

MARCH 1993

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STUDIO SOUND

AND BROADCAST ENGINEERING

THE INTERNATIONAL
PRO AUDIO MAGAZINE

SIGNAL PROCESSING

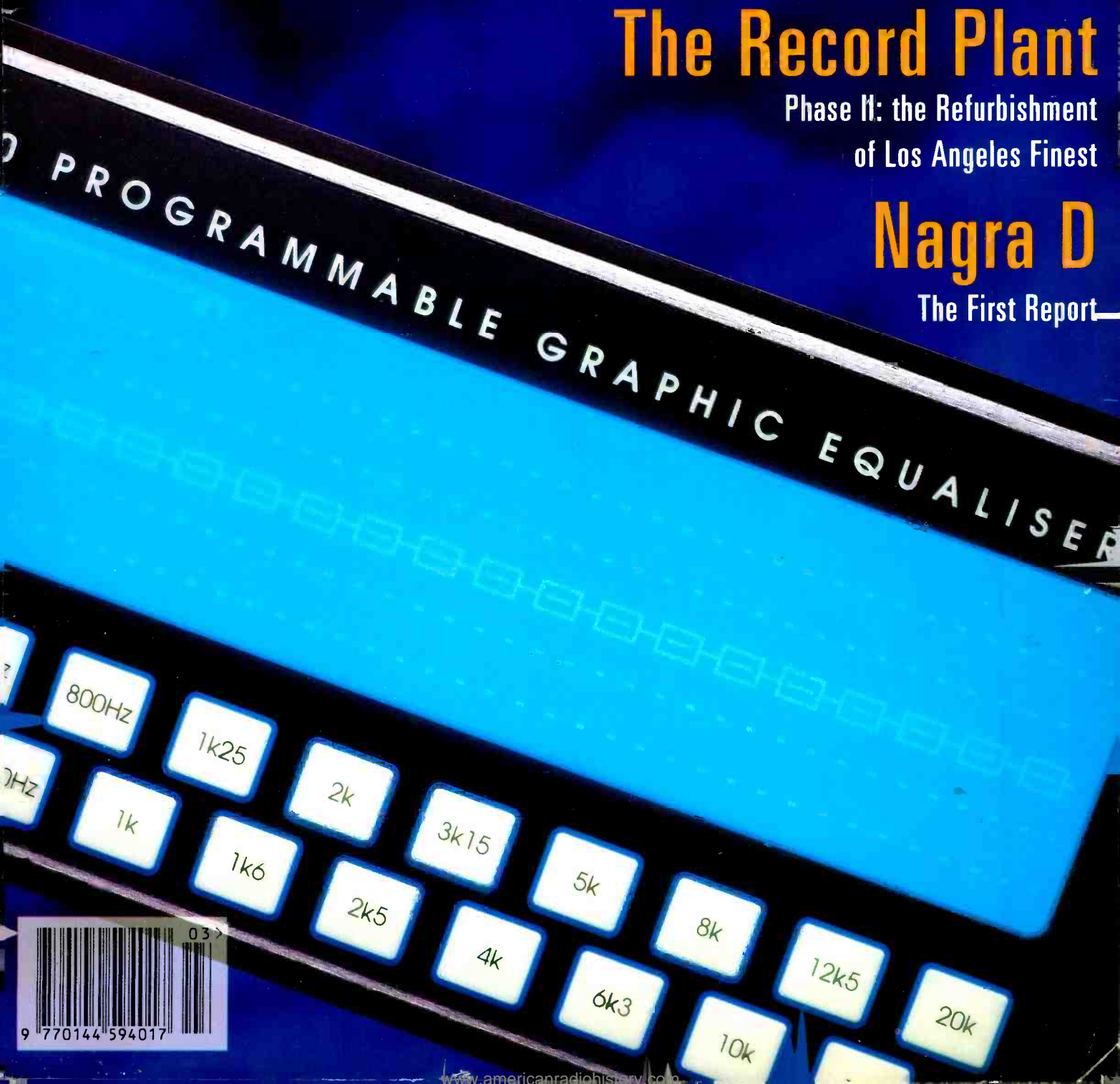
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The Record Plant

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W O R L D C L A S S



Photographed at The Hit Factory, New York City

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What No Noise?

As present industry momentum carries us progressively further into 'digital territory', noise emerges as an increasingly interesting phenomenon. The perception that professional advocates of digital systems are quick to assert the advantages of their extremely low noise and wide dynamic range and that the majority of hi-fi consumers have welcomed the consistent quality and convenience offered by CD is both commonly held and largely accurate. Only the analogue audiophiles on both sides appear alarmed by the growing use of digital electronics in the audio chain. But there is more noise than tape hiss and quantisation noise.

If we choose to regard noise in a wider context we can quickly see that it assumes a significant musical value; I recall doing a session in a demo studio following Julian Cope's use of the same facility. Cope, in his left-field wisdom, had dedicated one track of the multitrack master to recording the sound of a Fender guitar amp wound flat out but without any musical signal passing through it. The track ran for the duration of the song and, what to many ears was simply noise, became a musical element of the song—at least as far as Julian Cope was concerned.

This addition of 'noise' to 'music' can be pursued quite widely. Audience noise, for example, is an important element of many successful live recordings. The noise from an imaginary audience is also a part of a good number of tracks recorded entirely in the studio. U2's *Rattle & Hum* has donated its ambience to more dance records than I would care to count. Remaining with dance records we can identify another use of noise, in this case vinyl surface noise. Looped samples of noisy pieces of vinyl are frequently used to lend an element of 'authenticity' to tracks that are likely to see more needle time (an unfortunate term) as CDs and cassettes. The same application of vinyl surface noise to samples not taken off vinyl is sometimes used to create the impression of one which has—a rare groove sample, for example.

Taking the study a stage further still, mechanical and natural noises have been used as legitimate parts of musical structure. Whole musical movements are based around non-musical sounds, as demonstrated by John Cage, Kraftwerk and Einstürzende Neubaten. Cage lends a further aspect to the discussion with his completely silent composition. If no sound can constitute music, surely any sound can.

I have strayed from my opening identification of noise but, just as the issue of the desirability of tape compression only really became an issue after options to eliminate it had appeared, it may be that we will only really learn to appreciate the phenomenon of noise after we have eradicated it from our recording practices. Yes, it is always attractive to retain options on when one wants to address artifacts of recording, but I wonder if tape compression would be the issue it has become if someone had had to design it. And if we achieve a system of 'flawless' recording, will we like it? Will the public like it? Will it help sell records?

From the background radio noise of space to sampled vinyl snap, crackle and pop, noise is one of nature's signatures. Wherever we have learned to eliminate it, our music seems to demand we return it. Some of it, at least.

● On a different note, you might have noticed that *Studio Sound* has been undergoing something of a face-lift over recent months. The magazine you are now holding is still the essential document it always was—but the time has come to blow out the cobwebs and refine the objectives. Commanding the respect of the industry and the efforts of the best authors in their respective fields is no excuse for retaining outmoded presentation. Similarly, regarding the policies which have gained the magazine its prestigious position with too great a respect can only hinder its ability to continue to best serve its readership.

In a field which demands so much of its artists and its technology it is appropriate that the demands placed on its periodicals are similarly high. So it is that *Studio Sound* will continue to reflect this fast-moving and exciting industry. ■

Tim Goodyer

A CUTTING EDGE



To be, or not to be, that is the question : Whether 'tis
nobler in the mind to suffer The slings and arrows
of **A HORSE, A HORSE, MY KINGDOM FOR** outrageous fortune,
Or to take arms against a sea of troubles,
And by *opposing*, end them
To die,
to sleep.....



THE CUTTING EDGE



To be, or not to be, that is the question: Whether 'tis nobler in the mind to suffer
The slings and arrows of outrageous fortune, Or to take arms against a sea of
troubles, And by opposing, end them. To die, to sleep- No more, and by a sleep
to say we end The heart-ache and the thousand natural shocks That flesh is heir to;.....
..... *perchance to dream*

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BRITISH INNOVATION



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Nimbus produce first video CD

Nimbus Technology and Engineering have announced what they are calling the 'world's first feature length video CD'—a five-inch CD that promises to carry up to two hours fifteen minutes of full colour motion video and digital audio that will play on ordinary domestic CD players.

The development has been made possible by Nimbus' own laser mastering system together with Californian company C-Cube's video compression technology. The product is mastered at double the standard density which the Nimbus mastering system can do routinely and then pressed in the normal way by Nimbus Manufacturing.

They also claim not only the first full video CD but also the first double density pressed product.

Nimbus' research into double density mastering over the years has made this breakthrough possible. The purpose of Nimbus Technology & Engineering is to manufacture and market the Nimbus Halliday Laser Mastering system. The system is capable of the very high accuracy needed to cut double density discs. It is also capable of cutting quadruple density discs, but these would require special players for reproduction.

Dr Halliday of Nimbus, the inventor, has said that a prototype for a recordable video CD should be developed within the next 12 months, 'The expensive and technically complex "real time" compression technology means that the recordable format will be confined, for some time, to professional usage.'

Nimbus Technology Tel: +44 (0)600 890682
C-Cube. Tel: +1 408 944 8106



Codenamed 'Bluestone', the highly customised SSL 96-input mixing console recently installed at The Hit Factory Digital Studios in New York. Discrete Systems Technical Director David Bell specified the console's 'in-the-round' appearance to provide the engineer 'with substantial amounts of readily accessible table top workspace'—a keynote that Bell believes to have been overlooked by other solutions

Innovative Tyrell support

The Tyrell Corporation London, distributors of Sonic Solutions and Doremi products, have set-up what they believe is the UK's first computer controlled 24-hour customer support line for the audio industry.

Customers who subscribe to the line are given a contract PIN number which gives them access to the Tyrell Network via a standard touch-tone phone. When the customer has logged onto the support line they are presented with a number of options relating to the type of service they require. The computer then checks the database for customer details and the relevant information is sent to the duty support engineer's pager.

