

May 1990

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A LINK HOUSE MAGAZINE

STUDIO SOUND

BROADCAST ENGINEERING



MICROPHONES

ISSN 0144-5944



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pile. Now put it on top.
Do not disturb any
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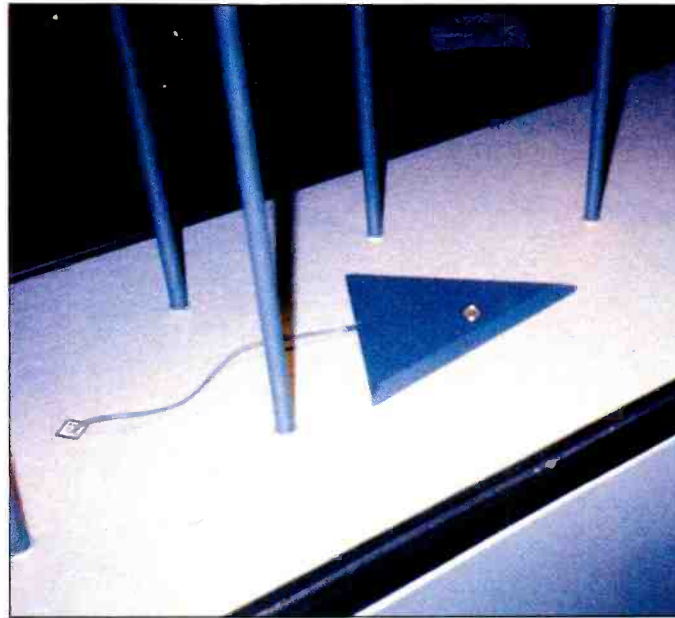
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STUDIO SOUND

AND BROADCAST ENGINEERING



Neumann GFM132 boundary layer microphone on show at the AES exhibition in Montreux

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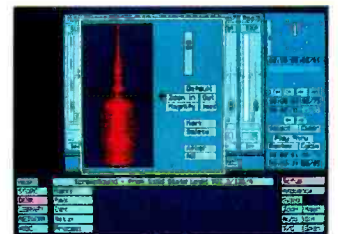
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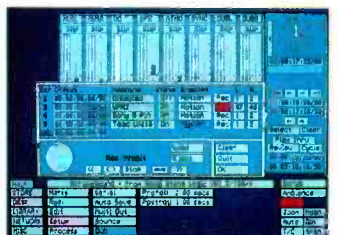
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Fickle future

One of the many problems that the '90s will bring to us all is just keeping up with technology. For many of us within the recording community there is no alternative with studio finances being closely tied to investment costs and marketability of a facility. In some cases developments are easy to assimilate on an operational level—low cost effects devices for example. However, the same advantages of low cost may cause difficulties in maintaining the marketing attraction of the larger, more expensive effects devices that you already own. This was the problem presenting itself in the latter years of the '80s and we have almost come to terms with it.

The '90s promise to be different. The commercial life span of a new development seems to be contracting to such a degree that unless you are keeping up with general advances in technology—and in our field this means the electronics and computer journals—by the time you have come to terms with the meaning of a new piece of equipment it may either have been replaced or have lost its marketing advantages. Being early into a new product can, of course, be fraught with problems but if you have made a thorough study of the technical background then your problems are minimalised. Some studios do operate in this manner and as long as they keep on top of their subject, all goes well.

So far this year we have seen the dramatic rise of the optical disc in a variety of forms. About a year ago some companies were suggesting their introduction as back-up systems for hard disk recording/editing systems. Also about the same time Taiyo Yuden (That's) were showing recordable CD format discs (CD-R) with a projected introduction 2 years later. Well, so far this year the MagnetoOptical Disk (MOD) is now available from several manufacturers of hard disk systems. One of the early concerns about the MOD was that it would be very slow and although it is not as fast as hard disk it has been shown that with intelligent disk management it can be quite usable and indeed, Akai have developed a complete recorder/editor/sampler around the MOD and at a fairly low price. The MOD would also appear to have reduced many of the reasons for adding banks of hard disk drives to existing hard disk systems except for disk-consuming multichannel work of 32 tracks plus. This will present not only a significant money saving but also reduce the problems of up and downloading (background operation for loading or saving data being generally possible or even working directly from the disk).

The CD-R is also now a reality in the form of two competing systems that allow single or multiple CDs to be made in little over realtime. The potential of the CD equivalent of the acetate test disc is now realised and presents a number of opportunities in the commercial sense. If a facility wants to take advantage of this they need to act very quickly as it is perhaps the type of product that *may* decrease in cost and then become a far more standard service and eventually be of no marketable importance. If you wait until you understand the technology after the event it may be too late.

As a magazine we will continue trying to make information available about forthcoming technologies but there are problems for us as well. Much of the development work is undertaken by companies for their own proprietary ends and therefore we do not have access to information long before a product is shown. We are, however, aware of the problems and will be attempting to address them more fully in future.

Keith Spencer-Allen

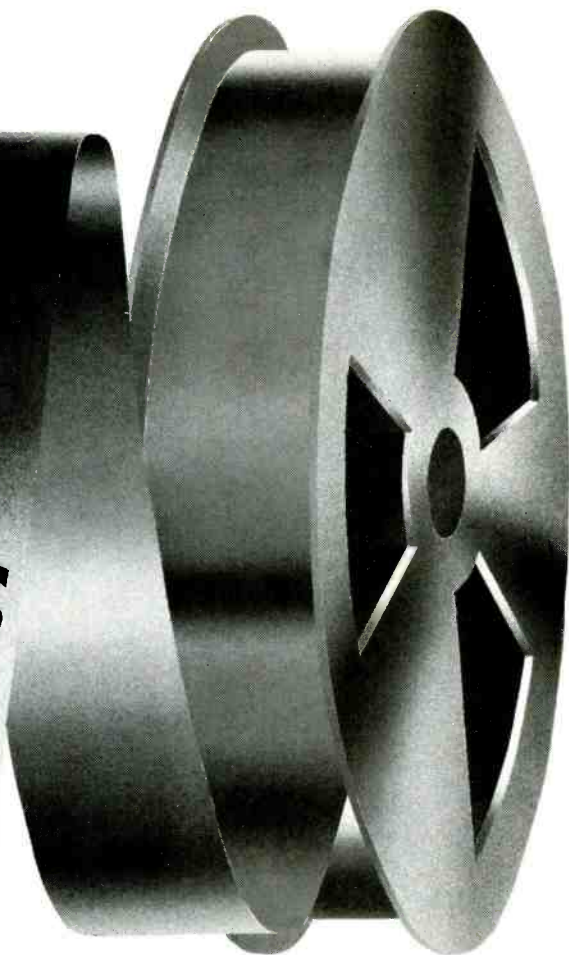
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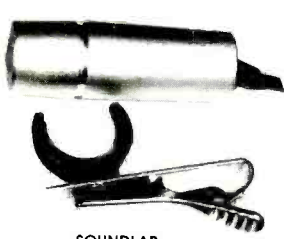
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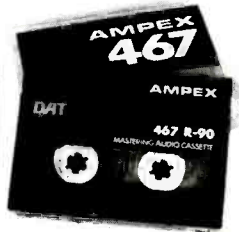
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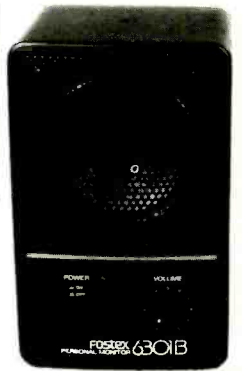
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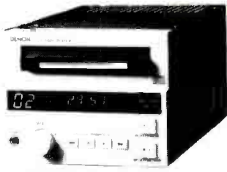
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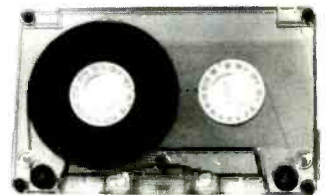
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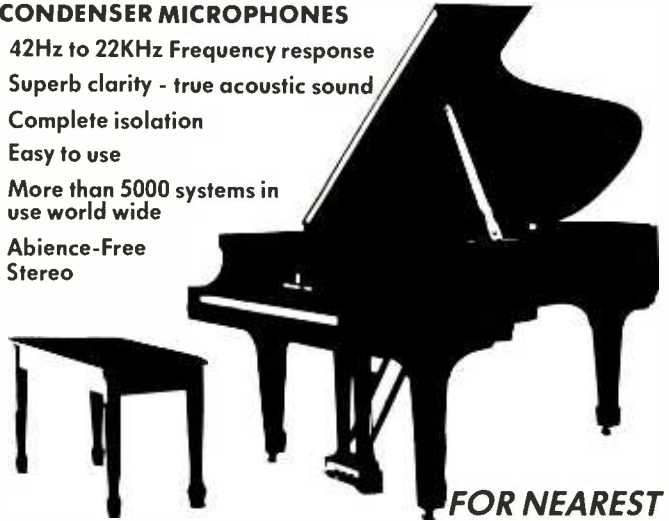
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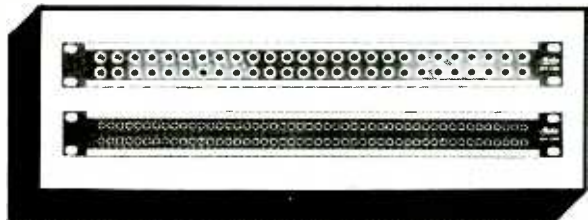
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All these reasons add up to why we are choosing AMEK for our second room. ”

Andy Waterman and Jon Baker,
The Bakery, Los Angeles, USA.



When looking for a console for our new residential studio we were especially concerned that it should do justice to our superb room acoustics.

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The fabulous AMEK sound and automation together with the unbeatable acoustics of the Windings will provide a service to the recording industry which will take us successfully through the 90s. ”

Rob Jones and Max Rooks, RPM Studios
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DIGITAL RECORDING

There's little doubt that digital technology has brought about a revolution in recording. But with A-DAM, Akai has gone one step further, achieving a technical feat by bringing the cost of digital multi-track recording within the reach of every studio.



Akai's 60 years of experience and long involvement in rotary head technology has resulted in the world's first digital multi-track using compact 8mm cassette tape. Accurate, stable and hard-wearing, this media has proven ideally suited to digital audio with the added advantage of being available in the high street at a fraction of the cost of reel to reel tapes. For the 8mm format, Akai has developed a unique transport system that provides extremely fast rewind and tape search time and maintains an audio quality

AKAI
DIGITAL

WHERE INNOVATION TRIUMPHS



CUT DOWN TO SIZE.

you'd expect from digital machines costing several times more. Combining ease of use with power and flexibility, the DL1200 programmable auto-locator offers a superb range of functions including the ability to slip tracks in time, set crossfade drop-ins, frame accurate drop-ins as well as providing 100 instantly available locate points. The auto-locator can control up to three DR1200 recorders for 36 track digital recording using its own automatic internal synchronisation. Designed to be adaptable, A-DAM will also interface with all popular digital formats. So whether you're planning a new system or simply wish to experience the creative freedom that only this technology can provide, A-DAM will satisfy your highest expectations at a cost that really cuts digital recording down to size.



A-DAM

D & R Dayner

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D & R



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All D & R products carry a 2 year warranty.

Studer's future secure

Studer announced at the recent AES Convention in Montreux, Switzerland, that they have merged with the Swiss group SAEG Refindus Holding Inc. By selling to a Swiss group of companies, Studer's founder and sole shareholder Dr Willi Studer has secured the long term autonomy and independent continuation of his company.

SAEG Refindus Holding was formed on September 5th, 1989 as a result of the merger between a Swiss-American Electric company and the Refindus Holding.

Studer's company structure will remain the same, though Dr Studer himself plans to step back from day-to-day activities and take an advisory role.

Overall management of the group will now be taken over by a Board of Management formed by Dr Leo Wehri, Eugen Spörri, Bruno Hochstrasser and Herman Stierli. Eugen Spörri: "Dr Studer has been



Dr Willi Studer

trying to find a solution to the subject of successorship for some time. This arrangement not only guarantees our independence, but also provides us with considerable financial and management back-up."

Address change

• **Broadcast Network Services**, the division of British Telecom responsible for the broadcast sound and vision circuits, have moved to

Becket House, 60-68 St Thomas Street, London SE1 3QU. Tel: 071-403 6777.

Exhibitions and conventions

April 22nd to 25th Vision and Audio International, Earls Court Exhibition Centre, UK. Tel: 081-776 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: 071-437 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, Wanchai, 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.

September 9th to 12th 90 Light and Sound Show, Olympia 2, London, UK. Contact: 3D Services. Tel: 081-569 9742.

News from the AES Hard Disk Recording Conference May 16th to 17th, 1990

Hard disk or 'tapeless' sound recording is probably the fastest-growing aspect of digital audio technology at the present time; there is a rapidly growing number of commercial systems, and the need for a deeper understanding of the principles involved grows greater every day. The Conference is designed to include a full morning of tutorial introduction describing disk drive technology and the way in which disk drives may be made to function as part of a digital recording system, given by well-known industry teachers and the Chairmen of the Conference, John Watkinson and Francis Rumsey. Complementary to this technical introduction will be a comprehensive survey of many current systems and their applications from digital audio consultants, Sypha. There follows a series of presentations both on technology and applications, given by end-users and product specialists, together with informal workshops and opportunities to discuss aspects of operation in more detail.

The Conference will be held at the IBA, 70 Brompton Road, London SW3. The registration fee will include documentation of the conference and refreshments including lunches and evening buffets.

Just before that on Tuesday May 15th, also at the IBA, a lecture will be given by David Bush of Sony Broadcast on the

subject of **Timecode DAT for Professional Use**. He will begin by describing how the DAT format, first developed as a consumer tape format to complement the establishment of compact disc, is being updated to accommodate the recording of timecode for professional use. The professional format, to be standardised soon by the IEC, retains complete compatibility with the existing consumer DAT format.

For many broadcast and post-production tasks, the professional audio industry has continued to be served by ¼ inch analogue tape which has seen a dramatic technical progression since it was first introduced. However, manufacturers have come close to the theoretical limits of analogue technology and the cost of developing further significant advances seem now to be outweighed by the potential advantages of moving to an entirely new format.

The lecture considers both the benefits and restrictions of the DAT format and predicts future applications for suitable professional hardware. It will start at 7.00pm (coffee at 6.30pm).

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

Conference Programme
Wednesday May 16th
Session A — 10.00-13.00
Chairman: Jeff Baker, BBC
Television OB

A1 Tutorial, on Disk Drive Technology, John Watkinson, Consultant

A2 Tutorial on The Disk Drive as an Audio Recorder, Francis Rumsey, University of Surrey
Session B — 14.30-18.00
Chairman: John Watkinson, Consultant

B1 An Introduction to Systems and Applications, Yasmin Hashmi and Stella Plumbridge, Sypha

B2 An Introduction to Operations, John Gluck, AMS

B3 Applications 1—Post Production, Derek Lancaster, BBC TV

Session C — 19.00-20.30
Evening Workshop
Thursday May 17th
Session D — 09.30-12.00
Chairman: Francis Rumsey, University of Surrey

D1 Real Time use of Magneto-Optical Disks, Nikolaus Seidel, Fougerolle

D2 An Optical Disk-Based Recording System, Steve Howell, Akai

D3 Applications 2—Music Editing, Ben Turner, Finesplice

D4 Applications 3—Radio Station Automation, Peter Jackson, Capital Radio

D5 The Integration of Music Sampling and Disk Recording, Nick Williams and Max Hoskins, New England Digital
Session E — 14.00-17.00
Chairman: Neil Gilchrist, BBC Research Dept

E1 Synchronisation of Disk-Based Systems, Mike Parker, DAR

E2 The Digital Audio Workstation—a Modular Approach, John Nelfinson, WaveFrame Corporation

E3 Integrated Audio Production using a Desk-top Computer, Sean Culley, Sound Technology

E4 Extended Discussion

30 years of Studio Sound

May 1962... The historic flight on February 20th, 1962, of Col Glenn in the Mercury Space capsule featured a unique form of tape detected by sensitive pickups taped to his body, obtaining detailed information for post-flight analysis.

In addition to the astronaut's voice commentary and physiological phenomena, which are detected by sensitive pickups taped to his body, the on-board tape records environmental conditions such as temperatures, pressures, acceleration and shock. On two separate tracks pulse duration modulation records the sequence of events and performance of the space craft.

Agencies

- John Hornby Skewes & Co Ltd, have been appointed exclusive UK and Eire distributors of USA made **Rapco** musical instrument cable.
- TAC have appointed new distributors in Germany and the Arabian Gulf. Mega Audio, Vorstaer 8, 6530 Bingen, West Germany. Tel: 6721 2636. Fax: 6721 13537. Arts Production, PO Box 10084, Bahrain. Tel: 728791. Fax: 590103.
- The dealer network for the **Fostex D-20** DAT player now stands at six with the inclusion of Ken Giles Music (KGM) in Wakefield, Yorks, UK; Audio Engineering in Dublin, Eire; and Raper & Wayman in London, UK. Existing UK dealers are HHB Communications; Stirling Audio; and Multitrack Hire.
- **Drawmer** have announced the appointment of Amber Technology as exclusive distributors of their products in Australia. Amber Technology Pty, Unit B, 5 Skyline Place, Off Frenchs Forest Road, Frenchs Forest, NSW 2086, Australia. Tel: (02) 975 1368. Fax: (02) 975 1211.
- **Saturn Research** have appointed R&S Electronics as distributor for India. This follows the sale of three Saturn 824 24-track tape machines in Bombay, Madras and Bangalore. R&S Electronics, 24 Ghanshyam Ind Estate, Veera Desai Road, Andheri (W), Bombay, 400 058 India.

AES Exhibitors Committee

At the recent AES Convention in Montreux, Switzerland, the AES announced that it has formed a study group along with SMPTE to determine the feasibility of jointly sponsoring some future conferences.

The group was formed in response to the proliferation of conferences and

conventions around the world with similar interests. The first such conference will be held in February 1991 in America.

The AES also announced that it had formed an Exhibitors Advisory Committee, to be developed immediately under the direction of

AES President-Elect Marshall Buck. The first phase of this activity will be to carry out a site preference questionnaire for exhibitors.

Dates for the 1991 European AES were confirmed for February 19th to 22nd at the Palais des Congres, Paris.

Swiss digital team form consultancy

Two European signal processing designers have teamed up to form a product development consultancy.

Scopein Research has been formed by ex-Studer designer Markus Erne and Christof Heidelberger from Apogee. From their Zurich-based office Erne and Heidelberger are to head a company to provide a

comprehensive electronic design service in the field of analogue and digital signal processing.

Scopein will provide hardware and software development as well as a complete product design service from conception to manufacture.

The partnership is already working on three contracts. For Munich-based

Klotz Digital, and Swiss hi-fi manufacturers Goldmund and Stellavox. The Klotz project involves the design of a digital 1/3-octave equaliser and delay line for Klotz's contribution to the new Shuttlesound sound reinforcement system to be installed at London's Wembley Arena.

New theatre section on CompuServe

The Broadcast Professionals' Forum on the CompuServe Information Service have opened a section for the Performing Arts Technicians. The section is called 'Technical Theatre' and is devoted to the production aspects of the performing arts including Theatre, TV, Film, Radio

and Video production. The topics covered include lighting; costumes and makeup; sets; props; special effects; audio/sound/MIDI; and computer hardware/software.

The Technical Theatre section consists of three areas. The Message section, which is an electronic

bulletin board and mail system. The Data library, where users can access files on various topics, download demos of software and upload files; and The Conference Room, where users can have Online, realtime conversations with other users.

SoundMaestro convicts pirates

On January 31st in a Dutch court of law, Audio Design's *SoundMaestro* digital editor was used to successfully prove a case of recording piracy.

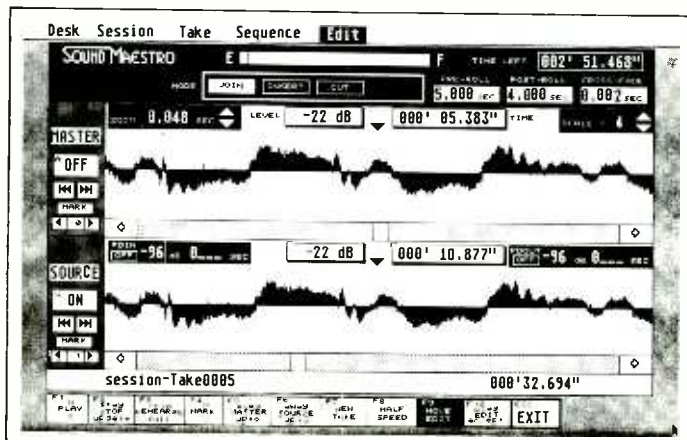
Foon, a CD mastering facility in Lier, Belgium, used their *SoundMaestro* system to help a Dutch client of theirs win the case. The Dutch client has released an album of German 'oompah' brass band music on cassette. Somehow a German pirate managed to acquire the master tape and re-released the music on CD using exactly the same order of tracks but including two extra tracks.

Foon's Dutch client took the pirates to court and submitted the use of laser printed screen dumps from Foon's *SoundMaestro* as evidence. The judge in the case showed great interest in this evidence and allowed it as permissible in court.

The screen dump actually shows two 12 second windows of the pirate

CD waveform (master screen) and the waveform from the original master (source screen). The displays convinced the court that they were indeed identical and that the owners'

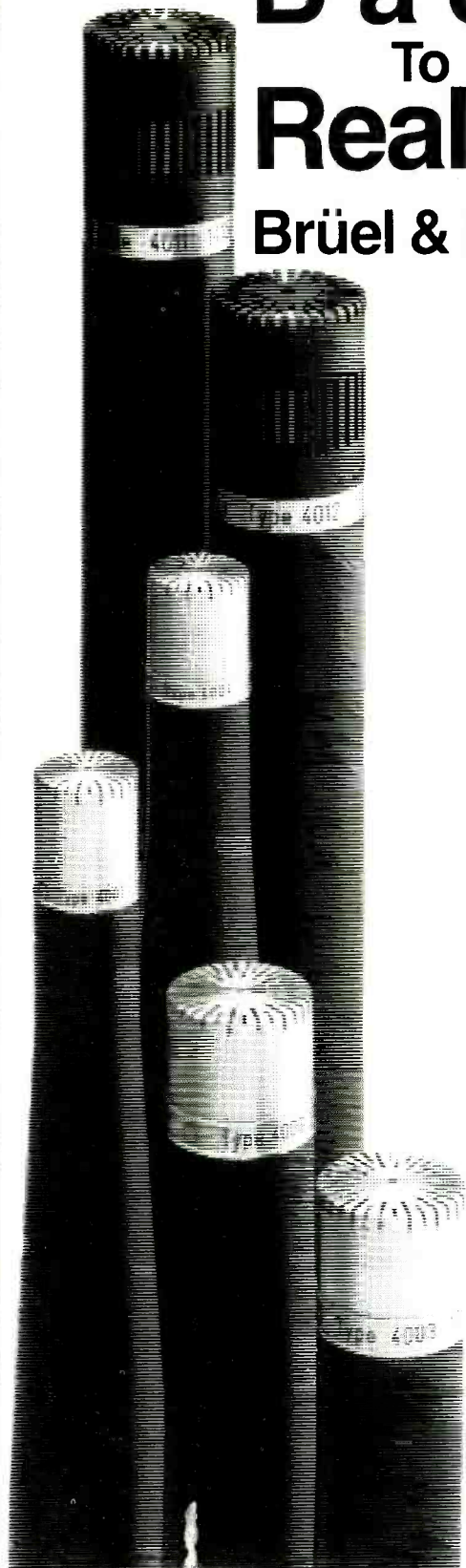
copyright had been infringed. For comparison the same piece of music played by a different brass band was displayed in the same way and was found to be completely different.



Master and source' screen dump

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44 Gloucester Ave, NW1 8JD
Tel: 01 722 3925 Fax: 01 577 3677

New HR format gains momentum

A growing number of products are showing up on the market that boast the newly developed HR (Half-Rack) format. This modular configuration offers electrical and mechanical benefits along with product compatibility. The format enables these signal processing modules to be mounted in a standard 19 inch rack either horizontally up to two modules across, or vertically with up to 10 modules across. Each HR module is self-contained and will interface directly with other pro equipment via terminal strip, XLR, and/or ¼ inch connectors.

The HR modular approach was conceived to satisfy a demand for compact, flexible, custom-designed installations. The idea is that very high-performance systems can be achieved cost-effectively by installing only the number of channels and functions needed. Future system expansion is equally efficient by avoiding product obsolescence and

replacement.

Although there are a number of half-rack designs in existence there has been no mechanical compatibility between different manufacturers until the HR format was devised through initial effort by ART, Ashly, Crown, dbx, Furman, Lexicon, Rane and Symetrix.

"We were trying to avoid the type of VHS/Beta format war that can undermine the strength of a new market," explains Larry Winter of Rane Corporation who chairs the HR technical committee. Over 35 other manufacturers were involved during the formation of the standard. To date the HR format remains an informal standard.

Due to time constraints, we decided to go ahead and develop a standard as a committee and get real product in the field," explains Winter. "In the meantime we will pursue formal acceptance by ANSI, a process that could take 2 years."

APT finances studios

Malcolm Toft, former managing director of Trident Audio, has recently formed APT Financial Services to introduce some financing schemes for recording studios wanting to purchase audio and video equipment.

Toft, "We spent several months researching the market, discussing with manufacturers, distributors and studios what shortcomings they experienced with existing methods and sources of finance and what improvements they would like to see."

Toft's partner in APT is Warren Palmer, for many years a director of

some major computer manufacturing and leasing companies.

"My industry experience with Warren's leasing expertise is a combination that enables APT to ideally match the specific requirements of our customers. During the past few months we have established close marketing relationships with many key suppliers and have already funded a number of projects and new customers."

APT Financial Services, APT House, Homelands Business Park, North Street, Winkfield Row, Berks SL4 4SY, UK. Tel: 0344 890289.

Literature received

• **BSI** have announced the following publications: *BS 5817 Audiovisual, video and television equipment*. Part 4: 1989 Specification for matching values for the interconnection of equipment in a system. Part 10: 1989 Specification for audio cassette systems. *BS 7239: 1989 Specification for digital audio interface* describes a

serial, unidirectional, self-clocking interface for the interconnection of digital audio equipment for consumer and professional applications.

• **The White Book 1990**, The International Production Directory is available from The White Book, PO Box 55, Staines, Middlesex TW18 4UG, UK. Tel: 0784 464441.

People

• Paul Lindsay has been appointed sales and marketing manager at **Hayden Pro-Audio**.

• Paul Whiting has joined **Michael Stevens & Partners** as sales manager.

• **Dreamhire**, London, have appointed Pete Towner as rentals operations co-ordinator. Towner joined Dreamhire in 1987.

• **Beyma UK Ltd** have announced the appointment of Martin Claydon as sales and marketing manager. Claydon had been head of pro-audio sales at Celestion.

• Andy Simmons, previously with Britannia Row Sales, has been appointed UK sales manager of **LMC Audio Sales**. Paul Ward, previously with TOA Electronics, joins LMC as

marketing manager.

• Alan Peoples has joined **Plasmec Systems** as applications engineer with particular responsibility for the studio industry.

• **Sony Broadcast & Communications** have appointed Howard Shephard as the new sales and marketing director. Shephard comes from a long career at Quantel as international business manager.

• Julie Murrell has been officially appointed the new studio manager of **Nomis Recording Studios**.

• Ian Silvester has joined **Hilton Sound** as full time research & development technician. Silvester comes from a spell in freelance engineering and before that at rental company Audio FX.

In brief

• Sheffield, UK: **Masterbyte Digital Audio** are to provide a mobile hard disk editing suite to cover post-production facilities in the north of England. Equipment on offer includes the *Mac Ici* running Digidesign's *SoundTools* software. For more information contact Austin Bambrook on 0742 550396.

• Hasselt, Belgium: **Apex**, the Belgian equaliser manufacturers, have recently won an award from the King Boudewijn Foundation in Brussels. The award is annually presented to outstanding new companies.

• Virginia, USA: After a record year in CD manufacturing during 1989, **Nimbus Records** are increasing their manufacturing capacity for CDs in both their UK and USA plants by 40% during 1990. This growth will raise the capacity of the UK plant in Cwmbran, Wales, to over 30 million CDs per year and that of the USA operation in Charlottesville, VA, to in excess of 20 million.

• Hertfordshire, UK: **Thatched Cottage Audio** have recently announced the opening of their new digital division based in a new 5,000 ft² complex adjoining the present Royston site.

• Leeds, UK **John Hornby Skewes** have just achieved the DOD Electronics Corp award for Distributor of the Year 1989. JHS are the exclusive distributors in the UK and Eire of all DOD products.

• Stirling, UK: Ex-senior development engineer at Tannoy, Des Fisher, has started his own company **NaTCH Engineering** offering CAD/CAM and production test

programming. Tannoy will be among NaTCH's first clients.

• Harrow, UK: A new leaflet from **Bruel & Kjaer** has been published to help manufacturers seeking to comply with impending legislation in relation to noise in the workplace. The leaflet sets out the questions manufacturers should be asking themselves in terms of the nature of their particular noise problems and the work patterns of employees. More information from Bruel & Kjaer on 081-954 2366.

• Bath, UK: **Moles Studio** have recently re-opened with a new facility on a previously unused floor. The floor now features a new control room with daylight vocal area, separate machine room and space for a future second control room.

• London, UK: **The Soho Soundhouse**, suppliers of musical instruments and pro-audio equipment have acquired the Turnkey Pro-Audio business in Charing Cross Road. The acquisition includes three purpose-built studios previously used by New England Digital now based in Hammersmith.

• London, UK: **Tape One** studios have become the first European facility to offer recordable CD as a commercial option. For less than £200 customers can walk away with a 'CD ref', a reference CD carrying up to 60 minutes of their own material to play on conventional CD players. The WORM CD reference disk is cut directly from a *PCM 1630* CD tape master and is an exact replica of the final CD including track and PQ (index) codes.

There are now several companies making a name with DAT. (Luckily, you need only remember one.)



AIWA
HD X1



FOSTEX
D20



SONY
TCD-D10PRO



TECHNICS
SV-260A



SONY
DTC-1000ES



RS-DAT
RS1000

Take a closer look at some star performers from the world's foremost supplier of DAT equipment.

Consider the palm-sized Aiwa HDX1. Specially imported from Japan, only HHB can offer this tiny portable complete with detachable A to D convertor, European power supply and an English language manual.

We're leading stockists of the Fostex D20. Already hugely popular amongst broadcast and video-post engineers, this four-head machine not only records digital time-code, but can be adapted to accept the forthcoming IEC time-code standard.

Sony's rugged TCD-D10 Pro is in great demand. Equipped with digital I/Os and XLR connectors, we can provide portable 'Pro' users with an exclusive 48 volt phantom power modification. The Technics portable DAT has already won wide acclaim for its excellent record quality, thanks largely to a unique 64 times oversampling 'MASH' A to D. The new 'A'

version of the SV-260 not only features a refined tape transport, but a higher specification mic input.

As the industry standard, our best-selling Sony DTC-1000ES needs little introduction. Not only have we been able to secure plentiful supplies, but every unit leaving HHB carries the company's famous 44.1 kHz modification. Underlining the versatility of the DTC-1000ES is the remarkable digital cart device, RS-DAT. Simple to operate and externally controllable, RS-DAT is now a firm favourite with our many broadcast and live sound clients.

Visit Scrubs Lane and you can evaluate HHB's full DAT range in Britain's finest demo-facility. But ask our customers. Buy from HHB and you also tap into technical advice and service support that's second to none. And if you're based outside the UK, don't despair. As the world's number one source for DAT, we now have a global network of leading agents.



Report from CES

While aimed at the consumer hi-fi and video trade, the winter Consumer Electronics Show in Las Vegas offered some items of interest. Products on show gave an indication of what the public will be using to play back the fruits of your labours.

Most notable was the first showing—outside Tokyo—of the revitalised *Finial Laser Turntable*, believed to have been permanently axed during last winter's CES. With the company now in Japanese hands, the various bugs seem to have been sorted through revised software. The player looked identical to the one shown a year before but operation seemed smoother and the overall feel was of 'shop-readiness'. In the interim, however, the player will be aimed at professional users such as radio stations and libraries, with only enthusiasts able to consider the new price of around £21,000.

DAT reared its head again at the first consumer show since the record companies decided to 'decriminalise' the hardware. Even so, most of the dozen or so manufacturers were playing it safe by burying their DAT machines in piles of more conventional components, or by covering the players with cards reading 'prototype', as if to obscure their intentions. A notable exception was Sony, who showed a whole range of decks bearing *ES* series model



Finial Laser Turntable

numbers, in keeping with their top range of specialist separates.

The renewed faith in DAT as a potential home hi-fi product overshadowed the launch of Dolby S, some arguing that it would be redundant if digital tape replaced high-end analogue cassette decks for home use. But the high price of DAT—unlikely to dip below analogue cassette hardware or software prices for some time—means that Dolby S does stand a chance of joining Dolby B, C and *HX-Pro* in the domestic sector. Pro-DAT doomsayers also discounted the fact that serious cassette users, the sort who would buy 'high-end' cassette or DAT machines, are also likely to have healthy libraries, which most would rather not transfer *en masse* to

another format.

Although no delivery dates were mentioned, Taiyo Yuden (manufacturer of That's cassettes) showed visitors how CD-Rs are produced by displaying a 'mini-factory'.

