the levels were no longer equal. Minor response irregularities in the different drive units caused some to sound significantly louder than others, while a different sound could easily reverse the relative loudness. This immediately posed the question of the balance of instruments within a mix. Being dependent upon the loudspeakers of the mixing process and the loudspeakers of reproduction at home, the relative balance of any two instruments could invert depending upon just what those two instruments were. In other words, a flute and a triangle could be deemed to be of equal level when mixed, only to appear triangle heavy by 2 dB on the home loudspeakers.

A flute and bell mix could be similarly adjudged to be 2 dB flute heavy when reproduced at home. Extrapolating from this, a mix of triangle and bell adjudged equal in balance in the studio could be 4 dB triangle heavy when heard at home, which would clearly be unacceptable. Changing the mixing loudspeakers or the home loudspeakers could reverse the situation. The degree of sensitivity to these tests was quite outstanding under such controlled circumstances. White noise even sounded different on some identical drive units from the same production batch and was generally grossly different from one loudspeaker to another. From this, it is to be expected that percussive sounds such as snare drums will change subjective pitch when switched from one loudspeaker to another. Where this is a function of amplitude response alone, equalisation is no answer. **Fig 1a** shows the response of the low frequency end of a monitor system. **Fig 1b** shows the response after adjustment by a ⅓-octave equaliser. While the overall levels have been adjusted the characteristic shape of the loudspeaker's response (the bumps on the bumps) is clearly still superimposed on the plot.

Even when two test loudspeakers were deemed very similar to say, archetype B on the first eight sounds, it was still not safe to assume that they would both sound like B on the 9th sound. In fact, one could sound like C, and one like D, it happened frequently! In many instances, two entirely different types of loudspeaker could be adjudged to sound generally very similar, with no apparent tie-up in terms of amplitude, phase, or non-linear distortions. Surely we must be looking at combinations of effects and transient waveform responses. It should be added that but for a few 'controls', all the units were very high quality devices. The degree of difference once the response is isolated from room characteristics is quite startling, strongly suggesting that with the phase and amplitude accuracy now made possible by digital recording techniques, control rooms which are more dead in nature may well be desirable where reference to just what is going to tape is concerned.

Unfortunately, the loudspeaker inconsistencies were only a part of the problem; the 'big half' involved the listeners themselves. The tests were not asking "which one is best" or "which do you prefer". The listeners were asked which of A, B, C, or D, do you think is the most similar to the sample. The listeners could tick the appropriate boxes marked A to D, or the box marked 'none'. If

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◁ it were considered that the sample sounded equally similar to two or more from A to D, then two or more boxes could be ticked. You name it, it varied! Some listeners ticked many multiple entries, very rarely resorting to the 'none' column, while others used the 'none' column almost exclusively and hardly ever used multiple entries. Some people were very clear cut in their judgement, while others were very arbitrary. Just how similar is 'similar' appears to be a very personal opinion. Some questionnaires were disparate to a degree that would have been unthinkable before the tests began. On a given sample, one person would clearly indicate that the sound of the waterfall was most similar to say Sample D. Another person may adjudge the same sound as similar to B. Repeating the test would produce the same results, both listeners being very sure of their opinion. Does the sample sound like D, or like B? Analysing the questionnaires from dozens of people could well show a strong body of opinion for D, yet certain people would still, quite unequivocally, opt for a similarity to B. Why, we must find out. Remember, this was not a test of preference but of audible similarity. Subjective preference differences we could have expected but such large objective similarity differences were not anticipated to the degree encountered.

The reactions to the anechoically recorded acoustic guitar chord posed an even greater problem. The change in sound from one loudspeaker to another, in certain cases was perceived by some people as a change in tonality. To other people it was perceived as an inversion change—as though it had been played further up the fretboard. For example, a chord of C major played as C, E, G, C was perceived by some people as the same chord but with a different timbre, while to others, the chord was perceived as having the same overall character but now becoming a second inversion G, C, E, G. Both chords are C major but notationally they are not the same.

During my years as a record producer, I frequently asked guitarists to be more dynamic, moving about up and down the fretboard. "Play the F further up the fretboard," I would say.

"It's the same chord," the guitarist would growl.

"It's not the same chord! Are you going to play it, or am I going to have to come in and play it myself?" I would ask; and so it would go. It is now very apparent to me that we may well not have been hearing the same effect.

Harking back to the example of the triangle and the bell, relatively minor response irregularities can cause one instrument to sound louder than the other, entirely depending upon the characteristics of the two sets of loudspeakers. If such effects can to some people change the actual perception of a chord inversion change, then not only the balance but the actual musical arrangement can be influenced by the loudspeakers.

While many people thought the Quad electrostatic loudspeaker to be excellent, others considered it to be bland, flat, uninteresting and not representative of other loudspeakers. For the tests, we specifically chose signals with no musical contact in terms of melody; one guitar chord and two flute notes were the most musical of the signals. The purpose of this was to try to avoid drawing people into making judgements based on sounds where they were familiar with the reproduction on other loudspeakers. Some people considered the flute to be unnatural when reproduced on the Quad electrostatics but many people hear flutes more frequently over

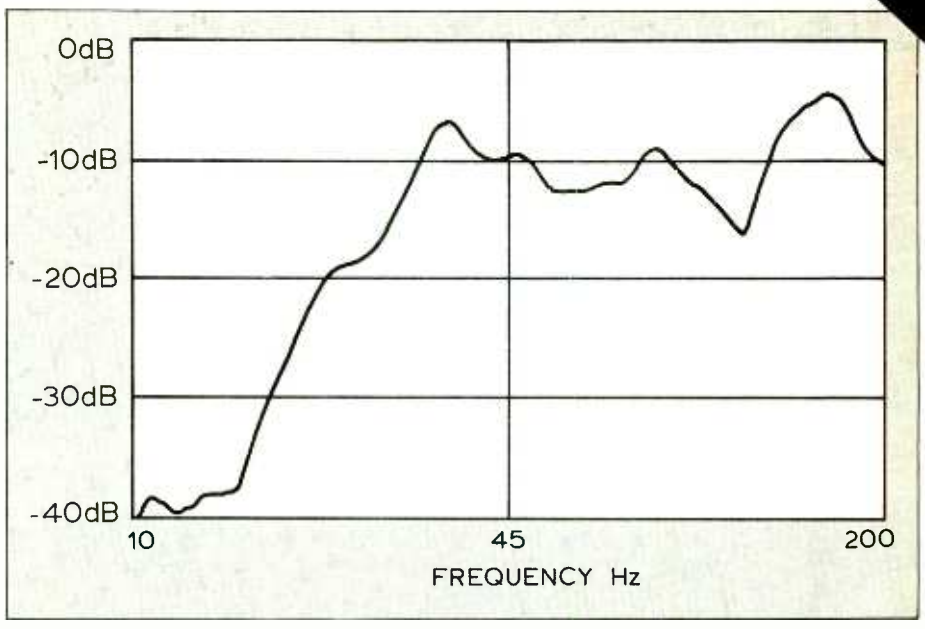


Fig 1a: Plot of response of a studio monitor bass driver after use of ⅓-octave equalisation. Note that despite the more uniform overall response than Fig 1b the characteristic 'signature' of the driver itself is still clearly apparent