Typical response time is said to be within five minutes.

Tyrell's Technical Manager James Shannon commented, 'Our paging system is unique and represents a breakthrough in *Macintosh*-based telecommunications.'

Tyrell Corporation. Tel: +44 (0)71 287 1515. AppleLink TYRELL.

Magmasters go to Hollywood

Soho-based audio post production studio Magmasters have acquired Burbank Film and Video recording in Hollywood. The 20,000ft² Burbank operation is the third largest in the Los Angeles area and is the largest supplier of sound for TV movies and animated films for television. The

Burbank studios are digitally linked to Magmaster's Soho studios so that clients can use facilities on both continents without leaving home.

Magmasters expansion plans had been put on hold since the death of veteran film dubber Bill Rowe, who was instrumental in their plans to turn the old Elstree Studios into a recording complex. The new move has brought in film dubber David Old who takes on the running of Studio 2 in Soho while partner Dave Maiden moves to Burbank.

Old had been with broadcast and film specialist Cine Lingual for nine years, latterly as head of sound. He commented on the move, 'After nine good years this is a major step for me but the challenge at Magmasters was too exciting to resist.'

Martin Audio's open letter

Martin Audio's Managing Director, David Bissett-Powell, has circulated a letter addressed simply to the friends and colleagues of David Martin (dated the 12th of February), in an attempt to get the facts surrounding Martin's recent disappearance straight.

Newspaper reports had spoken of how a close friend of Martin's, Kate, had tried to contact him on the evening of the 29th of December without success and had arrived at the house later to find no sign of him, lights on in the house, no locks secured and no alarm set. The police were called the next morning and they found blood in the barn where Martin kept his classic car collection.

The letter concludes:

'As we write this letter the police are changing their attitude towards the enquiry and they now consider it more probable that David has been murdered. All we can therefore do is ask his friends and colleagues to hope and pray for David and that one way or another, he can be found.' ►

International Exhibitions

- AES, 94th Convention. ICC, Berlin, Germany. March 16th-19th
- NAB '93. Las Vegas, USA. Featuring Multimedia World. 19th-22nd April
- MIDI Music show. Wembley Conference Centre, London, UK. April 23rd-25th
- SPARS 1993 Digital Audio Workstation Conference. Hudson Theatre, New York, May 15th-16th
- SATIS. Parc des Expositions, Paris. Featuring an audio section. May 25th-28th
- Test and Measurement, AES Portland, Oregon, May 29th-31st
- ITS. Montreux, Switzerland. June 11th-15th
- Multimedia '93. Earls Court 2, London. June 15th-17th
- NAMM. Chicago, USA. June 18th-20th
- APRS. Olympia 2, London. June 23rd-25th
- Pro Audio & Light '93. New World Trade Centre, Singapore. July 7th-9th
- British Music Fair. Olympia 2, London. July 25th-27th
- PLASA. Earls Court 2, London. Sept 12th-15th
- Vision'93, Film and Video Equipment Show. Olympia, London. October 5th-7th
- Photokina. Cologne, Germany. Sept 14th-20th
- AES, 95th Convention. Jacobs Javits Convention Centre, New York, USA. October 7th-10th
- SBES. Metropole Hotel, Birmingham, UK. 4th November
- Broadcast ASIA. New World Trade Centre, Singapore. June 1st-4th 1994

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In-Brief

●**Otari Europe formed:** With immediate effect Otari Deutschland GmbH, located near Dusseldorf, Germany, will take responsibility for all activities in Europe. Otari UK will continue to supply technical service and spare parts to British Otari owners from their same location. Otari Europe Tel: +49 21 59 50861.

●**Terminal Studios move to London Bridge:** Terminal Studios have opened up a five studio rehearsal room complex including a full production-sized room and a showcase room with Marquee-size stage. Every room has been fitted with Turbosound or Martin Audio equipment. Tel: +44 (0)71 403 3050

●**ADAT sells 10,000 units:** At the recent NAMM convention in LA, Alesis Corporation announced to their dealers and distributors that they have now shipped over 10,000 ADAT Digital recorders worldwide. Alesis have also recently produced a 'White Paper' explaining the development that went into ADAT and the technical issues involved. In the UK the Paper is available from Sound Technology. Tel: +44 (0)462 480000

●**New company formed to sell MBI:** A new company, First Broadcast Limited (FBL), has been formed to undertake sales and installation of MBI products in the UK. Mel Bowden, a founder of MBI Broadcast Systems Ltd, has set up the new independent company with Rob Eden and Viscount Peter Glenapp. FBL will move into MBI's old premises in Ship Street, Brighton. Further information Soundcraft Tel: +44 (0)707 665000

●**Nagra and Canal + joint venture:** Swiss-based Kudelski SA and Canal+, one of Europe's largest pay-TV network, have formed NAGRA+, a 50/50 owned joint venture. The new company, to be based in Cheseaux, Switzerland, will develop the broadcast encoding/decoding technology used by the two parent companies, who

jointly developed the Nagravision/Syster system. Demand for these systems, which scramble television signals to prevent unauthorised viewing, is growing with the expansion of pay TV networks around the world. Kudelski SA Tel: +41 21 732 0101. Canal+ Tel: +33 1 44 25 19 42

●**UK's first sports broadcast in Dolby Surround:** On the 28th of February Granada TV televised the match between Newcastle and Tranmere live in Surround Sound. Meanwhile the first European film with a Dolby Stereo Digital soundtrack, Joseph Vilsmaier's Stalingrad, has recently been released in Germany, Austria and Switzerland.

●**AMS receives US honour:** AMS Industries have won one of the USA's top industry awards, winning a EMMY for 'Outstanding Achievement in the Science of Television Engineering Technology'. AMS joins the list of past honourees like RCA, Phillips, Eastman Kodak, CBS Labs, Sony, Ampex, Grass Valley and NHK.

●**Rental company continues 50% price drop:** Music Lab Sales in London is to continue indefinitely the 50% 'across the board' cut in audio rental charges. The increased level of business since then suggest that Music Lab's approach has actually expanded the market as a whole. Prices include an Otari MTR90 for £100; Neumann U67 for £30; and a Akai S1100 8Mb smapler at £60. Music Lab Sales Tel: +44 71 388 5392

●**Rejuvenating old masters:** Innovative Development Technology Inc of Riviera beach, Florida use a five step process to evaluate, recover and transfer tape masters due to binder failure. The steps consist of Preparation; Chemical treatment; Cleaning; Heat treatment; Transfer. Recent clients include Crescent Moon Studios for Gloria Estefan; Flytetime Studios for Janet Jackson; ABC Broadcasting; Voice of God Recordings; and the Elgin Symphony Orchestra. IDT Tel: +1 407 844 2111 ■

Mitsubishi Pro Audio, has joined Amek as Area Sales Manager. Previously he has worked at Neve Electronics.

●**David Beardmore has been appointed** by AMS Neve plc to coordinate a corporate policy of quality management, across the spectrum of the company's products and services. He comes from six years experience in sales management and completed an MBA in Total Quality Management last year.

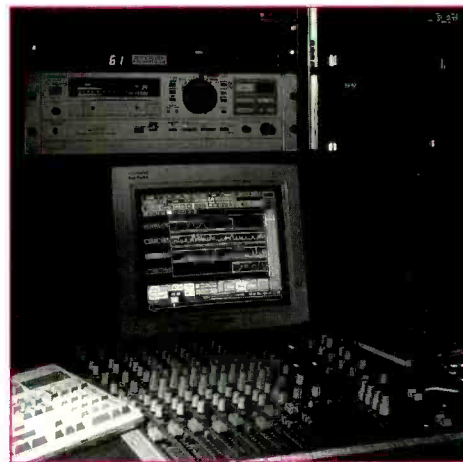
●**Fairlight MFX2 user Stephen Dewey,** has been awarded an American CLIO award for sound design. Dewey was acknowledged for his contribution to the Reebok commercial, *Cowardly Baskets*.

People

●**Formerly 14 years as Technical Director of the Power Station studios in New York, Ed Evans,** has joined the Touchdown organisation as their new Technical Director. Evans will be in charge of all technical operations at Touchdown Germany and is overseeing the design and construction on their new facility in Portugal's Algarve region. Kiera Leeming formerly of Harman Audio has also moved to Touchdown Germany as Marketing Director.

●**Karl Chapman,** previously with

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CD-R Theft

On the 31st December 1992—when the rest of us believed we had seen the last of the years' bad luck—a selection of equipment was 'purchased' from Audio Design in the UK's Berkshire countryside.

Unfortunately, the Cheltenham and Gloucester Building Society cheque used for the transaction proved to be one of 2500 blank cheques previously stolen from the Society—although the theft was not publicised by the police. As the two men involved claimed to be the Director and Engineer from a known

and respected company, the sales staff were caught off guard to the tune of three Audio Design CD-R machines (serial numbers 120050; 330019; 530011), one AD Smartbox CD-R and 100 blank recordable CDs.

Obviously, Audio Design are eager to receive any information which might lead to the recovery of their property and urge all UK parties to be on the lookout for the remaining 2499 cheques still unaccounted for. Any information regarding the CD-R machines or ancillary items should be directed to Audio Design, who are contactable on (0734) 844545 ▶

Contracts

●Independent German facility, Studio Funk has ordered a *Logic 2* digital mixing desk from AMS-Neve.

●DynaudioAcoustics have their first *M4* main studio monitor sales into Japan at the Fun House Studios in Tokyo.

●The *Nagra-D* digital tape machine (the subject of this month's bench test) has been used on location recently for Arnold Schwarznegger's new film and Callie Production's *Flesh and Bones* starring Meg Ryan and Dennis Quaid.

●SSI (Sound Services Inc) in Hollywood have bought a trio of Solid State Logic *ScreenSounds* for use on future projects.