The specialist hi-fi exhibits were relocated this year to the Sahara. Outboard DACs proliferated, with new units from Wadia, Theta, Musik Systems and others, while (at last) there were enough new transport-only CD players appearing to make this 'components approach' to CD playback a more viable affair. Barclay Digital released a CD transport housed in a massive chassis from DuPont Corian and Wadia showed their own transport based on the top Teac chassis, but the show-

stopper came from a Japanese company called 47 Labs. Obviously concerned about the psychological leap from LP to CD, 47 Labs assuaged the tensions of diehard analogue supporters by producing a player that looked exactly like a scaled-down turntable, complete with suspension, platter and a laser mounted on a 'linear-tracking' tonearm.

The specialist hotel is also the place for tube fanatics, with recent valve (tube) goodies including Milbert's all-tube in-car crossover (honest!). Valve amp manufacturer Manley has turned to the pro side with a new range of 'glow-in-the-dark' products including a playback equaliser, microphone preamp, a stereo 20 dB line amp, 10 dB compressor, midband equaliser, recording/mixing contour and shelf equaliser, a tape-head preamp and 40 dB monaural line amp. All the units come in 19 inch, 1U rackmount chassis and the company can even supply a special fan to keep the tubes from self-immolating.

The most impressive crossover from pro-into-domestic, though, is the range of speakers from Westlake Technology. The company offers a selection of cabinets configurable to suit every need, much like the modular approach employed by JBL. The look, despite the acres of walnut veneer and chocolate-coloured grille cloths, is decidedly 'studio chic'.

Ken Kessler

Contracts

- Acoustic designers **KFA** have announced the completion of a new digital suite for Porky's the London-based mastering room. Based on a modular design the acoustics of the 25 m² CD suite were arranged to provide a predictable and controlled soundfield.

- Three *Motionworkers*, the automation and synchronisation systems interface from **Motionworks**, have been installed at the Power Station studios in New York. In each studio the *Motionworkers* interface the SSL studio computer with Adams-Smith 2600 synchroniser systems.

- The Laban Centre for Music and Dance attached to Goldsmith College have chosen an **Allen & Heath SC Plus 416xF** featuring a 4x4 output matrix and a talkback module for their theatre.

- A second **DAR SoundStation II** purchased by Scottish TV marks the

50th sold worldwide by DAR since November 1988. This second sale to STV, a 16-channel system with the erasable optical disk subsystem, follows the 8-channel system installed before Christmas.

- An **Audio Kinetics ES Lock** system has been installed at London studio MasterRock. The installation comprises two *ES Lock 1.11* synchronisers, which will be used in a simple chase system with the studio's *A800* multitrack machines. Also the newly launched **M2 Audio** voiceover and post-production studio has installed **Audio Kinetics Reflex** console automation and **ES Bus** machine control and synchronisation products.

- **20th Century Fox** have purchased one of the largest **Solid State Logic** consoles ever assembled for movie sound and will be installing it later this year in the Darryl Zanuck dubbing theatre facility. The *SL 5000*

series console is a custom-designed three-man, 80-input configuration with moving faders and computer automation with *Total Recall*. Also, **Michael Marquart**, ex-drummer for **A Flock of Seagulls**, has opened his own studio, **Windmark**. The two room studio features an *SSL 4000* series console with *G* series EQ and computer automation, custom monitors and direct to disk mastering.

- **Audio Design** have announced recent deliveries of *SoundMaestro* digital editing systems to **D&J Recordings**, London; **Ultralinear International**, Singapore; and **Kaleb Sounds**, New York.

- **321 Studios** in New York, formerly **Record Plant**, have installed two **Neve V60** consoles and a **DTC** mastering console.

- **Abbey Road Studios**, London, have installed nine more **Audio Kinetics ES Lock 1.11** synchronisers, an

ES Lock SSU and one *ES Lock Penta* controller.

- The **BBC** have bought a 2-channel **DAR SoundStation II** disk-based editing system for Woodnorton, the Corporation's training centre.

- **SoundCastle/Post Modern** in Los Angeles and **Soundtrack Recording Studios** in New York are among the first US audio post-production facilities to install the new **Solid State Logic** digital audio-for-video film production centre, *ScreenSound*.

- **Austria's Creativsound** and **Denmark's Bellevue Studio** have recently installed **Lyrec TR-533** multitrack recorders.

- Recent sales of **TimeLine Lynx** Keyboard Control Units (KCU) and *Lynx* timecode modules include **Maryland Public Television**; the **United Way**; and **Musicfex** all in Washington DC, USA; **Studios Philippe Sarde** in Paris; and **FR3 TV Station** in Marseilles.

Announcing the perfect mix from HHB: The Soundcraft 6000 Series & the Tascam MSR-24



Thanks to Tascam's latest little wonder – the MSR-24 – studio quality 24 track recording is more affordable than ever before. Link it to a Series 6000 console from Soundcraft and you have an unbeatable combination.

But it makes sense to talk to the experts first. A high quality package like this should be supported by a selection of high performance, but equally cost-effective, outboard equipment, monitors and microphones. In our stunning new demo area, you can take your time picking from the latest and the best. And once you've mixed to perfection with your new system: master it down to digital stereo by choosing any one of twelve models from Europe's biggest DAT range.

As a key dealer for both Soundcraft and Tascam we enjoy special support and commitment from both manufacturers. And if you didn't already know, HHB brings you choice backed by the best advice and the finest after-sales support programme in the industry. From the new entry-level into 24 track recording, right through to professional leading edge digital technology, only HHB can offer all the right answers at the right price.

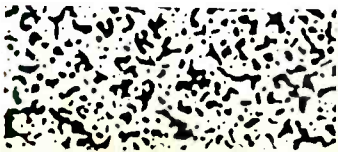
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STUDER A820 with Dolby SR cards and autolocator. v.g.c.	£P.O.A.
STUDER A800 MkIII with autolocator/remote.	£P.O.A.
STUDER A80 MkIII with auto/remote.	£14,500.00
STUDER A80 MkII with MkIII updates. auto/remote. Good condition.	£13,950.00
STUDER A80 MkII with auto/remote. Low hours. v.g.c.	£12,750.00
OTARI MTR 90 MkII with auto/remote. v.g.c.	£17,950.00
OTARI MX 80 with auto/remote. Good condition.	£16,950.00
SOUNDCRAFT SATURN with auto/remote. Excellent condition.	£17,000.00
M.C.I. JH24 with auto 3. 4 years old. Excellent condition.	£14,500.00

2 TRACK MACHINES

STUDER A820 1/2 inch. 12 months old. Excellent condition.	£P.O.A.
STUDER A810 1/4 inch. 15/30 ips.	£3,750.00.
OTARI MTR 12 1/2 inch.	£P.O.A.
MITSUBISHI X80 Low hours. Excellent condition.	£3,500.00

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SSL 4064E Total recall. G series computer. G series modules. Patchbay and producer's desk. 2 years old.	£P.O.A.
SSL 6048E G series computer. Total recall. Patchbay and producer's desk. V.U. metering.	£P.O.A.
WESTAR 8000 SERIES 44 channel with automation.	£P.O.A.
NEVE V3 SERIES 60 frame. 48 channel. Necam 96 automation.	£P.O.A.
TRIDENT DI-AN 48 frame. 48 channel, 32 group, 48 mon. Disk mix 3. Moving fader automation. Complete dynamics package upgrade.	£P.O.A.
TRIDENT TSM 40 frame. 40 channel with patchbay. Excellent condition.	£22,000.00
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Sony post products

At the Montreux AES Sony concentrated on audio-for-video products. The *VSP-8000* was shown in production form. This is a dedicated digital mixer for video editing and can handle up to 32 inputs in its expanded form. It interfaces directly with AES/EBU interfaces, such as on the *D-1* and *D-2* digital VTRs, and can communicate via a 9-pin serial interface with the Sony *BVE-9000* video editor. The *VSP-8000* allows full EQ, filtering and dynamics processing in the digital domain. The basic 16 inputs of the standard model can handle four independent PCM channels from each of four digital VTRs. Input delay times can be adjusted up to 9.9 frames in 0.1 frame steps to compensate for video delay and can be assigned to any of four outputs or two preview buses. Sample rates are switchable 48, 44.1 and 44.056 kHz. Automation is provided in the form of moving master faders and floppy disk storage

of snapshot control panel data.

On the analogue side, there were two new mixers: the *MXP-290* replacing the *MXP-29*, offers improved channel crosstalk, new cosmetics and individual master faders for the main output channels; and a preview switcher function that routes the output of the assigned VTR to the monitor inputs. There has been a similar change with the *MXP-210* replacing the *MXP-21*.

A new unit is the *VSP-A600* designed to match with the *BVE-600* editor. This is a 1U mixer with six input channels with two aux inputs mic/line switchable and can be controlled from the *BVE* editor.

UK: Sony Broadcast & Communications, Jays Close, Viables, Basingstoke, Hants RG22 4SB. Tel: 0256 483506. Fax: 0256 814397.

USA: Sony Corporation of America, Professional Audio Division, Sony Drive, Park Ridge, NJ 07656. Tel: (201) 930 1000.

BASE spatial processor

BASE is an acronym for an unusual signal processor from US company Gamma Electronic Systems, better known in some circles for the *Bedini* range of power amplifiers. The *Bedini Audio Spacial Environment* is a 2U 19 inch rackmount unit that is described as 'allowing you to hear more of the ambient acoustics present during the actual recording'. The processing is analogue and is not dependent upon software. When creating a stereo mix it is possible to alter the perceived width as well as enhancing a mono signal within the mix to create the desired effect or stereo placement.

A demonstration of the unit during the AES Convention showed that it could audibly improve the location of

signals with a stereo image. It is also able to bring some audio components forward of the speakers as well as increase depth. The manufacturers describe the processing techniques as being based upon research into binaural hearing patterns.

The *BASE* can be used at any point in the signal chain and does not appear to have any serious mono compatibility effects. It is also apparently compatible with Dolby, Dolby Surround and dbx processing, and the system has apparently had some extensive use in major feature films currently on release.

BASE, 600 West Broadway, Suite 100, Glendale, CA 91204, USA. Tel: (818) 500-4171. Fax: (818) 244-6664.

ASVS PG Plug

ASVS have introduced the *PG Plug* designed to enable sound recordists to use a portable video recorder, such as the Sony *BVW 35* as a sound-only machine. Housed in a standard 26-pin camera plug it fits into the camera socket of the VT and generates a suitable black signal to enable the servo systems to function correctly. It takes its power via this socket consuming a fraction of the normal camera consumption. The manufacturer claims that the crystal controlled oscillator within the plug maintains a typical timing accuracy of one frame over 12 hours at room temperature. Other facilities include full CCIR/RS170 sync waveform and the availability of 625/50 and 525/60 versions.



ASVS Television Systems, Unit 8, Littleton House, Littleton Road, Ashford, Middx TW15 1UU, UK. Tel: 0784 246818.

UK: DT Electronics, 6th Floor, Station Tower, Station Square, Coventry CV1 2GR. Tel: 0203 525 466.



Soundtracs *Quartz* console in its original form

Soundtracs Quartz

Soundtracs have announced that the *Quartz* console is now in production. Originally launched under the development name of the *PCX* (original plans were for it to be called the 'Prism' but these were changed due to a product name clash), the *Quartz* is a 24-bus in-line console with automated mute on all channels and auxes. The on-board MIDI muting system is an extension of that used on the *PC Midi* console. Notes may be written in realtime as 'note on' and 'note off'. Up to 100 muting patches may be stored in memory and triggered from a MIDI sequencer enabling the locking of mutes to timecode.

Channel features include 4-band

all-sweepable EQ and a stereo aux send with options of stereo inputs and additional effects returns inputs. In mixdown the monitor section may be used as extra inputs. All group and master buses are electronically balanced. Frame sizes for 32 and 48 modules are available with the 48-channel size being only 2.2 metres in width.

Soundtracs plc, 91 Ewell Road, Surbiton, Surrey KT6 6AH, UK. Tel: 081-399 3392.

UK: Larking Audio, 15 Cam Square, Hitchin, Herts SG4 0TZ. Tel: 0462 422466. Fax: 0462 421171.

USA: Samson Technologies, 485-19 South Broadway, Hicksville, NY 11801. Tel: (516) 932-3810

Orban 290rx adaptive enhancement processor

Orban have introduced a unit they describe as providing 'strong medicine for tired audio'. Basically the 290rx is a 2-channel dynamic single-ended noise reduction system with a downward expander for broadband noise reduction and a programme controlled sliding lowpass filter for hiss reduction. Added to this are a harmonic restoration circuit, which is described as a distortion cancelling circuit that generates second harmonics without

intermodulation distortion; and the spectral restoration section that dynamically analyses the spectral balance of the signal and re-equalises as necessary.

Orban division of AKG Acoustics Inc, 1525 Alvarado Street, San Leandro, CA 94577, USA. Tel: (415) 351-3500.

UK: SSE Marketing Ltd, Unit 2, 10 William Road, London NW1 3EN. Tel: 071-387 1262. Fax: 071-388 0339.



Sonic Solutions/Sony CDR system

Following a co-operative project between Sony and Sonic Solutions it is possible to extend the *Sonic System* to produce fully 'red book' standard CDs that have full compatibility with any CD player.

The *Sonic System* is a Macintosh based workstation for digital editing, mixing and CD master tape preparation. To produce recordable

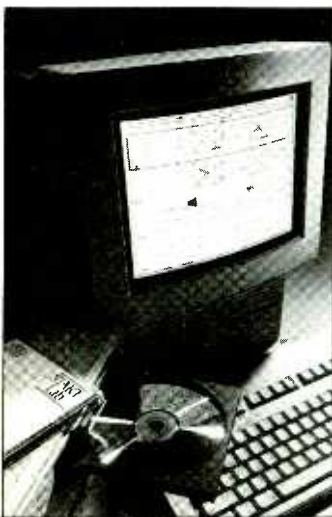
CDs it is teamed with the *CD Maker*, an encoding and recording system developed by Start Lab, a joint venture of Sony and Taiyo Yuden. The discs are manufactured by Taiyo Yuden (That's) and are write-once, being capable of recording up to 74 minutes of programme in realtime.

Each *CD Maker* system includes an encoder and up to 32 recorder units with the system connecting to the *Sonic System* as a peripheral device communicating through an SCSI port. The *Sonic System* can transfer programme to disc from digital audio data on tape or from the hard disk system.

Costs in the UK are quoted as £29 for the blank discs and the basic *Sonic System/CD Maker* combination from under £40,000 with additional *CD Makers* at £10,000 per unit. (Exchange rate approx \$1.61=£1).

UK: FWO Bauch, 49 Theobald Street, Borehamwood, Hertfordshire WD6 4RZ. Tel: 081-953 0091. Fax: 081-207 5970.

USA: Sonic Solutions, 6115 California Street, San Francisco, CA 94121. Tel: (415) 751-8666. Fax: (415) 751-8661.



Tascam 2-track and DAT

Tascam launched two new products at the Montreux AES. The *BR-20* series comprises three 2-track tape machines: NAB, DIN and centre-track timecode. All machines run at 157½/3¼ in/s with the higher or lower pair selectable at one time. Up to a 11.1 inch DIN reel hub can be accommodated with independent left and right reel size selectors. NAB and IEC EQ is selectable as is high (+4 dBm) or low (-10 dBV) level operating. Other features include spot erase, four locate points and repeat function, fader start facility and rack mount ability.

The second new product is the *DA-30 DAT*, a rackmount machine with *XLR* analogue ins/outs and an AES/EBU digital interface. Sampling rates of 32, 44.1 and 48 kHz are available with independent left and



right converters. Wired remote control allows controls of all functions and the provision of a parallel I/O port allows external control. Serial Copy Management System implemented only on low level phono inputs.

UK: TEAC UK Ltd, 5 Marlin House, The Croxley Centre, Watford, Herts WD1 8YA. Tel: 0923 225235.

USA: TEAC Corp of America, 7733 Telegraph Road, Montebello, CA 90640. Tel: (213) 726-0303.

TOA Saori

TOA have recently introduced a digital processing system to sit between the mixing console and power amplifiers to undertake the equivalent operations of two 30-band equalisers, two constant directivity horn compensators, two 4-band notch filters, two 4-way crossovers and eight digital delays—all within a 5U rack space. The signal remains in the digital domain throughout any processing and so reduces many traditional problems.

The construction is modular allowing field replacement and tailoring of systems to meet user needs. It is planned that future upgrades or functions will be added

via software ROM or new module cards. There are eight pattern-memory presets with all parameters independently programmable as well as under external PC control. In the crossover section, digital delay is adjustable in 21 µs increments on every output band with level adjustments being in ¼ dB steps.

TOA Electronics, Kobe, Japan.
UK: LMC Audio Systems Ltd, Unit 10, Acton Vale Industrial Park, Cowley Road, London W3 7QE. Tel: 081-743 4680. Fax: 081-749 9875.
USA: TOA Electronics Inc, 480 Carlton Court, South San Francisco, CA 94080. Tel: (415) 588-2538.



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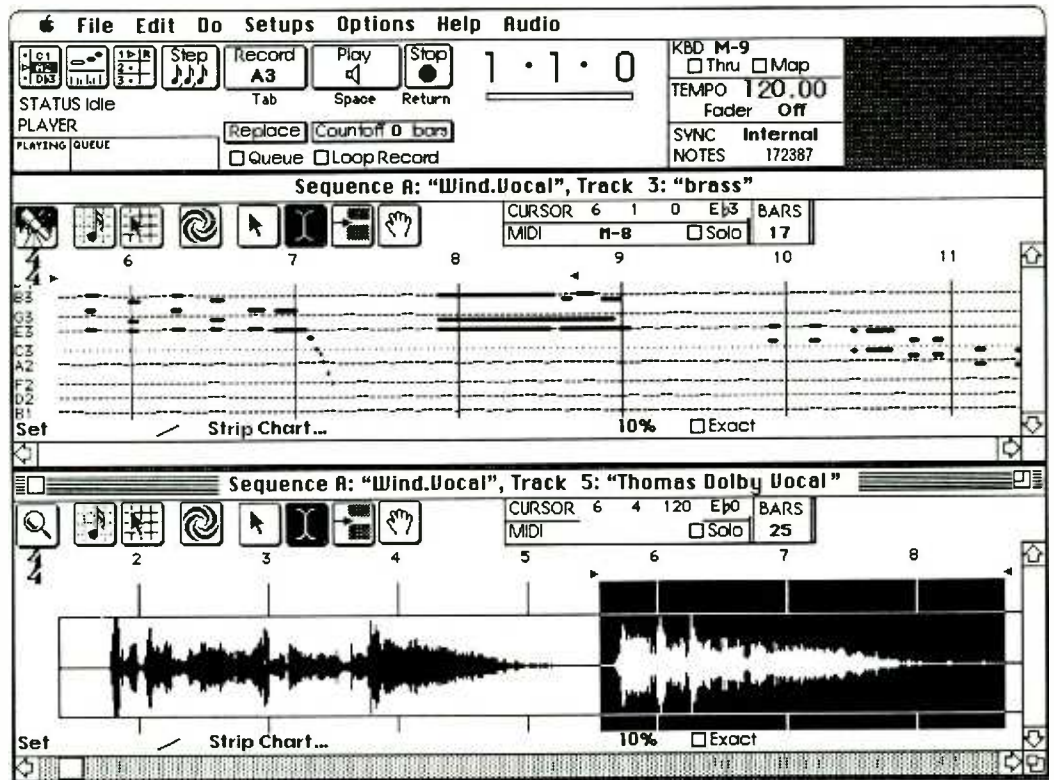
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DAVe from Opcode and Digidesign

Digital Audio Vision (DAVe) is the result of a newly formed alliance between Opcode Systems and Digidesign, both of Menlo Park, CA. The program uses Digidesign's A/D IN box and Sound Accelerator card to record and playback 16 bit sound. The software contains all the features of Opcode's *Vision* sequencer program for the Macintosh and adds the ability to record two independent tracks of digital audio along with the MIDI sequence information. The software has been designed solely for the Macintosh SE and Mac II series. Opcode Systems Inc, 3641 Haven Drive, Suite A, Menlo Park, CA 94025-1010, USA. Tel: (415) 369-8131.

UK: MCM, 9 Hatton Street, London NW8 8PR. Tel: 071-258 3454.



The main screen of DAVE from Opcode Systems

In brief

- Lyrec have added a timecode version of their *Frida* compact studio recorder to their range. This is in addition to 2-track and DIN stereo models introduced last year. A free-standing console has also been added as an option. Related to *Frida*, Lyrec have also introduced an oxide-out version of the *Fred* editing tape deck.
- LucasFilm/Sound Ideas FX: A co-production between LucasFilm and Sound Ideas has resulted in a new sound effects library of six CDs. Three of the discs have been produced by sound designers at Skywalker Sound, a post-production

facility at Skywalker Ranch and have been used in many well known LucasFilm movies falling into categories of industry, jungle animals and sounds of the Earth. The other three discs are produced by Sound Ideas and will feature aircraft, a US Navy aircraft carrier and high performance vehicle sound effects.

Sound Ideas, 105 West Beaver Creek Road, Suite #4, Richmond Hill, Ontario, Canada L4B 1C6. Tel: (416) 886-5000. UK: FWO Bauch, 49 Theobald Street, Borehamwood, Hertfordshire WD6 4RZ. Tel: 081-953 0091. Fax: 081-207 5970.

- C-Lab software updates: C-Lab have announced Version 2.2 updates for both *Notator* and *Creator*

software. Version 2.2 includes Soft Link, a new multitasking environment for the Atari *Mega* range, which enables the running of up to eight additional programs interactively with *Notator* or *Creator*. Other features include P-User commands to automatically load a song from disk, and User Defined Dynamic Groove.

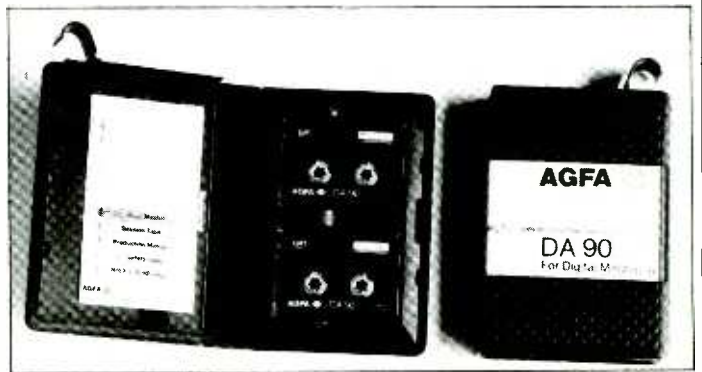
- Agfa add big DAT box: Agfa have introduced a large archiving box for DAT cassettes capable of holding two cassettes together with data sheets. Agfa also include some labels and stickers for individual use. The box is provided with a small hook so that it may be hung.
- D&R have introduced the *Qverb*, a

16 bit digital reverb. Among its 127 programs are gated, reverse, delays, multitaps and cross feed echo. Also the D&R *Dayner* console series will now feature a new extended master section, additional tape returns and two alternative monitoring systems.

- Fast-Trax Digital Technologies have announced a new product called The Music Archiver which, they claim, allows music libraries to encode up to 150 hours of mono lo-fi or 23 hours of hi-fi stereo music onto one side of a 12 laser disc. Reproduction onto any other medium is done through Fast-Trax's IBM PC Decoder software. Fast Trax claim 78 dB of dynamic range and 11.0 kHz in frequency if reproduced in stereo.



C-Lab Creator/Notator



The new R-DAT Archive box from Agfa

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Sony Broadcast & Communications 



RECORDING MISS SAIGON

David Mellor investigates the problems of transferring a live musical from theatre to studio for reproduction on disc

One of the longest running and best known musicals in London's West End is *Les Miserables*. An unlikely tale, by the current standards of musical productions, of life, love and death in the days of the French Revolution, based on a novel by Victor Hugo. Alain Boublil and Claude-Michel Schonberg were the writers responsible. And from this French team a new musical has emerged, currently playing at London's Theatre Royal in Drury Lane: *Miss Saigon*.

Miss Saigon is set in wartime Vietnam, now apparently an acceptable subject for a cinema or theatre audience, and has drawn from critics parallels between it and Puccini's *Madame Butterfly*, which also has an oriental setting with military connections. One difference between the creations of Puccini and the Boublil/Schonberg team is that in modern times a necessary accompaniment to any musical production is the original cast album. But how to translate the atmosphere of a theatrical production to an audio-only medium? The first question must be: is the album to be just a souvenir of the show—a glorified T-shirt—or an artistic endeavour in its own right?

Schonberg's answer is that anyone buying the album, on LP or CD, must be able to understand the story even if they haven't seen the show. Sleeve notes will help but the dramatic content of the show must survive the recording process. Recording a musical such as this is not simply a matter of stringing a number of individual songs together. The show has to be considered as a continuous piece of music, within which there are songs. A subtle but important difference.

Schonberg: "The atmosphere must be exactly the same as in the theatre but, of course, the sound in the recording is near perfection. You can't have that in the theatre, it is impossible.

What we must have on the cast album is the impact of the show. We must have the feeling that we are in the theatre but without watching something on the stage. The performance on stage must be captured on the recording. We can't reproduce images but the intensity must be there for the performance to make sense."

A musical could be recorded as a staged drama, with the characters moving about and with stage effects, a technique pioneered in the early Decca opera recordings. Or it could be done as though it were a recording of a 'concert performance' where the orchestra is on stage and the singers just stand up and perform without acting their roles. The recording of *Miss Saigon* is a compromise between these two extremes.

"When there is some noise on stage, when people have to make the noise of clapping or shouting then we are going to have it in the cast album. But we are not going to move people in stereo because they are moving from left to right on stage. If they are coming from very far away we will have the impact of a crescendo but we are not going to be exact. It has to represent the dramatic impact of telling the story through the music, which is different from being only a concert performance."

Theatre to studio

Recording commenced very soon after the show opened. The musicians still have the 'freshness' of playing in a new show but, even so, they have had plenty of rehearsal time to get to know their parts well. One potential problem in recording such a long piece—over 2 hours—is that continuity could easily be lost. But using mostly the same musicians that are in the pit, together

with the singers from the stage, means that the continuity of the show is thoroughly understood. The pit band numbers 30 players in total and another eight string players have been added for the recording. Traditional instruments, strings, woodwind, brass and drums, have been supplemented by Asian flutes, synthesisers, samplers and a large battery of percussion.

The engineer for the recording is David Hunt. Hunt has worked with Boublil and Schonberg since the first French language recording of *Les Miserables* so he knows their requirements well. His preparation for the project started in May 1988 and included visits to the rehearsals of the show. The planning stage of the recording was particularly important. One essential matter was to be sure of getting a good sound on the large and exotic percussion section.

Hunt: "In the past what we have tended to do is to try and get as much isolation from the live studio floor as possible. That works when you have smaller sections and it's especially important when you are taking the pit band and enlarging it for the recording. That enlargement tends to make the orchestra a little out of balance when you put them all in a room. So for jobs like *Les Miserables* we have tended to put all the percussion in the booth and get as much isolation between the individuals as possible.

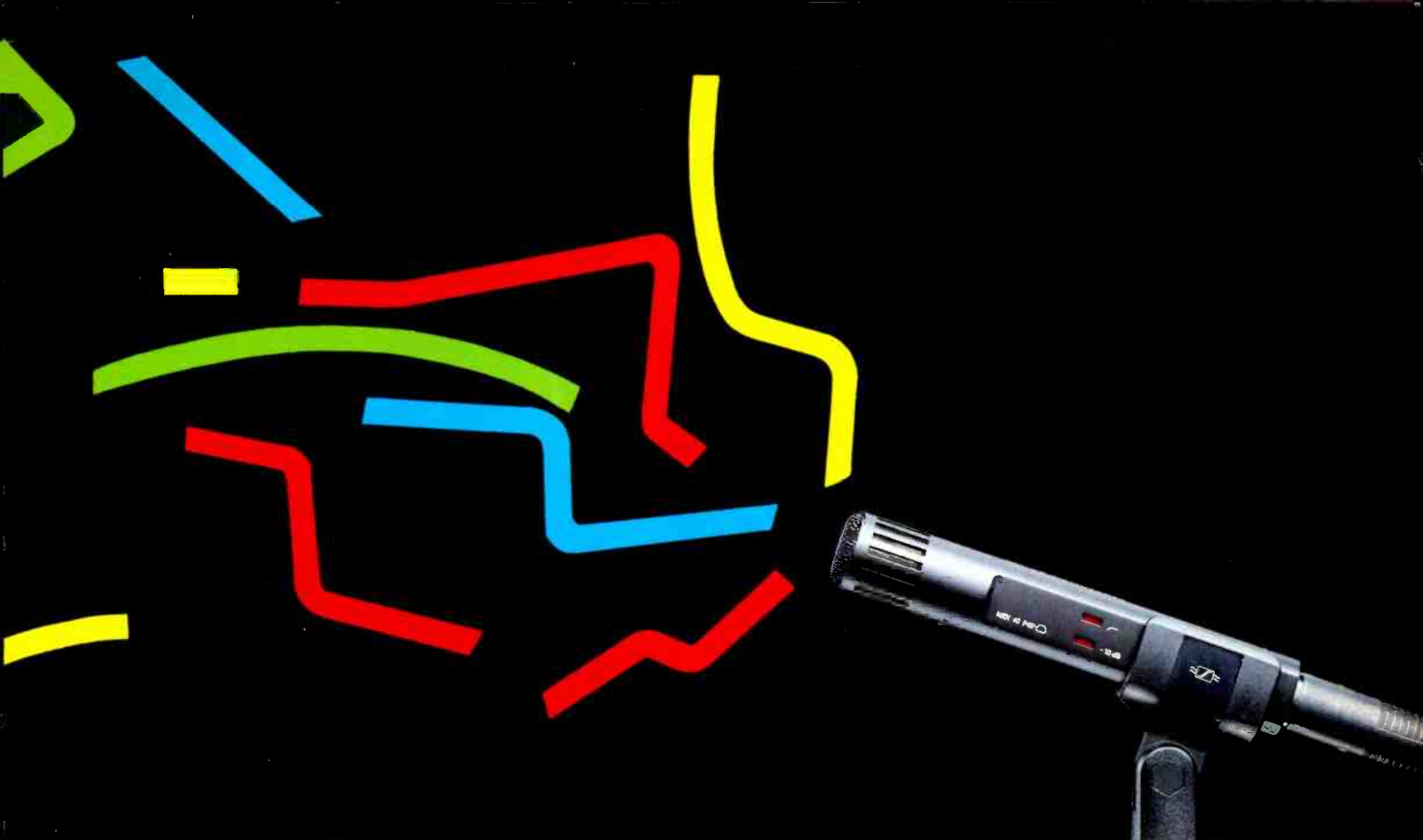
"On *Miss Saigon*, I felt that the percussion would sound better if we had some spill in the room. It was a question of making Claude understand what that was going to sound like. Of course he knew, but it meant that there would be less repairs that we could do. Things had to be more correct on the floor. What we are really recording, by and large, is the sound in the room and not the individual instruments. The percussion will sound better on the ambience mics. On the close mics they will sound small and tinny."

The studio selected was CTS in Wembley. The association between CTS and Boublil/Schonberg goes back a long way, to 1973. Schonberg says of CTS, "We cannot have any surprises here except good ones."

Hunt's main consideration was that this type of work was not a novelty to the studio. A studio may be big enough for the project, but when large numbers of musicians are booked, 'small' matters—like having enough music stands and having the right type and quantity of microphones—become expensive problems: "This just doesn't happen in a studio like CTS. They know that with an orchestra this size, 20 minutes lost is costing someone a lot of money. The choice was between just four studios. One of the bigger studios was ruled out because the desk didn't have enough inputs."

A Sony PCM-3348 multitrack was hired for *Miss Saigon*, mainly because of the number of tracks it offered, rather than any other consideration: "The last two recordings of *Les Miserables* were done on digital. The last was done on 32-track, the one before that was 24-track in America. On the 24-track, we wound up with a lot of compromises on vocals. The one we did last year (the 32-track) we had to take the tape around the world to record individual soloists so we needed the extra tracks.

"On this project, we primarily wanted the flexibility of never having to worry about running out of tracks. In one particular song there are sections in the choir where they are singing three parts at once. In the theatre they have a big problem with harmonies and tuning, so the solution is to record the three parts separately in stereo. That one thing takes six extra tracks.



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David Hunt at the controls

"We were going to do it on 32-track Mitsubishi. Forty-eight tracks are more expensive but not that much more. It's worth it though as it puts us in a situation of never having to worry about bouncing tracks, or wasting time because we're not sure if we have a track free. When we have finished all the orchestral dates we may need more gongs and heavy stuff down the bottom but we'll never have to worry about running out of tracks."

The alternative method of achieving 48 tracks by synchronising two machines was rejected on the grounds of inconvenience.

Orchestral sessions

The recording of the orchestra took 2 weeks with two sessions each day. The musicians were of course occupied in the evening in the theatre! The complete show, 2 hours and 20 minutes worth, was recorded, from which a 2 hour compact disc and an 85 minute album will be extracted. There will also be a highlights album. *Miss Saigon* is 'through composed'—musical jargon meaning that the score is continuous and the individual songs are linked by musical passages. This not only makes the recording process more exacting—long takes being necessary—it also means that extra passages of music have to be composed and recorded to form introductions and ends to the songs for the highlights disc.

CTS's Studio One has a large recording room with a particularly spacious drum booth, with an extra isolation booth for vocalists. Since the percussion section was large and difficult to fit even into CTS's booth and because of Hunt's desire to capture a particularly good sound

on the percussion instruments, most of the players set up their kit outside. But having the percussion in the main room causes a problem: all the instruments will be picked up as spill in the other mics, and fairly prominent spill at that. Also, since such a variety of percussion instruments precluded individual mics, the levels were more or less at the mercy of the players and where they chose to play their smaller instruments. Discussions on the studio floor between Hunt and the percussionists were necessary to solve these problems.