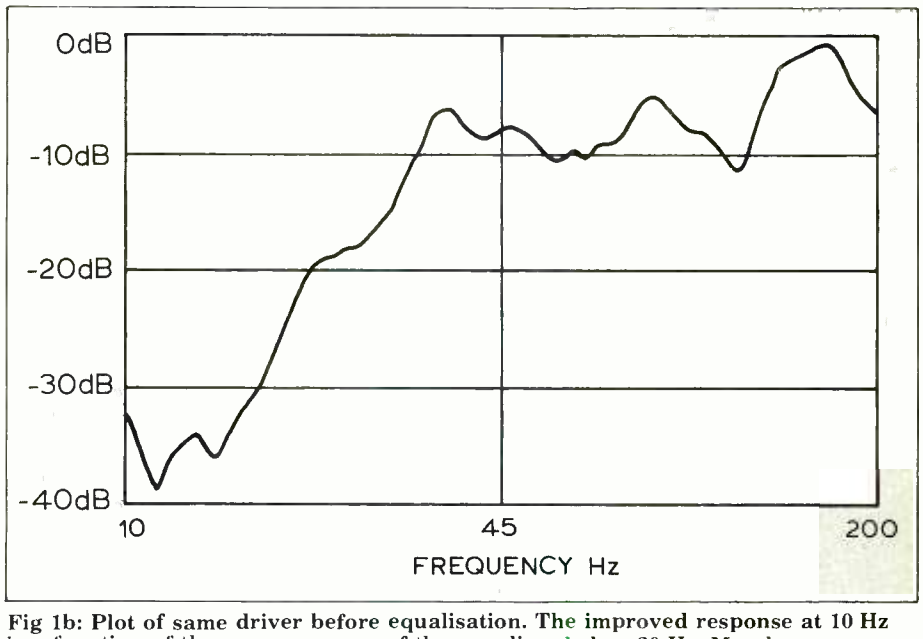


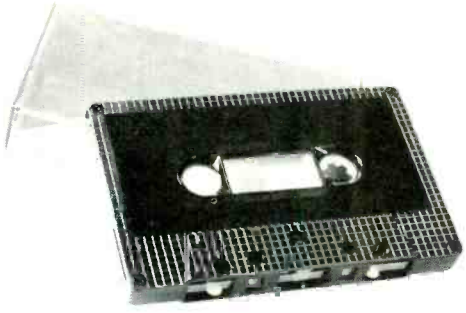
Fig 1b: Plot of same driver before equalisation. The improved response at 10 Hz is a function of the poor response of the equaliser below 20 Hz. Merely switching the equaliser in, cuts the very low frequencies

loudspeakers than in real life. All I can say is that when we were digitally recording the flute in the chamber in preparation for the tests, upon checking the recording via the electrostatics, the similarity to what we had just heard from the flute itself was quite uncanny! The electrostatic was also by far the most accurate reproducer in terms of impulse/step/squarewave response, by a long long way!

The disparities in the test samples were so great that any attempt to design studio monitor systems and control rooms to be representative of some 'average' or 'typical' domestic loudspeaker and environment would appear to be a non-starter. If 10 people each earn a different sum of money, person one earning £1, person two £2, person three £3, and so on till person 10 earns £10; then between them they will earn £1+2+3+4+5+6+7+8+9+10 or £55. On average, they would earn £5.50 each. In reality, however, none of them would actually earn £5.50, and only two of them would earn a sum within even ±25% of this figure! Clearly, to impose a tax or benefit regime based on an average income of £5.50 would be grossly unfair. When one considers the wide disparity in domestic loudspeaker responses and listening conditions, aiming for an average tends to leave the largest percentage of listeners grossly unrepresented.

When monitoring, it must surely be better to go for bland accuracy in order to be more fair to all. The true audiophiles will have to learn to spend as much on their domestic rooms as they do on their equipment. I can very strongly appreciate the commercial reasons for 'representative' monitoring but I truly cannot see how any useful domestic average can be achieved. It tends to lead to such a smearing of the standard that there are effectively no standards at all. I personally think that the studio industry should once again attempt to lead the hi-fi trends rather than following them—but do the record companies want it and do the musicians want it? Are we going for excellence and a standarisation of accuracy, or is everything geared to mass consumerism? Somebody somewhere is going to have to decide!□

PRODUCT PROFILE



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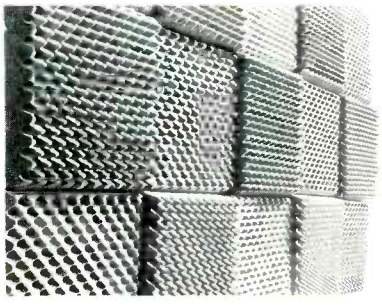

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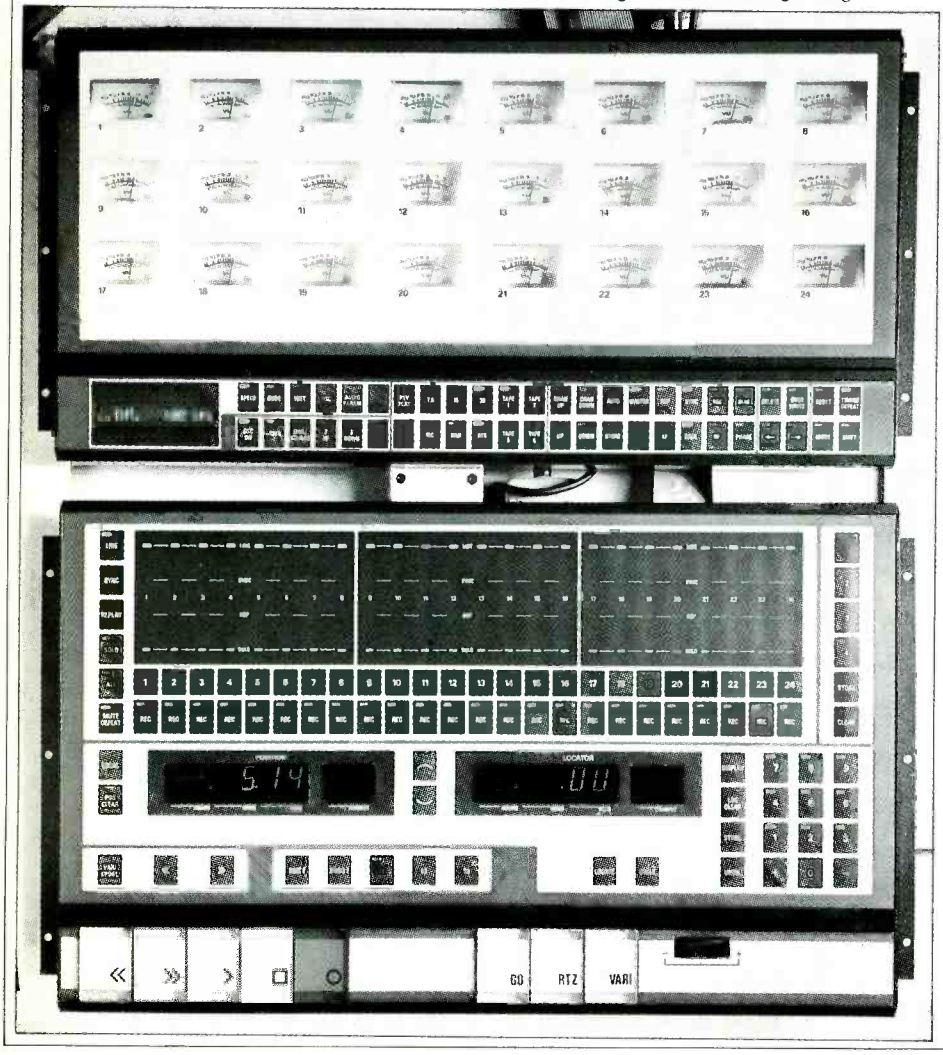
Saturn 824

A technical report by Sam Wise on a British multitrack tape machine

The *Saturn 824* is a semi-conventional 24-track 2 inch tape machine housed in the usual dark grey steel self-contained wheeled housing. The machine can be purchased with or without a meter overbridge, which was fitted to the review machine.