●Sales of Lexicon products by UK agent Stirling Audio include a *480L* and *300* digital effects processors as part of a complete studio package Elliot Brothers are supplying, in conjunction with Neve/Siemens, to The Concert hall in Athens. A *480L* has gone also to Wigwam Acoustics and three *300s* have gone to audio post production house Silk Sound in London's Soho.

●Pacific Ocean Post in California is the first facility to order both AMS and Neve digital consoles since the merger of the two companies. Two *Capricornis* and one *Logic 1* will be installed

●Le Studio Ellipse, one of France's foremost producers of cartoon series, is expanding its in-house post production facilities with the addition of an SSL *ScreenSound* digital audio editing system and a *SoundNet* digital audio network.

●Capital Radio, Britains biggest

commercial radio station, has bought

its second DAR *SoundStation SIGMA* digital audio production system. The new *SIGMA* will be used primarily to produce on-air promotions and trailers for its FM and Gold AM radio stations.

●Deliveries of the newly launched Trident *90* console commenced recently with installations in both Germany and Italy. Mona Music and Powerplay Studios in Germany and Marton SRL in Italy have all taken delivery of 40-channel consoles fitted with Trident's own dual VCA fader and switch automation package. The first UK console installation is to Gallery music owned by Roxy Music guitarist Phil Manzanera.

●Autograph Sales has equipped London's Rock Circus tourist attraction with a new sound system featuring Meyer Sound loudspeakers and QSC power amps. The system replaces the theatres infra-red headphone installation following problems with theft and the loss of 150 headphones during a bomb scare evacuation.

●Guangzhou TV in China has taken delivery of *EM 75* speakers and *EMX1* controller—the sale being conformed through Martin Audio's distributor New Sound Studio in HongKong.

●dCS has recently delivered a sophisticated computer controlled off-air recording system to the BBC's Brookman's Park site. This represents the BBC's largest off-air system to date, and first to use digital routing of audio signals.

●An Amek *Hendrix* console was used by Artisan Recorders mobile to record the worldwide hit 'I Will Always Love You', by Whitney Houston in Miami last year. ■



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CEDAR Production System



Tannoy re-launch

Scottish-based Tannoy have relaunched four of their dual concentric studio monitor speakers.

Incorporating a new range of capacitors and a new 'HF tulip' waveguide, the *System 8NFM*, *System 10 DMT*, *System 15DMT* and *System 215DMT* highlight the company's Differential Material Technology (DMT). The waveguide's low compression ratio (4:1) is claimed to provide 'smoother sound with lower second harmonic distortion and improved symmetrical dispersion across the horizontal and vertical axis'.

Other improvements accompanying the relaunch include a new copper-clad, rectangular section aluminium HF voice coil and the impregnation of a 'vibration-reducing' resin into the crossover. The *System 8* and *System 10* monitors also now feature injection moulded polyolefin copolymer cones.

The move to relaunch the monitors accompanies Tannoy's intention to re-establish their reputation within the professional audio monitoring field.

Tannoy Limited, Rosehall Industrial Estate, Coatbridge, Strathclyde ML5 4TF, Scotland.
Tel: +44 (0)236 420199
Fax: +44 (0)236 428230



Re-entering the pro studio monitoring fray—Tannoy's *System 15DMT II*—with new caps and resin-impregnated crossover coils

growing topic of multimedia services, placing digital audio in context with video and other channels of information.

In two days of presentations and discussion, existing audio interfaces and transmission practice will be reviewed, and the design and operation of computer data networks explained. The role of audio storage on physical media will also be examined. Speakers will evaluate networking and dedicated routing in broadcast operations. Workstation networks and file interchange will be the subject of a major session with contributions on the Open Media Framework, the use of FDDI, Ethernet and SCSI in audio, and the use of data reduction for purposes such as archiving. Multimedia services will depend on economic archiving and data retrieval to foster interactive and distributive working. Progress on establishing a worldwide computer-controlled standard data base will be described.

This conference will provide important information for audio engineers on the challenges arising from the international communications environment, in which digital audio will be a major component.

For further details, a programme and booking form, contact: Heather Lane, AES, PO Box 645, Slough, SL1 8BJ, UK. Tel: +44 (0)628 663725
Fax: +44 (0)628 667002 ■

UK AES News

Digital Audio Interchange

18-19th May, 1993, Imperial College, London

The AES 1993 UK Conference, Digital Audio Interchange, will focus on digital audio communication techniques, considering the principles, technology and system aspects of computer networking and their application in the engineering of digital audio studios, both present and future. The conference will address the

Address changes

● Dolby Labs have moved to Dolby Laboratories, Wootton Bassett, Wiltshire. SN4 8QJ. Tel: +44 (0)793 842100 Fax: +44 (0)793 842101.

● FM Acoustics have moved to FM Acoustics Ltd, Seestrass 5A, CH-8810 Horgen, Switzerland. Tel: +41 1 725 7777 Fax: +41 1 725 7790

lexicon

HEARD IN ALL THE RIGHT PLACES

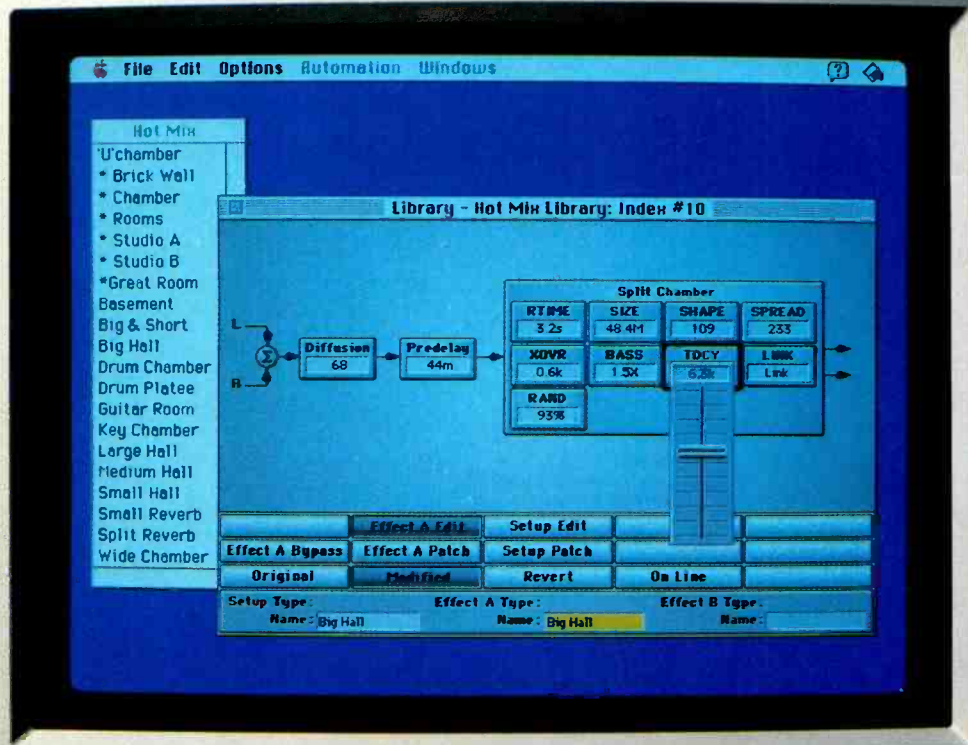
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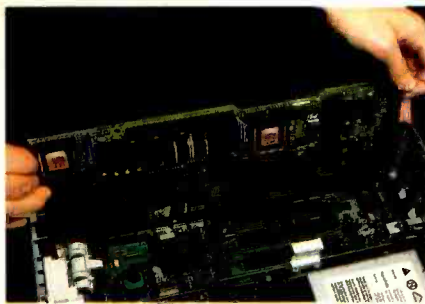
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Lexicon

HEARD IN ALL THE RIGHT PLACES



One of 172 BVE100s at RAI in Rome

Birth of a board

With the amount of attention paid to mass-market mixing consoles, it is easy to believe that a custom desk is well beyond the means of most. However, manufacturers persist in telling us that they are listening to us and some can even be seen to be responding to their customers' requirements—as the recent development of Soundcraft's BVE100 video editing audio console for Italian broadcaster RAI bears witness.

RAI is currently conducting massive changes to its Rome-based operations; the operation was previously located throughout the city at various sites dealing with the many facets of broadcasting to the Italian nation. The reorganisation involves the centralisation and reorganisation of the broadcaster's news operations at a new site at Saxa Rubra. This enormous plot in dusty Italian countryside was built as the information centre for the 1990 Football World Cup tournament, which Italy hosted. Circumstances have since dictated that the site be expanded and assigned greater importance in the RAI framework.

Faced with an opportunity to essentially equip from the ground up, Franco Gorini, who is responsible for the mixing console installation at Saxa Rubra, saw there were benefits to a degree of standardisation.

'We previously had a lot of different types of mixer which had resulted from separate and individual decisions,' he comments. 'When this centre in Saxa Rubra was built we needed someone who would make a mixer to our requirements. The manufacturer that was most helpful was Soundcraft.'

While the console is certainly not a custom one-off in the truest sense of the term (the BVE100 is now available commercially), the Italians asked and got what they wanted. The

standardisation of RAI and the willingness of Soundcraft to help has resulted in RAI ordering 172 BVE100s (at the last count), 70 of which are at Saxa Rubra in the 14 editing suits of each of its five main buildings. The BVE100 itself is an incredibly compact little desk that is well honed to its intended use while still being flexible enough in traditional mixer terms to be used elsewhere in the organisation.

As a stereo and mono output 8U-high rackmount with eight inputs, standard channels have 3-band swept mid EQ, high-pass filter, two auxes, and a VCA in each mono channel permitting an edit controller to run the desk. Each input also has a separate depth fader which presets the maximum amount of attenuation available to the edit controller via parallel interface. An optional serial control interface additionally provides compatibility with GVG100, ESAM 1, ESAM 2 and AMX 100 comms protocols. Other features include independent 2-track monitoring, a cue speaker, multifunction stereo metering, a phase meter and optional stereo input channels.