Sectional miking was used—rather than miking of individual instruments or an overall stereo pair—to capture the orchestra, with ambience mics over the strings in the centre of the room. Microphones were mostly Neumann: 84s and 87s. Ambience miking was B&K omni and a lone AKG C414 was placed on the trumpet.

The drums, apart from the snare and cymbals, are electronic. The guitarist, as well as playing conventional instruments, plays a MIDI guitar triggering an Akai S1000 sampler with samples of Asian plucked instruments. Among the many real percussion instruments nestles a KAT Percussion Controller, which, looking like a high-tech xylophone, acts just like a MIDI keyboard and also triggers an S1000. The percussion samples are played through a Roland instrument amplifier.



Alain Boubilil, and Claude-Michel Schonberg

Hunt prefers the sound of an amplified and miked up sample rather than taking it direct.

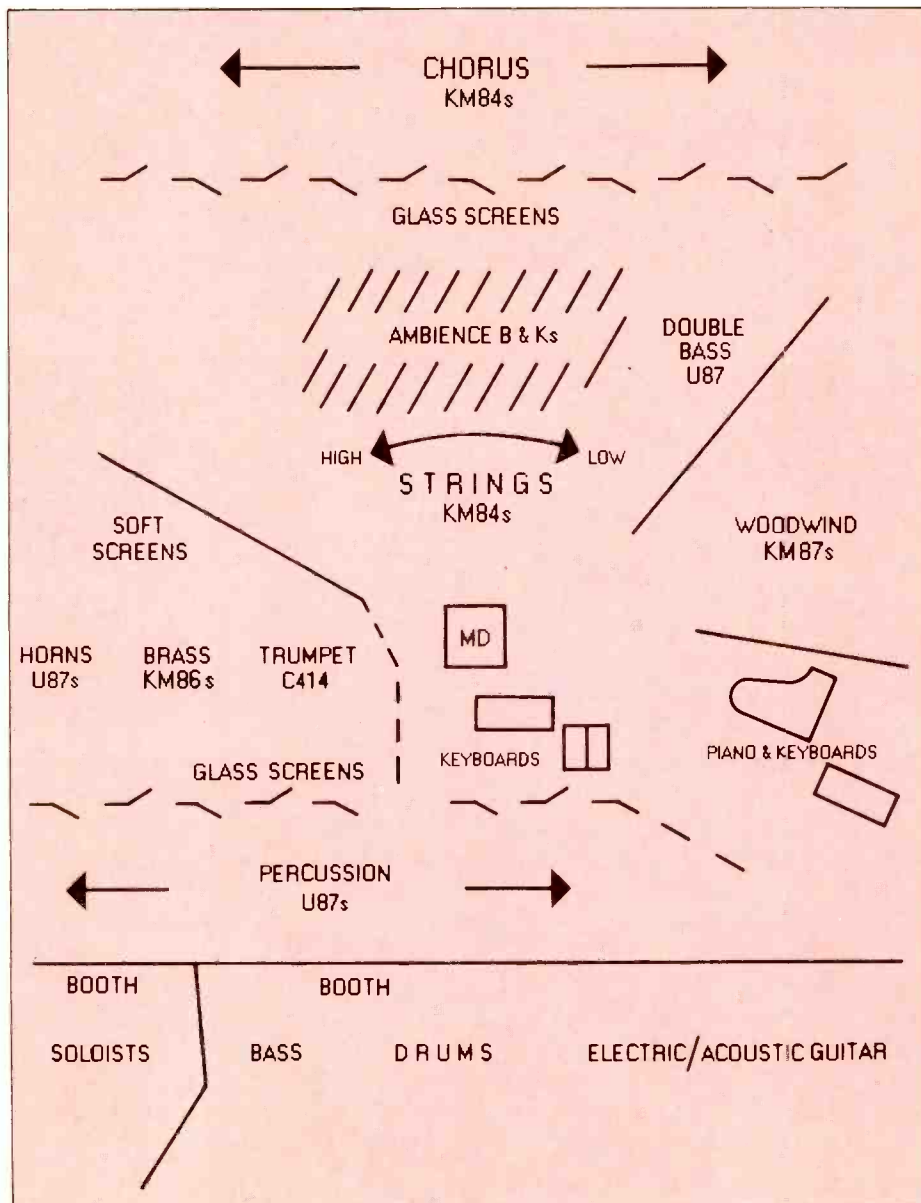
Although there are over 20 synthesisers and samplers employed in the production and in the recording, the aim is to go for a 'natural' sound but using the synths to get round situations that would have been impossible. For instance, the instruments of the Gamelan orchestra, Indonesian in origin.

Schonberg: "For the Gamelan sound we are using samples because that is the only way to have a complete Gamelan orchestra in the pit. What we are

playing on the sampler is always an instrument you can't have in the pit. Not an instrument doubling something already in the pit.

"The samples come from the Gamelan Ensemble of the University of Sydney. I saw the movie *Killing Fields*. On the credits I saw that the music was recorded with the Gamelan Ensemble of the University of Sydney. When I was in Sydney for the opening there of *Les Miserables* in '87, I went to see the Gamelan Ensemble at the University. The leader of the ensemble, Jennifer Lindsay, came to the recording studio where she played for me some instruments to sample. Bill Brohn (the arranger) and I wanted to have in the orchestration the feeling that we are in a very Far East country, warm wet and during a war."

There are also sound effects in the recording. The show uses a helicopter effect, not taken from a sound effects library but a new recording of the real thing. Autograph Sound Recording, who look after the sound in the Theatre Royal for the production, recorded different types of helicopter in various manoeuvres on DAT. The same effects are used in the recording of the show.



Studio arrangement for the recording of Miss Saigon

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Vocal sessions

Miss Saigon uses 40 singers including the six principals. Not all the singers are as experienced in the recording studio as they are in the theatre. Despite the potential problems, there are advantages.

Boublil: "After all that time in the theatre, it is going to be all right. We did it before and we know it is going to be all right. It is a mixture of people who have been in the recording studio for a long time and those who are inexperienced. The mix will be professional I have no doubt. What you get from these people sometimes is more enthusiasm. That's what creates the theatrical excitement. It's not for technical reasons that you get theatrical excitement. It's because you get people like that, that come from the theatre and have never been in the recording studio and are eager to match those who know all about it. This is the plus you get in this kind of recording."

Guide vocals were recorded during the orchestral sessions and although not all the pieces are in strict tempo, the singers are capable of

following their guide tracks without problems because they are singing the same material every evening in the theatre. Twice it was necessary to record the main choir at the same time as the orchestra because the rhythm was very loose and the orchestra needed to follow the choir rather than the other way round.

The final vocal tracks were recorded character by character, individually. There were some occasions when it was necessary to have two singers together because it was easier for them to sing their parts facing each other. In contrast with other methods of vocal recording, most of the songs were recorded in two or three complete takes with only very occasional words or lines being redone. Schonberg makes the point that since the singers are supposed to be acting at the same time it would be inappropriate to do it any other way.

The choice of microphone varied, not only according to the singer but the condition of each singer's voice at each session.

Hunt: "We tried Electro-Voice RE20, Neumann 47 and 87, and AKG 414 but it was never the



One of the keyboard setups for Miss Saigon

same twice. Because the artists are actors, they project so much that you have got a terrific wind problem. Two pop shields were sometimes not enough. Because they are performers on stage, they are not so interested in microphone technique. We found that on one day an artist would sound good on one mic, and on another day they would sound much better on something different."

If there were one main problem in recording the vocals, it was that it had to be done between strenuous performances. Schonberg: "It was not very easy because everybody was tired so we took a bit more time than we planned to record the voices. Everybody was working hard every night. It is a very demanding score, a lot of keys are very high because we wanted the score to feel the tensions and pressures that are in the show, the danger of the show. For a lot of people it was a very bad moment in the year because you have got colds and flu in October and November. It was quite difficult."

Mixing and editing

Miss Saigon was mixed onto a variety of stereo formats.

Hunt: "We are mixing onto DAT, 1610 and 1/2 inch analogue. I'll edit the 1610. The DAT is just for safety in case any of the tape has bad correction. We are doing the analogue out of research for the difference in sound, and it gives me the opportunity to razor blade cut. The analogue has a softer sound—it's 30 inch Dolby SR—it has a warmer sound especially on the vocals. But the master couldn't be on 1/2 inch because it is just too long."

Problems with spill had been anticipated and became apparent during the mixing.

"What we did was deliberate choice. There's a large booth down there that was occupied by the drum kit. We could also have squeezed the percussion in but we wanted to go for a bigger sound. We have certainly got spill but it is, to a degree, advantageous, certainly on the large crescendos because otherwise they won't sound as large no matter what you do to them. Things like the xylophone can be annoying. You can take it down but you can't remove it, especially if it is playing against pizzicato strings. But the correct perspective makes a big percussion section sound good. A big crash cymbal sounds awful on its direct mics but coming up within the room, provided it's played with the right dynamic, can sound really splendid."

After the mix comes the editing, which is a task somewhat more difficult than stringing together a series of individual songs. Since the music is continuous, it had to be recorded in sections. But since the complete show is being edited down to different length versions, and these versions could only be finalised by Boublil and Schonberg after the recording, to be sure to keep the correct dramatic flow, Hunt has his work cut out. The analogue mix helps, since it is quicker to try out a cut on analogue than on digital to see whether it works. After the rough cut version comes some final remixing and then the finished work, scheduled for simultaneous release in Britain and the USA.


Although the recording of *Miss Saigon* has evidently been hard work, if it is as successful as *Les Miserables* then it will turn into an industry in its own right, with original cast recordings in other countries, foreign language versions, perhaps a symphonic version. *Madame Butterfly* never had it this good. □

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20 BIT EVOLUTION

Californian company UltraAnalog Inc have developed a 20 bit A/D converter that evolved from the patented dbx noise-shaping, oversampling A/D architecture. Rémy Fourré, Steve Schwarzenbach and Richard Powers of UltraAnalog describe the ADC 20048 and why they claim it is the 'first practical 20 bit audio A/D converter'

During 1982 to 1985, dbx Corp developed a high-resolution, audio ADC based upon a 128x oversampling architecture. A prototype (using more than 100 MSI integrated circuits) was constructed, which achieved 103 dB dynamic range and consumed approximately 40 W! This innovative development led to the granting of US patent No. 4,588,979 in May, 1986. The patent covers many technical aspects of the noise-shaping, oversampling conversion theory and the ADC architecture.

After successful demonstration, dbx began developing a custom LSI integrated circuit of the ADC. After several attempts to integrate all the functions on a single silicon die were unsuccessful, the single chip IC design approach was abandoned. In 1987, a 3-chip design approach was begun: a front end flash ADC/DAC chip, F410; a precision resistor array, A1520; and a digital filter decimator chip, D20C10. In 1988, prototype chip sets became available and evaluation PC boards containing the 3-chip set and all ancillary circuitry were developed. These

18 and 20 bit resolution ADC evaluation boards were demonstrated at the AES Convention in November 1988 and at numerous customer sites. Further, the 20 bit ADC evaluation board was capable of achieving 112 dB dynamic range.

In 1989, UltraAnalog Inc obtained the exclusive rights to market and distribute the dbx chip set in North America and Europe. After a careful study of the evaluation ADC boards and many discussions with the original designers and users, the company developed a new Analogue Front End, AFE 20048, that is used in conjunction with the original Decimator, D20C10. The ADC 20048 is comprised of these two devices and described below. Those familiar with the noise-shaping, oversampling ADC theory may omit the next section and proceed to 'ADC Performance'.

Theory of operation

The ADC 20048 uses an oversampling architecture which includes a differential input amplifier, a lowpass filter, a summing amplifier, a lowpass filter, a summing amplifier, a

noise-shaping filter, a flash analogue-to-digital converter (ADC), a digital-to-analogue converter (DAC) and a decimator filter (see Fig 1).

The flash ADC converts at 128x the digital output sampling rate, or 6.144 MHz in the case of a 48 kHz word clock (48 kHz is the AES/EBU standard sampling rate). The sampled data values are applied simultaneously to the digital input of an internal DAC and to the decimator. The analogue output of the DAC is subtracted from the analogue input signal and the resulting error signal is then integrated by the noise-shaping filter prior to being converted by the flash ADC. The integration of the error signal guarantees that the average digital output code of the flash converter matches the input signal, within the accuracy of the DAC.

The noise in the noise-shaping loop is greater than the quantisation noise of the flash converter, which, in the case of a 4 bit flash ADC, is -25.84 dB (0 dB = full scale sine wave). If there were no noise-shaping filter, the flash converter quantisation noise would be distributed between DC and the Nyquist frequency of 3.072 MHz. If the quantisation noise were spectrally white and evenly distributed between DC and 3.072 MHz, this noise would have an unacceptably high level, as its energy in the DC to 20 kHz band would only be 21.9 dB below the total noise energy, ie it would be -47.81 dB. Furthermore, this noise would actually be very far from white and consist of several discrete frequencies, most of them in the audible range.

The two main functions of the noise-shaping filter are to randomise the noise and reduce the noise energy in the DC to 20 kHz band. A first or second order noise-shaping filter would be unstable and oscillate in the loop. In order to enter a chaotic mode, where the spectral distribution of the noise is white, at least three poles are required. The noise-shaping filter in the ADC 20048 contains four poles (three at DC and one at 12 kHz). In order to ensure loop stability, three zeros are needed and they are located at approximately 150 kHz.

These poles give the noise-shaping filter very high gain at low frequencies (154 dB at 1 kHz, 69 dB at 20 kHz). When the loop is closed through the flash ADC and the DAC, the low frequency

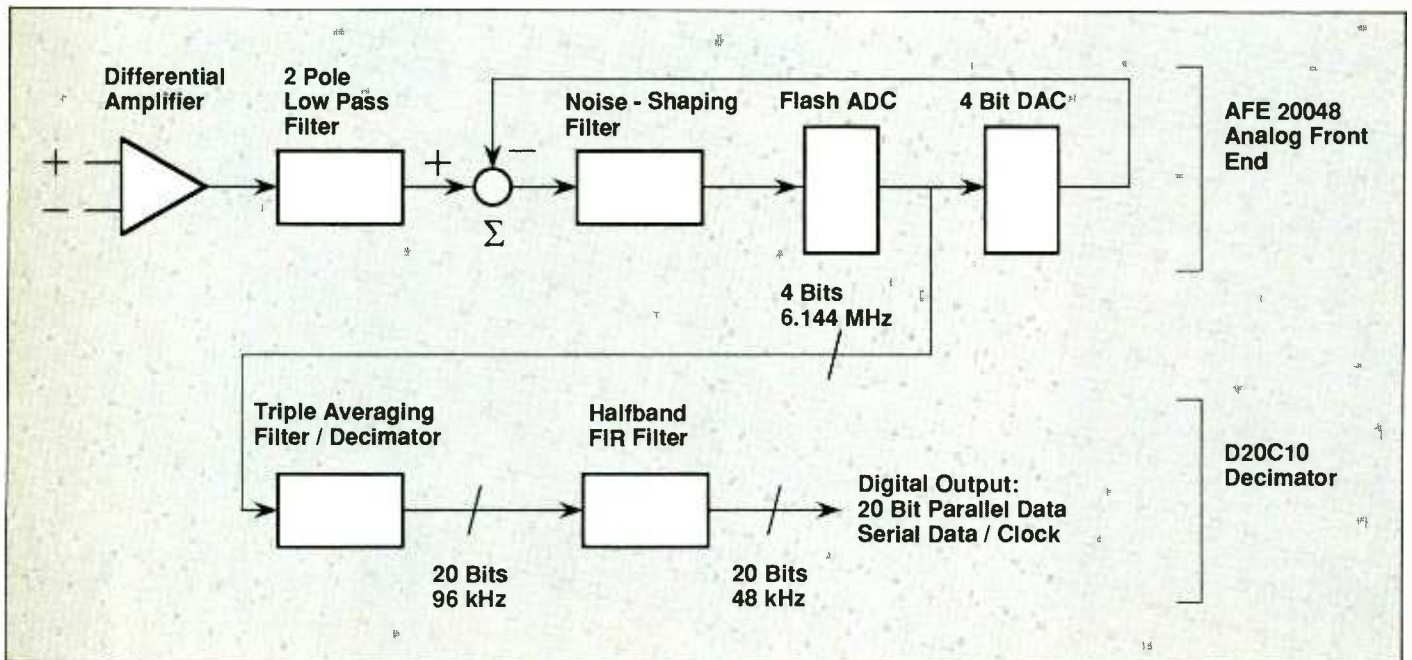


Fig 1: ADC 20048 block diagram

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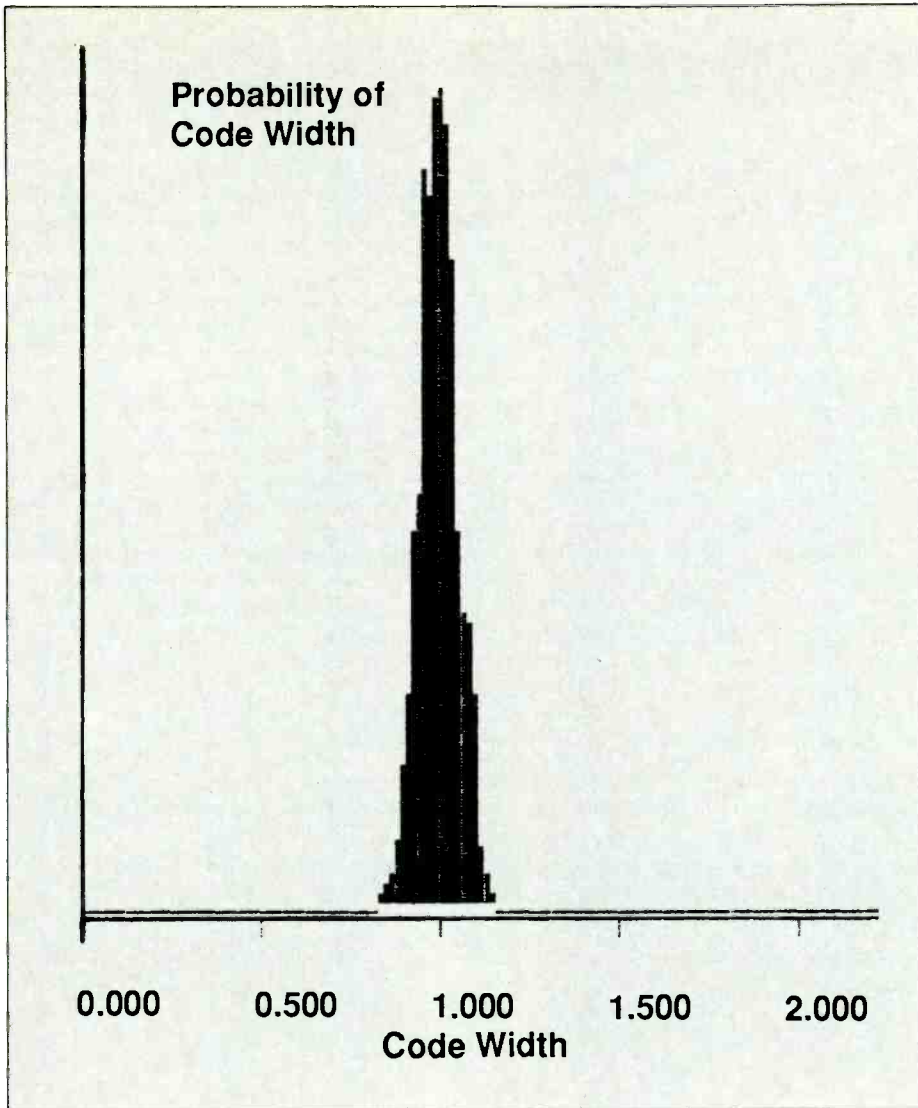


Fig 2: ADC 20048 code distribution

components of the quantisation noise are filtered, to give an S/N ratio of 108 dB in the audio band. The four poles also cause the quantisation noise to become random. A pattern develops at the output of the flash converter, and is centred around the analogue input value. This idle pattern appears as a random sequence made from two or three contiguous codes and it has an energy level slightly greater than the flash ADC quantisation noise.

The role of the decimator is to filter the digital output of the flash ADC to remove out of band noise and to reduce the sampling rate by a factor of 128:1. The reduction in sample rate from 6.144 MHz to 48 kHz is accompanied by an increase in resolution from 4 bit to 20 bit. (Note: the decimator is able to accept a 6 bit digital input, which offers the promise of further improvement in S/N ratio.)

Digital filtering is accomplished in two steps. First, the data goes through a series of three cascaded moving-average filters. The output of each filter is the average of the last 64 input values, and the transfer function of all three stages is:

$$G(f) = \sin^3(\pi f / 2F_s) / (64 \sin(\pi f / 128F_s))^3$$

where F_s is the sampling frequency (nominally 48 or 44.1 kHz).

This is essentially a lowpass filter, exhibiting its first null at $f=2F_s$. It has a linear phase characteristic, and a delay of 95 samples at the 128x conversion rate. The digital data path at

this point is 20 bits wide. Note that this filter presents an attenuation of approximately -1.9 dB at 20 kHz that depends on the sampling frequency. This attenuation is compensated for in the analogue front end of the converter. The high frequency part of the signal is sufficiently filtered to allow for a time decimation (sub-sampling). A new data sequence is formed by selecting one out of every 64 values coming from the averaging filters.

Second, the halfband FIR filter stage of the decimator uses this sequence (20 bits of data at $2F_s$) as an input. The frequency response of this filter stage viewed on a linear scale has an even symmetry, and the ripple in the passband is linear and equal to the ripple in the stopband.

The decimator filter characteristics are summarised below:

Passband	
$F_s=48$ kHz	0 to 21.77 kHz
$F_s=44.1$ kHz	0 to 20 kHz
Passband ripple	± 0.00087 dB
Stopband	
$F_s=48$ kHz	26.23 to 68 kHz
$F_s=44.1$ kHz	24.1 to 64.1 kHz
Stopband attenuation	-80 dB, min
Signal delay	26 samples of F_s
Phase response	linear

The output of this filter is then decimated from 96 kHz to 48 kHz (2:1 sub-sampling) and becomes the output of the ADC.

Noise-shaping, oversampling ADC performance

The oversampling architecture used in the ADC 20048 gives two major advantages over conventional A/D converters: a good differential linearity and the elimination of the expensive analogue anti-alias input filter.

The differential linearity performance comes from the fact that a change in the analogue input voltage never corresponds to a transition in the converter. Rather, a change in analogue input causes the idle pattern at the output of the flash ADC to shift by increasing the frequency of occurrence of one code while reducing the frequency of occurrence of another code. Since the energy of the idle pattern is somewhat larger than the flash ADC quantisation noise, smooth transitions are guaranteed across the entire analogue input range.

When the differential linearity performance of the ADC 20048 is compared to conventional successive approximation or multiple-pass subranging ADC architectures, the ADC 20048 has an overwhelming advantage. The differential linearity of these earlier architectures is dependent upon the matching tolerance of resistors or capacitors. The best available converters that use these architectures achieve approximately ± 0.5 LSB typical differential linearity at 16 bit resolution. In contrast, the ADC 20048 obtains ± 0.2 LSB maximum differential linearity at 20 bit resolution. That represents an improvement of 40:1. Even more significant for audio signal digitising is that the worst point in the transfer curve for successive approximation and subranging ADCs is the bipolar zero-crossing, which is the best point in the transfer curve for the ADC 20048. This means that low-level signal information is preserved when audio signals are digitised with the ADC 20048.

To measure differential linearity, a histogram representing code density is recorded, and a histogram of the histogram is then calculated. The result is a plot that shows probability of code width on the vertical scale and code width on the horizontal scale (see Fig 2).

The flash ADC converts at the $128 \times$ rate (approximately 6 MHz) so an anti-alias filter is not required. The anti-alias filter function is provided by the decimator. The FIR digital filter stage eliminates all frequencies between $F_s/2$ and

TABLE 1 Band	Rejection
$F_s=48$ kHz 28 kHz to 68 kHz 68.1 kHz to 1.5 MHz	-80 dB min -50 dB min
$F_s=44.1$ kHz 24.1 kHz to 64.1 kHz 64.2 kHz to 1.5 MHz	-80 dB min -50 dB min

$3F_s/2$, while the first stage (averaging filters), in conjunction with an internal 2-pole lowpass analogue filter, eliminates frequencies above $3F_s/2$. The final anti-alias performance is shown in Table 1.

Nearly all professional digital audio equipment currently in use contains anti-alias filters. Many users have complained about the noise, distortion, phase non-linearity and transient response of these filters. In some cases, companies have offered after-market plug-in filter upgrades to

improve the sound quality of the digital recording equipment. As evidence that the noise-shaping, oversampling ADC actually sounds better than earlier converters, Chesky Records have recorded several jazz CDs and recently released a sampler CD that includes digitally recorded comparisons between an oversampling ADC and a conventional ADC used in mastering systems. The jazz CDs have received uncontested, critical acclaim from numerous reviewers.

Improvements over dbx evaluation boards

As a result of careful investigation, UltraAnalog learned that users are extremely pleased with the improved audio digitising sound quality obtained from the dbx chips and dbx ADC evaluation boards when compared to other A/D converters. The benefits of linear phase response, good differential linearity, increased S/N ratio and improved dynamic performance for small signals all contribute to a significant improvement in digital audio listening quality.

However, several objections to using the original dbx A/D converters surfaced. Some objections were obtained from users while other objections arose during careful evaluation by UltraAnalog's engineers.

Most users are unprepared to construct a high resolution ADC that requires as many as 160 additional components (needed for the 20 bit resolution version). UltraAnalog addressed the high-component count by developing a 2x3 inch modular front-end design using double-sided, surface-mount technology. High quality discrete components are assembled using automatic assembly machines with great precision and at low cost. Careful material handling and quality assurance throughout the assembly process results in >97% initial acceptance yield. After a functional test, individual factory calibration and burn-in, the modules are encapsulated in high thermal-conductivity epoxy. The user only needs to connect the Analogue Front End module to the external Decimator IC and add the necessary clock and power supply.

The iterative adjustment required for the offset and distortion null trimpots on the dbx ADC evaluation boards is difficult and quite unstable. The integral non-linearity (and corresponding large-signal THD) is determined by the resistor ratio matching of a precision resistor array and the risetime/falltime matching of 8 bit latches. Careful analogue front end design and active trimming and calibration eliminates the trimpots and improves the large signal THD in the ADC 20048. UltraAnalog have developed several different test hardware systems and have written more than 20,000 lines of software code specifically for test and calibration of ADCs and DACs. Computerised active trimming of all significant circuit errors, including the resistor ratios in the precision resistor array, offset/gain errors of the front end amplifiers and clock timing delay is individually performed on each converter.

Fig 3a shows an untrimmed integral nonlinearity plot for the AFE 20048 Analogue Front End. The vertical scale indicates approximately ± 40 LSBs error (at 20 bit resolution) for a 1 kHz, -0.5 dB sinewave input, while the horizontal scale represents the codes from $-FS$ to $+FS$. Fig 3b shows a trimmed error of only ± 4 LSBs (again, at 20 bit resolution).

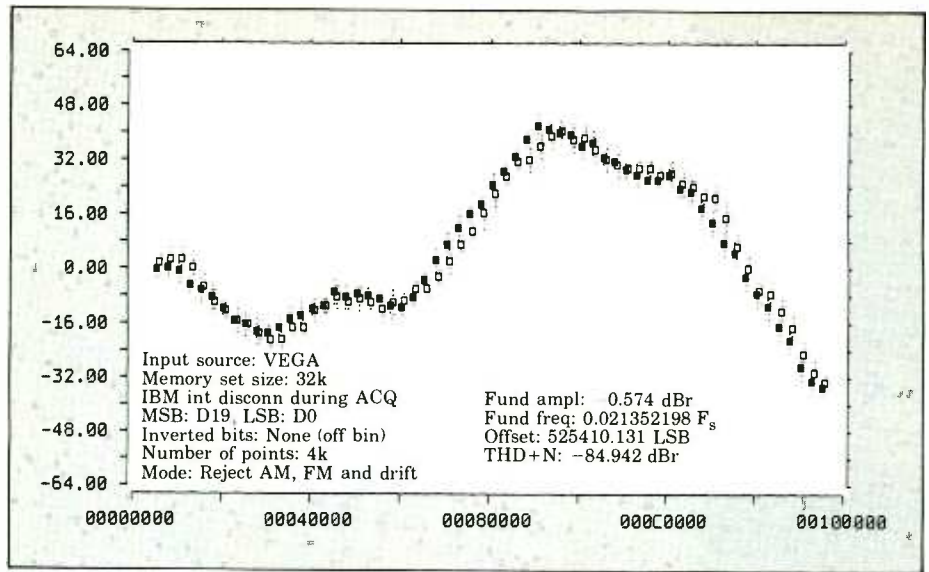


Fig 3a: Untrimmed linearity

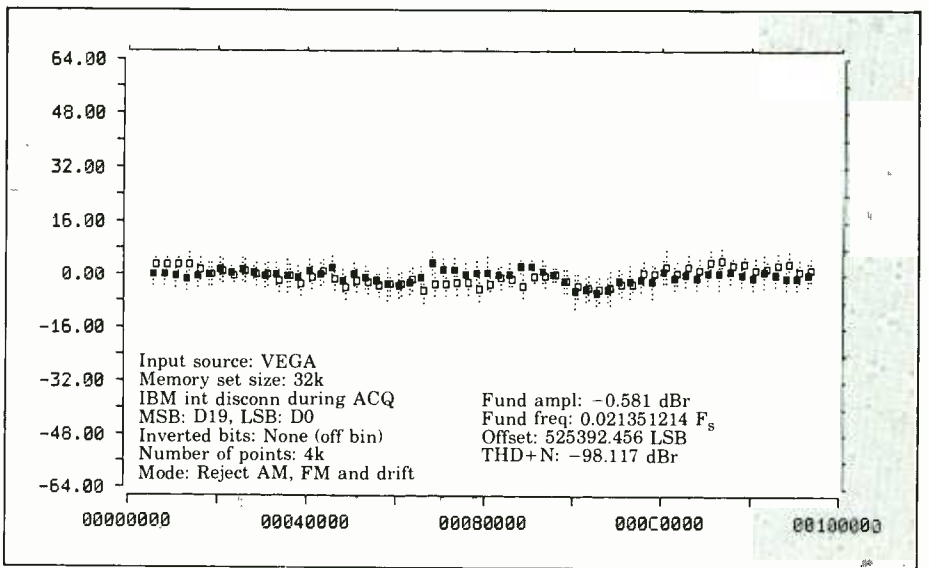


Fig 3b: Trimmed linearity

Large signal THD+N is improved from -85 dB to -98 dB. This calibration algorithm is based upon measurement of active circuit errors by analysing the digital output data of the ADC. Hence, all sources that contribute to the integral nonlinearity are corrected. In comparison, many other manufacturers trim converters by probing the actual element to be trimmed, eg resistor or capacitor. Note: small signal THD+N is -108 dB (referred to full scale) and guaranteed by the design architecture.

Sensitivity to clock jitter and duty cycle reduces the performance of the ADC evaluation boards in typical systems. Originally, the 12 MHz clock duty cycle was required to be precisely 50% duty cycle in order to develop the proper timing signal for the flash ADC and the clock that latches the DAC data. Any jitter on this clock (or noise on the power supply for the clock) could degrade the S/N ratio of the ADC. In the AFE, an internal timing generator (powered from a regulated supply) develops the 50% duty cycle clock synchronous with the 12.288 MHz master clock. This greatly reduces sensitivity to clock duty cycle and power supply noise.

Flat frequency response to 20 kHz is only possible when the ADC evaluation boards are operated at a fixed sampling rate but many users desire to have flat response with both 44.1 and 48 kHz sampling rates. Frequency response of an

oversampling ADC is determined by digital filter coefficients and clock frequency. In the case of the D20C10 decimator chip, the frequency response at 20 kHz is reduced by -1.9 dB. A second order, peaked lowpass analogue filter is included inside the AFE module to compensate for this rolloff. Since the D20C10 response is different at 44.1 kHz than at 48 kHz, two different lowpass filter selections are pin-selectable. When the ADC 20048 is operated at either of the two frequencies provided, the passband flatness is typically ± 0.02 dB from DC to 20 kHz. When the A/D conversion rate is varied from these two frequencies, the rolloff at 20 kHz degrades by ± 0.03 dB/°.