In visual appearance and feel, the machine gives an impression of quality in every aspect. The details are right. The internals are easy to access, most electronics are at the front, installed behind the nicely fitting front doors. Each channel's electronics are on one double-Euro sized PCB, with all 24 channels mounted in a single card frame. At the left end of the frame, an extender card is stored for easy maintenance. The large sized power supply beneath is fitted with slides, and pulls forward for servicing or unplugs and removes for replacement. The doors on the front of the housing do not just snap shut but are held virtually rattle-free by well designed latches. On each side of the housing, handles are fitted for pulling or even carrying the machine.

Loosening two Allen screws on the top of the machine releases the transport top plate, which lifts easily on two gas struts to an accessible position. The mechanics are simply elegant. As an owner of the machine said "there's nothin' in it". But that is not a criticism. Modern motion sensing and microprocessor electronics has rid the machine of mechanical complexity, providing tape handling as good as any I have seen. 'Nothing' inside consists of two massive reel motors, one capstan drive motor and a solenoid each for the tape lifters, head shields and pinchwheel. The dampers are sealed units, springs are few, and where are the brakes? Though there was no need to get the tools out, it looks as if everything is easy to access for servicing or replacement. The deckplate appears to be about 20 mm thick and is machined from aluminium. When lowering the deck as well as opening it, the gas struts take the load, removing the risk of damaged fingers.



The top of the transport also houses large pushbutton switches for transport control at the left, a back illuminated LCD alphanumeric display which provides a range of messages, and two long rows of pressure sensitive switches which are used for setting up and programming various machine functions. These pushbuttons have both tactile feedback (they feel OK) and click an internal relay for audible assurance that your press has been received and dealt with by the internal computer. Further up on the deckplate is a display showing the current locate position.

The installed meter bridge is clearly labelled and fitted with what seem to be real vu meters, though there was not time to test their ballistics. Each has an adjacent LED indicating record status.

Manufacturer's specification

Format: 2 in 24-track
Reel size: 14 in NAB
Tape speeds: 7.5/15/30 in/s (19/38/76 cm/s)
Wind time: 62 s for 2400 ft (min, user adjustable)
Start time: 0.8 s for 14 in reel at 30 in/s
Brake time: 1.0 s for 14 in reel at 30 in/s
Locate time: 26 s at 30 in/s, 18 s at 15 in/s for top of 5 min passage
Capstan lock: 2 s after switch-on or speed change
Speed accuracy: better than 0.1%
Speed stability: better than 0.05%
Wow and flutter: better than 0.03% at 30 in/s; better than 0.04% at 15 in/s; DIN 45507 peak wtd
Line inputs: electronically balanced −10 to +20 dBu for 0 vu (adjustable); impedance nominally 10 kΩ
Line outputs: electronically balanced −10 to +20 dBm for 0 vu (adjustable); impedance nominally 75 Ω
Equalisation: NAB; IEC; AES
Bias frequency: 227 kHz
Erase frequency: 114 kHz
Rec/replay frequency response: 42 Hz to 29 kHz (+1/−2 dB) at 30 in/s; 25 Hz to 22 kHz (+1/−2 dB) at 15 in/s
Signal to noise ratio: record to replay, 20 Hz to 20 kHz band limited

	1040 nWb/m	320 n/Wb/m
30 in/s	72 dB	63 dB
15 in/s	68 dB	59 dB

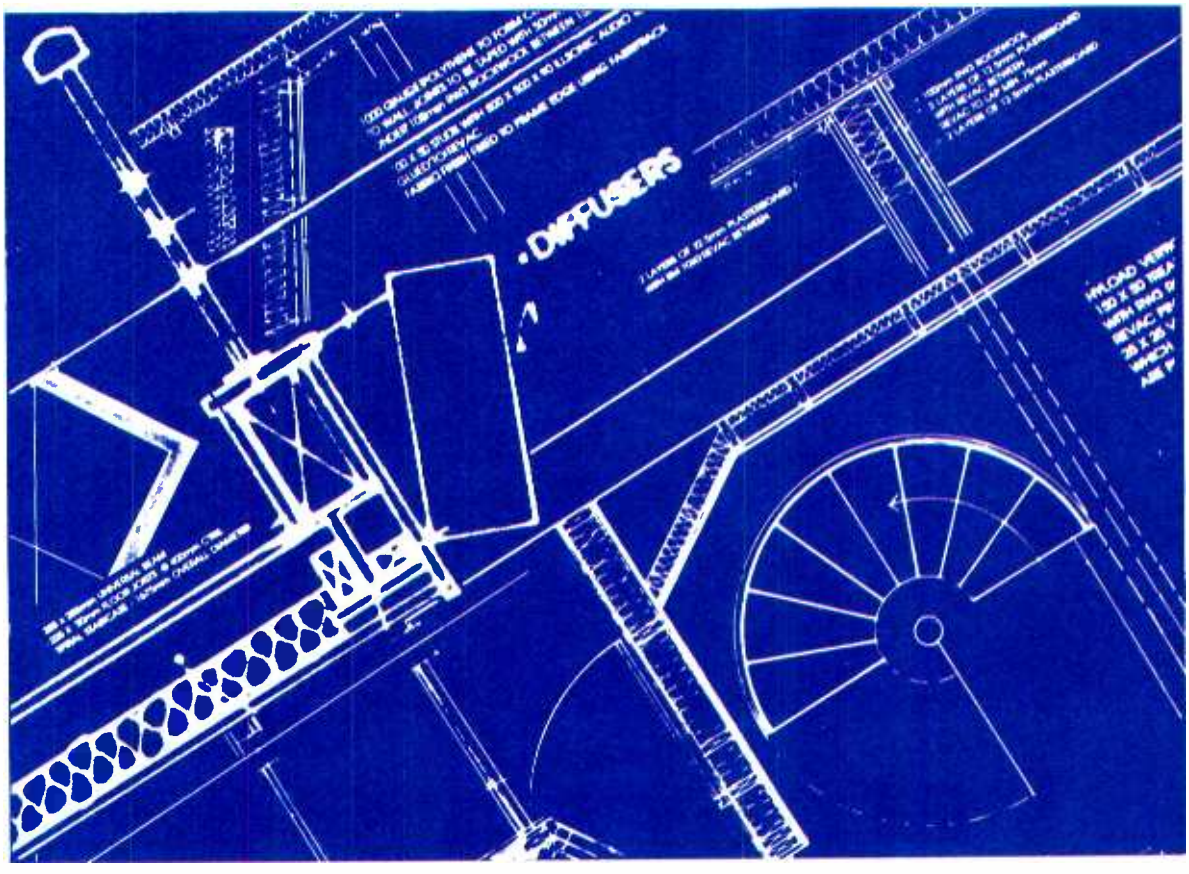
Distortion: 0.3% at 1 kHz at 320 nWb/m, 3rd harmonic
Rec/rep crosstalk: better than −55 dB at 1 kHz
Erasure: better than 80 dB
Alignment oscillator: sine or squarewave at 0 dB or −10 dB; 112 frequencies from 31 Hz to 31 kHz
Power requirement (mains): 110, 125, 220 or 240 V (±10%), 50 to 60 Hz, 600 VA at start-up
Dimensions: (whd) 760×990×660 mm (meter bridge option adds 380 mm height)
Weight: 220 kg
Saturn Research Ltd, Unit 3a, 6-24 Southgate Road, London N1 3JJ, UK.
Tel: 01-923 1892.