Gorini liked many of the features the Soundcraft Delta AVE but the problem it presented was one of size: 'I told Soundcraft that we intended something smaller. All the departments in Italy were involved and we decided to have a standard desk for everyone that could be 19-inch rackmounted and 8U-high. Those were our first requirements,' he says. 'The BVE, because it is physically smaller, gives us more flexibility in where we can put it. That is a very important consideration because when you work in video editing you need desk space.'

However, because the configuration of the mixer is so general purpose with mic and line

inputs, for example, we can use it for other things like football coverage.'

The BVE100 features that Gorini is particularly pleased with include all inputs being on XLRs: 'Two inputs can be connected simultaneously which can be selected on a switch instead of having to reconnect', and the stereo input option, 'We keep stereo modules in stock and we can change a desk by fitting the modules we need for the job.'

Gorini also insisted on the sort of crossfade depth control available on the Delta AVE and the ability to make connections from the back panel or from underneath the desk depending on how it is mounted: 'When specifying equipment, we use our experience to define a product that will satisfy our needs in the future. We have a lot of dialogue with manufacturers but some listen better than others and some are prepared to do more than others.'

In this instance, Gorini was essentially committing RAI to a mass order of AVE desks that were being built for them simply on the strength of a few conversations with Soundcraft and a drawing of the prospective product. Was he not apprehensive about his decision?

'We had Soundcraft products already like the 3200 and we decided that if they could make big consoles well then they should also be able to make small consoles well. We did not consider it to be a big risk. We've always had a good relationship with Soundcraft and its distributor in Italy, Audio Equipment.'

Soundcraft's console design guru, Graham Blythe, picks up the story from the conceptualisation of the BVE100: 'RAI wanted something that did what our Delta AVE or 200BVE (its predecessor) did but they wanted it small with certain features which they outlined and then left the rest up to us. They wanted our depth fader but we had a reasonably free hand. I produced a plan of it and waited to see what they'd say, and after a few passes to and fro we finally arrived at a spec.'

'The whole process was very fast,' Blythe continues, 'but one of the deciding times was the extrusions for the frame shape which takes around 14 weeks, so it couldn't have been much quicker than that.'

Blythe denies any suggestion that the BVE100 is just a downgrade of the Delta AVE.

'It had to be a new console, and it is wrong to say that I started with anything. Because RAI placed such a

big order it prompted us into doing something earlier rather than later.'

Blythe was also unworried by the prospect of meeting a broadcaster's specifications with such a desk.

'The quality of, say, a Spirit Live in terms of crosstalk, distortion and those sort of things beats almost any broadcast spec you can throw at it,' he claims. 'Broadcasters are very hot on crosstalk, but the BVE100's specs are particularly good because the desk is so small and has less wire hanging around inside.'

'The Mic channels have a high-pass filter which is the sort of thing people tend to leave off a little desk. There are particular requirements of BVE, for example you need to be able to independently switch the left and right hand track from send or return. That's essential. A phase meter, again, is a useful thing to have and not very expensive to execute.'

As a designer, Blythe prefers to work with a flexible brief because he believes it results in a better product.

'If you get yourself too tied down there is a danger of producing a 'me-too' product based on what everybody else has done and what the client has seen. It doesn't allow any free thought. I prefer a market brief to design something that does a job.'

These comments that beg the question of whether the customer actually knows what he wants.

'He does know what he wants but he's not a console designer,' replies Blythe.

'There are always price constraints, and when I'm designing I'm always thinking about the total solution, things like how the connectors will go into the main board, how the master section goes together and what is the cheapest way of making the whole thing work. That dictates to a certain extent where features go, so you bear in mind ergonomics and at the same time you think about the cost of making it.'

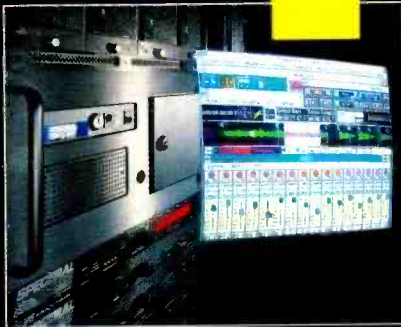
Blythe concludes that the overriding principle remains the same throughout.

'As a designer you must understand what features they want, why they want those features and the user application.' ■

Zenon Schoepe

Soundcraft, Cranborne House,
Cranborne Ind. Estate, Potters
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DAT's flexibility—Panasonic's ASC version SV3900

The remotest idea

The Panasonic SV-3900 DAT machine is set apart from its price peers by one remarkable fact: the inclusion of bidirectional serial remote control. This control is both ES-Bus and P2 standard selectable and Panasonic have a full protocol available for the machine which takes care of the machine language programmer's needs. For C buffs and other high-level language users, you can buy a tool kit for the *Macintosh* or PC which provides USR routines and macros plus sample routines and preliminary programs to get you started.

Audio Systems Components have taken advantage of this situation and developed a piece of hardware which integrates with the SV-3900 to act as an intelligent remote. This modification providing simple facilities accessed by large buttons ideal for use in the broadcast studio or the theatre.

Once you have added a microprocessor to a system, you have a definable system which can be programmed to carry out a variety of tasks. The failing of many multifunctional systems, however, is that life is often complicated by controls and functions intended for an application other than the one to hand. A good example of this is the good, old-fashioned 2-track tape machine; who needs sound-on-sound or track bouncing on a journalist's editing machine? Hardware that enables multipurpose operation cannot dematerialise to order;

software, on the other hand, can effectively be used to hide unwanted facilities.

The ASC Integrated Remote is a steel enclosure that, when attached to the bottom of the SV-3900, brings the size of the DAT machine up to 4U (17.78cm) of rack space. All interconnection is made by two tails which hang out of the rear of the remote to pick up power and the serial bus. The rear panel also houses a switch selecting the machine's primary mode of operation (Radio-Theatre-Overnight) and fader start input.

On the front of the remote are 'cart' buttons for CUE, PLAY and PAUSE, grouped logically together, a DOOR OPEN button, TRACK (PNO) SELECT knob and 7-segment LED display of track number and other relevant information. A series of three LED 'tallies' confirm the functional status of the machine.

In the on-air studio, DAT machines have finally made an entrance—it is a rerecordable, serial access, CD-quality player which uses relatively cheap, readily available blank media which may be up to two hours in length and be divided into up to 99 tracks. Satellite Media Services in London will distribute any audio you supply them by satellite to any or all of their subscribers and it will end up on DAT tape. You can compile a radio playlist on one or more DAT tapes; have a jingle mastered to DAT from which you can make copies; record this week's PSAs,

What's On, Helpline messages, Top Ten or maybe a stack of old gold standards.

But playing any or all of these at the SV-3900 price point necessarily involves using consumer equipment control. Presenters tend to prefer simplicity as defined by the cart machine—hence the appearance of CD 'cart' players like the Denon *DN951* and the Audiometrics *CD10*.

In Radio mode the ASC SV-3900 IR follows radio operation tradition. Press the OPEN button and the DAT draw opens; drop the tape in, dial the track required into the display and the system automatically closes the draw and locates-pauses the selected track, and illuminates the STOP light—just like a cart machine. Press PLAY and the track plays through with the elapsed time being indicated in the display. At the end of the track the machine re-cues unless you have selected another program number during play, in which case the machine displays the message 'this is not the track playing' and cues to the most recently selected track after finishing the current play. In this way, you can preselect your next track from the same tape.

Theatre mode, is similar to Radio mode except that, after a track has finished playing, the machine locates and cues the next track. This allows the recording of a sequence of effects coinciding with the stage action and subsequent, sequential playback from a single tape.

Operation here is much like that of

the 2-track machines currently used, but without the usual clicks and bangs and cueing problems. Theatre and Radio modes respond in a similar way when PLAY is pressed (or a fader start initiated).

Overnight mode completes the ASC SV-3900's repertoire. Operation is similar to Theatre mode except that all play commands are expected to arrive via fader start. In this mode, the system requests 'first' and 'last' track number and, once these are defined, locates to the first track and plays until the last is complete. On completion of the sequence, the machine re-cues to the 'first' track and the process is repeated. Hook the fader start to a 'close' contact on a sustaining device, and you can sequence through your preprepared ad breaks for the night. When the day shift arrives, Radio mode can be reselected for 'normal' operation.

A modified SV-3900 is likely to be suited to applications other than those specified by ASC—theme park messages and multimedia presentations, for example—but this is where we leave it. ■

Audio Systems Components Ltd,
1 Comet House, Calleva Park,
Aldermaston, Berkshire,
RG7 4QW. Tel: 0734 811 000.
Fax: 0734 819 813.



Soundcraft DC2000 console

The DC2000 is Soundcraft's latest endeavour in the budget console market and promises to offer features like integrated moving fader technology for a quarter of current market prices. The result of a three year research and development programme, the DC2000 is based around Soundcraft's own moving fader automation system. Soundcraft has developed the proprietary technology in-house, incorporating a custom silicon chip to control the moving fader and the in-house software design. The DC2000 will be the first of many product developments resulting from this technology.

The console is in-line and available in 24 and 32 input versions. Features include 4-band EQ; 2-band sweepable; stereo foldback returns; digital overbridge and touch sensitive

screen to control automated mix functions.

Soundcraft Electronics,
Cranbourne House, Cranbourne
Ind Estate, Cranbourne Road,
Potters Bar, Hertfordshire,
EN6 3JN, UK. Tel: 0707 665000.
Fax: 0707 660482

USA: Soundcraft, 8500 Balboa Blvd,
Northridge, CA 91329, USA.
Tel: +1 818 893 4351.
Fax: +1 818 893 3639.