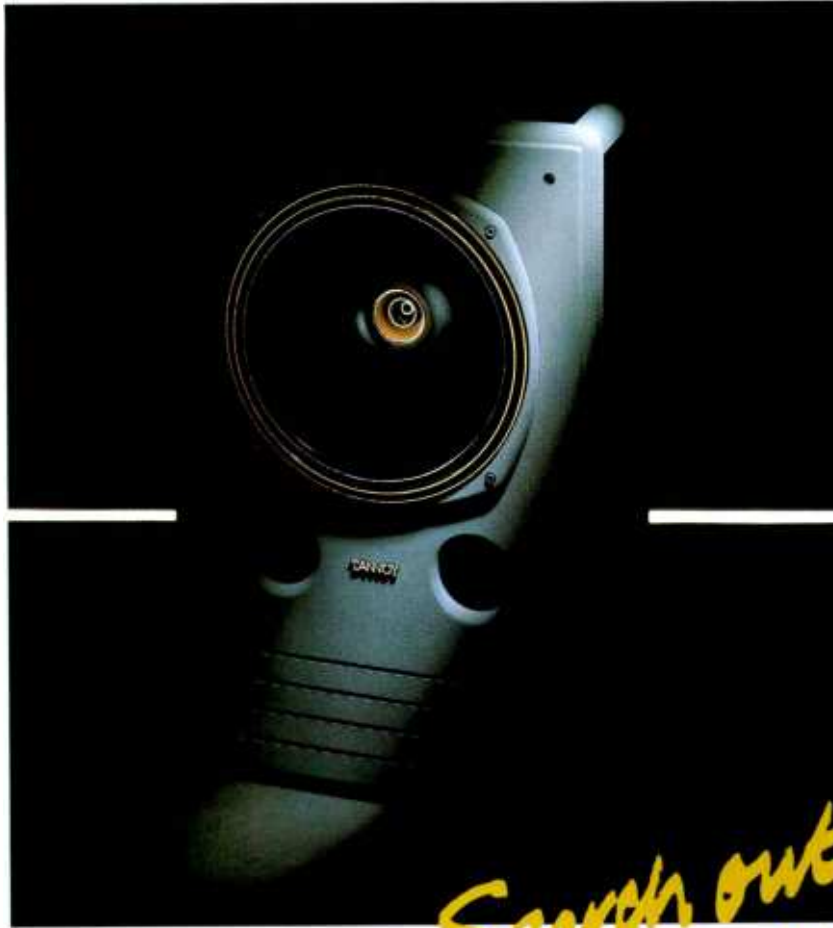
Finally, the AFE is configured with a true differential input and a choice of two ranges: ± 3 V or ± 5 V full scale. This configuration reduces conversion errors caused by common mode noise and allows easier interface to existing systems.

Once the calibration of each AFE 20048 is completed, the Audio Precision System One is used for recording final test data. This ensures that every ADC 20048 manufactured meets the published specifications prior to shipment. □

Reference

R W Adams, *An IC Chip Set For 20 Bit A/D Conversion*, presented at the Audio Engineering Society 7th International Conference, Toronto, Ontario, Canada, May, 1989.

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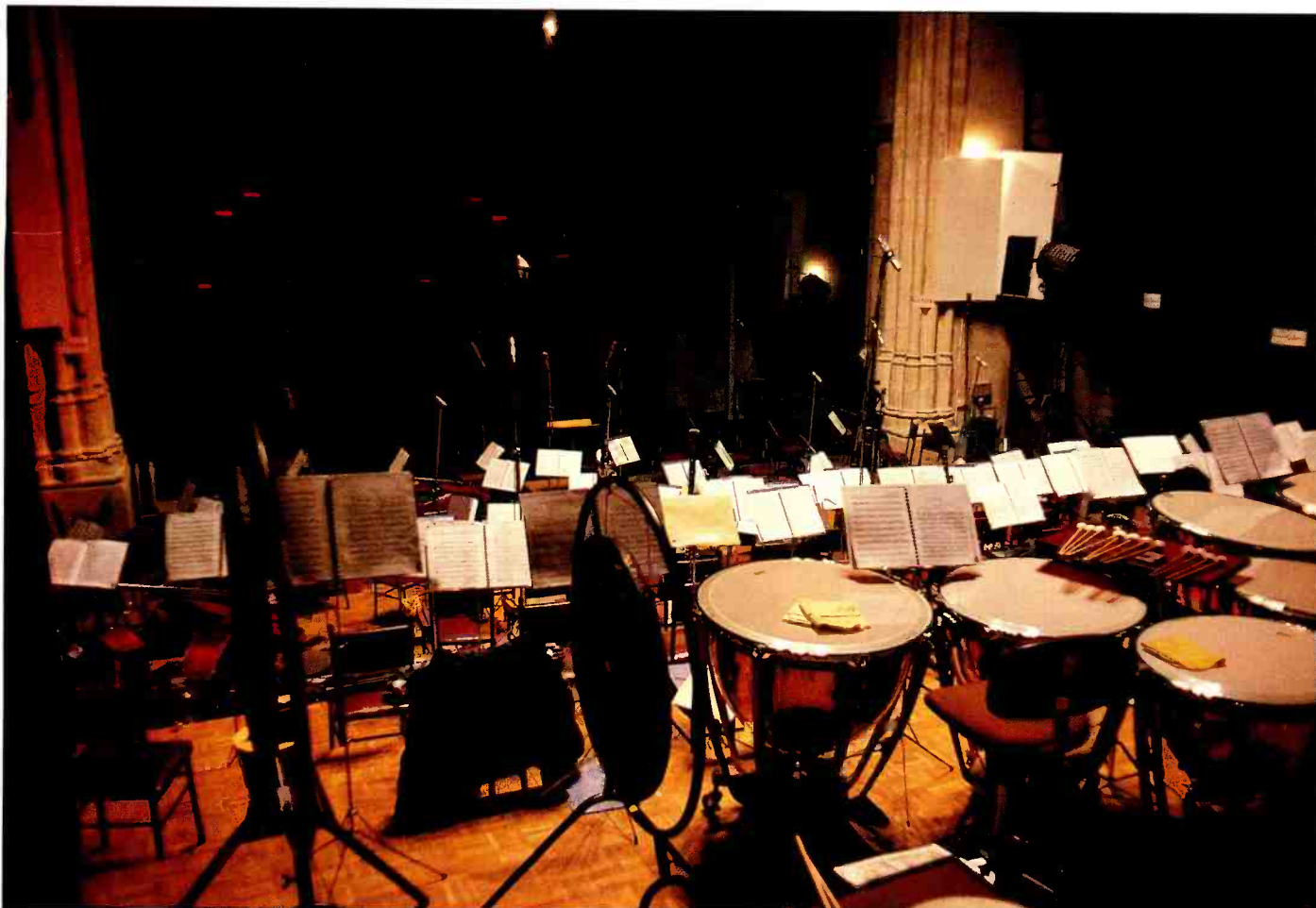
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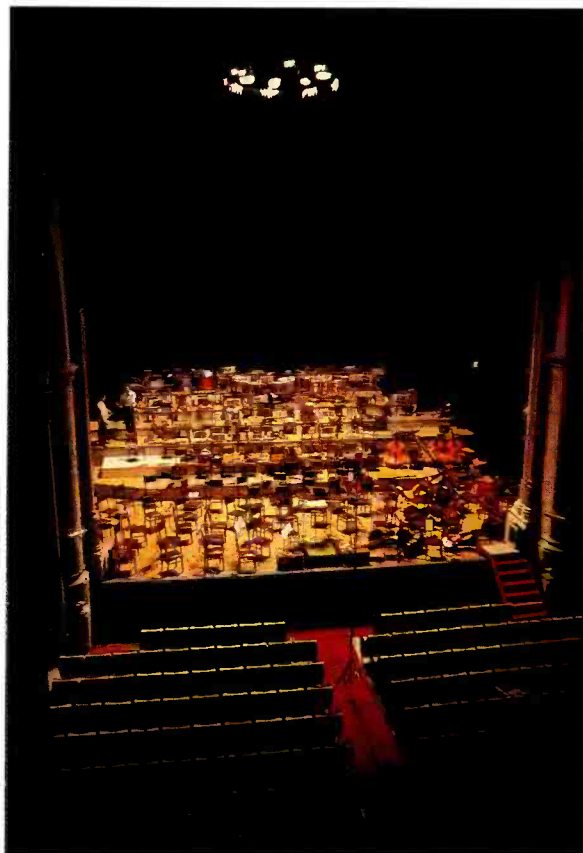
Dave Foister recounts some of the problems and rewards recording an orchestra in a Spanish church

I must confess that when I was first approached by my colleague Eric Hollis to record the Spanish National Youth Orchestra, of which he was a director, playing Stravinsky's *Rite Of Spring* in 3 days in a 200-year-old church for CD release, my gut reaction was 'No Way José'. Let someone else have the aggravation. But on further reflection I thought, that someone else will either screw it up or get all the glory and I'm just as well qualified to do either; what the hell. So I did it.

I was fortunate in two respects. I realised early on that this would not be a one-man job; I needed help (some might say putting my hand up for the job at all meant I needed help) and a very old friend and associate, Mark Sutton, whose greater experience of orchestral recording sessions was bound to be of use, agreed to come. Secondly, it turned out that Coca-Cola España were sponsoring the whole project, so equipment hire should be no problem financially.

The initial problems were the unknowns. I didn't know what the church sounded like—I had been told it had been used as a recording venue in the past and worked well, but we've all heard that one before. I didn't know how good the orchestra was—I was told they were up to a good professional standard, but they would say that wouldn't they. I didn't know what equipment availability in Spain was like. I didn't know what the conductor would be like to work with. I didn't know any Spanish.

The first step was organising the gear, and the problems we

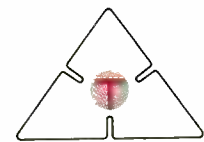


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encountered surprised me. Because I'd never heard the venue, and because it was impractical to check it out beforehand, I had to plan a catch-all rig to cover all eventualities. I've done a fair amount of orchestral recording in a variety of locations and generally prefer an almost minimalist approach. That, however, relies on a good acoustic, which I couldn't be sure I had. I therefore had to assume that I might need a number of microphones and some good artificial reverb, so that I could make the natural acoustic virtually irrelevant if it turned out to be dreadful. I wanted to go straight to stereo on *PCM-1630* and I thought that in itself might prove difficult to obtain in Spain. As it turned out, the digital gear was no problem; the hassles arose from much more mundane things.

I was put on to a hire company in Barcelona, who were able to provide a surprising amount of what I needed. They procured the digital recording gear in Madrid and were even able to supply a DDA desk, which I wanted for its noise performance, and a Lexicon 480. What they couldn't do were the apparently simple things: they couldn't come up with a decent pair of monitors, they couldn't fulfil the microphone requirements and, worst of all, they couldn't lay hands on a tall microphone stand to carry the main pair—not knowing the venue I couldn't rely on being able to sling. We ended up monitoring on *NS10s* (the *JBLs* they had brought, which would have been only slightly more suitable, got damaged in transit and could only be used for talkback) and a very good pair of Sony headphones. I got all kinds of substitute microphones, of which more later, and I had to take my own 20 ft microphone stand. This latter item turned out to be the focus of considerable attention and I could easily have sold it to the hire company at an extortionate price since such things are apparently unavailable in Spain. On the other side of the coin, things they were able to provide apparently effortlessly included a telephone for communication with the conductor—essential on a job like this—and a cue light to keep the orchestra under control.

The first potential stumbling block was the quote they came up with, which I thought was so far over the top as to make the project unviable. I had obtained a second quote from a London company, which amounted to 9 days' hire to allow for transit times and included all the freight and customs admin charges; this still came in £1,500 under the Spanish quote but to my amazement the sponsors had already accepted the Spanish deal.

The first thing we did on landing in Spain was to go to a concert by the orchestra (known as *Jonde*, for *Joven Orquesta Nacional de España*) in Madrid's new concert hall, playing the very piece we were to record. This put our minds at rest on two counts: the orchestra was clearly very good and the conductor knew his business. This all boded well for the following few days.

As it turned out, the Barcelona company, while falling down in a couple of areas and seemingly overcharging, came up with the goods in a big way in that they provided a six-man crew to rig and strike, and two people on site for the whole session logging takes and sorting problems, of which we had a few.

Miking up

Surprise, surprise, Cuenca's Church of San Pablo, beautifully situated though it is, was not such an acoustic paragon as we had been led to believe, it was small and dry with a curiously-shaped deep, narrow stage. The orchestra couldn't be moved out into the middle of the church because the seating was all bolted to the floor so my multimid rig turned out to be extremely necessary. And we put out 21 microphones—so much for minimalism! The microphones themselves were quite an assortment; I had wanted *TLM170s*, *414s*, *U87s*, *KM84s* and Schoeps but I got a few *87s* (with not enough stand mounts—one ended up lashed to its stand with gaffer tape), four *U47s*, half a dozen Schoeps, which had apparently been bought specially, and a suitcase full of *451s*. Fortunately we had taken some of our own—two *87s*, a *414* and four *KM84s*.

We rigged *U87s* as the main pair on my big stand, four *87s* and the *414* on the strings, two *U47s* on the brass, two more as a crossed pair behind the horns, all four *KM84s* on the wind, and Schoeps for percussion, ambience (hanging under the church's rear balcony) and a spaced pair near the stage. What with that little lot and the 24-channel desk, the *1630*, the two



DMR2000 U-matics and the Lexicon, we were told that the rig in that little church was probably the biggest and best recording setup in Spain at the time; apparently we had all the decent microphones in Madrid. The biggest surprise, and one of our most time-consuming problems, was that the *U47s* all began to pick up some local radio station. The problem took some time to trace since it wasn't evident when we started, was intermittent and started on one mic only to move on to the others as it got worse. The *U47s* had to come out; as we had by now used all the big mics they were replaced with *451s*, which were less than ideal.

Communication problems

Throughout all this, which caused considerable delay, communication between ourselves, who spoke no Spanish, and the Spanish hire people, who spoke no English, was a curious mixture of surprised success and total incomprehension. Many English technical words turned out to be the same in Spanish, but many are not, and Eric's good but non-technical Spanish didn't quite bridge the gap. A good example was the problem with the Lexicon 480. This is not a device I am very familiar with and, while programming the reverb I wanted was reasonably self-explanatory, saving the end result for use the following day was not. Although the legending on the *LARC* was in English, the manual was in Spanish and trying to decipher this and explain to the Spanish what I was attempting to do turned out to be astonishingly difficult.

The one thing that called for more tact and diplomacy than our combined interpretative skills could manage was the unexpected arrival, while we were rigging, of a Spanish TV crew. Coca-Cola had arranged for the whole session to be recorded on video, as a record, and nobody had thought to tell us. Oh, how we laughed!

The jollity began when a man appeared in our 'control room' (which was in fact a very live chapel off the side of the church that had, until the second day, no lights) with a Nagra, which he proceeded to set up on a bench in the corner before handing me the end of a cable and pointing at the *XLR*, all without a word. I surmised that perhaps he wanted a feed and, as I'm too nice to say 'No,' I plugged him into an auxiliary and sent him the pre-fade signal from the main pair, on the assumption that this would give him the best, most consistent and least interrupted feed as we tweaked and fiddled with the rest while getting our balance and checking things between takes. I must learn to be less nice, as we shall see. (I was intrigued to note that he did not appear to understand his Nagra—he was cranking up the mic inputs with my feed in his line input and wondering why all he had was noise. Naturally his first assumption was that this was my fault.)

Unfortunately, the TV crew didn't really seem to understand what was going on, that we were trying to run a high-quality recording session. This became apparent during our first main



**Microphones by
Sh... you know WHO!**

take, when they continued to rig cameras and lights while the orchestra played, and were seen (and heard) to actually throw things around the church to each other. Once they had been persuaded to keep quiet during takes their second sonic contribution became clearly audible—the power supplies for their huge lights. These were sitting on the stage beside the musicians and all contained noisy cooling fans. When this was pointed out they agreed to switch the fans off for short periods during takes but the fans were masking other noises—the acoustic hum of the huge mains transformers and the clicks and twangs made by the lamphouses as they expanded. Fortunately the orchestral management and the conductor felt strongly that our sound recording came first and the TV people were told to switch off during takes. The trouble is those same lamphouses take a long while to cool down and as they do so they emit more loud bangs and creaks as they contract. More delays, and a very fed-up TV crew sitting around the church reading newspapers and sleeping.

Rewards

After 2½ days of recording we had the piece finished—112 takes on six U-matics, all double-run for safety. The orchestra, who had never recorded before, produced a polished professional performance, charged with youthful excitement. They were a credit to a fine conductor, Edmon Colomer, who throughout the tribulations had been cheerful, unflappable, co-operative, sympathetic to our problems and committed to getting the best out of his orchestra. When we finished Edmon called us on stage and made a speech we didn't understand at the end of which the whole orchestra gave us—the engineers and producers—a standing ovation. We could not have wished for a finer set of musicians or a nicer bunch of people to work with.

Our jubilation was short-lived. When we got back to the control room to start packing up there was a row brewing that made me wish I had been less pleasant to the TV sound man. The TV people were complaining about the sound feed they had

had, saying it lacked detail and had been unusable. I was astonished. Out of the blue, and out of a misguided spirit of co-operation, I had given them what I felt to be the safest feed I could, in a way which I understood was common practice. They had said nothing for 2½ days, only complaining about it after it was too late to do anything about it. First, they wanted to take our second set of masters, which of course we refused point blank; apart from not wanting to part with our safety backups we smelt a rat. Then they wanted us to make 15 in/s analogue copies of the whole session when we got back; when we told them what this would cost they changed their minds. Finally, just before we came to blows, it was agreed that they should have a copy of the final edited master when it was finished. They went off grumbling, and it left a nasty taste after what had been an intense, exhausting but highly rewarding 3 days.

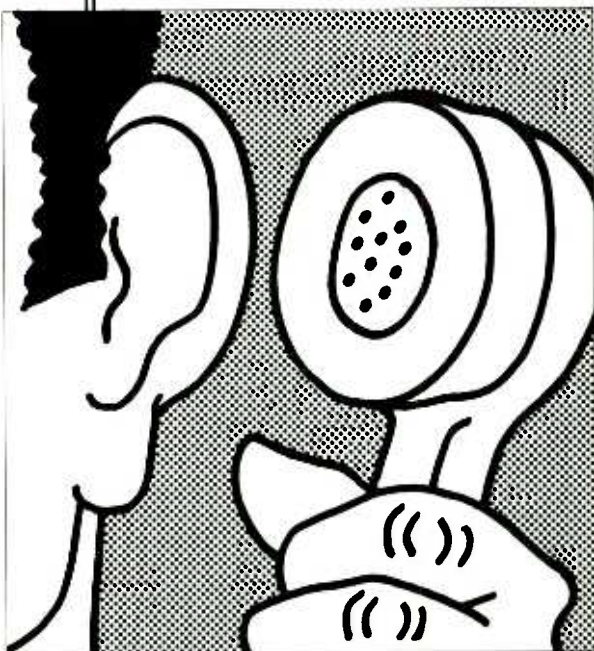
Our troubles were not over yet; we had to waste our last day, when we could have been free to see Madrid, persuading the organisers to hand over the money we had been promised, then we had to battle with a Spanish airport policeman over the master tapes. I was determined to avoid putting them in the hold and obviously they shouldn't go through the security screening gate but digital master tapes are not something these people have to deal with everyday, so persuading him proved difficult and involved letting him open every single U-matic box to check its contents. And of course the KM84s in my briefcase looked like guns on the X-rays...

We edited in London, with a DAE-1100, a few weeks later. The 70 edits took about 24 hours, largely because Edmon hadn't had time to listen to the cassettes I had sent him before arriving in London and a lot of our time was spent listening through the various takes.

The edited master was finished some time ago and in keeping with the mañana attitude we encountered throughout, the record has yet to be released, despite the considerable cost and the fact that everyone is apparently extremely pleased with it.

And strange though it may seem, if I had the chance to do it all over again, I would jump at it. □

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After rebellion against last year's Memorandum of Understanding on DAT by the music publishers, and mounting resistance to the SCMS (Serial Copy Management System) deal, the IFPI has revealed that the statement put out at the time of the MOU omitted vital details. Quite simply we were not told a full, straight story (DAT players sale agreement reached, *Studio Sound* October 1989).

The IFPI's statement of July 28th, 1989 talked only vaguely about the signatories to the June MOU agreement "to explore the feasibility of a technical mechanism for alternative systems of private copying remuneration in future digital recording devices". Now the IFPI's *Gazette* (Winter 1989) "reiterates" the situation in quite different terms.

The 'reiteration' specifically refers to a scheme for using debit cards to "provide an electronically accurate method of payment for private copying".

The 'reiteration' also says that the signatories will "co-operate in the development of an analogue base band signalling system for implementation within DAT technology to prevent circumvention of the standard by recording via the analogue domain". The original statement talked only vaguely about "refining the SCMS system in the analogue domain" as "advances in technology permit".

So what's going on?

The IFPI explains that the references to an analogue base band signalling system and debit card system, are direct quotes from the MOU, which is a confidential document.

Why wait 6 months to release such important information? Why wait until after the music publishers have rebelled? It's all very puzzling.

The debit card system is based on smartcard technology. A smartcard is a credit card that contains computer chips, either memory or processor or both. France has pioneered smartcard technology and Sky is first to use it in the UK to authorise the decoders to de-encrypt its scrambled *Movie Channel*. French banks use smartcards for credit exchange and point-of-sale debiting. French telephones work with simpler versions. Denon of Japan is believed to be well advanced in developing a system for using smartcards to log home taping. There are two main options.

The simple option, is for the public to buy smartcards that contain a number of cash credits, rather like a telephone card. When inserted into a DAT or CD-R recorder, the card enables home taping. Circuitry inside the recorder sucks a credit out of a card each time a disc is dubbed. When the card is empty of credits, the recorder refuses to make any more dubs. The user then buys another card and starts again.

The advantage of this system is that the card can be relatively cheap. The disadvantage is that there is no way of knowing what discs have been dubbed and thus no way of feeding cash back to the copyright owners whose work has been copied. It's the direct equivalent of putting a tax on a write-once recordable disc.

The other option is more complicated and thus more expensive. The smartcard records copyright details of the disc being dubbed. It takes these details from the table of contents or subcodes on a CD or pre-recorded DAT cassette. The owner then

Barry Fox

CD copying, small product, large package, write-once recording

takes the card to a collection point and wipes it through a reader, which registers the recordings made and charges the card holder accordingly, perhaps by directly debiting the home taper's bank account. The copyright holders get appropriate remuneration. But the logistics and cost of implementing the system are horrendous.

It looks as if we are now in for a whole new round of industry arguments, with record company executives calling for technical solutions they have heard about but do not understand.

In the meantime, the BPI in Britain also has a new man at the top. When Chairman, Terry Ellis took the job, he made sensible noises about the BPI and record industry needing a better PR image. Within weeks Ellis was facing a snowball of public opinion against the high price of full price CDs. This was brought to a head by a *Which?* report.

When asked by the *Sunday Times* to comment Ellis replied, "We don't have to justify our prices to anybody."

As a radio presenter put it the next morning: "With that kind of attitude, they have only themselves to blame, it's an open invitation to tape CDs."

Two questions *not* to ask: Don't ask Philips about their plans to offer a digital version of the analogue compact cassette. All you will get, at least until May, is, "No comment."

The company have been jetting the top executives from record companies, hardware companies and audio tape duplicators to Eindhoven to reveal their secret plans. Needless to say, tongues have wagged.

The bottom line is that although Philips will launch conventional R-DAT recorders this year, the company is hedging bets and offering the music industry an alternative approach—one that would not involve the duplicators in installing completely new equipment and one that lets the trade continue with single inventory stocking.

In short, the Philips' plan is to put a digital audio signal on a compact cassette, in addition to the conventional analogue stereo recording.

The details I have are sketchy but it seems to involve putting an extra HF carrier on the tape, with S-DAT heads. Think of it as frequency-modulating the bias signal with digital code.

Needless to say, engineers are horrified at the practical problems. More details as I get them.

Be sure, too, not to ask Virgin Classics about their trip to Kokkola, far up north in Finland. The mission was to record cellist Stephen Isserlis with the Ostrabothnian Chamber Orchestra, a talented 20-piece group of young string players founded in 1972 by Juha Kangas. The recording—

onto digital tape—was a success. Wisely Virgin engineers made a back-up DAT recording.

Early this year I asked when the recording was due to be released on CD to the public. A Virgin spokeswoman said there were "no plans". When pushed, she elaborated a little: "The music is being re-recorded."

Someone, who doubtless prefers to remain nameless, had accidentally erased the master tapes. When Virgin called for the back-up DAT cassettes it was found that someone, who also prefers to remain nameless, had re-used them. So nothing usable remained of the original Finnish recording.

Nothing daunted Virgin's production team was due in Helsinki in February, to re-record everything from scratch.

The Sonic Solutions' *CD Maker* looks all set to become the standard for studio write-once recording. But I do wonder

about the chain of marketing command. Chemical company Taiyo Yuden (maker of That's tape), developed the disc, Sony the hardware. Together they formed Start Lab. Now Sonic Solutions has integrated the Sony hardware with its other studio systems.

In the UK Bauch already distributes for Sonic, so Bauch, rather than Sony's Broadcast Division, will handle the *CD Maker* in the UK. Bauch will also sell blank discs made by Taiyo. Harman, which is already Taiyo Yuden's distributor for That's tape, will sell the blank discs too.

In Japan, Start sells direct. The recording unit costs the yen equivalent of around £7,500 and the encoding unit needed to process the signal before recording costs around £4,500. In the UK the pair cost around £16,500 with extra recorders at £10,000 each.

So on hardware, there is not much in it.

But in Japan Start sells blank discs for well under £15 each. In the UK, they will cost £29 each—double the Japanese price. Sounds a little bit like razors and razor blades.

3M describes DAT as "already well on the way to becoming a new standard for professional 2-track mastering... for CD and music cassette duplication, safety copy masters, mastering for radio commercials and sound sampling for electronic music".

There are plenty of engineers and producers who would give 3M an argument on this, on the technical grounds of robustness, reliability and compatibility. And even those who are happy with the technology, share one reservation.

The small DAT cassette is just too easy to lose or steal. There is also not enough space on the cassette to write programme information.

In fact even 3M agrees on this. The company is now selling a modified Betacam video cassette box, which makes the DAT cassette artificially large. It's the same principle used by the record companies to make cassettes and CDs, especially 3 inch singles, artificially too large for shoplifters to pocket. The large box, says 3M, also provides protection for transport and mailing.

Which raises the question—if a miniaturised format must be stored, transported and mailed in a large package, is there really any point in miniaturising it in the first place? □

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BERWICK STREET

Ralph Denyer visits one of the few remaining recording studios in central London

Berwick Street Market is one of the decreasing number of distinctive and traditional characteristics of the area in London known as Soho, though nowadays often referred to as part of the West End. Through the '80s most of the area's infamous sex shops and strip clubs were replaced by upmarket restaurants, wine bars and stylish shopping emporiums. Just as the area has changed radically, so have Berwick Street Studios. During 1988 Rod and Helen Gammons bought the place, completely gutted the building and started afresh.

In less than 18 months they'd established the studio as a versatile MIDI and keyboard orientated track laying facility, offering quality recording to suit a range of budgets right up to Mitsubishi/Otari 56-track combined digital and analogue work. During 1989 they added a keyboard and programming suite giving them two studios.

The studios have developed an enviable and diverse client list that includes prime dance music man Mark Moore of S'Express, Channel 4 television, advertising agents Saatchi & Saatchi and, from the orchestral and film music world, Michael Kamen. Other clients include Lee-John of Imagination, Rococo, Youth and De La Soul, Mark Saunders, Quartz, Linda Law, DJ/producer Colin Faver and master dance mixer Richie Rich. Rod Gammons has produced many projects at the studio himself, including the Eartha Kitt and Bronski Beat hit single collaboration *Cha Cha Heels*. He's also produced Carol Kenyon for CBS Germany there.

As well as the recording studios there are publishing and production companies. Gammons was in lucid and communicative form as he told the tale of being "very much the country boy", who suddenly had a studio successfully "up-and-

running in the West End". As he explained, the foundations for their current success were laid long ago and far away; on the tranquil Isle of Wight.

"When I was 13 I started playing drums while at high school and within 6 months I was playing semi-pro: garage bands and that kind of thing, playing covers in pubs and clubs. I also studied music and art at school. I played classical, particularly percussion and when I was 20 I became head of Percussion Studies for the Isle of Wight County Council where I remained for 5 years. While I was still pursuing a career as a professional musician I was also teaching about 5 days a week and setting up a small studio down there. I was also getting songs published and having quite a lot of success with that side of things as well."

As he was immersed in music for most of his waking hours he gained a broad background in music and working knowledge of basic recording in a relatively short time. His wife, Helen, handled the business side, placing songs and productions with smaller dance labels and building a chain of overseas licences. She is now acting managing director for their Designer Music Company.

"Now I tend to prefer using really good drum samples and spend a lot of time programming because in the end I get a lot closer to what I can envisage using modern technology than I could do physically as a performer," says Gammons. "Now I enjoy applying this 15 years of experience as a rhythmist to the new dance music fields. And I do a lot of dance production for various labels."

He gained most of his early production knowledge in virtual isolation being situated on the Isle of Wight which only had one 16-track studio, and that was his. It was strictly self-tutoring hands-on experience, backed up by listening to records produced by Quincy Jones and others.

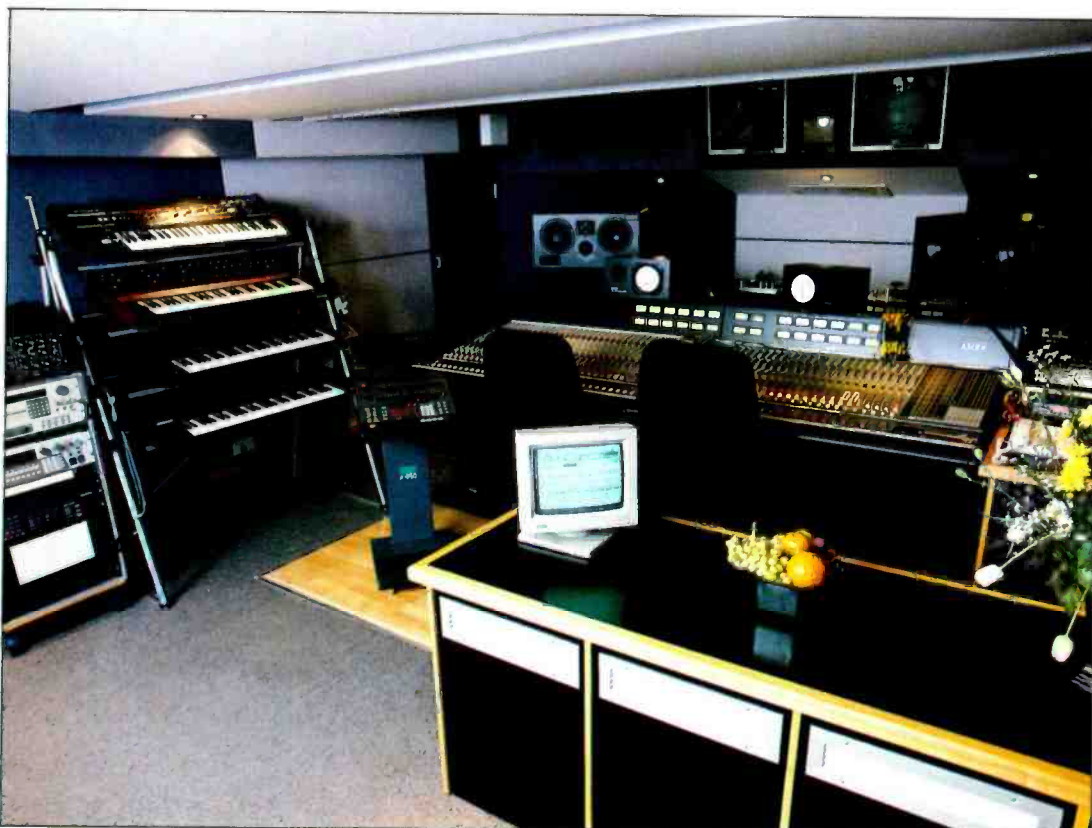
As they progressed into publishing and production Rod was increasingly travelling to London to use major studios and as they became involved in music for advertising they decided to move up to London. He operated from a South London studio while options were considered.

When they became aware that Berwick Street Studio was on the market they could hardly believe their luck. Here was a studio less than 50 yards away from Wardour Street, a major centre for the UK film industry, and virtually surrounded by major advertising agencies and clubs. Apparently the highly successful and predatory Zomba group—a major force in film, TV and advertising music—had expressed an interest in acquiring

the studio but just a little too late.

Well aware that a growing number of studios were competing for a decreasing amount of work for studio rates that were also decreasing dramatically in relative terms, the Gammons had very clearly defined objectives. The studio was to be self-sufficient. Their own Starcoast production company would be a major client but would have to pay for studio time just as any other client would. The studio would have to have a healthy rate of bookings in order to cover the cost of design, construction, acquiring a lease, staff and equipment.

Gammons' own production work is very sampler/computer/outboard control room orientated. He was well aware that his approach was also proving popular with people working in advertising and film work. Also, despite the establishment record industry's 'If we ignore it, it might go away' policy, dance music was gathering momentum.



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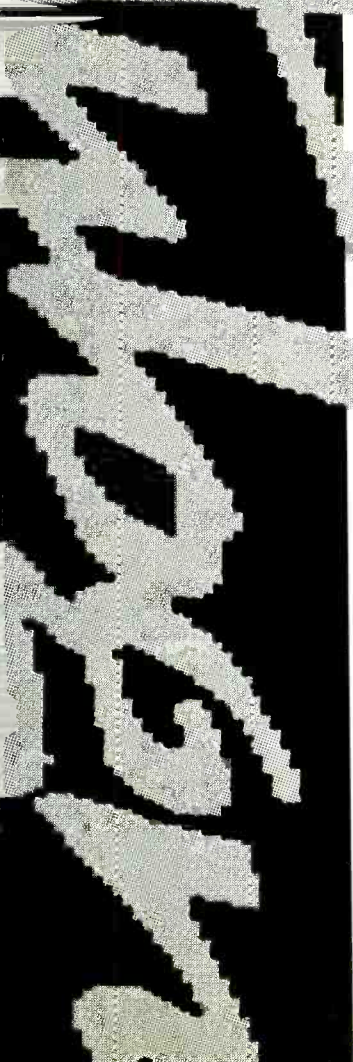
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Gammons felt there was more than a good chance that a modern studio equipped to suit his personal needs would also pull in clients from film, advertising and dance music, enhancing the likelihood of a healthy bookings book.