The rear of the machine allows inputs and outputs to be connected via either Neutrik *XLR-3* types, or Varelco/Edac multipin connectors. The rear swings open too, revealing ribbon cable interconnection and a further small rack of PCBs mounted in the door. This is the 'auxiliary' rack and contains the meter LED drivers, remote buffer and various other interface boards.

Operation

The machine is fitted with well-designed NAB adapters, which tightly clamp the spools. Lacing the tape is easy and requires only pulling the tape around the tension arms on either side and through the pinchroller gap. Having put a few ▷

MUNRO ACOUSTIC DESIGN



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Not surprisingly, we soon came to dominate our market, becoming . . . the largest pro-audio supplier with nearly all the companies we dealt with (Alesis, Korg, Drawmer, Casio, Fostex, Tascam, Yamaha, Studiomaster and a good few more). This had two knock-on effects; firstly, our customers received (if possible) an even better service – if we were unable to help quickly the manufacturer could; secondly, we were in certain instances, able to purchase 2 items at discount rates giving savings which we passed on to our customers.

This combination of service plus value proved unbeatable, and last year we sold nearly SIX HUNDRED eight and sixteen track systems. During this period though, two significant things happened. Many of our customers began asking if we could supply more advanced systems – budget 24 tracks for producers and artists, and full-blown systems for large installations. Unfortunately there seemed to be a huge price gap between sixteen and twenty-four track (in any case, top end multitrack was already handled very capably by existing companies).

At the same time though, technology came to our assistance! Many of the companies we dealt with who were known for budget multitrack suddenly started launching leading edge technology items at previously unheard of prices. For the small professional studio, or producer/artist, Tascam developed the cheapest 24 track in history, Allen & Heath at the same time designing a medium price, full feature MIDI console with 24 track compatibility. For more advanced systems the Yamaha digital multitrack, the Fostex timecode R-DAT and the Digidesign hard disc recorder were all examples of high tech initiatives from a new breed of companies.

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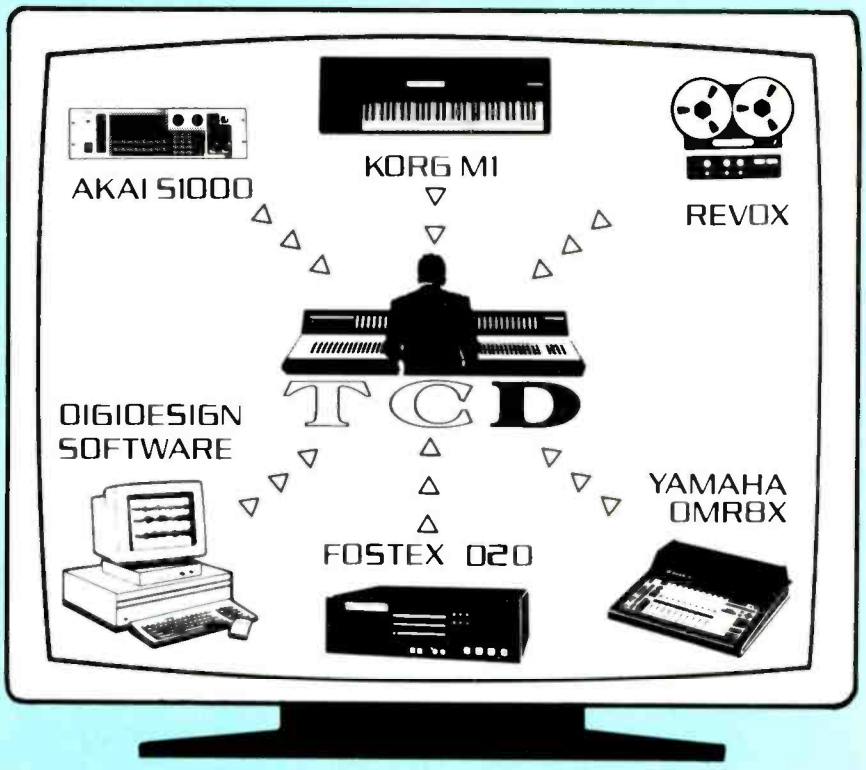

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turns on the take-up spool, pressing LOAD places the tape under tension. The tension balance is achieved by the transport actually measuring the tape on the spools when you manually wind on during lace-up, so sometimes up to four turns are necessary if you want it to settle on first push. PLAY engages the reel motors, which bring the tape up to speed, and not until this is reached does the pinchwheel activate. At that point there is a little jostling of the tape supply and tension arms, which is well within their free travel. Then the head shields quickly rise. This sequence is completely software controlled and very effective.

Pressing » or « fast winds the tape at a user-definable speed up to 600 in/s until it approaches the reel end. At that point, the deck senses the tape remaining and brings the spools to a halt. The days of accidental wind-off and tape damage are over. A further press of « or » slow winds off the remaining tape and the spools then come to a quick but smooth stop.

During the tests, the deck was shuttled for 10 continuous hours without one slip by the mechanism. Fear for the life of the test tape rapidly evaporated as the 10 autolocate memories were used to speed up replay frequency response measurements.

Programmable transport controls

Saturn Research are aware of the fact that users 'grow accustomed to the face' of their existing or favourite tape machine. Rather than trying to force a philosophy of operation down the engineer's throat, they have cleverly made most transport operations user-programmable. Thus the machine can be set up to mimic the operating modes that the user prefers.

For example, RECORD can be interlocked with PLAY, or programmed to be 'one-touch'. All tracks READY RECORD are then activated. During recording, pressing RECORD READY actually does the opposite, placing selected tracks into drop-out ready condition. Punching RECORD then drops these tracks off record, leaving the remainder in record mode—a useful feature. It is also possible to lock certain tracks off record at the deck preventing the remote REC READY from operating and thereby the accidental erasure of material such as timecode due to a momentary slip of the brain.

All of these functions are duplicated at the deck and the remote, while the remote provides many further useful facilities. Among these are a nine-memory autolocator, four memories for monitor selection setups and three programmable function keys that can be loaded with a sequence of up to 32 key presses, enabling automation of regularly used command sequences.

The machine's control facilities are very comprehensive and proved to be easy to learn during my 13 hours or so of hands-on operation. It really is impossible to describe them all here but what you want or need is likely to be available.

Quiet and cool

The machine was quiet in operation, most noise being generated by tape scraping slightly bent reel flanges rather than from the transport or internal fans. The *Saturn* should therefore be usable within the control room although the comprehensive remote and transport reliability really do permit unattended remote operation, which must be the best solution. ICC Studios in Eastbourne have their machine in a small room in the hallway adjacent to the control room.