New mics for Sennheiser

The MKH80 P48 variable pattern condenser is still so new that various aspects of the microphone are the subject of several patent applications. The model is switchable between omnidirectional, wide-angled cardioid, cardioid, supercardioid and figure-of-eight patterns. The MKE102 is a new clip-on radio miniature microphone using changeable

capsules. The SKM5000 UHF hand-held radio mic is Sennheiser's successor to the long serving SKM4031 microphone. Major new features include fully integrated antenna, switchable over 16-channels, new capsule technology and a choice of two condenser capsules with either cardioid and super cardioid patterns.

The SK50 VHF version of Sennheiser's new 16-channel switchable miniature body pack transmitter and the EM1046 VHF, a VHF version of the new 8-channel diversity receiver system. The EM203 is a new 3-channel UHF diversity receiver, using the same true-diversity modules as the EM1046 model.

UK: Sennheiser UK, 12 Davies Way,
Knaves Beech Business Centre,
Loudwater, High Wycombe, Bucks,
HP10 9QY.

Tel: 0628 850811
Fax: 0628 850958.

USA: Sennheiser Electronics Corp,
6 Vista Drive, PO Box 987, Old Lyme,
CT 06371. Tel: +1 203 434 9190.

dbx 266 dual compressor-gate

The US manufactured 266 features two fully independent channels of compression and gating which can be master-slave coupled for stereo operation, along with patented dbx RMS detection and VCA technology, plus new attack and release circuitry which allows the unit to be 'tuned' for different applications. According to JX Loeb, Product Manager for dbx, 'For many musicians the problem with affordable compressor-gates has been that at best, only the compressor or the gate portion of the unit was bad, and at worst, both were musically pretty useless. The compressor circuits generally can't get the smooth dbx sound, or they feature attack and release controls that only really work usefully in a very limited part of their range, and the gate circuits are typically worse — opening late and swallowing

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The HHB 1 Pro is supplied complete with an XLR splitter lead for the balanced XLR mic. input. For failsafe operation, a "Key Hold" switch disables front panel controls. Counter functions include "Program Time", "Absolute Time" and "Tape Counter". The unit can simultaneously accommodate ten dry cell batteries and a rechargeable battery, extending power-up time to up to 4 hours. The HHB 1 PRO is also available as part of "The Kit", along with Sony ECM979 microphone and accessories in a steel reinforced flight case.

A BATTERY OF FEATURES AND A CHOICE OF BATTERIES

transients or closing early and choking off decays or reverb tails.'
AKG Acoustics Inc, 1525 Alvarado Street, San Leandro, CA 94577, USA. Tel: +1 510 351 3500.
Fax: +1 510 351 0500
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Audio Design convertors

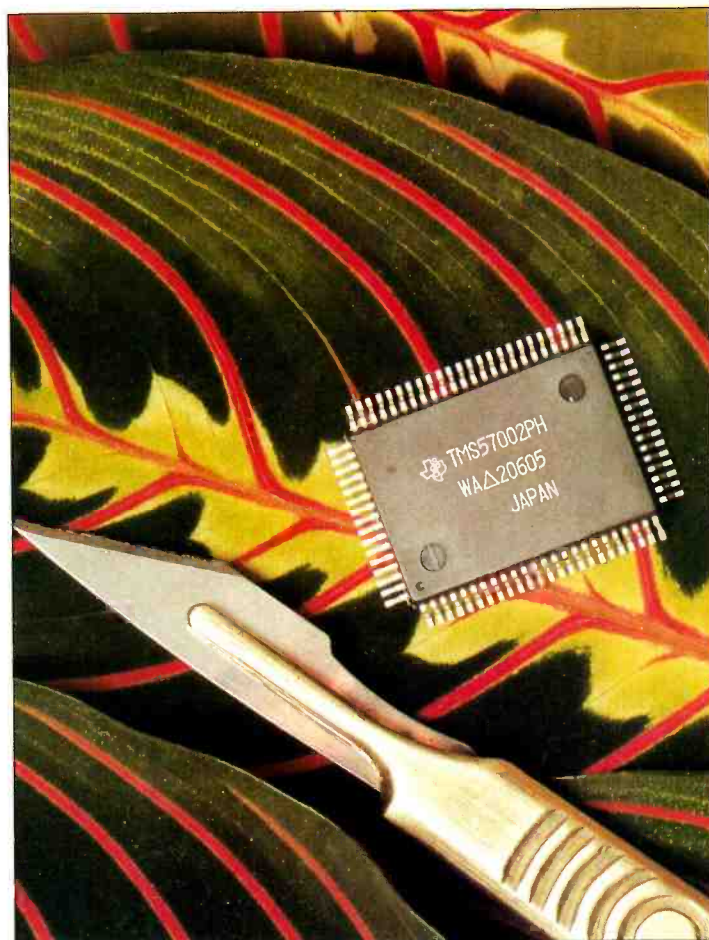
The first of a new range of A-D-D-A convertors have been launched by Audio Design. Two ranges are in the course of development: Extending the *PROBOX* range, will be *PROBOX 9* and 18-bit D-A; while *PROBOX 4*, an 18-bit A-D is expected in April. At the top end of the market will be Audio Design's Reference series 20-bit A-D and D-A devices, scheduled for release later in the year.

The *PROBOX 9* DAC includes an 8x digital interpolation filter followed by an 64x oversampled 18-bit Delta Sigma DAC offering a S-N ratio better than 103dB when referenced to full 16-bit input modulation. The *PROBOX 9* provides a warning indicator that is activated when the input sample rates are outside the acceptable standard ($\pm 4\%$). LEDs indicate incoming frequency, lock, emphasis present and errors which may occur down the line ranging from CRC error, parity error and bi-phase coding error.

Audio Design, Unit 3 Horseshoe Park, Pangbourne, Berks. RG8 7JW, UK. Tel: 0734 844545.

Polar DSP

A new signal processing IC solution incorporating all required to implement surround sound and other digital sound effects has been introduced by Polar Electronics. The Texas Instrument's *TMS57002* DASP is the latest addition to a family of devices, and is designed for use in ►



Polar DSP - the cutting edge?

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 Contact: Finn Juul

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Studiotec
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 Contact: Peter Strahlman

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Denis the Fox
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KEM Electronics O.E.
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 Contact: Thimios Koliokotsis

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 Contact: Daan Vershoor

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 Contact: Mr YT Tan

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 Phone: 02 145460
 Contact: Egil Eide

POLAND

Studio Dave
 Phone: 02 227 5061
 Contact: Bogdan Wojciechowski

PORTUGAL

Soc. Promotora de Comercio Lda
 Phone: 1 692456
 Contact: Paulo Ferreira

SOUTH AFRICA

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 Phone: 11 886 9662
 Contact: Dennis Feldman

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Kash Productions SA
 Phone: 91 367 5222
 Contact: Jim Kashishian

SWEDEN

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 Contact: Mikael Sjostrand

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RTG Akustik AG
 Phone: 061 2721912
 Contact: Thierry Sutter

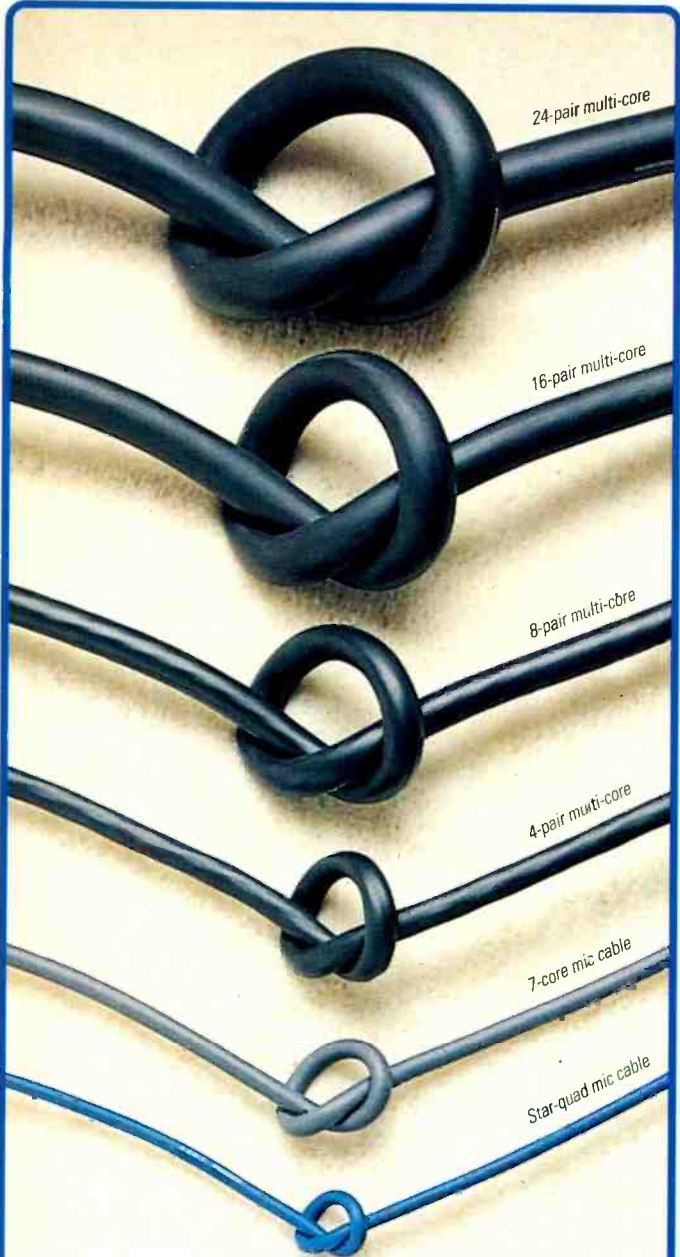
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Colourful news—DAT tapes from HHB

digital filtering, dynamic range control, active tone control and mixer desk applications. The Texas Instruments DASP series is designed to meet the growing demand for features such as speaker response correction and room response correction.