By reversing the roles of the existing studio and control room they would end up with a large control room with an adequate overdubbing room. Initially the basement studio was completely stripped out and refitted. The ground and upper floors being allocated for reception and recreation areas, and administrative offices for the publishing and production companies.

Andy Munro carried out an acoustical survey of the bare studio area before any firm design decisions were made. The existing smaller control room was turned into an overdubbing room and the larger L-shaped studio area converted into a live-end-dead-end-type control room.

"So unusually, the control room is at the back of the studio and not between the monitors. The new layout gave us the most logical use of the available area and the lovely big space at the back of the control room."

Though quite discreet, the colour scheme of blues and greys was carefully planned more to provide an aesthetically pleasing working area than to feature in glossy design magazines.

"Some studios have been built recently using just all black materials. I must say that for me as a producer that's like sitting in the Black Hole of Calcutta. I really did want to have a light and airy control room but also these blues and greys are warm to work with. They're nice and relaxing so you can stay down here working for long periods without wanting to escape because of the oppressive nature of the room. That's quite important."

The overdub room is much larger than an overdub booth yet smaller than the typical mid-market studio recording area.

"It's a good sized overdub room. We could do a live drum kit in there. We can certainly do a brass section or miked-up guitar amps. And with the totally mirrored back wall and other more absorbent walls there is enough of an ambient environment to try various tricks and ideas.

"Agreeably, the one big problem that you always have with smaller live areas is that small room ambience tends not to be particularly useful. It's the sort of thing that it's best not to have too much of because trying to correct it out can be a problem. So it's best to have a quite tight dry sort of sound that is crisp. We've found we can make it work extremely well. We get a great vocal sound and we've recorded quite a lot of unusual things in there such as chamber quartets, which also worked extremely well. Admittedly it is more of a close mic technique but the room is ideal for our purposes."

A keyboard rig is permanently set up close to one end of the DDA AMR console while a U-shaped work surface adjoins the other. Thus a range of keyboards is ready to go and the work surface can also accommodate computers used for MIDI domain control programs and synth voice editors.

There is plenty of space on the work surface for additional equipment brought in by clients while racking below houses the outboard equipment. The AMR console and Munro M2 mid-field free-standing monitoring system are adjacent to the wall

opposite the doorway into the control room. As a result visiting administrators from advertising agencies or film companies can come into the studio and hear what is going on, marvel at the technology, tell the artist how much they admire their work, suggest they try a purple tambourine on the second chorus to add 'that extra sparkle', and check that the budget is not being dramatically over-stretched, all without necessarily stopping the recording in progress.

While working in a number of middle and up-market studios in the past, a major frustration was unnecessary delays at the start of a session setting up, finding enough leads and inputs for a wide range of keyboards and sound modules. So Berwick Street is set up with all in-house keyboards ready to record with individual audio stereo inputs to the console. Also spare inputs routed to the desk seductively invite studio users to patch in whatever additional equipment they wish to bring in. The keyboard area has a total of 32 audio lines.

A comprehensive range of familiar outboard effects and processors includes a Lexicon 224XL with LARC, Lexicon PCM70, Yamaha REV7, AMS 1580s, Drawmer, UREI and dbx gates and compressors, and a Neve stereo valve compressor.

The in-house synths and other sound sources are all patched into a MIDI bus, which allows additional inputs around the studio so clients' computers, sound sources and MIDI controllers can be situated almost anywhere. Currently the favoured MIDI domain control program is C-Lab's *Notator* with *Unitor* taking care of the MIDI routing and SMPTE. Again, the list of available keyboards and modules is comprehensive and includes a Yamaha DX7, Roland D50, Yamaha TX816 and Akai S1000 sampler.

"We usually run C-Lab's *Notator* and we have all the add-ons now like the *Unitor* SMPTE interface which is absolutely excellent. We've got the *Export* additional output ports, which gives us a system that is 96 MIDI channels on six outputs with three inputs so we can have three master controllers running MIDI merges and all sorts."

A range of other programs and keys are available should they be required. The only piece of outboard or keyboard-based equipment not included in the basic rate is a Fairlight III, available with programmer on request.

Gammons is totally enthusiastic about every aspect of the studio design and has obviously liaised closely with designer Andy Munro. Mention the merits of the positioning of virtually any wood screw in the place and Rod will tell a tale of how a particular session at a particular studio made him realise that was exactly where it should be in his studio. He seems to have a photographic memory in terms of recalling the positive and negative features of studios he has worked in. Anyone who has worked at studios where the solution to most problems has been to throw vast amounts of money at them and little in the way of expertise will appreciate the resultant utilitarianism of Berwick Street.

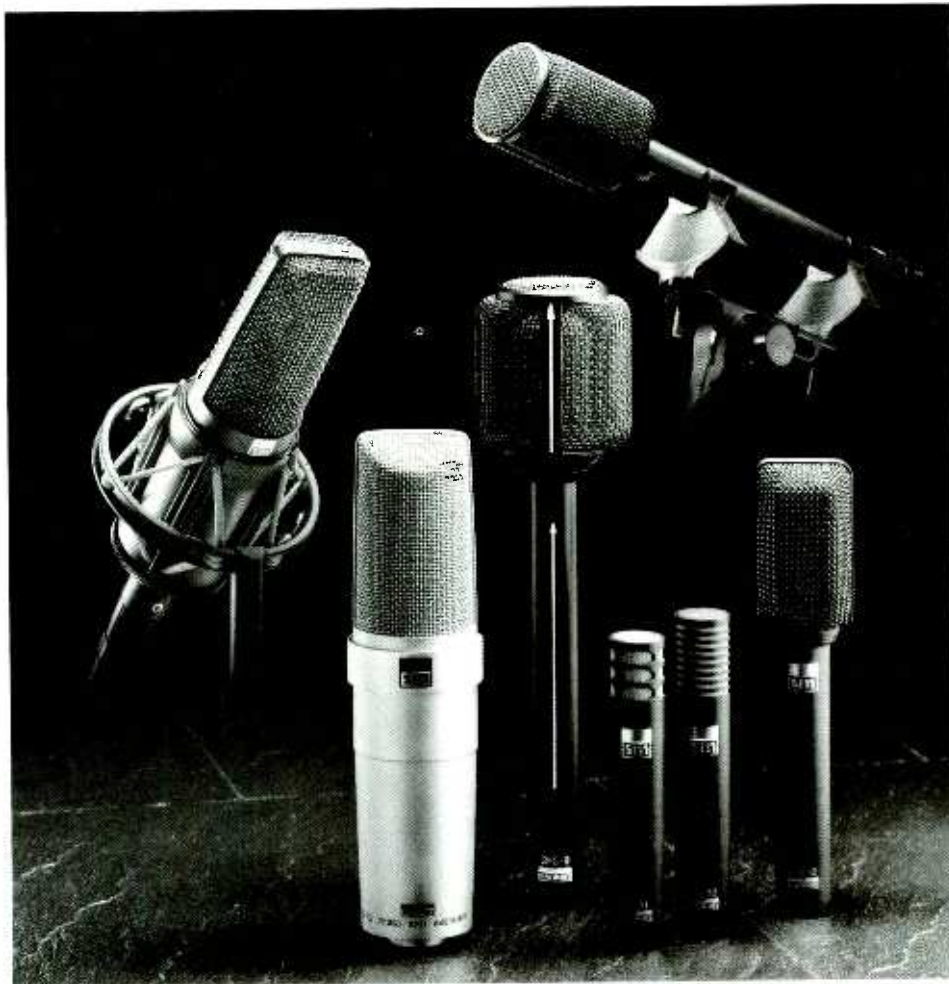
Gammons' choice of monitors was Andy Munro's M2 mid-field system. About 18 months ago Mike Hedges asked Munro to build him the best possible quality mid-field free-standing semi-portable monitor system that available technology could provide, regardless of cost. In practical terms Hedges required the system to allow sufficient levels for the accurate solo assessment usually carried out on large house monitors, yet at the same time to be a precise mid-field general use system. The result was Hedges' 3K system (3K being the name of his production company). This request coincided with research and development Munro had been engaged in on the *Jade II* monitors. All this came together as the M series of systems, which incorporates *Jade II* enclosures (developed by Munro with Klark-Teknik) with separate additional custom sub-woofer enclosures.

Gammons is in no doubt that he made the right decision in purchasing the M2 system, albeit very expensive. He pointed out that, to his knowledge, most detractors of the quality mid-field monitor concept have not actually heard the M2 system, let alone in a custom-designed acoustic environment.

"We decided to use a proper 4-way 3.5 kW M2 rig with the big sub-woofers, four Carver amps with individual BSS crossovers. When the room framework was finished Andy came in again and carried out a further analysis with the new acoustic absorption. He went away and built the crossovers, came back and installed the system and it is just wonderful."

Gammons played a Jam/Lewis-produced track from Janet

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Jackson's *Rhythm Nation 1814* CD. "As you probably noticed listening to the Jam/Lew track, the sound is very present and clear but not overly so. It is about as bright as I would ever want a monitoring system to be but accurately portrays the top end. I sometimes find it confusing working in control rooms where they go the other way. The top end is very dull and people end up unconsciously putting too much top end on because that's the way domestic systems tend to sound these days. Japanese hi-fi systems tend to be very bright. So it's about time some studio designers woke up to the fact that that is how the end user is listening to music these days. And you should be able to record so that you can hear what's happening up there because the top end is one of the main areas where major problems are likely to occur.

"As a result of the speakers being relatively adjacent to the desk two things happen. One is that you get much more precise stereo imaging. Also the resultant acoustic of having the speakers fairly close to the monitoring position allows you to have a much more dynamic system. There's not so much loss or compression in the room and there's a lot less reflected ambience from adjacent walls and control room surfaces before the sound reaches your ears. So it is a truer cleaner image. I have heard that Neil Grant is very against the concept of having sub-woofers concealed below the level of the console. But as Andy points out, the frequencies handled by the sub-woofers are very non-directional, almost completely non-directional."

Andy Munro is unconcerned about comments other studio designers may or may not have regarding the *M2* system. He said that as the *Jade II* cabinets were designed as full range enclosures with the sub-woofers only handling frequencies below 100 Hz he would be surprised by informed criticism with regard to the sub-woofers being situated at floor level in terms of directional considerations. Also as one is talking of wavelengths in the order of 3 metres, phase problems could hardly be an issue either.

Gammons: "The thing about the *M2* system is the precision and very effortless and uncoloured high frequency handling. I tend to find that work I record using the *M2* tends to sound the same when you play it on other studio's systems but not vice versa. The *M2* system seems to identify any oddness in the harmonic balance of a recording made on another system."

Many studios have taken a similar path, deciding to set up MIDI and sampler orientated studios. But many have kept their costs down on their choice of console and other equipment. In opting for the DDA *AMR* console Berwick Street can offer top quality audio, both analogue and digital. So with their equipment the studio offers high quality recording within a range of reasonable budgets. And Rod is in absolutely no doubt that he made the right choice of console.

"I don't think I know of a single DDA console-equipped studio that isn't doing OK and most of them are doing very well. Our clients love the desk and they just keep coming back for more. They think it's really great, particularly in the field we're in, involving lots of keyboard and mix orientated, and advertising work. The advertising people love it because it's a very quick console to work with. You don't get bogged down with some whacky in-line format that takes time to get used to. They also like the clean sound and adaptable EQ. Also for keyboard work the *AMR* gives you a huge number of inputs with EQ and full auxiliaries. We have a total of 84 inputs at mix, which is very useful for us because we actually do quite a lot of 56-track work."

In terms of synthesised and sampled sounds, essentially if you can describe the type of sound you want and can play keyboards, the rest can be left to studio staff. They will take care of all MIDI concerns and the locating of suitable sounds from libraries of several thousand voices. They'll even do a bit of voice tweaking with an editor program should clients require.

"All our engineers are also very good musicians and very keen, particularly in the area of dance music. I look for enthusiastic and helpful people. They're always out and about doing things, either as DJs or playing in bands or whatever. And that is extremely healthy in that they have an empathy with the type of clients that come here."

Although Rod says he feels the Akai *S1000* is in certain ways a superior performance sampler to the Fairlight *III*, he makes a Fairlight available on request because of its immense sound library, true multitasking, direct-to-disk sampling, the fact that

it "sounds wonderful" and is also a fully integrated system. Also he finds some older generation musicians and producers have grown so used to the system that they would be a little lost without it. Generally though, most users are happy working with Akai samplers, MIDI software running on Atari *ST* computers with a comprehensive range of synthesisers and sound modules. All except the Fairlight are included in studio rates.

At the beginning of 1989 the studio was fully booked for 3 months. Among others Michael Kamen was in recording the music for the Don Johnson movie *Dead Bang* and Chas Jankel was booked in for a month to record the soundtrack for *Killing Dad*. The Starcoast production company was becoming very involved in the Eartha Kitt album project and Rod found himself effectively locked out of his own studio. They decided to turn an upstairs room into a programming and keyboard room but with recording facilities. A second Otari 24-track was installed along with the smaller DDA *D* series console and Yamaha *NS10* monitors. A mirror setup of the keyboards in the main studio was installed. The room was intended for use on in-house projects and for outside clients, with whom it has proved popular for smaller budget projects or for developing ideas and songs that are later finished in the main downstairs studio. With the two studios and the digital or analogue option, Berwick Street then found themselves in a position to tailor a session to suit any sensible budget. From MIDI and keyboard orientated publishing company song development to a full 56-track digital/analogue sound-to-picture project, any sensible budget could be met without concession to quality. Again the high quality of the DDA console was a critical element.

"A lot of dance labels use Studio Two to do good quality clean productions they don't have a big budget for. The *D* series is great and you can mix less complicated projects on it. We've done in-house projects that haven't had to go downstairs to the main studio at all and they sound great. The indie labels are using it for the same thing. S'Express used it for pre-production and programming for their album, as well as Baby Ford, Chrysalis, BMG and various other people. Studio Two has been quite a surprising success. It's ideal for keyboard writer/programmer/producers who just want a little room they can go into and lock themselves away in for a day, whack a load of stuff down on tape and know that it's going to sound good when they get it somewhere else. Because the trouble is that using a cheap studio tends to mean studios with very old desks and beaten up old Studer *A80s* or even worse multitracks. Consequently you take the tape somewhere else to finish the project and find it is covered in pops and crackles and sounds rather dull because the *A80* was on its last legs and the heads needed relapping or something.

"What is nice about Studio Two is it is an inexpensive studio to use but all the equipment is really clean and new so the sound is good."

Gammons points out that the *D* series input module is based on the monitor section module of the *AMR*, and that many people are using the *AMR* monitor section for additional inputs for a mix, especially for virtual tracks. With a slightly different configuration of the *AMR* monitor section the *D* series therefore has essentially the same transparency, headroom and high specification of its bigger brother.

"You don't have the same precision with the EQ because it is a monitor section which is just switchable high frequency cut or boost and dual parametrics in the middle. You don't have bandwidth controls. So if you wanted to do some subtle equalisation you'd have to utilise a Massenburg or Focusrite floating EQ. Apart from that it is a very nice little desk. We've gone for the dual input option which is switchable. So we have all the keyboards permanently plugged in so switch to Mic B, turn on the keyboards and desk and you are ready to go."

There are some wonderful and well designed studios around that take the concept of studio design on to a fresh plateau. And there are others that, for anyone interested in the *art* of recording, provide the equivalent of visiting Fantasy Island. But for the no-nonsense professional film composer or the young up-and-coming record maker looking for high recording standards combined with a very pleasant working environment within a budget, they should check out Berwick Street Studios. □
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What the *MIDI Metro* does

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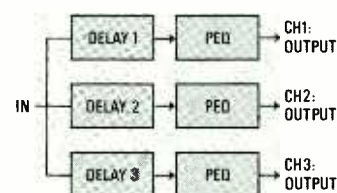


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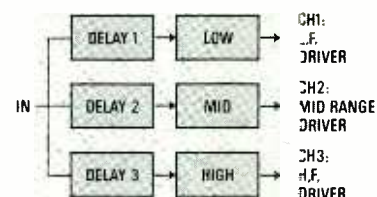
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BUSINESS OF CEDAR

There has been a considerable wait for the commercial appearance of the Cedar noise reduction system for cleaning up old or damaged recordings. Barry Fox has unravelled the story behind the delays

There is a common question in the audio industry: "What news of *Cedar*, the British rival to the Californian *NoNoise* system?" The question is prompted by the hard sell publicity for *NoNoise* currently being generated in the UK by British facility house Chop 'Em Out and others.

Cedar, like *NoNoise*, removes unwanted hiss, click and scratch noise from old recordings. If only because *Cedar* is British, many in the UK audio industry are rooting for its success. But an extraordinary web of intrigue and confusion is tangling up the British system.

What *Cedar* can offer by way of noise reduction, at what price and to whom, varies depending on who you talk to and when. Rash, unkept promises on price and availability have turned potential customers to the competition. There have been bursts of publicity but no clear policy on PR. I never received any information until I asked for it. And then I had to ask many times of many people over a period of months. More than 4 weeks after being promised one, I was still waiting for a cassette recording to demonstrate what the system can do.

The story begins at the British Institute for Recorded Sound, an archive in Kensington which was absorbed into the British Library in 1983, renamed the National Sound Archive and dosed with funds. Around 1980, technical staff at the BIRS saw how NSA was cleaning up pictures from space with digital processing and wondered if the same could be done with their old recordings.

Many of the archive's recordings have come from libraries, and are badly worn; others are cracked and broken or physically decaying.

The BIRS talked to Martin Jones of Neve, then working on a digital mixing desk for recording studios to use with digital recorders, to become the DSP. Jones thought the clean-up idea was "possible".

In 1983 Dr Christopher Roads was appointed

director of the new NSA. Those who have met, or worked with Dr Roads, agree that he is a persuasive talker, with an impressive technical vocabulary. He does not waste time on false modesty when recapping his past achievements.

After getting a history doctorate at Cambridge, Dr Roads joined the Imperial War Museum in 1962 and helped computer company ICT (now ICL) design a system for computerising the War Museum records.

"I was the first person to introduce computerised archives," says Roads.

He also worked on the preservation of old nitrate film, making the existing test procedure "into a useful test".

In 1979, after "pushing frontiers in many directions" he left the War Museum and spent 5 years in audio/video archive consultancy before taking the NSA job in 1983.

As Roads puts it, he felt he was right for that job because of his "excessively technological oriented background".

He negotiated with the MCPS (Mechanical Copyright Protection Society) to create the National Discography, a computerised database of all sound recordings, past, present and future.

The MCPS here fills in the details. The idea for a national discography came from Godfrey Rust when he worked for Gallup. Rust organised an industry roundtable and one of the organisations present, the PRS (Performing Rights Society) recommended that the MCPS be involved. All other organisations, except the NSA, failed to put their money where their interest had been.

The MCPS created a wholly owned subsidiary, National Discography Ltd, into which the British Library puts funds. Dr Christopher Roads is one of the non-executive, unpaid, directors. So, as well as being director of the National Sound Archive, Roads is now a director of National Discography Ltd. The database, he admits, is now costing "more to create than expected" with 30 discographers needed to enter details of both past

and present recordings.

When Roads took the job at the NSA, he immediately saw (or more accurately heard) the "appalling quality" of some of the NSA's stock, often LPs thrown out by local libraries. When asked by the British Library, Roads specified that he wished to concentrate on "restoration".

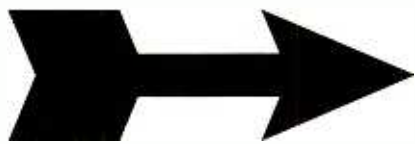
His initial move was to order one of the first DSP desks from Neve, at around £75,000. The desk was to control digital dubbing from old discs to digital code on Beta video tape. Staff at the NSA questioned the wisdom of purchasing a digital mixing desk, believing that a £5,000 analogue desk would have done the same job. When delivered to the NSA in November 1985, the DSP also had a switch facility for 'scratch reduction', to be implemented when software was ready. Neve were intending to provide the software, tailored to requirements but the scheme was abandoned. To this day the desk switch remains inoperative.

Last year, 1989, word in the audio industry went out that the NSA's DSP desk was for sale.

Dr Roads confirms that the desk is for sale "to raise money for other projects". He believes that the NSA did well out of his decision not to enter into the costly maintenance contract Neve was offering.

"After 6 months testing when it was installed," says Roads, "we ended up with a very reliable desk, which has cost us only a few hundred pounds since then. We have done well from the gamble."

Neve still provides technical support for DSPs (the BBC, WDR and ORF all have them) and Tape One were on the point of buying the NSA desk for a figure believed to be £22,500. Bill Foster pulled out of the deal when he discovered that there would be difficulty over modifying the desk to suit Tape One's requirements—mastering CDs. The NSA desk has no insert points at which signals can be injected into or tapped from, the main digital bus. Tape One were told that the



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The original system used 12 bit converters but was later upgraded to 16 bit working. The original prototype took over 10 hours to process a 3 minute recording. Cedar claims that since the end of 1989 it has been able to process for hiss-reduction in 'realtime'

software could not be modified to provide inserts because Neve's original source or core software had been corrupted.

But Mike Woodley of Neve says this is not so. Neve still has the original source or core software and has supplied it to a third party contract house. But, says Woodley, the desk is really suitable only for the purpose for which it was custom-designed. Hence it remains with the NSA.

Dr Martin Jones has long since left Neve. Siemens have since bought the company. Few people now working with Neve were around at the time of the NSA design. Dr Roads explains

why there was never a working button for 'scratch reduction'.

Neve, he says, found the project "too much for them" and Siemens were not interested. So,

Martin Jones suggested that the NSA should talk to Dr Peter Rayner at Cambridge University's Engineering Department. Rayner advised that the noise reduction process should be built as a standalone system, not part of a mixing desk. Roads came round to the new way of thinking. The British Library funded the research.

It took about a year for the Cambridge researchers to get a meaningful result. Their first achievement was to remove the clicks from a broken record, which had been stuck together. The next step was to remove the 'frying' sound from old 78 shellac discs. The snag was that the system stripped out some HF music information as well. But it looked as if the researchers were on the right track.

The first public demonstration of a working prototype of *Cedar*, was given at an archival exhibition in West Berlin in May 1986. The NSA left the exhibition with a list of potential customers. Publicity material put out by the NSA promised a "low cost digital signal processing package" which "exploits existing IBM PC technology".

A conventional IBM clone PC was hooked to additional magnetic hard disks. The analogue original was converted into digital code, stored on disk and chunks sucked into memory and processed to reduce noise before being shunted back to the disk. Hence the name *Cedar*—Computer Enhanced Digital Audio Restoration. The original system used 12 bit converters but was later upgraded to 16 bit working. The original prototype took over 10 hrs to process a 3 min recording.

As the NSA reminded potential customers, anyone with *Cedar* software on a house computer could just leave it cooking overnight, when computer time is more readily available.

It was this promise of a low cost, overnight system that excited producers working on tight budgets. A price of around £500 for the software was bandied around at a Berlin symposium in May 1987.

But *Cedar* changed. By February 1989 speed had been increased to 3 mins of music per hr, the result of 50 million calculations per sec. The hardware has been updated (Dell or Compaq PCs, with 386 chips, are used with large capacity hard disks and DAC boards). But it is still virtually all off-the-shelf hardware technology; the novelty is in the software, which, like *NoNoise*, seeks to distinguish noise from music.

Cedar now claims that since the end of 1989 it has been able to process for hiss-reduction in "realtime". You feed a sound signal in, twiddle knobs and listen for a min or 2 then start again and make a digital dub of the processed signal. So it takes 3 mins to remove the hiss from 3 mins of music.

The target is to achieve scratch and click removal in realtime by May 1990. Removing hiss and scratches and clicks all at the same time is not yet possible—you must get rid of the scratches and clicks first, which takes around 8x realtime.

With his customary impressive turn of phrase, Roads talks of *Cedar*'s "algorithmic armoury" and



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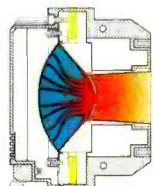
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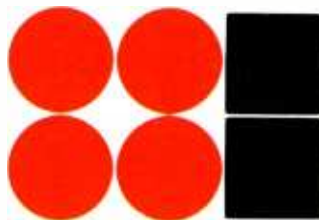
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Engineers who have heard Cedarised material are impressed by its ability to remove clicks and cracks from 78 shellac discs but less impressed by the hiss reduction. As always, the difficulty is in separating noise from low level reverberation

promises "algorithms to remove distortion and perhaps even enhance picture images".

Robert Parker, famous for his old-but-clean jazz record BBC broadcasts and BBC record releases, visited Cambridge around 2 years ago and was quoted £6,000 for the full hardware/software system. Later Parker was told the price had risen to £30,000. But he was still interested in buying. Early this year, 1990, Dr Roads told me that the target selling price was "under £100,000". Cedar Audio's office in Cambridge had just said that the "price of a Cedar processing system is currently about £13,000". It's all very puzzling.

In any case, in the late autumn of 1988, the plan to sell the software had been dropped altogether. Instead, music producers would be offered a bureau service with payment by track or on a royalty basis. Also, although the original idea for Cedar came from the NSA, and the NSA's early publicity material talked of developing Cedar in collaboration with others, the NSA subsequently lost the right to use the technology unless it pays for it.

When Neve dropped out of the picture, the NSA looked for another manufacturing partner. The NSA tied up for 2 years with Cambridge Electronic Design. Production difficulties with the digital converter boards slowed progress. Early in 1987 CED opted out. Dr Roads believed that the future of Cedar lay with a privatised company. In 1987 he went to communications giant Cable and Wireless. Roads knew people in C and W from early days of running a hobby group on marine biology in the Middle East; the group had been a tenant in C and W's building in Port Sudan and Roads had lunched with C and W's managers. C and W saw the Cedar system as a way of enhancing sound quality, for instance on broadcast phone-in programmes.

Roads joined with C and W to create a company called Audio Video Text Communications. C and W put £125,000 into AVTC and has a long term plan to use C and W's fibre optic links for distributing audio signals round the world. According to this plan, the audio signals will be sourced from optical disc stores of old recorded material. And Roads' plan for the NSA is to transfer old records to optical disc format.

Roads tells how he had previously been working on a deal with Madame Marcos to build a factory for optical technology in the Philippines. The British Library would like it known that they knew nothing of this.

When the industry started to worry about the life of optical discs, the Research and Development Department of the British Library set up a committee to test the life of discs, with the help of Plasmon, a British/American manufacturer of optical blanks. There is clearly no sense in embarking on a project to transfer old recordings to optical format, if the optical discs may degrade with time.

The discs under test are 13 cm computer optical discs (not 12 cm CDs). There are two types under test for longevity, which Roads refers to as "plated" and "spluttered". If it were not for the fact that he spelt the word out to me I would

have supposed he was referring to the standard deposition technique of "sputtering".

Dr Roads says that first results of the tests suggest that disc life will be "more likely millennia than centuries". When will the results be made public?

"When we have got an impeccable package," says Roads.

The company AVTC is jointly owned by the British Library and Cable and Wireless; AVTC owns 85% of the Cedar company, the other 15% is split between Peter Rayner and Cambridge University. This leaves Dr Roads as a director of Cedar Audio (he describes himself as *de facto* executive director but the BL rejects this), as director of AVTC and as director of the NSA.

The work on the Cedar system continues at Cambridge, where five people are employed by Cedar Audio Ltd. The company were unhappy about their downmarket premises and the image created for potential customers. The staff were due to move into new premises by Spring 1990. Perhaps then Cedar will improve its line of communication with the audio industry and press.

What happens next

So who is using the system and how well does it work? The latter question is vitally important because Roads' plan is for the NSA to start transferring old recordings onto optical discs this year and (although the original recordings will be kept for as long as they last) to "Cedarise" the sound before storage. The obvious snag is that any imperfections in the Cedar system will be frozen into the optical archive copy.

Dr Roads says he hopes to make money out of the NSA's archive by selling cleaned up copies back to record companies for re-release and to broadcast stations for storage and transmission. But clearly, if the Cedarised optical archive copy is ever judged imperfect because the Cedar system has in the interim been improved or discredited, the record companies and broadcasters may reject the NSA's stored material. The whole scheme then comes tumbling down like a pack of cards.

Engineers who have heard Cedarised material are impressed by its ability to remove clicks and cracks from 78 shellac discs but less impressed by the hiss reduction. As always, the difficulty is in separating noise from low level reverberation.

It seems odd, bearing in mind Dr Roads' original intention to restore the NSA's material (often ex-library LPs), that Cedar's first software was targeted on shellac 78 rpm noise. Some

potential customers (eg radio record libraries) wanted to clean up old vinyl LPs, worn and damaged by broadcast station disc jockeys, producers and office staff. Software to clear the 'ground-in noise' you get from well worn LPs is now promised. But if Cedar had liaised more closely with prospective customers, the LP software might have been ready ahead of the shellac software.

Certainly if they had liaised more closely with the record industry the damaging muddle over how to market Cedar might never have happened.

Dr Roads explains why, in late 1988, the plan to sell software or hardware/software systems was scrapped: "We decided it would be folly to sell," he says. NSA were worried about people pirating the software.

The solution to piracy was seen as a bureau service. Instead of selling the system or software, Cedar would keep the system in-house (in Cambridge) and offer a clean-up service for tapes at around £150 per track, or £1,400 for a CD master.

Precious few radio stations can afford to pay £150 per disc processed. The BBC were offered a deal on the basis of royalties paid per broadcast of processed material but turned the idea down flat because of obvious administrative problems.

The NSA started taking bureau orders in May 1989 and say several record companies have already paid for "Cedarisation". Cedar cite CBS, Nippon-Columbia (Denon), Polygram, EMI, Thames Television, Channel 4, Reader's Digest and PRT/Nixa. Cedar also cite Robert Parker as having titles in preparation for release. The bottom line was that in January 1990 the only material readily available for over the counter purchase was PRT's *Planets Suite* on Nixa-CD6013.

The inclusion of EMI and Parker in Cedar's list is especially interesting.

Robert Parker knows more than most about cleaning up old releases and the flak to be had from those who object. Currently, Parker works in the analogue domain. He feeds the analogue sound from the original source record through a bank of analogue sound processors (filters, etc) with up to 50 variable controls. The processed sound is then recorded on a Sony DAT deck and later transferred to U-matic 1630 format for CD mastering. It is, says Parker, "very laborious". A digital system could be much faster.

He says he is "rooting for Cedar" because he is not yet happy with the results obtainable from *NoNoise*. But Parker is most definitely not happy with the bureau system offered by Cedar. And he told them early on that the royalty scheme was a dead duck. No-one would fill in the forms.

Neither, warned Parker, would people with a serious interest in restoration let third parties do the restoration job for them.

"I thought it was a lunatic scheme and told them so," recalled Parker later. "People want to buy a system and use it themselves. At least Cedar have now forgotten about the royalty scheme but they have still not decided whether to sell the system or insist on the bureau idea.

Adjusting any hiss reduction system is a very subtle process. It cannot be done independently of equalisation and sound shaping. You can't divorce the processes or separate the operation, which is why the bureau system idea cannot possibly work

"Although I would use a bureau service to remove clicks or repair broken records, I certainly won't use it for hiss reduction. I want to be there when the work is done. Adjusting any hiss reduction system is a very subtle process. It cannot be done independently of equalisation and sound shaping. You can't divorce the processes or separate the operation, which is why the bureau system idea cannot possibly work. I am very cross about this. I have seen the idea degenerate from a simple low cost system, costing around £10,000.

"Cedar are following the wrong path and piracy is not the problem. You can keep up revenue, by selling software updates. Apart from anything else the bureau idea is uneconomic. Too many people get involved and that puts up the price."

Significantly, the British Library now acknowledge that the *Cedar* project would have benefited from a partner in the record industry. This is just what staff at the NSA were arguing when the deal with Cable and Wireless was struck, after little or no consultation with audio engineers who believe they could either have raised money for a deal which left the BL in total control or done a deal with a company more closely connected with the record and music industry than the hard-headed communications monolith Cable and Wireless.

Robert Parker warns that when judging hiss reduction it is very easy for those outside the music industry to be seduced by the noise reduction effect.

"You have to forget about the technology," he says. "You must listen to the life and vitality of the performance, not the absence of hiss. When you do that, you notice subtleties, like slight compression and loss of ambience".

In late January 1990 Robert Parker confirmed that he was, as Cedar had said, indeed using *Cedar* to process four tracks. But he stresses a point that is not made clear by Cedar's publicity, namely that he is using *Cedar* only for de-clicking.

One of the four records Cedar got from Parker had been found nailed to the wall of a junk shop—the nail had gone through the shellac. The resulting crack produced a thunderous series of clicks and thumps, although the grooves were relatively unworn. Another record had been sent through the post, arriving in two pieces. Parker put them together again, with inevitable cracks and bumps. The other two tracks were vinyl pressings with heavy scratches but otherwise in mint condition.

At the end of January, Parker in Australia had received three back from Cambridge. He describes the de-clicking as "excellent" with unusable pressings made usable. But Parker goes on to say he is not yet certain that even the de-clicking process hasn't altered the sound content.

"I took the transfers for Cedar to work on from one-third of the way through my system and played the results back into the system at the same point. In this way noise reduction and equalisation were all done after the *Cedar* de-clicking. And plugging the original discs into the system produces a sweeter, albeit more noisy,

sound.

"I wonder what happens in their process?" continues Parker. "Is it 16 bit, 44.1 kHz or do they work at a lower sampling rate and maybe have a couple of extra DA/AD stages. I am beginning to suspect the latter, although I won't know for certain until I get my original transfers back from them so I can plug them into the system at the same point as the de-clicked versions. This will reveal all."