Another noticeable characteristic of the machine is cool running. Even after 10 hours of operation in a somewhat confined space, the deck plate was still cool to the touch. This bodes well for the recorded quality helping to minimise print-through and self-erasure.

Digital alignment system

In the *Saturn*, everything required for tape alignment, except mechanical head adjustments, are digitally controlled. Comprehensive pushbutton type controls for this are provided on the transport deck and on the remote. Since the data is digitally stored, setups for four different tapes can be preset on any combination of the three operating speeds and IEC, NAB and AES equalisation standards.

In addition, an optional auto-align function allows the tape machine to calibrate its own record bias, gain, equalisation and phase compensation in about 10 minutes. This means that each new reel of tape can be set up for optimum performance if required. The software uses autolocate memories 8 and 9 to define the tape section which will be used for alignment, avoiding unnecessary tape wastage.

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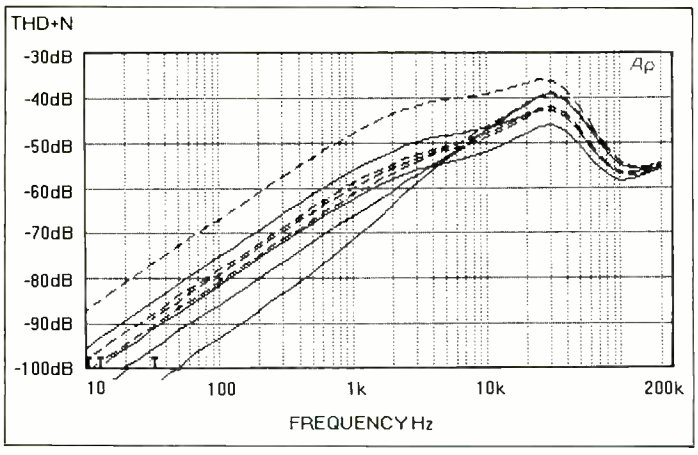

Fig 1: Input common mode rejection

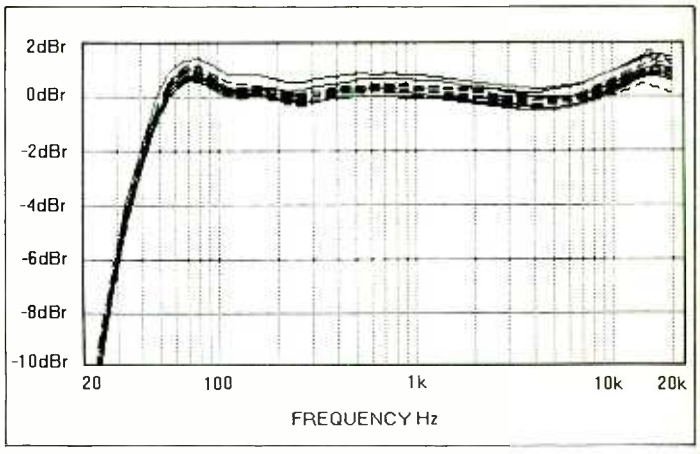

Fig 2: Record to replay level 30 in/s AES, input level 0 dBu

Meters

The main meters have a calibration accuracy of about ±0.2 dB and are clearly meant to be full specification vu meters, though this was not confirmed during testing. The miniature meters fitted to the remote were useful as a general indication of level but were not such as to be regarded as proper vu meters. Their reference level was accurate enough at 1 kHz (±0.3 dB) to provide a reasonable check of the result of an auto-align run prior to using a new reel of tape.

Inputs and outputs

For the tests Ampex *456* tape was used but ICC Studios, who kindly provided access to the review machine, have now switched to Agfa *PEM460*, which is said to have better print-through performance.

As set up, 0 vu on the meters is equivalent to +4 dBu. This produced a recorded tape flux level of 510 n/Wb/m which used to be peak level little more than 10 years ago. Having not thoroughly tested an analogue recorder for some time, the improvements in performance of tape plus electronics is impressive. ICC use their machine without noise reduction, so a high operating level is mandatory to achieve low apparent noise. As will be seen later, the tape/machine system handles this well.

The electronically balanced inputs have a sensitivity range of −10 to +20 dBu for 0 vu, while they will handle signals greater than +30 dBu before overload. The input impedance measures 24 kΩ, and is independent of control settings.

As can be seen in **Fig 1**, the common mode rejection varies from track to track by more than 20 dB at low frequencies, reducing to 40 dB at 20 kHz for some tracks. At the important lower frequencies, rejection is adequate at 60 dB.

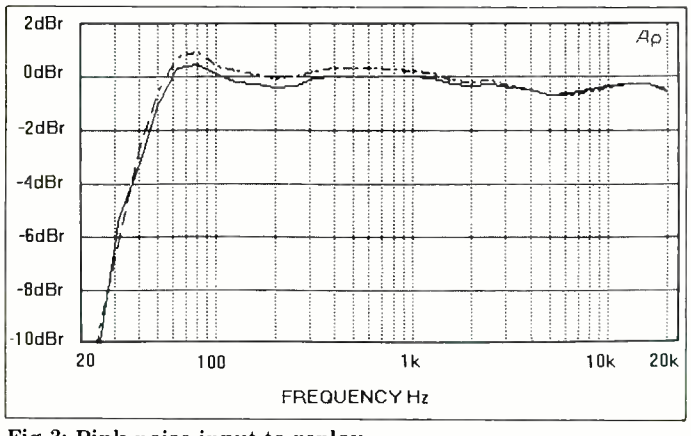

Fig 3: Pink noise input to replay 30 in/s AES, input level 20 dBu

The output is a servo'ed, electronically floating output, which will drive either balanced or unbalanced loads at a maximum of +24 dBm (600 Ω). Like the input, the operating level can be varied from −10 to +20 dBu for 0 vu. The source impedance measured about 75 Ω, which meets specification.

Frequency response

Using the Ampex *456* tape mentioned earlier, and following AUTOALIGN the machine produced a record to replay frequency response of ±1 dB from 50 Hz to 23 kHz at 30 in/s with AES equalisation. The −3 dB points are at about 37 Hz and 30 kHz. **Fig 2** shows the superimposed results for about half the tracks. This is with a drive level of 0 dBu (−4 vu) or about 320 nWb/m. Switching to a pink noise input signal and increasing the level by 20 dB still achieves the same frequency response when measured by sweeping a ⅓-octave filter as shown in **Fig 3**.

In **Fig 4**, the tape speed is reduced to 15 in/s, resulting in a smaller high frequency bump and a more rapid HF fall-off. The low frequencies are slightly extended, giving a −1 dB point of 25 Hz and a −3 dB point of about 20 Hz. Both of these results match the manufacturer's specification.

Looking at the sync output things bear a remarkable resemblance to replay with minor performance reductions at the band ends. (**Fig 5**.)

Experimentation showed that it is possible to manually obtain slight improvements in the response flatness compared to AUTOALIGN but the differences are likely to be inaudible since things are good anyway. The range of equaliser adjustment was not measured but nudging the buttons up and down produced an apparently adequate range of adjustment. NAB equalisation was also checked and found to produce the same results.