Polar Electronics, Cherrycourt Way, Leighton Buzzard, Bedfordshire, LU7 8YY.
Tel: 0525 377093.
Fax: 0525 378367.

62, 92 and 122 minutes. Every tape includes an adhesive labelling system that conforms to APRS and SPARS guidelines. Stringent design specs and manufacturing procedures claim to dramatically reduce error rates - as well as physical problems such as jamming - to lower levels than ever. As a result, HHB is rating the tape's archive life at a minimum of 15 years. **HHB Communications, 73-75 Scrubs Lane, London. NW10 6QU.**
Tel: 081 960 2144.
Fax: 081 960 1160.

New HHB DAT tapes

Late last month Pro-audio supplier HHB Communications held a press conference to launch their new range of DAT media and to access the state of the DAT marketplace with the help of Chris Hollebhone of Sony Broadcast. Sony's annual sales figures for DAT hardware in Europe have risen above 50,000 machines for the first time since the manufacturer widened distribution of the format in 1989. To date, more than 130,000 Sony DAT recorders have been sold in the European market.

HHB have launched their new DAT range primarily to ensure that DAT media fulfills its professional remit as a fully reliable exchange and archive medium. The range is the first of HHB's 'Advanced Media Products' - and replaces the PQ Professional Series, currently one of the UK's biggest selling DAT tape.

The new tape comes in six lengths, offering recording times of 15, 30, 48,

Sabine Exterminator

The *Exterminator* uses patent technology to automatically eliminate feedback in sound systems and so improve gain without significant degradation. Nine, independent, digital notch filters can be used in either a fixed or dynamic configuration. Because the filters are very narrow the overall audio quality is retained, in contrast to typical wide bandwidth EQ methods. The Sabine *FBX 900* is suitable for installed speech-music systems, touring foldback and F-O-H systems as well as 'normal' PA requirements.

Sabine Music Manufacturing Company, 4637 NW 6th Street, Gainesville, Florida 32609, USA.
Tel: +1 904 371 3829.

Fax: +1 904 371 7441.

UK & Ireland: Shuttlesound, 4 The Willows Centre, Willow Lane, Mitcham, Surrey. CR4 4NX, UK.
Tel: 081 646 7114. Fax: 081 640 7583.

dbx dual mic-preamp

The new model 760X provides two channels of high performance microphone preamplification. Typical applications include direct-to-DAT or sampler recording, field recording and use as a performance upgrade recording, field recording and use as a performance upgrade for existing

microphone preamplifier stages in a mixer.

Each channel of the 760X provides standard professional mic-pre features including gain trim, polarity reverse, 48V phantom power and overload indication.

AKG Acoustics, Inc, 1525 Alvarado Street, San Leandro, CA 94577. Tel: +1 510 351 3500.
UK: AKG Acoustics, Vienna Court, Lammas Road, Godalming, Surrey GU7 1JG.
Tel: 0483 425702. Fax: 0483 428967.

In-Brief

● Cedar's new *HISS-1* Noise Reduction system was launched at Midem in January. As well as the already established noise reduction capabilities, the system includes an integrated 512-node equaliser with two types of parametric EQ, low and high pass filters, band pass, band reject and notching filters, plus Cedar's noise-free equalisation. This allows the user to re-equalise a signal without generating additional noise.

Cedar Tel: 0223 464 117

● Reflexion Arts, now wholly Portuguese owned, have announced the reintroduction of the Model 250 nearfield compact monitor. Sergio Castro MD commented, 'Today there are so many circumstances, particularly in home facilities, studios short on space or in temporary locations, where acoustic treatment is non viable. In such circumstances, a high quality compact monitor at close range can be the best practical solution, though there is no real substitute for good room acoustics. **Reflexion Arts Tel: +34 86 29 21 79.**

● Sony Recording Media have launched two new Hi-8 tapes which have been designed for minimum dropout. The *E5 HME*X series of metal evaporated and the *P5 HMP*X series of metal particle tapes are available in 30, 60 and 90 minute tape lengths. **Sony Recording Media Company. Tel: 0784 467334.**

● London-based HHB Communications are holding plentiful stocks of Philips' own branded 74 minute CD-R media. Retailing at just £18.95 (exc VAT) per disc, HHB is also offering an attractive discount structure for volume customers. Naturally, HHB are continuing to offer 63 minute

blank media at a unit price of £16.95 (exc VAT).

HHB Communications.

Tel: 081 960 2144.

Fax: 081 960 1160.

● Designed for the cost-conscious user the Signex MODPATCH panel uses quarter-inch, 'A' gauge Jack sockets for front and rear connection. The sockets are arranged in two rows of 24 within a standard 1U rack-mounting panel. The design is modular and each channel has front and rear sockets mounted on a discrete printed circuit module. **Isotrack. Tel: 0202 747191**

● A new single chip digital sound field processor to enable the inclusion of Dolby *Pro-Logic* Surround Sound in high-end audio and video products has been launched by Polar Electronics. To facilitate the implementation of Dolby *Pro-Logic* Polar Electronics has introduced the *YSS215*, a single IC which fully implements a DSP-based *Pro-Logic* decoder, and comes with on-chip A-D and D-A converters. In addition, the device can be used in a simulation surround mode, which allows various types of effects to be produced by mimicking both the direct sound as heard by the audience, and the sound reflected back from the surrounding walls, ceiling and floor. **Polar Electronics. Tel: 0525 377093.**

● BGW have introduced the Performance *Series 2* power amplifier, a 2U-high 300W per channel model featuring dual speed forced air cooling; XLR and quarter-inch connections; and a full complement of LED indicators. Five-way binding posts are supplied for speaker connections. **BGW Tel: +1 310 973 8090. ■**

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The advent of MIDI has had a profound and lasting effect upon the drummer. While keyboard players could substitute sequencer manipulation for playing technique, the real virtuosi harnessed the power and controllability of MIDI to launch into a new generation of sounds. Guitarists remained aloof to being replaced by any convincing keyboard substitute and are not really being catered for by the small yet expensive selection of available MIDI guitar controllers. Similarly bass players, most notably with the release of the Peavey *MIDI Base*, can at last fight the replacement of their role by sampled and synthetic sources on their own ground. But for drummers it has all been different.

The beatbox—with its strata of sophistication afforded by the various sequencer-sampler combinations—was first to replace a real-life band member whose equipment was bulky and noisy. It remains strange that many people would not dream of standing in on a lead vocal, guitar solo, or an especially tricky slap-n-tap bass line, yet many will have a go at a keyboard pad and most will certainly feel confident enough to kick up a drum groove on their own. It is equally strange that the same people would acknowledge that real drums played by a real drummer and recorded quickly and on the money, would be preferable to the 'home-rolled' equivalent. The reason for opting for something other than the real thing is usually one of convenience. Real drums and real drummers take up space, are hard to record quickly—particularly if you want something a little different—and can not usually be kept waiting around in a studio while the growing pains of a MIDI-based piece are being thrashed out in the control room.

MIDI drum pads are not new and, while drummers might be content to beat the hell out of rubber mats, ask them what they think of the sound they are getting and the chances are they will say that the subtlety has been lost. And while most keyboard players would now be particularly unhappy to play a single sample-per-note grand piano with velocity tied to an amplitude envelope, this is precisely how the majority of drum samples are played from pads or programmed sequencers.

The Real Drum Company have set about preparing a CD-ROM of drum samples to end all others. They have adopted an approach of sampling



The CD-ROM of drum samples to end all others?

Masterkit drum library

drums that responds to a drummer's touch, and they are proposing that the library be run from a DAC CD-ROM player through an Akai *S1000* triggered from a *DrumKat* MIDI percussion controller. The CD-ROM is compatible with Roland, Peavey and Kurzweil devices as well, and can be triggered from a keyboard or a percussion controller, but it is worth bearing in mind that the controller must be up to the task to get the most of the care, attention and programming that has been put into the sampling.

Rather than go through a blow-by-blow account of the sounds, which amount to more than 300Mb worth, I will relate the theme and the sources. Instead of absorbing memory with a multitude of different and unrelated sounds which have been deployed in multisampling. To give an example, there is a Noble & Cooley Zildjian alloy snare on the disc which has been sampled in four different zones from the edge to the centre of the drum for left and right hands, with five levels of velocity for each hand.

More than £20,000 worth of drum hardware was hired in and recorded at Wytherston Studio and Park Gate Studios. Kits were assembled from highly regarded components, set up, miked and left for all recordings to achieve a sense of consistency within a kit. The aim is after all is to create as realistic a source for the drummer as possible, as opposed to the usual obsession with the search for the biggest snare on the planet.

Consequently the air of realism is frightening with little details like the

slightest kick drum pedal squeak and sympathetic snare rattle on toms left intact.

Left and right-hand hi-hat strikes that progress towards the bell with, of course, velocity multisamples are an indictment of just how uncomplicated the majority of drum samples have now become. Cymbals ring for a minimum of ten seconds and while brushes and more esoteric percussion is planned for future releases, Volume 1 does include a 36-inch Paiste tamtam gong.

The data is organised into three kit types with stacks of cymbals throughout. The Power Kit is a Tama *Cranstar Power Depth* kit with six toms, double kick drums and a choice of Zildjian, Sonor *Signature* and 6.5-inch Ludwig *Black Beauty* snares. The Studio Kit is based around Drum Workshop rim-mounted toms, Drum Workshop and Yamaha kick drums with Noble & Cooley, 5.5-inch *Black Beauty* and Remo piccolo snares. There is also a funk kit with heavily damped Yamaha *9000-Series* toms and Ludwig *Pioneer, Radio King* and 4-inch *Black Beauty* snares. In all instances, apart from some of the kick drums, no EQ is used with workably dry or slight ambience.

While there is a selection of loops and rolls played on the various kits, one-shot template kits for rudimentary pads, General MIDI setups and keyboard maps, the Masterkit library comes into its own when used with a sophisticated percussion controller. Here the care that has gone into the programming becomes apparent. Thus a minimum

of 32Mb of sampler RAM are required to get the most out of it, although prudent use of memory can give workable results with considerably less.