Parker reiterates his distrust of de-noising on a bureau basis.

"I continue to be very wary about the wholesale use of *Cedar* and will never use the de-noising process in its present form."

When told the NSA were considering *Cedarising* archive material before transfer to optical disc for long term storage, Parker said: "I am horrified at the thought of using *Cedar* for archival purposes."

Significantly, Kenneth Cooper, chief executive of the British Library, was prepared to go on record in February with the categorical reassurance that: "There is no policy commitment whatsoever to *Cedarise* before optical storage."

Fortunately, there is also a financial disincentive to *Cedarise* before archiving. When the private company Cedar Audio was created, the British Library's National Sound Archive lost any right to free use of the system it had originally helped create. And this, Dr Roads readily admits, has created a "ludicrous situation".

As a director of Cedar Audio Ltd, Dr Roads must stop himself as director of the NSA from using technology they helped create and want to use. More accurately, the NSA has to pay Cedar Audio to process a record, and because Cedar Audio's bureau prices are so high the NSA cannot afford to process many records.

The British Library is in an invidious position. It has invested six-figure money in the *Cedar* project and cannot burden the young company Cedar Audio by insisting it work for the NSA at cut price.

Cedar's literature claims that the system is "patented worldwide". Patenting is an expensive business and Dr Roads admits that the bill has been "horrendous". He also admits that in fact the patents are still pending, rather than granted and there is still a dialogue going on with patent office examiners around the world. This is not surprising. The heart of the *Cedar* system is the software and in many countries patent law excludes software from protection.

Usually computer software is protected by copyright, which is free. Why patent then?

"We didn't want *NoNoise* to do it our way—and we also didn't want to be barred from doing it our way by anyone else's patents," says Roads.

Here EMI enters the picture. At an early stage of the game EMI showed interest in *Cedar* and 2 years ago played around with the software. Since then there has been a long series of behind-the-scenes legal talks. These culminated, in October 1989, with an announcement that EMI had signed a deal with Cedar to use their own version of the system. Signalling a heavy legal wrangle between the two parties, everyone is very careful about what they will say about this.

"All I can say is that it was expedient to do a deal," says Dr Roads. "This means that EMI pays us for their own use and can only offer a very limited service to other clients. I can also say that the version we have licensed to EMI is the version of *Cedar* as it was 2 years ago. They will have to pay extra for any updates."

Inside the BL some sadness is now evident that a deal could not have been struck to put EMI in partnership with the NSA on *Cedar*, rather than across the table in a legal dispute.

"We can't afford to use the system ourselves. We are hoist by our own petard. It is ludicrous and not good for morale," admits Roads. "We do use the system but not anywhere near as much as we would like."

The answer?

"The Treasury should provide more money," says Roads.

The taxpayer would then be providing more for the National Sound Archive to pay for using a system which began life in the NSA and which expensive patent protection, bought by a company part-owned by the British Library, now helps prevent the British Library's Sound Archive from using without payment.

The latest twist in this extraordinary tale, is that there has very recently been a complete rethink on the policy of how to exploit the system. The clearly unworkable idea of insisting on bureau and royalty schemes has been dropped and the plan now is to go full circle back to the original idea of selling the system. But the system will now be sold only as a hardware/software package, for between £60,000 and £80,000. This puts independent producers, like Robert Parker, out of the ball game. For them Cedar is considered a hire arrangement. But Parker is based in Australia. . .

In the long term there *might* be a choice between a slow, low cost system and realtime high price processing. Hopefully it is still not too late for Cedar to get their act together with a clear marketing and pricing policy, rationalise its publicity arrangements, make A/B demonstration material available, ideally on pressed or write-once CDs, and prove its technology with comparative demonstrations of the system given to the audio press and industry engineers. Potential users might then forget the absurd confusion and original daft price promises. If not *Cedar* could end up as just another example of Britain's inability to exploit its own innovations. □

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MICROPHONES

A list of models from major microphone manufacturers introduced in the last 2 years compiled from information available to us at the time of writing

AKG

C525S hypercardioid condenser for stage use with phantom or battery powering. *C426B* stereo condenser with fully variable polar pattern and MS/LR operation. *PPC1000* slip-on polar pattern converter for the *C1000S* that changes cardioid to hypercardioid. *D905* cardioid and *D955* hypercardioid both rugged designs for stage use. *MicroMic* miniaturised condenser close miking system, the *C406* and *C407*, is a range of extremely small mics that attach to instruments, designed for studio and live use. *C406* is a hypercardioid condenser gooseneck mic with a



Beyer HM 560 headworn microphone

multifunctional snap-in bracket for optimum positioning. *C407* is an omnidirectional condenser mic designed for speech applications. *C407* is available with a phantom power adapter or a special connector for wireless use. *C747* comb condenser hypercardioid mic for studio and sound reinforcement use. *C522* cardioid condenser for ENG use.

AMS

ST250 stereo microphone. Minim Electronics manufacture B-UHJ encoder to match control unit for the *ST-250*.



Bruel & Kjaer's 4012 studio microphone

Beyer Dynamic

SHM10 gooseneck condenser. *Tour Group* series range for live use. *MCE86* lightweight pre-polarised gun mic. *SHM 20* gooseneck condenser mic range supplied in customised designs. *TG-X* live application high output microphones. *TS190* pocket radio transmitter. New versions of the tie-clip mics. *HM 560* headworn dynamic microphone with adjustable boom for vocalists. The boom mic within the *HM 560* can also be mounted to the Beyer *DT100* headphone for monitoring purposes or for live on-air broadcasting. *MC 742* stereo condenser mic with remote control and power supply *MSG 740 N*.

Bruel & Kjaer

4011 pre-polarised cardioid. New series *4012* pre-polarised condenser with a first order cardioid directional pattern powered from the B&K 2-channel power supply *2812*. B&K have also joined forces with Panasonic to produce a portable R-DAT recording system featuring a Panasonic *SV-55* portable DAT recorder and two B&K *4006* omnidirectional mics with stereo mount and *UA-0777* nose cones. The *5930* head & torso simulator has been designed specifically for binaural and stereo recordings. The simulator consists of a mannequin known as *HATS*, with mathematically-describable surfaces replicating the geometry of a median adult head and torso. The mannequin is fitted with two phase matched, B&K *4006* studio microphones mounted in the ears of the dummy head.

Crown

SASS-P PZM mic and the *SASS-B* stereo boundary mount for two Bruel & Kjaer *4006* mics fitted with the *UA 0777* nose cones. The *SASS-P* is designed to give highly localised stereo imaging for loudspeaker reproduction for such applications

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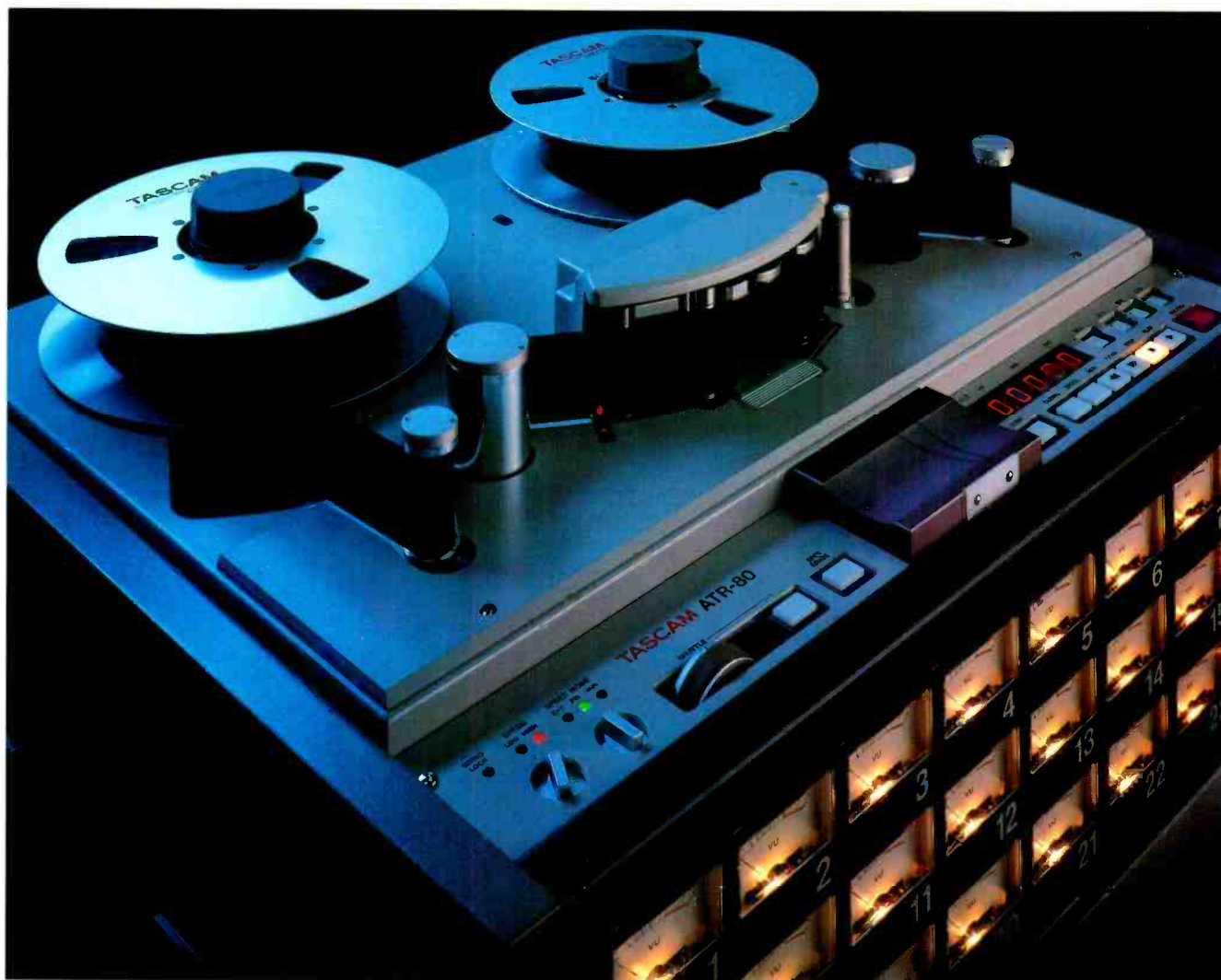
Audio Professional SA.
New address for contact:
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Francisco Tarrega, 11,
08027 Barcelona,
SPAIN.
Tel: (93) 340 2504

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116 24 Stockholm,
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Tel: (08) 743 0750

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Neumann GFM132 boundary layer microphone

as classical recording, film and TV sound or location recording where the soundfield must match the physical spacing of the sound sources rather than provide a stereo 'wash'. The SASS-P can be phantom powered or by two 9 V batteries. Its boundary mount has similar specifications to the SASS-P but is recommended for applications requiring extreme low noise.

E-V

Electro-Voice have added three new mics to their PL range using Neodymium technology. The PL950-N/D is cardioid, PL60-N/D supercardioid and the PL70-N/D hypercardioid with the PL60 and 70 incorporating humbucking coils for electrical noise cancellations. E-V have introduced the N/DYM series II line of dynamic mics. Features vibration isolation system employing E-V's new DynaDamp low-Q elastomeric material.

Fostex

M11RP unidirectional; M22RP MS stereo with 'printed ribbon' elements; M33RP triple layer windscreen waterproof microphone for outdoor use; M44RP with 3-step selector for matching equalisation; M77RP unidirectional for bass and bass drums; M88RP bidirectional type for speech.

Milab

D-37 robust dynamic; BM-75 condenser design with switchable pads for stage applications; VM-44 transformerless condenser with cardioid pattern includes a 12 dB switchable pre-attenuation pad; DC-96B condenser cardioid; LC-25 condenser cardioid; LC-28 condenser cardioid transformerless; VIP-50 transformerless condenser with variable patterns.

Neumann

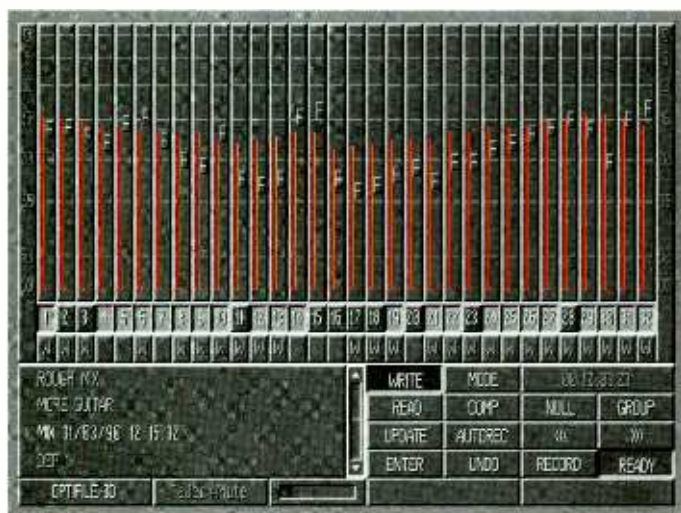
KM100 active capsule design miniature condenser system. RSM190i stereo transformerless short shotgun with built in MS/LR matrix. GFM132 new design boundary layer microphone with transformerless active capsule.



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Pearl

CC30 cardioid transformerless with rectangular double membrane capsule for studio applications. TL-4 studio microphone features a double membrane system with two amplifiers. MS2/MS8 are stereo condenser microphones, the MS2 with an MS matrix built into the microphone body, both microphones produce mid and side signals. TL6 cardioid. MD 87 dynamic cardioid range consisting of MD 87, MD 87S with on/off switch, MD 87H with acoustic bypass filter, and MD 87SH with switch and filter. PA 54 condenser cardioid transformerless mic.

Peavey

PVM 535N lightweight cardioid designed for vocal use.





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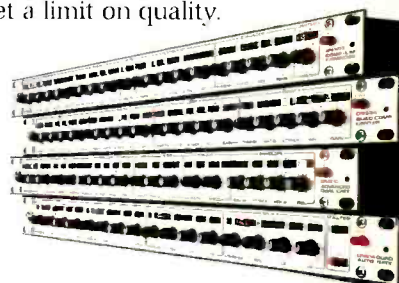
Most importantly, it delivers all the clean, quiet sound quality and reliability you'd expect from Klark-Teknik.

The same high standards are common to all Series 500 products — from the compact DN504 Quad Compressor/Limiter, to the flexible DN510 Dual MIDI Noise Gate and DN514 Quad Auto Gate.

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Milab's range of microphones

Sanken

CU-44X transformerless dual-capsule version of the *CU-41* condenser. *CMS-9* portable stereo cardioid mic available in MS and LR formats. Super-small lavalier microphones in either tube case. *COS-11*, or flat case, *COS-12* (as yet unavailable). The flat type microphone uses a more conventional round diaphragm and backplate but provides similar specification and performance.

Schoeps

VMS 52 UB stereo microphone preamplifier incorporates an MS matrix and 48 V phantom powering.

Shure

Beta 57/58 supercardioid dynamic microphones developed from *SM57/58*, *55SHII* redesign of classic *55* series *UNIDYNE II* mics. *SM99* supercardioid miniature gooseneck condenser. *VP88* one-point stereo condenser microphone offering true MS stereo, designed for pro stereo applications in ENG, A/V and studio broadcasting. □

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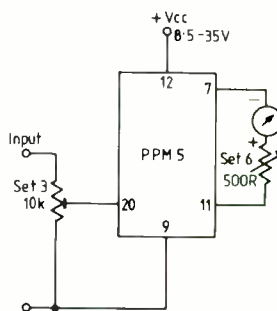
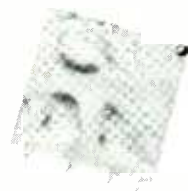
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WA 98103. Tel: (206) 633-1956.
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Europe: Electro-Voice SA, Mark IV Industries, Keltenstrasse 5. CH-2563, Ipsach, Switzerland. Tel: (032) 51 6833. Fax: (032) 51 1221.
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The exhibits were very attractive. The manufacturers had spent tens of thousands of dollars to convey to potential buyers the importance and creative impact of these, their best digital audio products yet. This was 'The' professional audio show of the year and the improved product lines would be given the best venue possible. The carpeting in the booths was so thick that one could almost lie down and take a nap on it. The various sales staff were wearing expensive suits—most Italian cut, if not actually Italian in origin. In one particular booth emphasising digital audio editing workstations, good quality white wine was being offered as well as a range of French and Italian cheeses from gorgonzola to brie with English water biscuits on the side.

There were several well-dressed customers in the booth chatting with the sales staff when the two young people came into the booth. The young man was dressed in blue jeans, a white dress shirt, tie and a blue sweater vest. His loafers were well polished. His lady friend wore a black peasant skirt over suede boots with a loose white peasant top. Her hair was nicely styled and she wore light make-up and lipstick. The boy sat down at the editing position of the largest workstation. He picked up the manual chained to the console and started to read it. After a time, he succeeded in firing up the unit and asked his friend to attract the attention of one of the sales staff. It was clear that the sales people wanted nothing to do with the young man and the girl was ignored. She helped herself to a small plastic cup of wine and some cheese on a cracker.

Eventually, the young man achieved some sense of operability of the unit and began to use the workstation in earnest. Fifteen minutes went by and the young man appeared to be quite excited about the things he was doing. The booth cleared out and the gentleman who was the obvious leader of the sales staff walked over to the two young people. The sales person looked disdainfully at the young man's badge and clearly asked the two young people to leave the booth. The two complied without hesitation.

If someone had walked over to the two young people and asked them what had happened, they would be told that the students had been asked to leave yet again, since they were 'keeping other customers from using the equipment', and 'eating our food'. The bottom line was that since they were students they would not be buying equipment and should not take up space for those who would. The students offered the fact that at least here, they had been treated with respect and civility, which was more than they could say about some booths where they had been ejected with little waste of motion. The students responded by saying that they felt at the show the same way a homeless person might feel at a society ball. Curious. Very curious.

Well, boys and girls and ladies and gentlemen of the world audio industry. What do we have here? Another one of 'Mother' Polon's famous fairy tales? Sadly, we have a compiled scenario representing actual experiences of audio

Martin Polon

Our US columnist says the youth of today are the experts of tomorrow

students at booths in several different audio shows over the last year. It seems that it is a long term practice in the audio industry for some vendors to give the elbow to college students as 'tyre kickers'. Not that this is new. It happened to me when the Los Angeles Audio Engineering Society Convention was held at the Hollywood Roosevelt Hotel and I was a high school student. I always thought it was because I tried to bring my dinosaur inside. We rode dinosaurs then, back in the dark ages of audio with vacuum tubes.

A sales manager for a medium-sized company put it this way: "These students are nothing but trouble. I will not go so far as to call them 'tyre kickers' as some do but they rob you of house and home. They take all the literature and in multiples. If you ask them why they need 13 copies, they tell you it is for their friends back home. They'll eat any food you have around and drink your wine. I had a kid in here who picked up a quarter wheel of brie and walked off with it, munching happily. Not much I could do about it. Used cheese is not something I would serve my customers. The wine bottle I grabbed just before he tried to chug-a-lug. They also desperately need deodorant and can empty your booth of paying customers in just under 15 seconds. They sit in the demonstration positions for a half-an-hour at a time, blocking the paying customers from ever trying your products. All-in-all, they do little good and can do a great deal of harm."

This declaration does add another facet to the reception of students by the audio industry. That perceived trait is of gluttony, slobbery and sloth. Some students are probably guilty of it and far more non-students who look and act like students in the eyes of the exhibitors are equally guilty. Most students today are representing their institutions and are under competitive pressure to provide the best possible example of themselves. Students at most institutions I am familiar with or teach at, emphasise the importance of standards of dress and deportment in professional contact settings such as trade shows. Any negative reports will impact the students' standing back at home base.

Unfortunately, trade shows attract large numbers of people from local community colleges, electronics courses, musicians in struggling local bands and other audio 'groupies,' some of whose prehistoric pseudo-hippie styles and long hair fit the image of 'audio student' held by so many vendors. This despite the fact that most have nothing to do with any formal audio education programme. Nevertheless, it is wildly

inappropriate to try to label any group or jump to any kind of discriminatory conclusions. Another element clouds the overall issue of student participation in audio industry events. With over 200 schools actively involved in audio education in the Western World, the potential for even the best behaved students to overwhelm a particularly desirable exhibit does exist at most audio events.

Most students attend trade meetings and conventions 'on their own dime'. Students believe so strongly in their own future and the future of the audio industry that they frequently undergo rigorous and barely civilised conditions to attend professional meetings and conventions. They take trains and midnight 'mail' flights. They stay four together in a hotel room that wasn't big enough for one. They live on pizza and hot dogs. Their number one goal is the show and the rest of it is accepted as a 'price to pay'. It is probably acceptable to realise that, contrary to vendor opinion, most students are not just 'a bunch of rich spoiled brats'. Most audio students are from middle class families and can barely pay their tuition, student fees and living expenses.

A 4 year student described his effort at showgoing during a recent AES Convention: "We took the train down because it was the cheapest—especially if we travelled before 7am and after 6pm. That meant we left the campus at 5am to catch the 6.30am Amtrak to New York. The food on the train was really awful. We got into the Pennsylvania Station at 11.04am. We decided to walk since their were no cabs and the show had started. We walked in the rain for 20 blocks to the Hilton. Once there, we stowed our bags behind some curtains and went to the papers and workshops. That night we checked into our hotel several blocks away. We had a tiny room for the four of us. We went out to eat and discovered Ray's Pizza. We ate there every night. By hook and by crook, each of us spent only about \$225 for transportation, three nights and the show."

One could ask why the faculty do not monitor their students at the trade shows; especially when untoward behaviour by a few sours the exhibitors on the many. Unfortunately, the same vow of poverty expressed for the students could be quoted for many an audio school faculty. Stated one, "I only have a \$1,200 travel budget. Professionally, academic survival being what it is, I have to go to the Music Industry Educators Conference (MELA) and to the National Association of Schools of Music (NASM). There is just no money left for AES or NAMM. Worse, all the recent budget cuts that are plaguing higher education have reduced the availability of existing travel funds. But I can't go to New York and find a room for less than \$150 per night. Airfare is over \$200 round trip. With cabs and food, I cannot do a big city trade show for less than \$1,000. Under the new tax laws, I don't get any more than a 10% effective deduction. I just can't go."

In addition, the concept of *in loco parentis* which gave school officials control of their students in place of the student's parents, has been adjudged invalid—especially off the campus premises. For any number of good reasons, the students are on their own.

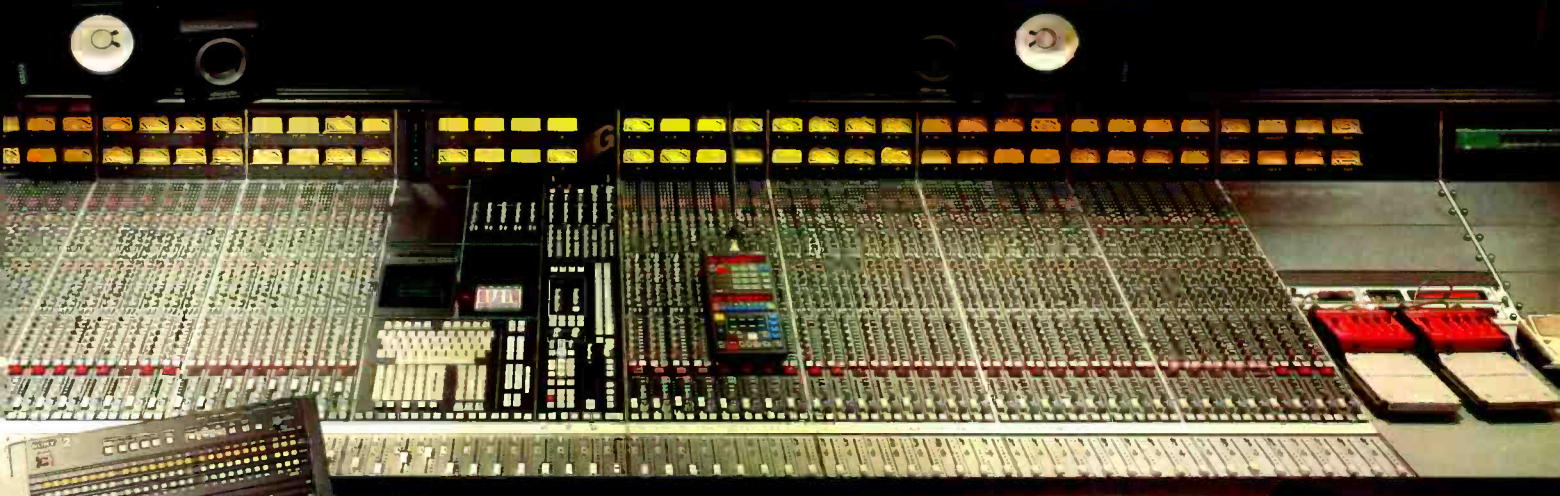
Spring '90

Solid State Logic

G Series Console for 'Studio of the Year'



Worldwide Sales
Success for
ScreenSound
(page 5)



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'Studio Of The Year' Chooses G Series Console

Mix Magazine's 'Studio of the Year', Power Station has installed a modified SL 4072 G Series console with Total Recall™ as the centrepiece of its new audio-for-video mixing suite.

The New York-based studio is co-owned by Tony Bongiovi, who has 50 gold and platinum records to his name. He has worked with artists ranging from Jimi Hendrix and Bon Jovi, to Talking Heads and Gloria Gaynor. Power Station's facilities have also been used for scoring the hit movies *Lethal Weapon*, *The Snowman* and *The Right Stuff*.

The suite features all the facilities needed for mixing audio to video and boasts a wide range of analogue and digital tape machines, projection video monitoring, and custom designed surround sound speakers.

Most of the 72 inputs on the console will be used for effects access. The concept behind the room is to offer a 'self-contained' operation ranging from music recording to dialogue replacement. The equipment is also intended to capitalise on the developing HDTV (High Definition Television) market.

Tony Bongiovi explains that the new room has been designed to fit in with the working methods of a wide variety of clients, ranging from advertising directors producing TV commercials, to



▲ Bob Walters (left), President of Power Station and Ed Evans, Chief Engineer

rock musicians remixing a single to picture on screen. Bob Walters, Power Station President, adds, "The SSL G Series was absolutely the best console to choose for this application. We wouldn't have considered anything else."

"Clean Musical Sound" for Take One

Los Angeles studio Take One has been used for mixing by a wide variety of bands - including Guns'n'Roses, Heart, and Was (Not Was). In response to client demands, Take One has upgraded its facilities with an SL 4000 console.

President Steve Smith says, "The room is so beautiful it seemed a waste not to have a top console in it. The SSL is perfect for our needs - especially since we plan to expand into more audio-for-video post-production work."

Examples of post work carried out at Take One during the last year include three US 'Movies of the Week': *Naked Lie*, *The Prize Pulitzer*, and *Blind Witness* which starred Victoria Principal.

Steve Smith has also worked on the Roy Orbison/k.d. Lang duet *Can't Buy Me Love*, as well as tracks from Billy Idol's latest album.

"The room is finally living up to its sonic potential," says Smith. "The console has an amazingly clean, musical sound."

SL 4000 G For Kiva's 'Sonic Neutrality' Room



◀ The SL 4000 G Series in Kiva's Tom Hidley designed room

Memphis studio Kiva has added a specially designed SSL room to its facilities.

Leading studio acoustician Tom Hidley was called in to implement his 'sonic neutrality' design concept which aims to create an undistorted three-dimensional quality of sound. The installation features a 56 channel SL 4000 G Series, fitted with G Series Studio Computer and Total Recall™, in the 24 Hz room.

Studio owner Gary Belz is delighted with the result. "We are confident that the combination of Tom Hidley's brilliant sounding design and the very best equipment will make this room the busiest in Memphis and will lead to major growth in the Memphis recording scene."

Other acclaimed Tom Hidley designs include Masterfonics in Nashville, equipped with a 48 channel SL 4064 E Series; and the 20 Hz Nomis studio in London, which boasts an SL 4064 G Series desk.

"You should be able to hear the three-dimensional soundfield without any discolouration," Hidley insists. "And when you make an adjustment on the console, the difference should be immediately apparent." The SL 4000 G Series is the only top quality console compatible with Hidley's design requirements. With a profile of only 26 inches, it is also one of the slimmest available.

Memphis is famous for its association with Elvis Presley, and for its original brand of R & B music. More recently the city has gained a reputation for recording pop and R & B hits. Kiva has built up an extensive client list, and was the site of some of the recording sessions for the Jerry Lee Lewis film *Great Balls of Fire*.

Battery Companion Studio Opens In New York

Last Autumn saw the opening of the New York companion to London's well known Battery Studios. The New York studio's state-of-the-art decor and layout is complemented by the installation of a 64 channel SL 4000 G Series console with G Series Studio Computer and Total Recall™.

Dream Hire, Battery's affiliate equipment hire service, is conveniently located downstairs in the same building.

Battery Studios, London, is an established SSL studio attracting a range of artists and bands to its three SSL equipped rooms. The facility's consoles include an SL 6056 E Series (Studio 1), an SL 4040 E Series (Studio 3) and an SL 4056 E Series, fitted with G Series Studio Computer and Total Recall™, (Studio 4).

Bob Mallett, Studio Manager, is pleased with the performance of the desks. "We are looking forward to a busy Spring. Artists using the studio include Bryan Adams, Iron Maiden and The Men They Couldn't Hang. We are adding a further eight channels to our SL 4056 E Series, and are continually upgrading the facilities here."



▲ SL 4000 G Series in Battery Studios, New York

Leading Producers Insist On SSL

Pieter Riebeek, Owner/Manager of Studio 150 in Amsterdam, faced a difficult dilemma when he came within reach of a six month 'lock out' booking from heavy metal band Def Leppard. The band were planning an album project and, while Def

Leppard favoured the idea of booking time at Studio 150 because of its city centre location, they and their production team insisted on an SSL to record and mix the new album.

"Technicians want to use an SSL," explained Riebeek. "They want the sound quality these consoles provide, and in the case of Def Leppard, Mike Shipley was familiar with the board and would not consider using an alternative."

Riebeek decided to take the plunge and ordered a 32 channel SL 4000 console. The desk was installed and commissioned in record time, and Def Leppard moved in for their six month stint.

Since the SSL installation, Studio 150 has been thriving. Following its inauguration the console has been used by a variety of clients, including Samantha Fox and Johnny Hates Jazz, who appreciate the studio's location - and the availability of the SSL console.

The installation of the SL 4000 has given Studio 150 another advantage - it is taking on an increasing number of post-production projects. Riebeek has recently received an audio post booking for 39 episodes of Holland's popular soap opera, *Medical Centre West*.

"We are delighted with the SSL," he commented. "The difficult situation has worked out better than we could have imagined. Since installing the SL 4000, Studio 150 has not looked back."



▲ Studio 150, Amsterdam - an SL 4000 for Def Leppard

EMI Expands Global Network of SSL Rooms

One of Germany's foremost recording facilities, EMI Cologne, is installing an SL 4056 G Series console with Total Recall™ in a new re-mix room as part of a major upgrade.

Ken Townsend, Studio Manager at London's Abbey Road Studios, and General Manager of EMI recording studios worldwide, comments on the Cologne installation. "The choice of a Solid State Logic desk was influenced by our studio users. This is the console they want to use and it was up to us to provide it."

One of the first artists to work in the new room will be Herbert Grönemeyer, one of Germany's most popular singers.

"The SSL G Series is the best known console there is," says General Manager of EMI Cologne, Ernst Rothe. "A number of prominent freelance engineers - people who will be using the re-mix room - have worked extensively with SSLs, and want to work on a desk with which they are familiar. Another main influence in choosing SSL was the fact that we like the G Series design and automation."

Other EMI recording studios worldwide with SL 4000 Series consoles include Abbey Road Studios, London; Pathé Marconi, Paris; Studios 301, Sydney, Australia; EMI Studios, Johanneshov, Sweden and EMI Hong Kong.

Universal Installs SL 5000 M Film Console in Hitchcock Theatre

Hollywood film giant, Universal City Studios, has installed an SL 5000 M Series post-production console as part of its recent Alfred Hitchcock Theatre renovation. The SL 55128 M has 80 inputs and accommodates three operators. It is fitted with SSL's Instant Reset™ system.

Like all SL 5000 M Series consoles, the new Universal desk is highly customised. "Basically, we needed a console with a tremendous amount of inputs that also had a considerable amount of flexibility built-in, so that any of the three frames could feed a given combination of recorders," explains Universal's Chief Engineer, Doc Goldstein.

The resulting design features 80 individual channels, though each fader consists of two separate inputs and submixers. "The more inputs the less pre-dubbing you have to do, which means you retain a lot of flexibility in the final dub," explains Goldstein.

Universal's console was delivered nine months after the design was completed. Just 17 days later it was up and running, working on a dub for Sidney Poitier's new film *Ghost Dad*, which stars Bill Cosby.

The advantages of the SL 5000 M Series system have become increasingly clear to the Universal technicians. "The console's redundant power supply keeps the mix moving, even in case of power cuts. The soundmixers have raved about the EQ sound. And, considering its complexity, the console has been almost maintenance free," says Goldstein.

Film Console for 20th Century Fox

Leading film production company 20th Century Fox has placed an order for one of the largest Solid State Logic consoles ever assembled for film sound.

The SL 5000 M Series console has 80 channels, moving faders and Total Recall™. It is configured to accommodate three operators, with master sections for effects, dialogue and music, and will be installed in the Darryl Zanuck dubbing theatre.

With this order, 20th Century Fox joins the growing ranks of film companies who have realised the benefits of the SL 5000 M post-production system. Other recent Hollywood film installations include independent facility JDH, Disney's Buena Vista Studios, and Universal City Studios.