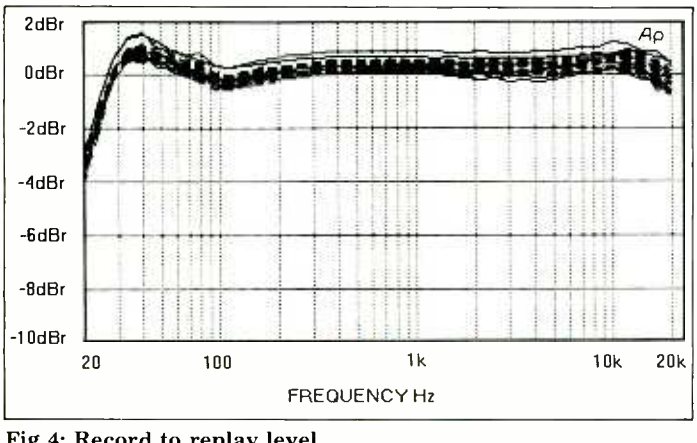

Fig 4: Record to replay level 15 in/s NAB, input level 0 dBu

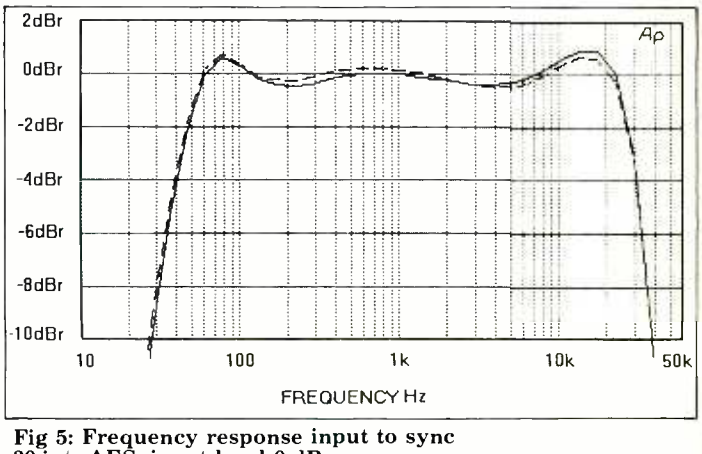

Fig 5: Frequency response input to sync 30 in/s AES, input level 0 dBu

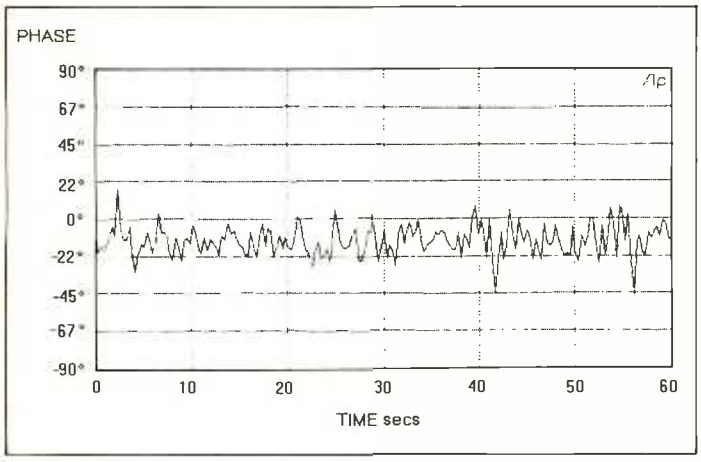

Fig 6a: Phase difference at 15 kHz, replay output

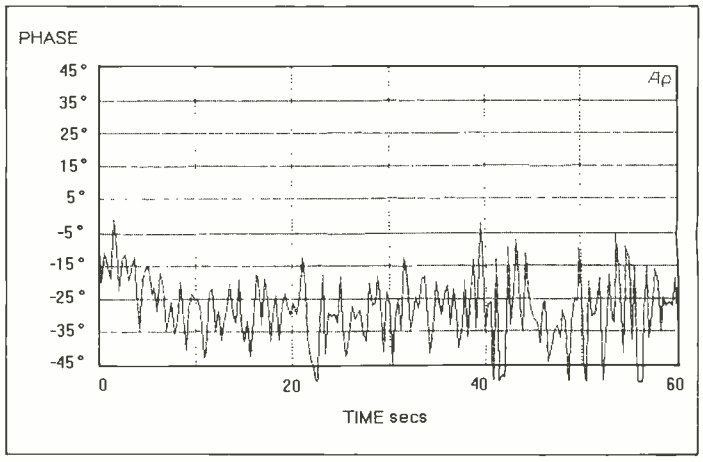

Fig 6b: Phase difference at 15 kHz, sync output

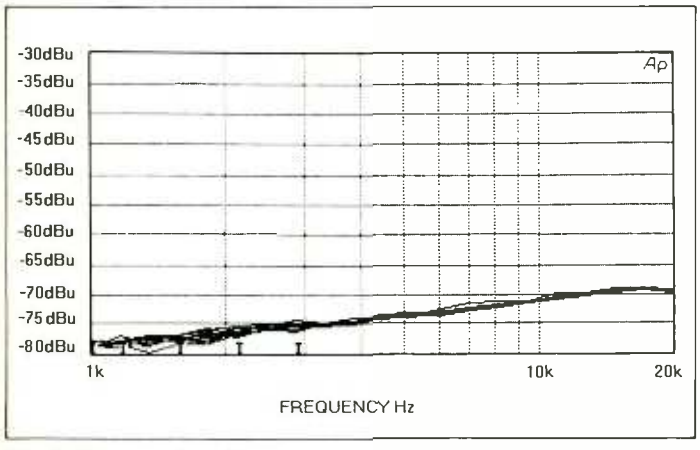

Fig 7: ⅓-octave bandpass Modulation noise, input to replay while recording

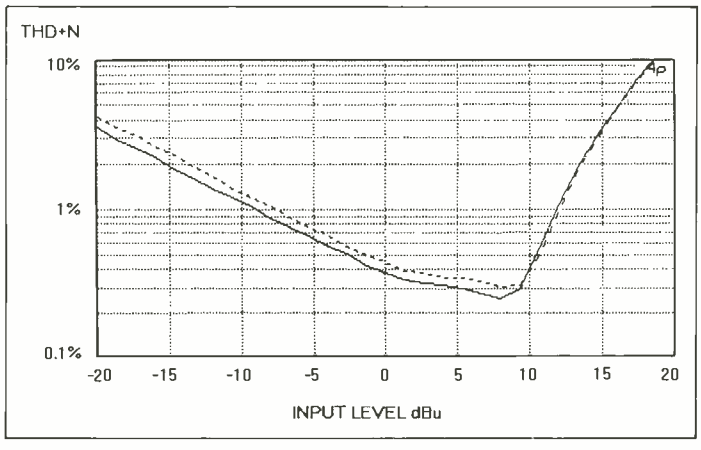

Fig 8: THD vs input level at 30 in/s Record to replay while recording

Phase

Absolute phase is very good with little phase shift with frequency over the audio band. The auto-align phase compensation produced this good result. Track-to-track phase variation was also quite good. The worst case error was found between tracks 3 and 23, which differed by about 25° at 15 kHz. Peak-to-peak phase jitter is about 10°. These details are shown in **Fig 6**. Other tracks were typically within 12° to 15° with a similar jitter.