More important than the financial investment required to realise the full potential of *Masterkit* is the freedom that it gives a drummer compared to the sort of cost that the constituent percussion sampled on the CD-ROM would cost. Armed with the portable package of a CD-ROM drive, Akai sampler, KitKat pads and the library, a drummer will at last be able to record in a control room or any other small space straight to tape or into a sequencer in the knowledge that the sounds will be of high quality, reproducible and will reflect technique and nuance faithfully. This will be of particular benefit to session drummers who can be up and running even more quickly than normal.

There can be no doubt that *Masterkit* is a major advance in drum sampling that effectively reintegrates the drummer into the band. I believe records will be made using this approach and given its best shot through a good desk by a good engineer, there is no reason why the results should not be excellent. While it would be misleading to state that the *Masterkit* samples are indistinguishable from the real thing, they are currently about as close as you can get. ■

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Music News is compiled
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NAMM IN 1993

Paul D Lehrman reports from the American NAMM show on some of the latest developments in digital audio recording, processing and MIDI.

The January meeting of the National Association of Music Merchants (NAMM) was in some ways a surreal affair. Despite the lyrics of the song, it rained in Southern California for the entire duration of the show, and tornadoes, mud-slides, and flash floods were reported uncomfortably close to the Anaheim Convention Centre where the show took place. For those in the industry who look forward to their annual week of sunshine in the middle of January, it was soggy, depressing, and disappointing, and if those attending did not arrive with head colds, they certainly left with them.

But what went on inside was hardly disappointing. It was the biggest show ever, and from the standpoint of new products, many were saying it was one of the most interesting shows in years. For an industry that has slowed its pace considerably in the recent past, it was a welcome lift.

Hard-disk audio

Not surprisingly, hard-disk recording led the way in terms of interesting new gear. Akai's *DR4d* was being touted as a 'digital *Portastudio*', not because of its appearance—it is an impressive four units high, with alpha wheel, autolocator, and plenty of buttons—but because of a price of less than \$2000. A 4-track device, it uses standard SCSI hard disk units for storage, and a second SCSI bus can be added for computer control. It uses 18-bit converters, and has two channels of AES-EBU I-O in both professional and consumer formats, with a second pair of channels available as an option. As many as four units can be slaved together for 16-track operation, and up to 2Gb of storage can be addressed. Availability is promised for summer.

Another new Akai product crosses the line between samplers and hard-disk audio. The *S3200*, one of five samplers the company introduced at the show, is a 32-voice, 16-bit, MIDI-controlled sampler with a twist: it can record and play sounds directly to and from hard disk (not supplied, but any SCSI disk will do) as well as RAM. The unit also reads and writes SMPTE time code and has a built-in list editor for SMPTE-based event cueing. Delivery is slated for March, and price will be \$6395.

ART, the American signal processor and mixer manufacturers, are also diving into the fray. Their *DR-8000* 8-track tapeless recorder-editor was on display in a special section of the booth open only to authorised dealers and press. The company are not saying what kind of storage medium is being used, but whatever it is, it handles 160 track-minutes. It has digital and balanced

analogue ins and outs, visual waveform editing with an optional mouse, monitor, and keyboard, and makes extensive use of both MIDI time code and MIDI Machine Control. Up to three expansion units, with eight tracks each and their own internal storage, can be added. The price will be 'comparable to [digital] tape-based systems', and they plan to have it out by late in the year.

Yamaha have entered the field with the first American showing of their *CBX-D5*. It is a platform-independent stand-alone 'recording processor', which depends on a personal computer for its front end, and on SCSI drives for storage. It records two channels, from either analogue or digital inputs, and plays back four, and has word clock synchronisation built in. It includes digital EQ, and can also function as a real-time effects processor. Two units can be ganged together without additional connections to the computer, or even an additional hard drive. Delivery is scheduled for March, and the price is about \$3000. A number of manufacturers have already jumped on Yamaha's bandwagon: exclusive one-year agreements for front-end development were announced by Mark of the Unicorn for *Macintosh* computers, and by Steinberg for Atari and *Windows* PCs.

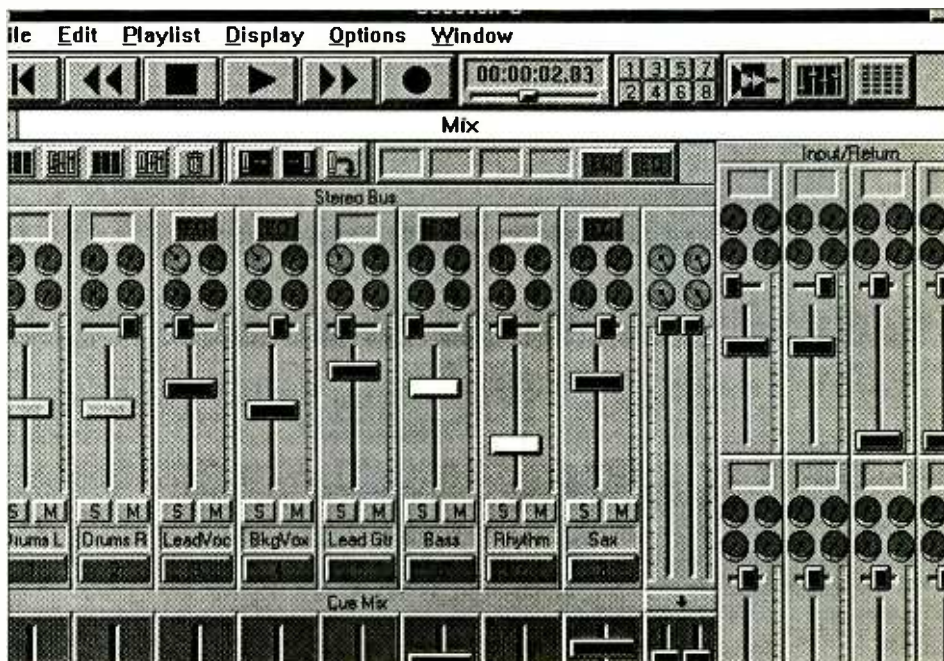
The Canadian mass-storage company *DynaTek* were touting their wide range of products' compatibility with the Yamaha system, as well as with just about everything else. *DynaTek* are the latest disk drive manufacturer to target the music market (others in the past have not been particularly successful), and they appear to be serious: 7% of their sales are for music and audio, a spokesman said. Their line includes fixed, Syquest, and magneto-optical disc drives, as well as streaming tape drives, all specially designed to put up with the rigours of the road. They sport front-to-back ventilation for rack-mounting,

universal power supplies, and steel casings. The company claim they took the extraordinary step of actually buying various samplers and recording systems to test them out before announcing their gear's compatibility with them. Their distributor in the UK is Key Audio.

At the Atari booth, the new *Falcon 030* computer was the centrepiece. It features an onboard Motorola 56001 DSP chip for 16-bit, 50MHz stereo audio, and a SCSI2 interface for fast hard-disk data transfer. Among the first of the audio manufacturers to take advantage of it is British company D2D. They were showing a software-only version of their audio recording and editing system, which promises to provide a lot of power at a very reasonable price—well under \$500 per program. Digital F/X, the California company that absorbed Hybrid Arts and WaveFrame, were showing more elaborate four-channel/16-track synchronisable systems using external hardware.

One of the busiest booths at the show, despite its location in the Convention Centre's new and inconveniently located Hall E (also known as 'the basement in the back'), was *Digidesign*'s. Not a company well known for keeping secrets in the past, they managed to catch a lot of people off base with their announcement of *Session 8*, a \$4000 8-track system for (surprise) *Windows*-based computers—it is their first product for the PC platform. The system consists of two cards, one for audio and the other for control, and a stand-alone box containing analogue and digital inputs and outputs, four assignable analogue inserts and three effects buses, and a 10 x 2 analogue submixer. Lest you think that is too much analogue, digital mixing and routing is also a major part of the design, with comprehensive, highly intuitive software to handle it all, as well as graphic waveform editing.

A remote controller with nine sliders, four ►



Digidesign managed to catch a lot of people out with their *Session 8*

knobs, and a couple of dozen buttons will be available in a few months. A 'Pro' version, the *Session 8 XL*, features balanced audio I-O, and includes two Audio Interfaces, the same converters that are shipped with the company's *Pro Tools* system. It costs \$6000. Delivery of the two versions was to start imminently, and a *Macintosh* version is promised for the autumn.

Digidesign also announced an agreement with **Alesis** to develop an interface that will allow real-time, synchronised transfer of multichannel digital audio between the former's hard-disk systems and the latter's ADAT recorder. No model names or prices were revealed, but the

announcement indicates that both companies seem to think that the future of digital recording will encompass both tape and disk.

Tape: digital and otherwise

Tascam had on display working versions of both their *RA-4000* disk system and their *DA-88* 8-track digital cassette deck based on Hi-8mm technology, both of which are scheduled for

shipment by the time you read this. The 8mm format allows the tape to run at near-normal speed (unlike S-VHS systems, which run at three times normal), which the company says can mean significant advantages in tape cost, convenience and, because high-speed shuttling operations are faster, session costs.

Behind a curtain at the **Fostex** booth was a mock-up of their S-VHS-based digital 8-track which, as previously announced, will be compatible with ADAT. The machine will feature a built-in synchroniser, with SMPTE and word clock read-write. The sync information will be placed in the helical scan signal, which should help make recordings more robust than Alesis's method, which places it on the linear control track of the tape. The price will be 'competitive', and shipping is scheduled for the second quarter of 1993.