20th Century Fox's Sound Director Don Bassman chose Solid State Logic because the SL 5000 M is, "the optimum state-of-the-art piece of equipment - especially because we want to circumvent obsolescence."

Bassman attributes the system's flexibility to its modular construction, and looks forward to the increased creative potential its operation will enable. "The console allows you to pan eight channels and handles stereo surround sound considerations," he explained. "The moviegoer will definitely notice the difference."



▲ SL 5000 M Series Film Console installed in Universal's Alfred Hitchcock Theatre

▼ SL 5000 M Series installed in Dubbing Theatre 7 at Pinewood Studios, near London



Pinewood Installs First UK SL 5000 M Series Film Console

Pinewood Studios, near London, is Britain's premier film studio, with production credits ranging from classics like *A Passage to India*, to a string of *James Bond* movies.

Pinewood recently refurbished its Dubbing Theatre 1 in a major upgrade of the studio's equipment. As a result Britain's first SL 5000 M Series film post-production console was installed.

The SL 5460 M has 60 channels and is fitted with SSL Instant Reset™. It has three operator positions and features programmable joystick film panning and a G Series Studio Computer.

Graham Hartstone, Head of Post-Production at Pinewood, is impressed with SSL's console specification process. "The ability to configure the layout of the SSL console to meet our requirements exactly was a positive advantage. Pinewood offers a unique facility for film dubbing in Europe. The addition of our new SL 5000 M Series will give us a creative edge."

Orders for SL 5000 M film consoles have been placed by other prestigious UK film production companies, including Elstree Studios and Roger Cherrill's.

Worldwide ScreenSound Sales

ScreenSound is now firmly established as the first choice for digital audio post-production, with sales to many leading post-production companies around the world.

The system is acclaimed by users for its machine control capabilities, full colour screen displays and ease of use.

ScreenSound is a digital audio editing, mixing and recording system for off-line video and film post-production. It provides full machine control of VTRs/VCRs and film reproducers. The simple pen and tablet control surface gives easy access to comprehensive facilities for edit and review, cross-fading and time-offset. ScreenSound's WORM optical disc system also enables the creation of a digital quality, custom effects library.

North American installations include Soundcastle/Post Modern in Los Angeles, Producer's Color Service and Image Express in Detroit and Toronto's Magnetic North.

In Europe, operators of the system include London post-production house The Mill, Ecoutezvoir in Clichy, France and the Dutch broadcasting organisation, Nederlandse Omroep Bedrijf. In Japan, Osaka-based ABC has also purchased a ScreenSound system.



▲ Buddy King, owner of Soundcastle/Post Modern, with the studio's SSL ScreenSound system

ScreenSound Posts New Spielberg Production

Post-production house, Soundcastle/Post Modern in Los Angeles became the first US ScreenSound operator last November.

Within an hour of its delivery, Soundcastle's engineers were using the ScreenSound system to edit dialogue and add sound effects and music for a new cartoon series, *Tiny Toon Adventures*, produced by Steven Spielberg for Warner Bros. The audio for all 65 shows has been post-produced using ScreenSound.

More recently, Soundcastle/Post Modern has been involved in the first ever digital ADR (automatic dialogue replacement) session to use ScreenSound. ScreenSound's instant rewind of audio and a TEAC Laserdisc's instant picture search made the whole process of re-recording dialogue faster and simpler. Soundcastle Owner-Manager Buddy King commented, "We did 44 lines of dialogue and the director saved five minutes a line."

Two of the studio's rooms are already equipped with SSL consoles and Soundcastle is now refurbishing its facilities to create a new 'digital editorial suite' based around ScreenSound.

ScreenSound Better in Direct Comparison

Post-production house Image Express has become the second Detroit-based facility to install a ScreenSound system. It joins neighbouring Producer's Color Service in choosing ScreenSound to expand existing audio-for-video equipment.

"Our selection of ScreenSound resulted from a two-year study of numerous systems. ScreenSound was chosen because both staff and customers found it easier to use," says Image Express Vice President and Senior Editor, Bill Riss. "It was a natural progression to go from digital picture editing to ScreenSound.

This way we can handle our digital audio the same way we do our digital video."

The first TV advertisements produced using the system, part of a new campaign for Chevrolet, were edited at Image Express by Agency Producer Craig McGowen. He was especially impressed by ScreenSound's flexibility and simple operation. "It is the easiest to use, and the best laid out and thought out sound device for this purpose," he commented. "I foresee the day when every advanced editor is going to have to have one of these."

ScreenSound Speeds Up Advertising Production

New York-based Soundtrack is the first East Coast ScreenSound installation, and has already used ScreenSound for a commercial, *Winter White Sale*, for America's Disney Channel.

"ScreenSound's performance was fantastic - we did 90 ads in 10 hours," explained Chief Engineer Bob Giammarco. "It lets the user interface with the mixing process, and the clients can see how things operate. It gives you the tape feel with all the benefits

of digital audio - and everything is instantly changeable and moveable."

Soundtrack is currently in the process of using ScreenSound to transfer its effects library to Optical Disc. "We are uploading as we go along," Giammarco explains. "Ultimately there will be no more need to run to the CD catalogue. It will be phenomenal."

Soundtrack is already equipped with SSL consoles, including two SL 4056 G Series and two SL 6056 E Series desks.

TVS Adds SL 5000 M Broadcast Console

Southampton-based TVS, one of Britain's leading broadcast television companies, has joined the wide range of European broadcasters which rely on SL 5000 M Series to fulfil their specialised audio needs.

TVS's new SL 5431 M Series console has 24 mono and 7 stereo channels, and is fitted with G Series Studio Computer. It also features a post-production multitrack structure, enabling it to be used for dubbing, rather than live broadcast production work.

TVS already operates two SL 6000 desks, and the SL 5000 M Series is to be installed in a new film and video dubbing suite, where it will be used for post-production on a variety of television programmes.

Mike Brooks, Project Supervisor, Planning and Installation Department at TVS, explained why the SL 5000 is the answer to TVS's very specific programme dubbing needs. "The SL 5000 M is the only console that we could configure to fit in with our post-production requirements and the way we work. It is designed

for post-production, and is not simply a modified music recording console like so many others."

Mike is particularly impressed by the desk's G Series automation. "It allows one operator to control not only the console, but a variety of machines as well."



SL 5000 M Series console for the new dubbing suite at TVS ▶

SL 5000 M Series For BBC Radio 5

The BBC's new radio network, Radio 5, will operate two new SL 5000 M Series broadcast consoles when it goes on air in Summer 1990. The choice of Solid State Logic consoles reflects the growing awareness among film and broadcast companies of the benefits SSL can provide for the highly specialised needs of post-production and live broadcast work.

Alan Stokes, Project Manager Control Room and Networks with BBC Network Radio, said, "We have chosen an SL 5440 M Series console with 8 mono and 32 stereo channels for the new Radio 5 Mixer Suite, and a smaller SL 5424 M with 6 mono and 16 stereo channels to be used for general production work in the Network Studio. Both consoles will play a significant part in the development of the Radio 5 network, whose output will include sport and education programmes."

"The larger desk will handle Radio 5's complex Outside Broadcasts," adds Stokes. "Obviously, the network's sports coverage will generate quite a few of these. The SL 5440 M Series console will also be used for special, one-off events. The SL 5424 M is intended for more general use. Both SSL desks are

designed to feed the network directly and they have the capacity to record live programmes."

Simon Shute, General Manager Operations and Engineering, BBC Network Radio, added, "We are excited at the prospect of launching Radio 5. When it goes on the air for the first time on 27 August, 1990, it will be the first new BBC radio network - and, indeed, the first new radio network in the UK - for 21 years. We welcome the advent of Radio 5, particularly as it completes the package of radio programmes the BBC offers its listeners. We will be operating a range of networks providing specific types of programmes, so listeners have a wide choice without confusion."

Shute continues, "We are delighted that Solid State Logic will be part of the new network. The BBC were influenced in their choice of SSL consoles for Radio 5 by the success of our SSL installations at Radios 3 and 4. We also have quite specialised requirements for large, on-air consoles, which SSL have been able to fulfil. We are in the process of setting up a whole new network, and we feel confident of Solid State Logic's ability to come up with the right consoles to suit our needs."

ITN Chooses SL 5000 M Series Audio Production Consoles For New Headquarters

ITN has placed an order for two SL 5000 M Series broadcast consoles as part of its major refurbishment and relocation plans for 1990. The order for the SL 5456 M Series and SL 5444 M Series desks is an example of ITN's decision to incorporate the latest broadcast automation technology into its new headquarters building in London.

Richard Stokes, Project Engineer with ITN, commented, "These consoles are our first SSLs. They will be based in two new

studios, and will be used for live news broadcasts, for which these desks are ideal. Our requirements are quite different to those of a music recording facility, for example, and we found the SSLs to be tailor-made to meet our specific on-air needs."

Richard is particularly impressed by the SL 5000's Instant Reset™ system. Instant Reset™ enables rapid changes to the desk setup - a key element for live broadcasts involving sudden alterations in programme requirements.

World Leader in Satellite Communications Turns to apt-X 100 Audio Data Compression

Long Island-based communications company LNR is a world leader in the manufacture of transmitters and receivers for satellite communications.

Recently the company has adopted the apt-X 100 audio data compression system for its satellite transmissions of digital audio. apt-X 100 is manufactured by Solid State Logic subsidiary Audio Processing Technology (APT). The apt-X 100 system offers real-time compression and retrieval of audio data, with no subjective loss of quality, and is suitable for use in low capacity, high quality transmission and storage applications. In addition to satellite transmissions it may also be used for digital audio storage, terrestrial broadcasting, Integrated Services Digital Network (ISDN) telecommunications and cable audio distribution.

APT's data compression system apt-X 100 has been successfully demonstrated in LNR's equipment, enabling the satellite transmission of digital audio of 'compact disc quality' previously unattainable within an economical data bandwidth.

O.J. Hanas, Vice President of LNR's Advanced Telecommunication Products Division, explains. "We have integrated the apt-X 100 digital audio encoding and decoding into our DAVSAT equipment and have tested the complete system extensively over both Ku-Band and C-Band satellites in real situations. In this way

we were able to demonstrate the advantages of the combined apt-X 100 and DAVSAT system to LNR's potential clients."

"Our turnkey terminals can now transmit CD-quality audio directly to another site via a digital satellite link. One of the chief applications for our equipment incorporating apt-X 100 is radio networks who need to distribute music to affiliate FM stations.

"The new system can also add value to 'back-hauling' of live concert recordings. In this situation the music is 'back-hauled' or transmitted from a remote or ill-equipped site, to a studio where it can be re-distributed and passed on for broadcast. APT technology has enabled our equipment to provide clear, uncluttered music transmissions."

"The data compression provided by apt-X 100 saves bandwidth on the satellite by reducing the data rates. Since a client must pay for the amount of satellite bandwidth used, this also saves money. Similarly, LNR's forward error correction technology saves satellite power - which also saves cost. With the combination of APT's and LNR's technologies it is possible to enhance the satellite link by at least 5 dB while utilising only half the RF bandwidth. LNR makes some of the highest-quality equipment in satellite communications. apt-X 100 ensures our equipment transmits the highest-quality digital audio".

Effanel Mobile Enjoys Continued Success – SSL Attracts Leading Producers



◀ Bob Clearmountain in the Effanel mobile

number of interesting live projects.

These include recording the Rolling Stones' Pay Per View cable television concert in Atlantic City in December. Bob Clearmountain was once more on hand to manage the live mix using Effanel's SL 4000 console.

This was also one of the first live recording situations to see the addition of SSL's new Logic FX modules to a desk. Logic FX Dual Mic Amplifier and Equalisers augmented the 40 input console, and impressed Randy Ezratty with the additional flexibility they offered. "We thought Logic FX were especially good in a mobile situation," he explained. "The fact that they have an additional mic impedance control that is not on the input module improves what we already think is the best mic preamp sound around."

Directly after the TV broadcast of the Stones' concert, the Effanel mobile headed for Los Angeles where it recorded audio for the NBC Network Special *David Letterman's Anniversary Show*. Continuing their cross-country travels, Randy Ezratty and his truck returned to the east coast and New York to work with Producer/Engineer Frank Filipetti on a live Carly Simon Special entitled *My Romance*, which was created for HBO at the New Apollo Theatre.

Other remote recording projects include The-The in Detroit with Engineer Bruce Lampchov. Ezratty commented afterwards that it was "one of the best live recordings I have ever done."

Most recently, Effanel was on the road recording sound for a film about cult American band REM. The mobile could also be seen parked outside New York's, gothic Cathedral of St. John The Divine for a recording of Zubin Mehta and the New York Philharmonic with Placido Domingo.

Since becoming the first US independent audio mobile to install an SSL console, Effanel Music has been busy with a variety of major recording projects throughout the USA, involving some of the world's top producers.

Effanel is equipped with a 40 channel SL 4000 console. Its first major success was the live broadcast of The Who's rock opera *Tommy*, recorded in Los Angeles and broadcast for TV. Handling Effanel's live mix of the concert was leading producer/mixer Bob Clearmountain.

Since the recording success of *Tommy*, Effanel Music's mobile, and its Owner Randy Ezratty, have been called in to work on a

Japan Is Growth Market For SSL

SSL Japan KK was established last April as part of the company's long-term commitment to the Japanese and Far Eastern markets.

In the period April 1989 to April 1990, a total of 30 new consoles have been installed. Some particularly notable additions include an SL 6072 G Series desk at JVC Aoyama (their 10th SSL), three identical SL 4064 G Series consoles at Tokyo Fun, an SL 5664 M Series console at Tokyo Broadcasting Systems, and an SL 4056 G Series at post-production facility, Art Plaza 1000.

Takeo Asano, Managing Director of SSL Japan, attributes the continuing growth to a combination of technological excellence and experienced service support. He explains, "Japan has long been involved in the electronics industry and the equipment chosen by Japanese studios tends to be high quality, rather than simply 'affordable'. Both these factors have been influential in making SSL systems so successful here."



▲ SSL 6000 G Series at JVC Aoyama

SSL Canada Celebrates Console Sales

SSL Canada has made recent SL 4000 console sales to Le Tube in Montreal, and Winfield Sound Studios in Toronto.

"We are making even further inroads," comments Vice President/General Manager Gerry Eschweiler. "The opening of our Toronto offices is the best evidence of SSL's complete commitment to Canadian studios."

Newly expanded, three-room studio Le Tube, in Montreal, specialises in audio-for-video, including television, film and corporate video.

Music mixing is also undertaken there. Le Tube clients include popular Canadian artists such as Paradox, Madam, and Celine Dixon.

"We went with SSL because they are the standard everywhere in the world. With the G Series software, mixes can be rebuilt in minutes. Plus, all the top engineers want to use an SSL," says Daniel Pierre-Rheault, co-owner of Le Tube.



SSL People

John B. Kilcullen has been appointed Treasurer/Controller of SSL Inc. John, who has over 19 years experience in financial management, joins SSL's New York Office from Oratronics Inc, where he served as Vice President of Finance.

Danny Mundhenk, formerly a New York-based salesman for SSL, has been promoted to Eastern Region Sales Manager. Prior to joining SSL, Danny worked as a Staff Engineer for Transcom Media in New York and at Nashville-based Bullet Recording, where he gained considerable experience mixing music, television and commercials.

Joining SSL Inc as Eastern Regional Sales Engineer is Dave Powell. Dave, whose primary responsibility is eastern US ScreenSound sales, has extensive experience of record engineering and post-production work.



▲ Danny Mundhenk, promoted to Eastern Region Sales Manager, SSL Inc

◀ CBC's SL 6000 - one of many SSL consoles recently installed in Canada

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SSL London

In order to provide improved sales and service facilities for London Studios, SSL has opened an office in Paddington.

The office offers local access for the capital's many music, broadcast and post-production facilities. London office sales are managed by Nick Cook, with service and technical support provided by Clem Marsh.

"London joins the other major recording centres of the world in having its own SSL office," says Nick. "The opening of the new office has enabled us to increase our contact with the studios and their staff, reinforcing our relationship with them, and helping us to become familiar with their current and future needs."

Now it may look like the idea here is to enlist sympathy for those who have chosen the academic path to their career in audio. That is not the point of this discussion. What is the point is for the audio industry to recognise that the audio students of today are as dedicated to learning their craft as the audio 'knockabouts' and 'apprentices' were in years past. Unfortunately, trade show attitudes towards students are but the tip of the iceberg in the litany of audio industry disinterest and downright abuse of the up and coming audio practitioners of tomorrow. At a recent AES meeting I faced a number of students from different institutions. They all asked the same question; so did my classes: "Why are we being treated so badly?"

I couldn't answer!

Few in the audio industry take the time to find out that most schools are under-funded and under assault from within and without. Most audio education programmes are at not-for-profit

2 year and 4 year institutions of higher learning. Funding for such industry-related curricula, is always dependent upon how closely the specific business supports the programmes. Unfortunately, deans and academic senates are not impressed by the relative 'hands off' attitude of the audio industry towards higher education. Critical public statements criticising audio students made by well-meaning but misinformed industry 'experts' also hurt the various programmes' in-house credibility. Without industry support, audio educators find deaf ears turned to their pleas for more funds.

No issue is more important to the schools than the ability to stay 'current' with the latest audio products for instruction. Yet the makers of audio equipment deliver little more than lip service to the audio education community.

Said one off-shore product manager in exchange for his anonymity, "We are not idiots. We know the schools are hurting for state-of-the-art systems. But we cannot afford the process of being deluged with requests from needy educational institutions. We have a financial bottom line to deliver too, and charity is not accommodated in such a relationship. Further, the Japanese parent does not understand such 'begging' and does not encourage me to condone that behaviour."

Unfortunately, such a display of attitudes is one of the reasons that very few audio students receive a digital education in the 'hands-on' domain.

This is in marked contrast to 'education and industry' attitudes involving computers or aerospace or industrial electronics. It is only at audio or broadcast shows that the pattern of abuse of students seems so definitive. In other technical industries, the continuing need for refreshing the 'manpower' pool obviates the professional and diplomatic response that students receive. Companies actually court the emerging student, both in terms of supplying up-to-date

hardware to institutions and in terms of solicitations, grants and internships for students. Professional relationships between many computer companies and their employees frequently begin while the prospective staff members are still in school. Providing technical staff to assist with instruction is an SOP (Standard Operating Procedure) in the aerospace, high-tech and computer industries. IBM frequently offers its senior staff 6 month and yearly teaching sabbaticals. How much more appropriate audio education could be with active professionals taking direct part in the instructional process.

To search for reasons behind the relatively poor response to students from the audio industry is a trifle counter-productive, since the answers are not especially flattering to the professional audio

new faces to be seen in the audio industry. It is clear that many of these folks are interested only in operating equipment without the need to 'be intimate with it'. So the nurturing of those students who are interested in hands-on audio engineering or technology seems that much more important. But the real bottom line is that today's 'tyre kickers' are tomorrow's equipment buyers—some of them are even buying today. The number of audio students who build their own home studio, either while still in college or just after, has risen to approximately 10% of the home studio market place. Therefore, on many different levels it would seem that the audio industry needs students far more than the students need the industry.

It is time for the audio industry to accept

tomorrow's audio experts and recognise their efforts today. Clearly, there are some companies in the US that do encourage and nurture students. The record in Europe and the UK is somewhat better than in

No issue is more important to the schools than the ability to stay 'current' with the latest audio products for instruction. Yet the makers of audio equipment deliver little more than lip service to the audio education community

mien. In fact, there are several forces that seem to be at work here.

First, this is the best educated entry level group ever to confront the audio industry *en masse*. These college students are the first group purpose-trained for the audio field, on top of their musicianship and liberal arts education. It appears that they intimidate some currently at work in audio. Not everyone currently employed in the audio industry trained specifically for a career in audio and in fact, many migrated from diverse fields totally foreign to audio.

Second, the professional audio industry operates with a mind set that emphasises sales of hardware today. Now. Short term. Bingo! Sales potential or employee potential from students in the future does not seem to be a strong motivator. Even surrendering a half-hour segment of time is like pulling teeth for many audio professionals, when asked for help by students trying to conduct on-the-job interviews in the audio industry.

Third, some foreign audio companies operating in America project a nonchalance about recruiting employees that seems to come from the knowledge that the parent company remains a virtually endless source of staff. Some analysts see the decline of American companies in the audio business as the root of the problem and the mark of contrast between audio and other high technology industries and attitudes. It is interesting to note that of the 44 American companies represented at the first AES show in 1949, only nine of those exhibiting at that time are still in business at all and only five of these are still involved in audio.

A crucial factor of the future of the audio industry is the relative decline in the number of students and new entrants who are interested in audio engineering and/or audio technology. There has been a shift to musicianship among many of the

the US due to close ties between the industry and the various Tonmeister programmes. To improve the reception of students across the board, the following suggestions are pertinent. It is most appropriate for the AES, APRS, BKSTS and SMPTE to consider the addition of student sessions to the various convention activities of these learned societies. Student papers from various institutions all over the map could be surveyed by committee with the various best papers being presented in a yearly session. It is equally appropriate for manufacturers to grant funds for specific research projects to various institutions. Such a process provides enhancement of the academic setting from the faculty leader as well as for those students involved with the project. Such activities frequently yield major accomplishments at a relatively small level of investment. If the process is good enough for the MOD (Ministry of Defence), the Pentagon, IBM, ATT, Philips, etc, then it should be good enough for the audio industry.

It might also be appropriate to establish travel grants for outstanding students to attend important professional meetings such as European AES and the IBC (International Broadcasting Convention). This would increase the educational value of such meetings by enabling those students most desirable to the industry to attend.

Lastly, the heretical concept of establishing a regular pattern of equipment donations to qualified institutions just might have the same kind of rebound that IBM's contributory efforts have had for the computer industry. The close involvement of the educated and the educator with high technology has been one of the 'secrets' of success for the computer, aerospace, biotechnology and defence industries. Perhaps the same magic could rub off on the audio business and these days that wouldn't hurt at all. Not one bit. □

THE GENTLE ART OF DIGITAL SQUASHING

Michael Gerzon takes us through the various methods of data compression and their feasibility for future applications

One of the problems with digital audio is the large amount of data it requires. Ignoring error-correction overheads, which can add about 30% to the data rate, the CD standard of 16 bit stereo at 44.1 kHz sampling rate transmits 1,411,200 bit/s, which is around 10 Mbytes/min or 600 Mbytes/hr.

This very high data rate uses up a lot of expensive bandwidth when broadcast, sent down telephone channels or by satellite. When stored on tape, in RAM or ROM or on hard disk, an awful lot of memory is easily used up—witness, for example, the limited sampling times available on samplers and the high cost of hard disk memory in digital editors. If one could 'compress' this data rate to, say, 4 bits/sample without losing quality, one could get practical terrestrial digital broadcasting, extra long play CDs and quadruple hard disk storage or sample memory length.

The philosopher's stone of top-quality audio in as few bits as possible has been pursued for several years, based on lower-quality systems of audio data compression developed in the 1960s for telephone network applications. Some of the current systems now claim CD-indistinguishable quality at less than 2 bits per sample, and others on the market use 4 bits per sample. Clearly this technology is a coming thing, and we can expect to see many systems become commercially available. Solid State Logic's *Apt-X 100* system (a 4 bit system) is the first of this newer generation, although earlier systems such as those of dbx, Dolby and the BBC's NICAM system have been around for some years.

To non-specialists, audio data compression appears almost akin to black magic. The technical literature describing such systems is full of esoteric technical jargon on Rate-Distortion theory, Transform Coding, Adaptive Differential Pulse Code Modulation, Entropy Coding and so forth. Since such systems are going to become commonplace, and because their use is going to require some understanding of their strengths and weaknesses, there is a crying need for a straightforward description of how they work. And the fact is, that although detailed engineering design of such systems requires a lot of theory, their basic principles are surprisingly simple and understandable.

How do these systems work, do they really give results indistinguishable from 16 bits and what advantages and disadvantages do they have?

A word of caution at the beginning. All the systems giving a large reduction in bit rate do alter the audio signal, and what comes out is not what goes in. The trick in designing a good system is twofold: to make sure that the

difference between the output and the input is as small as possible; and to design the nature of the errors in the output to be subjectively difficult to hear in the presence of the signal, ie to fool the ears by psychoacoustics into not noticing the error.

Before we get bogged down with the details let's look at systems that do not introduce any error in the output. These systems, known as entropy coding systems, use information theory to spot systematic patterns in the signal, and to rearrange the information in the signal to exploit these patterns to reduce the data rate. No information in the signal is lost by entropy coding. By entropy coding, 16 bits can typically be reduced to 13 or 14 bits. This is not a huge improvement, although a useful one. Why not, then, use entropy coding as a matter of course, since it loses no quality?

There are other disadvantages. First, the data rate depends on the input signal. A very random signal, like full-amplitude white noise, has very little systematic pattern, so can hardly be reduced in data rate at all by entropy coding. Also, entropy coding systems optimised for specific common types of pattern in audio signals are liable to *increase* the data rate if they encounter a very uncommon type of audio signal. Thus entropy coding is virtually useless for applications like broadcasting and constant-speed tape or CD recording where the data rate must be fixed in advance.

Second, by removing all the systematic patterns in the signal, errors become harder to spot and conceal, so entropy coding can only be used if the transmission channel has very good error protection. The tiniest error can cause huge changes in the output signal. The trouble is that extremely good error protection requires the transmission of extra data, partly nullifying the advantages of entropy coding.

Apart from a very modest rate reduction in one version of the Compusonics system, I know of no commercial high quality audio data rate reduction system that relies mainly on entropy coding. All systems giving a useful reduction in bit rate introduce signal errors that, hopefully, are subjectively masked by the signal itself.

Just like noise reduction

There is a strong conceptual similarity between analogue noise reduction systems and digital data compression. Indeed, using an analogue noise

reduction system around a digital channel with fewer bits (eg a Dolby SR noise reduction around a 12 bit channel) may be considered to be a system of digital data compression. However, the term 'digital data compression' is usually reserved nowadays for systems in which all the signal processing is done digitally although earlier hybrid systems of digital data rate reduction (such as the satellite transmission systems of Dolby and dbx) used digitally controlled analogue signal processing.

Behind the apparently very different terminologies and technologies, the similarities between analogue noise reduction and digital data compression are far greater than their differences.

Both types of system try to get a subjectively error- and noise-free signal from a channel that on its own would give a high noise level. Both are based on the same idea of reducing noise and error by increasing the signal level and 'spectral occupancy' (ie the range of frequencies present at a high level) of the signal so the channel is always fully modulated by the signal. The decoding that reverses the data compression or noise reduction encoding restores the original signal levels by pulling the boosted frequency components back down again, at the same time reducing the background noise level by a corresponding amount.

These principles are common to analogue noise reduction and to digital data reduction systems (other than entropy coding). The differences between the two lie in the different natures of the typical analogue channel (eg tape, FM broadcasting) the typical digital channel (eg digital tape, CD-I, ROM or hard disk storage) and, to a lesser extent, the different things that can be done most easily with analogue and digital circuitry.

The typical analogue channel suffers from an unpredictable degradation other than noise. The output of tape may fluctuate due to variations in tape coating thickness, the frequency and phase responses may have ripples and fluctuations that may vary according to the tape used, the tape machine, tape bias and head contamination. The tape medium also suffers from level- and frequency-dependent non-linear distortion and wow and flutter, as well as slight errors of tape speed. Any analogue noise reduction system must give reasonably good results in the presence of all these degradations. Additionally, when the noise reduction is applied, there is no way of knowing what the errors produced by the recording channel will be.

Digital predictability

With digital systems, on the other hand, provided error protection is doing its job (or if one is using a system such as ROM storage not subject to significant error) one can predict *exactly* at the time of coding what the errors caused by a limited number of bits will be (for example, by adding a decoder to the encoder and taking the difference of the output from the input).

This has two consequences. First, one need not design the data compression system to be subjectively tolerant of 'small' signal degradations—hopefully there will be none—which means that some of the design compromises necessary in analogue noise reduction are not necessary in digital. One can change the gain of a digital signal by 24 dB between successive moments of a signal without the risk of getting

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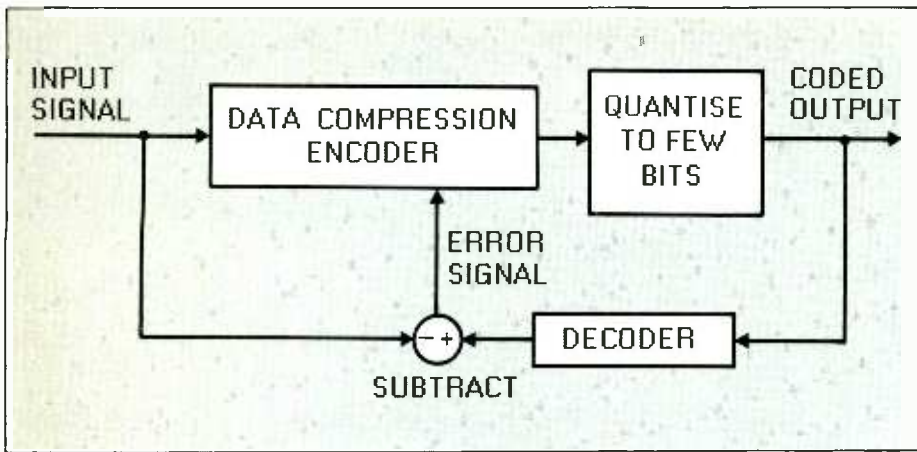


Fig 1: Feeding back the error due to coding into the encoding process to improve quality

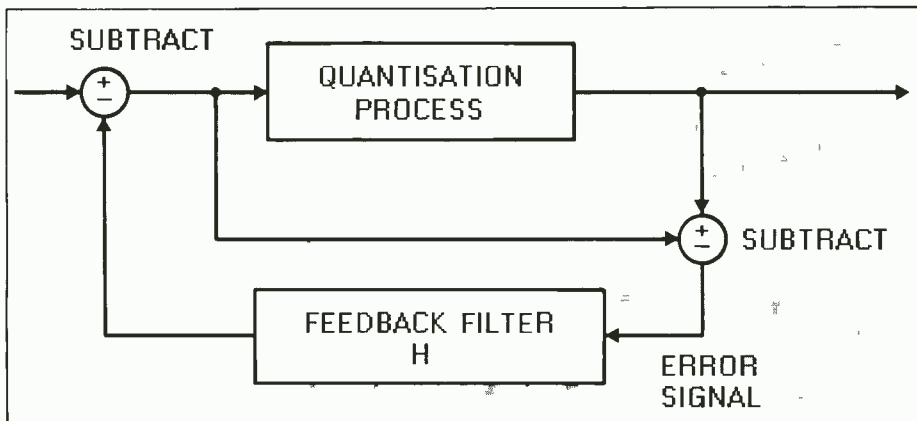


Fig 2: Noise shaping the quantisation error by negative feedback of the error via a filter

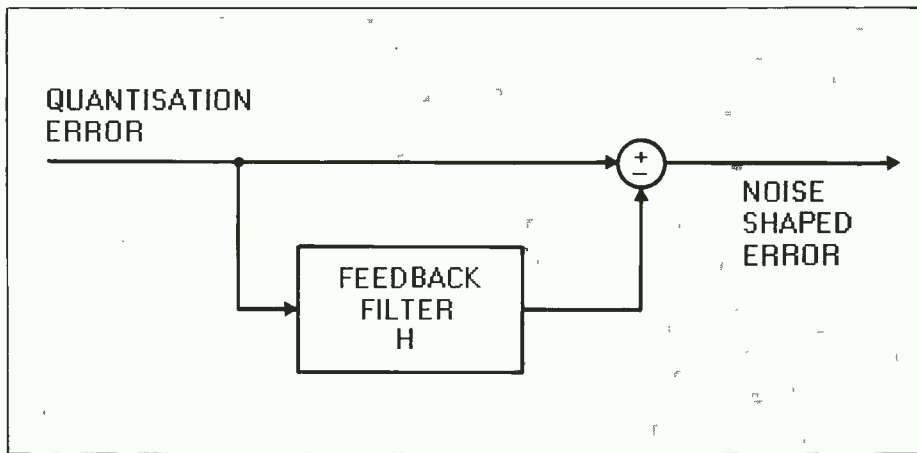


Fig 3: The effect of Fig 2 is to filter the quantisation error signal as shown here

the wrong gain, whereas with analogue signals one would risk getting huge gain errors for a short while. To avoid such mistracking in analogue noise reduction systems, it is necessary to make any gain changes fairly slow ones.

Second, one can predict at the time of encoding exactly what the ultimate error will be in the final decoded output due to the quantisation errors of using only a few bits. One can use this knowledge to modify the error to have minimum audibility by feeding the error information back into the coding process (see Fig 1). This process of feeding the coding error back into the coding process is very much the same idea as negative feedback in amplifiers to reduce distortion errors. The theory used is very similar.

These two features of digital data rate reduction mean that the 'noise reduction' achieved can be

very much more powerful for a given number of bits than for analogue noise reduction round a channel with a similar signal-to-noise ratio. A 4 bit digital channel has a signal-to-noise ratio of around 24 dB and a 4 bit digital data reduction system such as *Apt-X 100* can sound very listenable, whereas an analogue channel with a 24 dB signal-to-noise ratio would sound pretty appalling, however sophisticated an analogue noise reduction system used.

Designer mistakes

Although in principle digital is capable of much better results than analogue noise reduction, it is in practice much easier for audibly bad design mistakes to be made in a digital data compression

system if the designer is not very careful. This is due to the nature of digital signals and cheap digital signal processing. The potentially horrendous sound of 'quantisation noise' in digital systems is, by now, familiar as is the fact that this can be turned into a nice-sounding 'analogue-type' noise by adding a carefully controlled noise signal (dither) before quantising.