Modulation noise

Any process of recording (even digital) produces modulation noise. This is usually audible as a high frequency hiss which varies with the level of a lower frequency tone. And yes, it can be very audible on programme. The level of mod noise any recorder produces is a function of tape, heads and transport. Increasing tape tension may, for example, increase high frequency output while also causing this form of noise to increase. Any vibration of the tape along its length (also known as scrape flutter) adds to the problem. It is most audibly obvious when recording a pure tone.

In this area, as in many others, *Saturn* have got things right. Audibly, it just doesn't seem to be there. Admittedly, the machine was running with brand new heads but this nasty and common feature of tape recordings couldn't be found. **Fig 7** tells all. A low frequency tone was recorded, then removed from the output using the test set filters and the remaining noise plotted by sweeping the ⅓-octave bandbass filter. The level of the low frequency tone is then increased and another sweep is performed. This test is commonly used to show up A/D and D/A converter errors. As is evident, the resulting narrowband noise remains low at −78 to −70 dBu, or −92 to −84 dB below peak recording level.

There are also no audible dropouts.

TABLE 1

Measurement method	Noise referred to 320 nWb/m (0 dBu) 30 in/s tape
22 Hz to 22 kHz AVG	−61.5
22 Hz to 22 kHz RMS	−60.5
A-weighted RMS	−64.0
CCIR-weighted RMS	−56.0
CCIR-weighted quasi-peak	−52.5
CCIR-weighted ARM	−62.5

Broadband noise

Table 1 shows the results of broadband noise measurements to various standards using machine-erased tape. These are not as good as the published figures, which do not specify the rectifier used and this can have a large effect on the result. At 30 in/s, the dynamic range between the tape 3% MOL level and noise is about 75 dB RMS unweighted. The intrinsic machine noise without tape was well below these figures, indicating well designed replay electronics.

Distortion

Fig 8 shows the total harmonic distortion plus noise curve at 30 in/s at 1 kHz, with increasing input level. 3% THD+N occurs at a level of +15 dBu, or +11 dB above the 0 vu point corresponding to 510 nWb/m. THD+N at 0 vu is good at 0.3%. In **Fig 9** it can be seen that distortion is predominantly third harmonic, with the others a good 7 to 10 dB lower. The result at 15 in/s is very similar, with noise more evident at lower frequencies. These results meet the published specs.

SMPTE intermodulation distortion using 60 Hz and 7 kHz tones, is shown in **Fig 10**. As is evident, this begins to rise at a lower level than THD, reaching 3% at +10 dBu. This type of distortion has not been commonly measured or published for tape machines, so is difficult to compare between products at this point. CCIF measurements using two adjacent high frequency tones were also made and gave results of about 0.1% which altered little with level.

Crosstalk

Fig 11 shows typical crosstalk versus frequency with Track 11 input terminated in 50 Ω and adjacent tracks 10 and 12 having identical inputs all on record. This is a good performance except at frequencies below 70 Hz. Here we are only 20 dB down on adjacent tracks, while other

manufacturers manage 30 dB. Putting bass and bass drum together on edge tracks should minimise any audible effect. In the mid-band, where everything is happening in the mix, the 60 to 70 dB isolation is very creditable, being somewhat better than average.

Sync crosstalk is typical, with very little isolation at high frequencies.

Erasure

Again a good result as indicated in **Fig 12**, with a 5 to 10 dB degradation with respect to bulk erased tape below 200 Hz. Above this frequency measurements are limited by the basic tape noise.

Wow and flutter

Wow and flutter to IEC standards was measured at both ends and the middle of a 10½ inch reel of tape. Typical results are shown in **Table 2**, an excellent performance and well within the published specification. On difficult material such as piano and acoustic guitar, wow and flutter were inaudible.

Speed variation from one end of the tape to the other at 30 in/s was better than specified at 0.02%. Absolute speed accuracy was impossible to measure since the test tapes varied more than the machine did. The transport offers three fixed speeds, being 7½, 15 and 30 in/s.

Varispeed operation gives a range of ±50%. In practice, manual operation of varispeed provided a smooth and manageable response from the transport. It can also be preset and switched in when required. In this case, the speed transition is also smooth and without any apparent overshoot.

TABLE 2 Wow and flutter

Tape speed	(IEC wtd)	(IEC unwtd)
15 in/s	0.01%	0.02%
30 in/s	0.007%	0.014%

Other matters

Experiments with drop-in and drop-off using a fixed frequency, single tone were impressive. There was a just perceptible dip in level at the drop-in point, while drop-off was click-free.

Summary

As you can probably tell, I was a regular user of a past generation of multitrack recorders and I liked this machine. Indeed recently an opportunity arose to rebuild the recording complex within a major opera house development in Taiwan. The machine there was far more expensive and made by a much better-known manufacturer. There is no question that in operational and performance terms, the *Saturn 824* is superior.

But, the advantage of the other machine is that the manufacturer has been around a long time and is noted for making spares available almost indefinitely. So, is the purchase of a machine like the *Saturn*, made by a small company, worth the risk? My advice is, if you want a good analogue recorder, defintely put *Saturn* on your list of for evaluation.□