In digital data compression systems, after one has processed a signal to increase its level over a wide range of frequencies, at some stage one has to reduce its data rate to fit the limited data rate available in the channel used. In other words one has to quantise the signal to a fewer number of bits. This requantisation process can produce subjectively nasty side effects just like ordinary undithered quantisation. Even when some of the techniques described later are used to mask the quantisation error, it is still liable to produce subtly disturbing side effects. Possibly designers of data compression systems should investigate the use of dither when requantising the processed signal to reduce some of these potentially nasty effects. By a technique known as subtractive dither, whereby the dither noise signal added during encoding is subtracted again during decoding, it is possible to get the benefits of dither with relatively little noise increase. I know of no commercial data reduction system, however, that uses dither in the coding process.

In the absence of dither, it is still possible to improve subjective results by very careful design of the quantising process but this is still a poorly understood topic among designers, especially at the very low bit rates of some recent systems.

Signal errors

Although data compression systems vary widely, the general principle of all systems is to raise the signal to near peak level (either overall or in several separate frequency bands), so the signal-to-noise ratio is more or less constant the whole time, and then to take the signal level back down again during decoding, taking the noise down with it.

The effect of this process is that the noise level goes up and down with the signal, causing what is termed modulation noise. One can measure modulation noise by comparing how far (in dB) the error-signal level is below the wanted signal.

Modulation noise is already familiar with analogue noise reduction systems. Certain signals—notably piano—are exceptionally good at showing up modulation noise subjectively. dbx noise reduction used with poor tape channels (eg cassette tape) is well known often to produce audible modulation noise with some sounds, and personal sensitivity to this fault varies from acceptable to totally intolerable. Although no noise reduction system can totally eliminate modulation noise, they do differ markedly from each other in the degree to which they subjectively mask modulation noise.

Masking is a psychoacoustic phenomenon, whereby the presence of a low level sound in one frequency band is masked or hidden by a much higher level sound in another frequency band. In general (and with some important exceptions), low level errors in any frequency band are well masked by much higher level sounds in the same frequency band (which at mid frequencies can be 1/2- or 1/4-octave wide). The degree of masking reduces as the frequencies of the wanted high level signal and unwanted low level error get further apart. The worst case normally encountered for masking is a low frequency signal

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accompanied by a high frequency noise—in some cases, the noise has to be up to 100 dB below the signal before it becomes inaudible! In other cases, where the frequencies of signal and noise are similar, a noise well under 40 dB down can be completely masked by the signal.

The more advanced analogue noise reduction systems (such as *telcom* and Dolby) make extensive use of masking to reduce the audibility of modulation noise. They all make sure that high level, low frequency signals are not accompanied by a high level of high frequency noise. The multiband systems (*telcom*, Dolby A and Dolby SR) additionally control the precise relative levels of signal and noise in adjacent frequency bands.

The crudest digital data compression systems, like the BBC 14/10 bit NICAM system, the 16/12 bit DAT 'long-play' system and the 10/8 bit system used in Video 8 digital sound, are all wideband companding systems (analogous to systems like dbx) and so have relatively poor

masking of noise by low frequency signals. As a result, such systems have to be designed to use a relatively large number of bits, with only a modest degree of data compression, if the modulation noise is not to become too audible.

To get the most efficient noise reduction and data compression, more elaborate systems that take into account the masking properties of different frequencies and adapt to the instantaneous frequency content of a signal are necessary. There are several different ways of doing this.

ADPCM

One approach is to use a single-band system of increasing the level of signals but to vary the frequency response of the signal according to its frequency content. Thus, if a signal has very little

treble, it is encoded with the treble boosted more than the bass. On decoding, the treble content is reduced back again, taking down the level of treble noise to a point where it is masked by the bass. This, of course, is the well-known principle behind Dolby B noise reduction. The audio data compression system used on CD-I (CD-Interactive) allows a choice of four different equalisations in encoding, which may be varied as the signal varies.

In digital systems, one can predict the exact noise error at the time of encoding (as in Fig 1), so one can try to cancel out the noise error by subtracting it from the input, ie by negative feedback. Because digital systems are sampled only at discrete moments of time, such feedback can only operate if the feedback signal is delayed at least one sample. Such feedback turns out to alter the frequency spectrum of the quantisation noise. In general, this frequency spectrum can be adjusted by putting a digital filter in the feedback path as shown in Fig 2. This 'noise shaping' process can shape the frequency spectrum of the noise so that it is masked as well as possible by the frequency spectrum of the signal, possibly by varying the noise shaping from moment-to-moment to match the signal's spectrum. The effect of the filtered 'error-feedback' system of Fig 2 is not to alter the spectrum of the signal at all but to alter the spectrum of the noise by, in effect, passing the noise through the filter shown in Fig 3.

Such noise shaping is not possible in analogue systems. With digital compression, one can tinker in encoding not only with the level and frequency response of the signal, but also with the frequency spectrum of the noise. Systems doing both are capable of a lower and better-masked noise than analogue noise reduction. A digital system using equalisation and noise shaping is termed a Differential Pulse Code Modulation (DPCM) system, for historical reasons we shall not go into here. Even if the equalisation is fixed for all signals (say at a 6 dB/octave bass cut) such systems can give much better masking of noise by signals (by 20 or 30 dB) than simple near-instantaneous companding systems like NICAM.

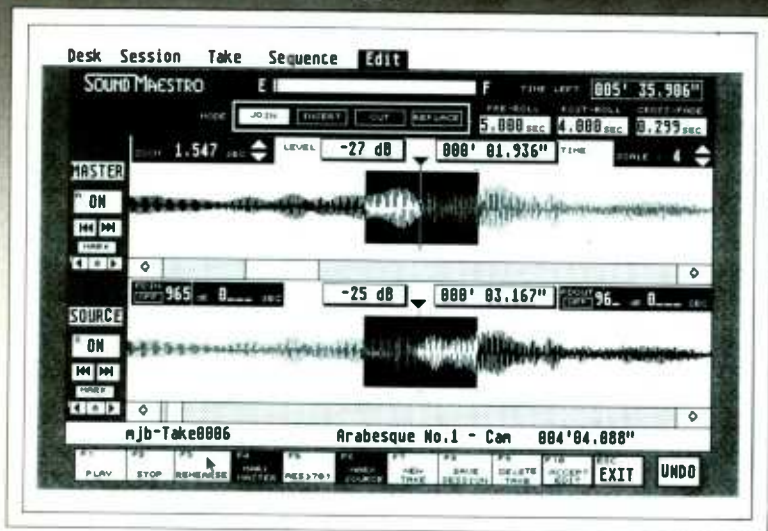
If the EQ and the noise shaping are made adaptive, ie to vary with the signal to improve masking further, the data compression system becomes known as Adaptive Differential Pulse Code Modulation (ADPCM). ADPCM was widely studied by engineers in the '60s and '70s. The data compression system on CD-I is an ADPCM system, albeit a crude one with only up to four different equalisations. The CD-I standard offers various 8 bit and 4 bit data compression options, the 4 bit options using more varieties of equalisation but having a higher modulation noise and poorer quality.

The strategy that gives the lowest objective amount of noise with ADPCM is to equalise the signal so its spectrum becomes white, and to shape the noise spectrum in such a manner that, after decoding, it becomes white. This is termed predictive coding because it attempts to predict the next sample of the signal from previous decoded samples and transmits a quantised version of the difference between the sample and its predicted value. Additional noise shaping beyond the white results of predictive coding, to maximise the subjective masking of noise by the signal, will give subjectively better results.

One special case of predictive coding is of particular interest. Many audio signals in speech and music (and in other cases such as machine noises) have periodic waveforms, ie waveforms that repeat over and over again almost exactly. If

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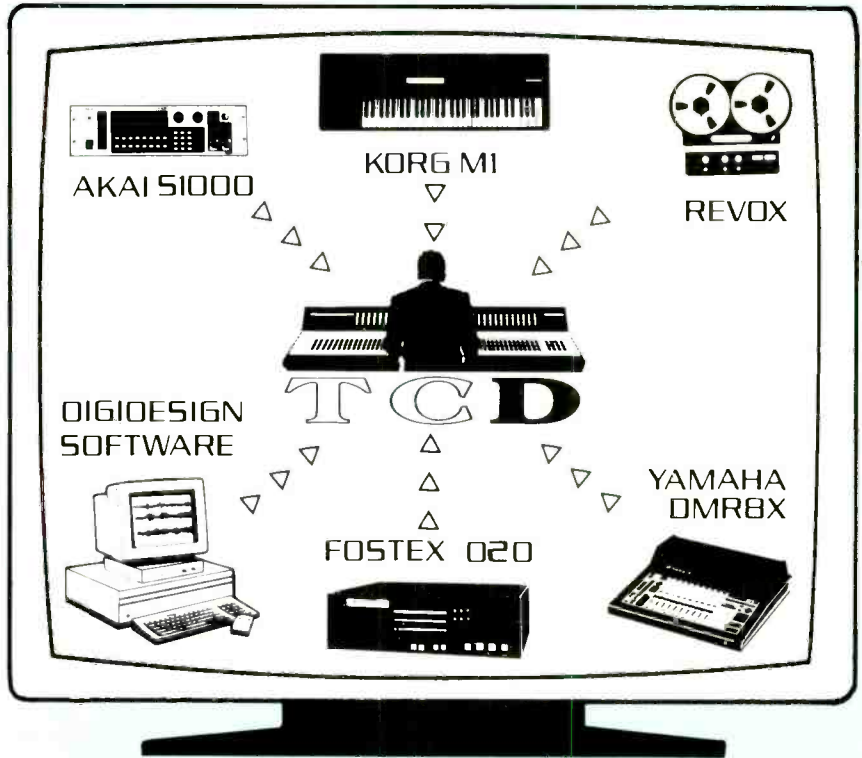
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a coder is designed cleverly enough, it can use a period of the repetitive waveform to predict future periods. A predictive encoder of this type is equivalent to an ADPCM coder with an extremely elaborate equalisation and noise shaping, and has the advantage that it codes well a wide variety of commonly occurring signals that the ears are good at analysing critically.

Multiband systems

Although a well-designed ADPCM system with enough equalisation options (perhaps hundreds, or even a continuously variable family of equalisers, rather than the four of CD-I!) could obtain a near-optimal low level of modulation noise with good masking, most efforts to improve on crude ADPCM systems have involved splitting the audio into several frequency bands. Each band is data-compressed and quantised separately, and the bands are re-expanded and put back together again during decoding. This means that any noise produced because of the presence of a signal frequency will be fairly near that frequency and so will be well masked by it.

All the multiband systems I am aware of use a technique known as dynamic bit allocation between the bands. This means that if one frequency band has a lot more energy than another (as perceived by a listener), more of the available bits are allocated to quantising that band and less to the others. In this way, the noise behind the highest energy bands (which would otherwise be at quite a high level) is brought down in level, whereas the noise behind the low energy bands (which would be at a very low level indeed) is brought up a bit in exchange. This way, if the bit allocation is carefully done, the overall amount of noise can be substantially reduced. Bit allocation achieves a similar redistribution of noise energy with frequency to that achieved by noise shaping in wideband systems.

By dynamic bit allocation, the most energetic signal components are encoded with a higher relative accuracy, reflecting the fact that they are the most important parts of the signal.

Actually, there is nothing that dynamic bit allocation achieves in a multiband system that, in principle, cannot be achieved by dynamic equalisation and noise shaping in the ADPCM system. Both systems redistribute signal and noise energy between the different frequencies to achieve roughly similar results. One has a greater flexibility with ADPCM systems since one is not restricted to a fixed set of frequency bands with rigidly designed crossover frequencies. In particular, the multiband system has no simple method corresponding to predictive coding of periodic repetitive waveforms in the ADPCM case. It is not altogether clear to me why multiband dynamic bit allocation systems are being widely worked on in preference to ADPCM systems.

Commercial multiband systems

The *Apt-X 100* system, developed in Belfast, uses a combination of dynamic bit allocation with just four rather wide bands (not in themselves narrow enough to give effective masking) with ADPCM techniques within each band. In some ways, this gives the best of both worlds, since it allows predictive coding of repetitive waveforms within each band. However, *Apt-X 100*, to judge from the limited published information, does not permit the

absolute maximum advantage to be obtained from masking on non-periodic waveforms.

A very different approach aimed at squeezing absolute maximum advantage from psychoacoustic masking, has been developed in Germany in association with the Eureka project. These systems are still under development and, according to reports, are continuing to improve dramatically with virtual CD results being reported at astonishingly low rates of as little as 1 bit/sample. The Eureka systems are based on dividing the audio signal into a large number of frequency bands (around 20 or 30), each typically around ½-octave wide. Each band is quantised separately and the number of bits allocated to each band is chosen to maximise the masking of the resulting noise spectrum by the signal, by using very detailed models derived from psychoacoustic experiments on how different audio frequencies mask one another.

These systems are very extreme in that, if a particular frequency band of the signal itself is at a sufficiently low level to be (supposedly according to the models of psychoacoustic masking) completely masked by the rest of the signal, then that band is allocated 0 bits, ie completely gated out. The Eureka systems incorporate an adaptive multiband noise gate (using around 30 bands) to reduce the audio data rate. It is claimed that the effect of these noise gates is inaudible due to masking. I need rather a lot of convincing that this is the case, since simple psychoacoustic masking experiments on how sinewave frequencies or narrow bands of noise mask one another need not necessarily apply to complex signals having a high degree of mutual correlation, and conveying subtle cues about stereo positioning, distance, space, instrumental resonances and complex orchestrations of sound.

Subjectively, while the *Apt-X 100* system has more obvious modulation noise than early prototype Eureka systems, this audible modulation noise is far less disturbing (despite a rather 'grainy' sound) than the artefacts of the latter. To my ears the Eureka systems have a rather 'unstable' sound quality, especially in stereo, somewhat akin to the effects of slight gain mistracking and pumping in analogue noise reduction systems. Theoretical analysis of the behaviour of quantisers at very low bit rates (even at more than 0 bits!) shows that gain modulation effects are highly likely unless extraordinary design care is taken, especially if the quantiser is not accurately matched to the signal statistics. In analogue noise reduction systems, the effects of gain mistracking of less than 0.1 dB can be highly audible as a loss of sense of depth, and some people have suggested that gain modulation much less than this (down to 0.001 dB) might be audible.

Also, since these multiband systems do not allow full predictive coding of nearly repetitive waveforms, they are liable to produce more audible effects on such waveforms than properly designed ADPCM systems. My experience in developing a dynamic multiband ambisonic decoder in the '70s showed that the ears seem to be exceptionally sensitive to modulation effects on signals having a narrow bandwidth (flute, cello, etc), the resulting effect sounding like a particular kind of gross non-linear distortion. Possibly because my ears are particularly tuned to this effect, I have noted similar 'narrowband' distortion effects on demonstrations of early multiband systems. Systems like *Apt-X 100* which incorporate predictive coding of repetitive waveforms such as narrowband signals, would be expected to be much better in this respect.

It cannot be denied that the multiband coding systems being developed in Germany are a remarkable technological feat, and as work proceeds, no doubt they will be improved further. Even if some of the faults mentioned remain, they will provide an extremely useful means of conveying acceptable signal quality at bit rates that would otherwise prevent audio from being conveyed at all. The main caution about these and all other audio data compression systems is that they should not be used totally uncritically and their performance should not be overclaimed. (Remember 'perfect sound forever' on early CDs?) This is the case in critical professional and state-of-the-art high quality applications.

Nothing like the input

One remarkable thing about all systems having a very low bit rate is that they sound much better than they measure! The output waveform, compared side-by-side with the input waveform on an oscilloscope, bears little resemblance to the input. It is well known that two signals can have very different waveforms and yet sound similar. For example, passing a signal through a simple all-pass network can totally mangle the shape of a squarewave and yet have remarkably little audible effect.

Nevertheless, the alteration of the waveform does suggest that efficient bit rate reduction systems cannot be treated purely as a neutral transmission channel and a lot of questions need to be asked about their performance in the real world before they are used in any given application. For example, what happens to stereo effect? Stereo works through having precise amplitude and phase relationships between the two channels. If a separate bit rate reduction system is used for each of the two channels, will the stereo quality be degraded? and if so, to what degree? What happens to more subtle cues like sense of distance (on recordings that have it) or of space and ambience?

It is possible to design audio data compression systems specifically to preserve stereo relationships (and, done properly, this is not simply a question of 'ganging' the compression parameters of the two channels) but I am unaware of any true stereo compression system under development.

There is also the problem of timing cues. Both in hearing stereo and in unravelling the relationships between many musical lines in a complex orchestration, the ears make use of the precise timings of transients down to a fraction of a millisecond. All the more efficient data compression systems tend to blur or displace such timing in a signal-dependent fashion. The German multiband systems have involved a considerable amount of empirical work optimising 'temporal masking'—the degree to which error signals need to coincide in time with the wanted signal. If the error proceeds the wanted signal too much, it becomes highly audible and masking ceases to work. However, such timing displacements and errors may also have a more subtle disturbing effect on the ears' ability to sort out complex stereo signals.

Professional use

Enough of how audio data compression works. What uses do such systems have and what kind of

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operational problems might they cause? Even if such systems have problems, we have learnt to live with the problems of analogue noise reduction and in appropriate applications we might learn to live with the problems of digital data compression, too.

Whether or not a data compression system is adequate for mid-fi consumer use, professional users are much more demanding. A first problem is that of processing delay in the encoding and decoding process. Suppose that one has a wonderful system that gives good CD subjective quality at 2 bits per sample. For many applications, it would nevertheless be quite useless if it has a long delay before the decoded signal finally emerges. For example, if data compression is used to store samples in ROM or RAM in a keyboard or sampler, one cannot wait half a second before the sound starts. In fact, for musical purposes, delays of more than 4 ms are certainly unacceptable, and delays of under 1 ms are desirable. Otherwise, the timing and feel of the music are affected.

Unfortunately, the most powerful data compression systems involve significant processing delays. A delay of 50 or 100 ms may not be too important in tape playback or broadcasting applications they might even be acceptable in digital cart applications for spinning in commercials, but in applications where timing is critical, less powerful data compression systems having shorter delays have to be used, at least for the early portions of a sound sample.

Then there is the problem of the complexity of the signal processing used. The most powerful compression systems involve very complex processing, which will involve very expensive circuitry or chips unless they are produced in huge commercial volumes. Generally, simpler systems involve cheaper processing.

For some uses (satellite links between broadcasters) this cost is not particularly important but it is important for consumer use and for professionals who may require tens or hundreds of encoder/decoder systems (eg for a 48-track digital recorder).

And then there is another problem in professional applications. You have just spun into your mix a 200 sec sample, which had been data compressed to 2 bits to fit into the RAM of what would, at 16 bits, be a 25 sec sampler. Fine, except that in later post-production work, you might need to recompress the mix you did back down to 2 bits again. What happens to sounds after encoding and decoding several times? Does all the modulation noise that has been so cunningly masked remain masked? Do those ever-

so-subtle side effects that you are reassured cannot be heard in subjective tests remain subtle?

I would be suspicious of using data compression for serious professional use in broadcasting, sampling, hard disk storage/editing/mixing or for digital tape recording unless the results of encoding and decoding (say) 10 times in succession are still highly acceptable. Moreover, this acceptability must still hold even if the signal is subjected to normal post-production operations like editing, gain changes, adding effects and mixing with other sounds, at intermediate stages.

Uses

Despite all these problems, which professional users will have to be aware of, it is likely that data compression will become an increasing part of the audio technology we all use. It is interesting to speculate about the kind of products a successful and economical bit rate reduction system would make possible.

One could envisage a suitably packaged collection of eight encoding and decoding systems for compressing 16 bit audio channels into 4 bits, and of putting the compressed channels into a conventional 16 bit stereo signal format, as a 'black box' for converting a stereo DAT recorder into an 8-channel recorder. Such a box would also need to incorporate eight A/D and D/A converters. Although such a unit would only give simultaneous recording of all eight channels at the same time, if it also incorporated means to add additional 4-bit channels to information containing less than eight channels, it could be used with two DAT machines to provide full 8-track recording facilities. Quality losses due to data compression could be minimised by using more than 4 bits/channel if less than eight tracks were used.

Such a unit would also allow other stereo digital media to be converted to (say) 8-track at relatively low cost. For example, one could send out library music on data-compressed CD in 8-track format, permitting the final mix to be optimised by the end user for his/her specific program use—although it would be wise to choose levels in the eight channels such that a straight equal-level mix should give the preferred standard mix for cases where the time is not available for detailed post-production work.

Similarly, the number of channels on hard disk media could be increased greatly. This would increase storage time and allow more rapid writing and reading of the hard disk (due to the lower bit rate) and more rapid loading and

unloading from the hard disk system to and from tape. For the same reason, the transfer of samples via MIDI exclusive systems, which is normally very slow due to the low data rate of MIDI, could be speeded up.

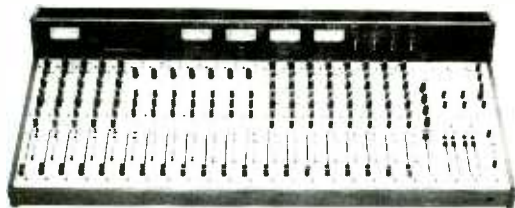
Obvious applications of data compression would include terrestrial or satellite digital broadcasting using modest bandwidths and extra-long play CD or DAT for music, muzak and talking-book type applications or for low-cost archival purposes. Data compression also makes more likely the long-discussed idea of being able to access music from a central library anywhere in the world via digital phone link, since the music could be accessed at a reasonable rate via a modest capacity digital channel. Setting up links between studios in different parts of the world when artists are unable to travel to a session also becomes more economically viable without spending a fortune on the satellite link. A standard 56 kbit/s or 64 kbit/s link normally used for telephony might prove adequate for near-CD quality mono channels. Even if the quality of such a link is not up to the most critical studio standard, it would be good enough for preliminary production decisions to be taken and, providing a means of sync'ing is available, an uncompressed digital tape could be sent by mail or courier later for syncing up during post-production.

Providing its quality is good enough, data compression also makes practical methods of production hitherto ruled out by the lack of tape channels. For example, most multitrack work today is still multi-mono, mixing together say 24 or 48 monophonic tracks. It has long been known that the results could be a lot better if each of the 'tracks' were stereo, or even 4-channel B-format ambisonics, but this doubles or quadruples the required number of tape tracks, turning a 24-track machine into a 12- or even 6-track machine. However, if each track is fitted with a stereo or 4-channel data compression/expansion system, optimised to work well on stereo or B-format material, then each tape track could be allocated a stereo or ambisonic signal at no extra cost. This would mean using mixers with purpose-designed stereo or ambisonic 'channels' for best results, or else using very large mixers, but for the first time, data compression might make the use of multi-stereo production, with all its known advantages in terms of 'feel' and quality of stereoism, feasible.

Again, if data compression can be used to reduce the storage requirements per unit time in samplers and hard disk systems, it will become much more economic to incorporate sampling and spin-in facilities as parts of other studio equipment—perhaps the day is not far off when every mixer channel incorporates its own sampler? At this point, the boundary between tape recording, sampling, editing and mixing will start to get very blurred (as it has already on top-end mixer/hard disk systems), and product definitions and packaging will have to be re-evaluated.

All this, of course, presupposes two things: that the quality of data compressed audio can be upgraded to the highest professional audio standards, and that the processing chips can be made in sufficiently large quantities to bring down unit costs to a low level. The latter will be most likely if the same chips are used for both domestic and professional use, possibly with internal switching to different grades and quality levels of data compression to cope with different applications. Providing the quality and operational problems of audio data compression can be solved, its future looks assured. □

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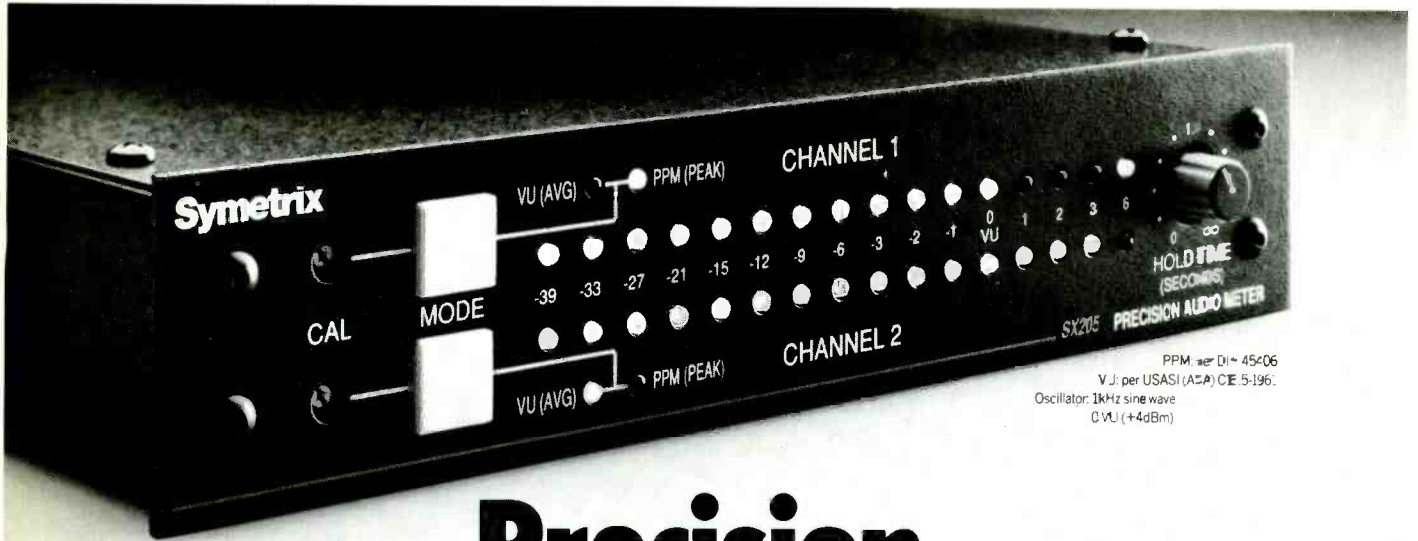
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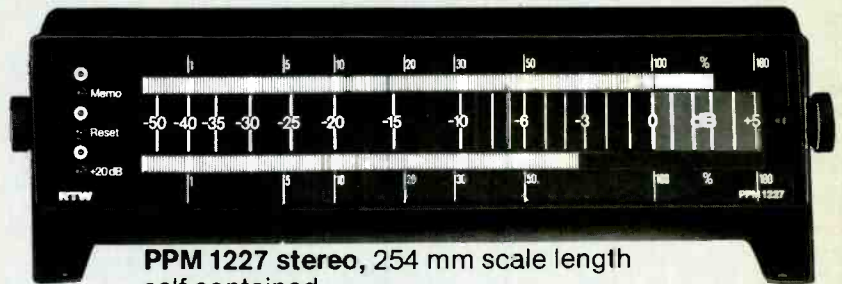
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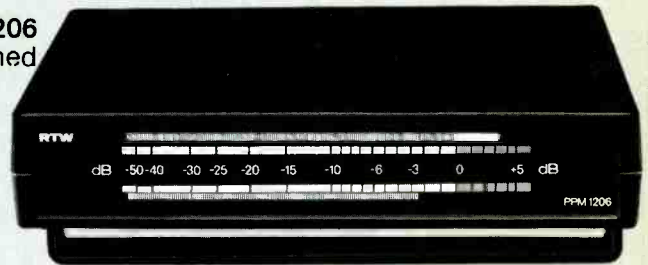
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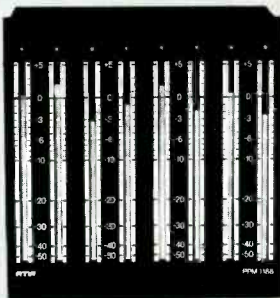
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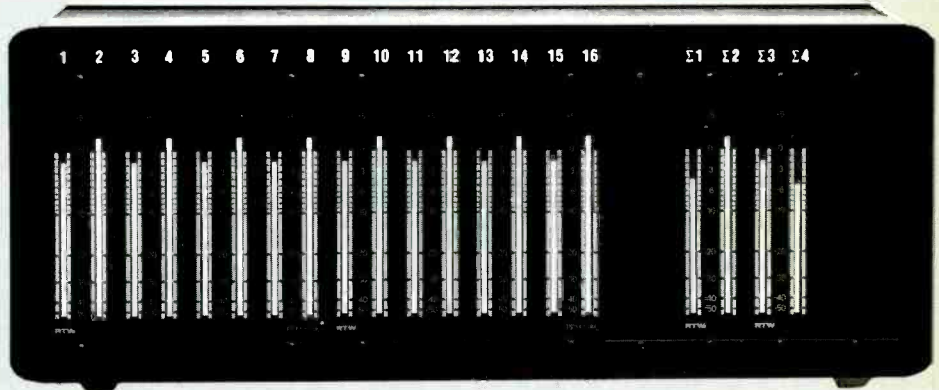
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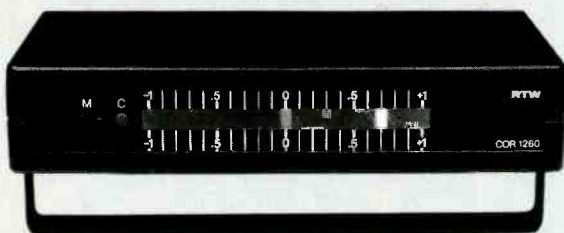


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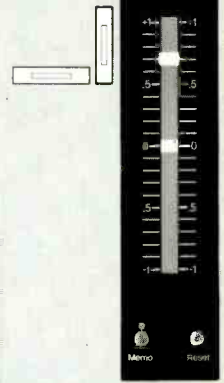
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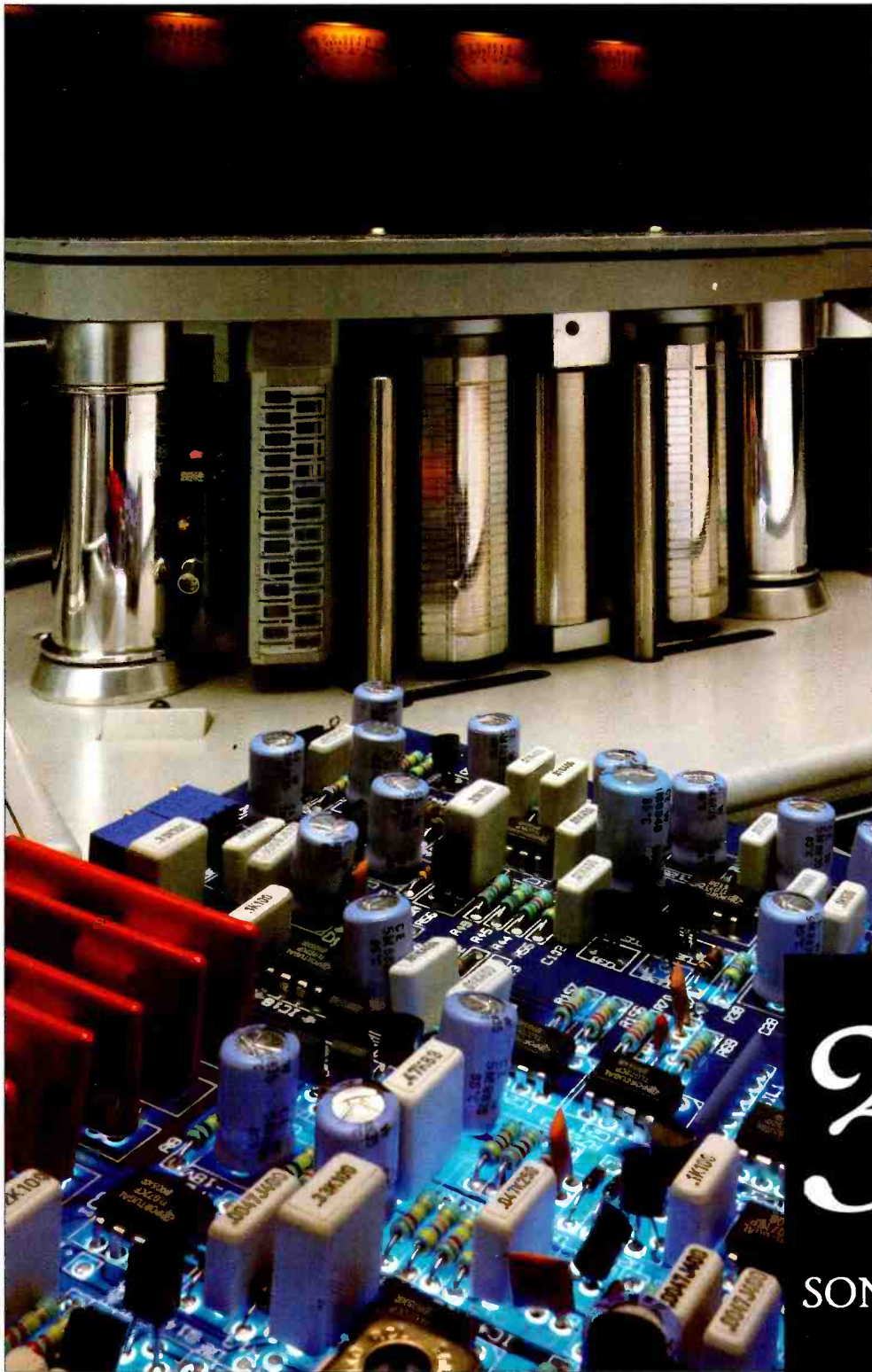
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