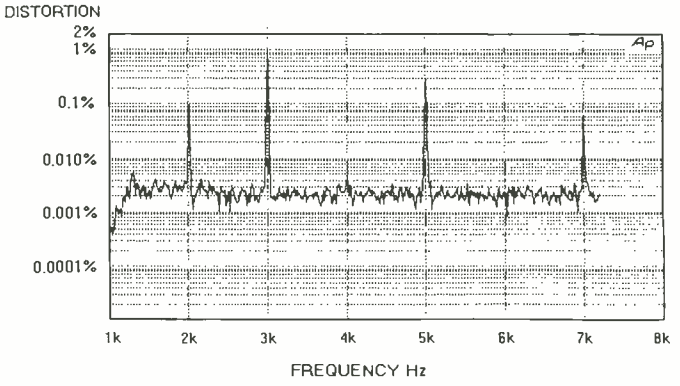

Fig 9: Spectrum response of 1 kHz THD at 30 in/s

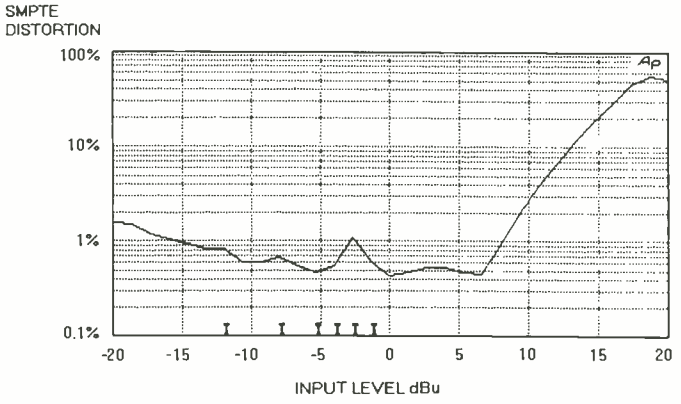

Fig 10: SMPTE vs input level at 30 in/s
Record to replay while recording

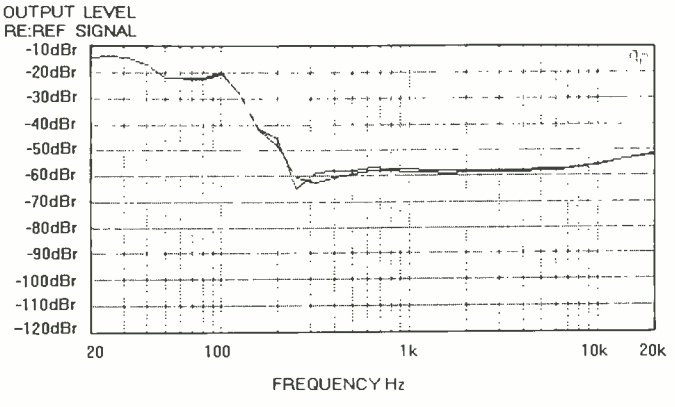

Fig 11: Record/replay crosstalk, 30 in/s AES

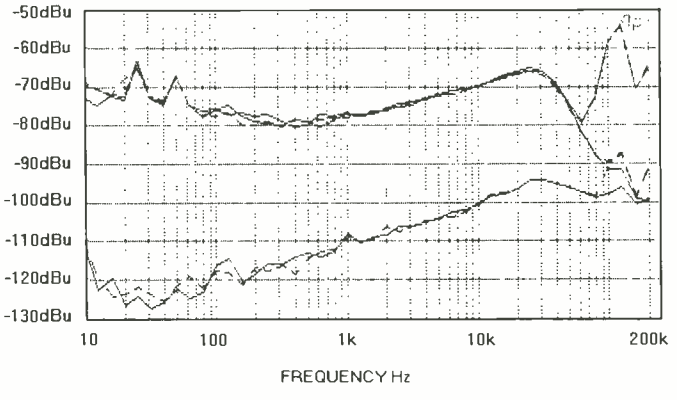

Fig 12: Erasure noise spectrum
30 in/s AES EQ
0 vu=+4 dBu, 320 nWb/m
Top curve at 80 kHz—replay output during recording
Middle curve—replay output during replay
Lowest curve—replay output, tape stopped (amps only)

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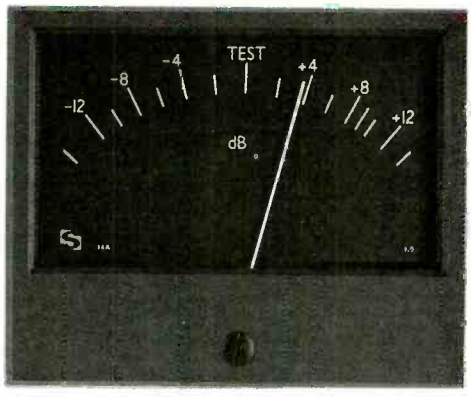

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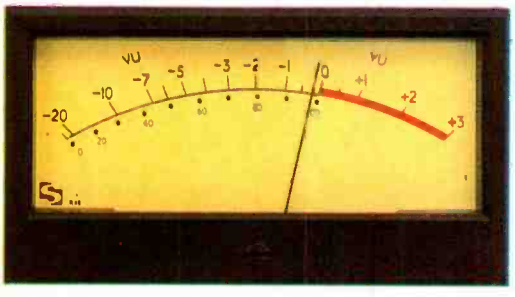

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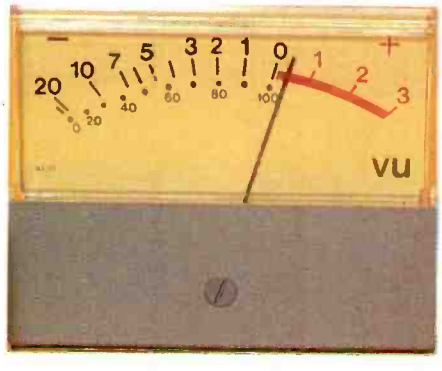

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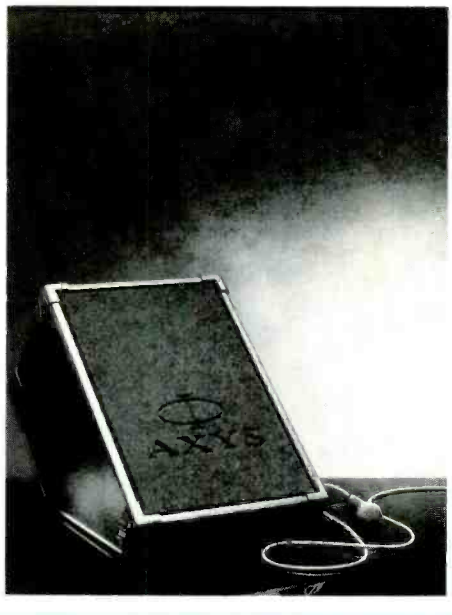

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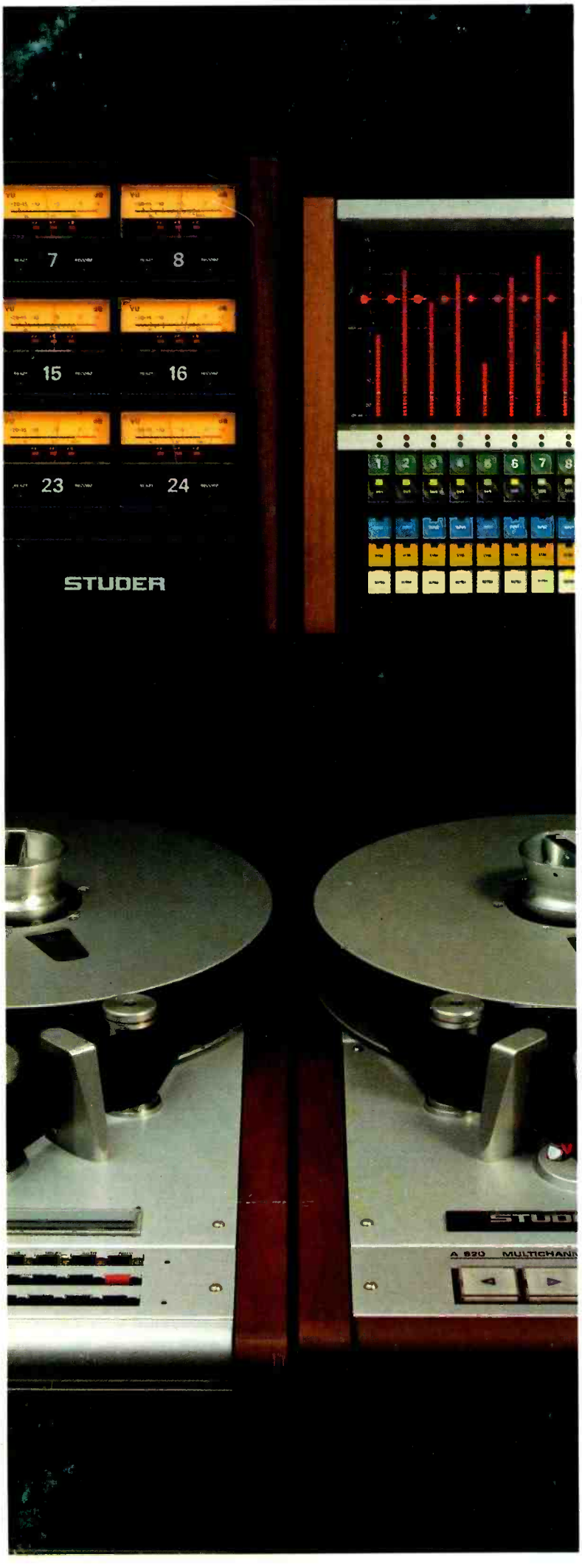

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