It is not digital, but Fostex were also showing a very slick 4-track analogue cassette-based production system in their *GT-10* 'multimedia recorder'. Fostex have managed to squeeze a SMPTE track onto the tape between audio Tracks 2 and 3, and are using MIDI Machine Control to operate the device from a computer front end, which can also play MIDI sequences at the same time. The hardware and software are designed to interface with the company's *DMC-100-Mixtab* automated mixing system, to create an integrated low-cost MIDI-with-audio studio. The cost of the recorder is around \$1200.

Mixing and processing

NAMM is not the place for high-end console manufacturers to hawk their latest wares, but things at the low end are getting mighty sophisticated.

Alesis were showing their first large console, the *X2*, which features 24 main and 24 tape-input channels, eight submasters, six auxiliary and two cue sends, and eight stereo returns. Each channel has balanced XLR and jack inputs, and there are also three sets of 8-channel ELCO mic connectors. Each input has 4-band EQ, the middle two bands of which are fully parametric. A built-in automation system provides 99 programmable mute memories, which can be triggered from SMPTE, MIDI time code, or directly from the sync output of an ADAT. The price will be \$6,495 and availability is expected around the end of the year.

Mackie Designs had a fully working version of their long awaited 8-bus board, and announced that finished units will start 'trickling out' in March, with full production slated for April. They were also showing their new OTTO automation system for the *CR-1604* mixer, which will be released in March. It uses a daughter board that goes inside the mixer and a MIDI breakout box for communication. The *Macintosh*-based software, which is both MIDI Manager and Opcode MIDI System-compatible (but requires neither), can handle up to three mixers simultaneously, with six independent fader subgroups and six mute subgroups. It provides both snapshot and real-time mix control, with 33ms resolution for ►

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Akai's DR4d was being touted as a 'digital Portastudio'

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fader moves and 8ms resolution for mutes. The whole system costs \$799 (excluding the mixer). The board's existing faders are not used when the automation is turned on, and so an external Fader Pack will be available—no price yet. In the meantime, any slider box that generates MIDI continuous controllers will do fine.

Lexicon's *NuVerb* is the first of what promises to be many professional audio signal processors on a computer card. It puts the rough equivalent of a *Model 300* onto a *Macintosh NuBus* card, with facilities either for stand-alone operation or running in conjunction with Digidesign's *Pro Tools*, using the latter company's new high-speed TDM data bus. Software is provided that gives each program five 'hot' parameters which can be adjusted on the screen; according to a spokesman, this should encourage users to experiment more with real-time control over the processing algorithms. Price will be about \$1,800, and it should be available in April.

AKG announced a line of new processors under the dbx name that they say provide the sound quality associated with the company's older products, but with greater flexibility and at greatly reduced prices. The *Project 1* series includes the *model 266* dual compressor-gate, which adds attack and release time controls to the old *166* design, at \$299; the *274* four-channel expander-gate at \$449; and the *296* stereo spectral enhancer, which provides separate controls for low and high-frequency detail as well as hiss reduction, at \$349.

MIDI, sync and synthesis

Mark of the Unicorn announced smaller, cheaper versions of *MIDI Time Piece* for both the *Mac* and the *PC*. Besides being multiport MIDI interfaces with up to 96 MIDI channels, the new *MIDI Express* models include software-based merging, filtering and routing, as well as SMPTE generation and MTC conversion, with adjustable flywheeling. The *Mac* version has four independent MIDI Ins and six Outs, and includes a 16-scene memory with front-panel selection controls. It will sell for \$349. The *PC* version has six Ins and Outs and connects to the computer via an internal card. It includes a *Windows* Multimedia Extension software driver for using the unit with any *Windows*-compatible MIDI programs. Price is \$295.

The company also started a chain of events whose outcome was still unknown at press time, but which potentially bodes extremely well for all *Macintosh* MIDI users. The opening salvo was the announcement by Mark of the Unicorn of Free MIDI System, a multiport, multiapplication system-level software program, that would accomplish the same objectives as Opcode Systems' well-established Opcode MIDI System (OMS), but would be available to developers absolutely free, rather than through the sometimes expensive licensing agreements that ▶

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A Mac version of *Session 8* is promised for the autumn.

Opcode require.

The prospect of two competing systems sent the *Macintosh* music community into a mild panic, and a hastily called meeting was held on the second night of the show, which included most of the major music software providers (some of whom have not even announced *Macintosh* products as

yet) as well as Apple Computers, whose own MIDI Manager—yet a third system that programmers have to deal with—has suffered from arrested development. An official statement from the meeting is still being formulated, but it is likely that agreement will be made on a single system which will be available to all comers, with few or

no restrictions, thereby making it much easier for programmers to create products that will talk to multiple MIDI streams, as well as each other.

Another new product from **Digidesign** is *Sample Cell II*, the successor to their popular sampler-on-a-card for the *Macintosh*. The new model addresses most of the problems early users complained about: it can take up to 32Mb of RAM, has on-board digital filtering, and loading time has been significantly reduced. The price is the same as the older version—\$2,000 (without any RAM)—and shipments should start in March.

Also of interest was a working version of **Alesis's** (these folks are ambitious) entry into the synth market, the *QuadraSynth*. Structurally it bears some resemblance to the old Oberheim *Matrix 12*, with its complex routing and modulation system (it was designed by some of the same people), but it uses 16Mb of sample ROM for its sound sources. It has 64-voice polyphony, and four independent on-board effects processors. All that for only \$1,495 for the 76-note keyboard version, or \$995 for a rackmount module. Shipments are scheduled for early summer.

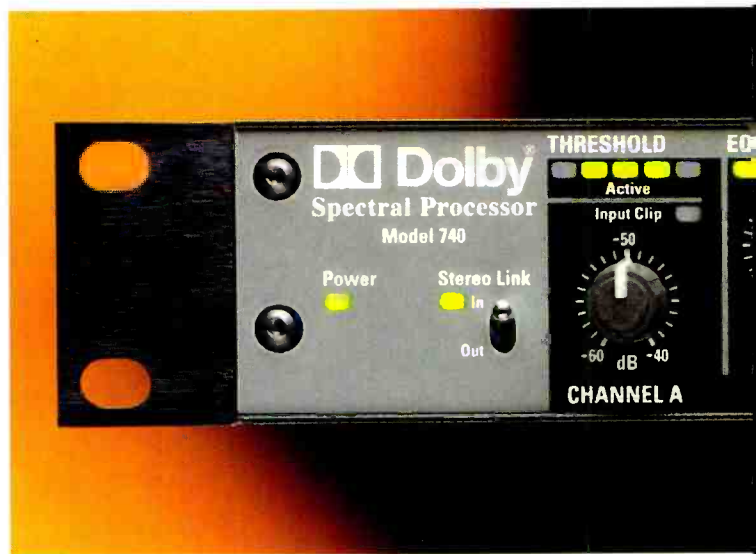
Waldorf Electronics, the German synthesiser manufacturer, were giving an impressive demonstration of their new *Wave* to enthusiastic crowds. The instrument is highly performance-orientated, and boasts eight programmable faders,

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nine increment dials, 27 buttons, and 53(!) knobs, all of which can be used to modify internal sound parameters in real time, or to broadcast MIDI System Exclusive messages. These messages can be aimed at other MIDI devices, so a fader, for example, can be programmed to open and close a filter on another synthesiser or sampler. The various controls can be grouped so that multiple sounds can be edited in parallel, and-or multiple parameters of a sound can be controlled by one knob.

The engine is built on a principle called Dynamic Spectral Wavetable synthesis, and the unit contains 128 wavetables, each of which has 64 'slices'. Sixteen voices can sound simultaneously, and expander modules will be available to take it up to 48 voices. There are three pairs of stereo audio outputs, plus a stereo send, and two independent MIDI Outs. A built-in disk drive is MS-DOS compatible. Shipments are scheduled for March, and the US price is \$7,900.

Perhaps the most startling news at NAMM from the world of synthesis was the announcement that **Creative Labs**, the Singapore-based company that has quietly been making millions of dollars with low-end computer sound cards like the *Sound Blaster*, bought E-Mu Systems, one of the oldest and last American-owned synthesiser manufacturers. E-Mu had been

working with Creative Labs to provide a high-quality General MIDI sound chip for multimedia applications, but the extent of their negotiations was a complete surprise to outsiders.

Meanwhile, **E-Mu** introduced a Vintage Synths version of their *Proteus* sample-playback module, which includes sounds from a host of old and new electronic instruments. An impressive display of old synths, arranged Keith Emerson-style, was on hand to promote the product, and picture-taking sessions for those of us old enough to remember those beasts were held on the hour. A long hippie wig and granny glasses were thoughtfully provided to complete the illusion.

TimeLine, the California synchroniser manufacturer, do not consider NAMM their primary show when it comes to introducing product, but they did have one new item which will be of great interest to video postproduction studios. It is a VITC reader card for their *MicroLynx* system, with automatic or manual line selection, and seamless switching between longitudinal and vertical time-code reading.

And finally, in the 'We don't know what it's for, but we'll find something' category was the *Janus* machine, developed by a couple of young graduates of the Massachusetts Institute of Technology who call their company **IX Development Technologies**. This little one-

control box lets anyone play or sing backwards, live. Its actually a sampler, with up to 2.5s of memory, that immediately spits out in reverse direction anything that is played into it. There is a very clever algorithm at work to prevent glitching, and after you get over the disorientating effect of the machine, it turns out to be a great deal of fun. The designers see it being used both on stage and in the studio, and the projected retail price is about \$1,000.

It is impossible to say whether they will be successful, but as the music manufacturers who started in someone's basement ten years ago become multimillion dollar international concerns, it is encouraging to see that the real process of invention and creativity has never stopped: there are still small startup companies who see opportunities for themselves in the industry. We need them as much as they need us. ■

PAUL D. LEHRMAN was the creator of the world's first all-MIDI album as well as having worldwide composition credits for film, radio and television, and has been on the Executive Board of the MIDI Manufacturers Association since 1991. He presently teaches courses in computer music at the University of Massachusetts-Lowell and is co-author of the forthcoming book *MIDI For The Professional*.

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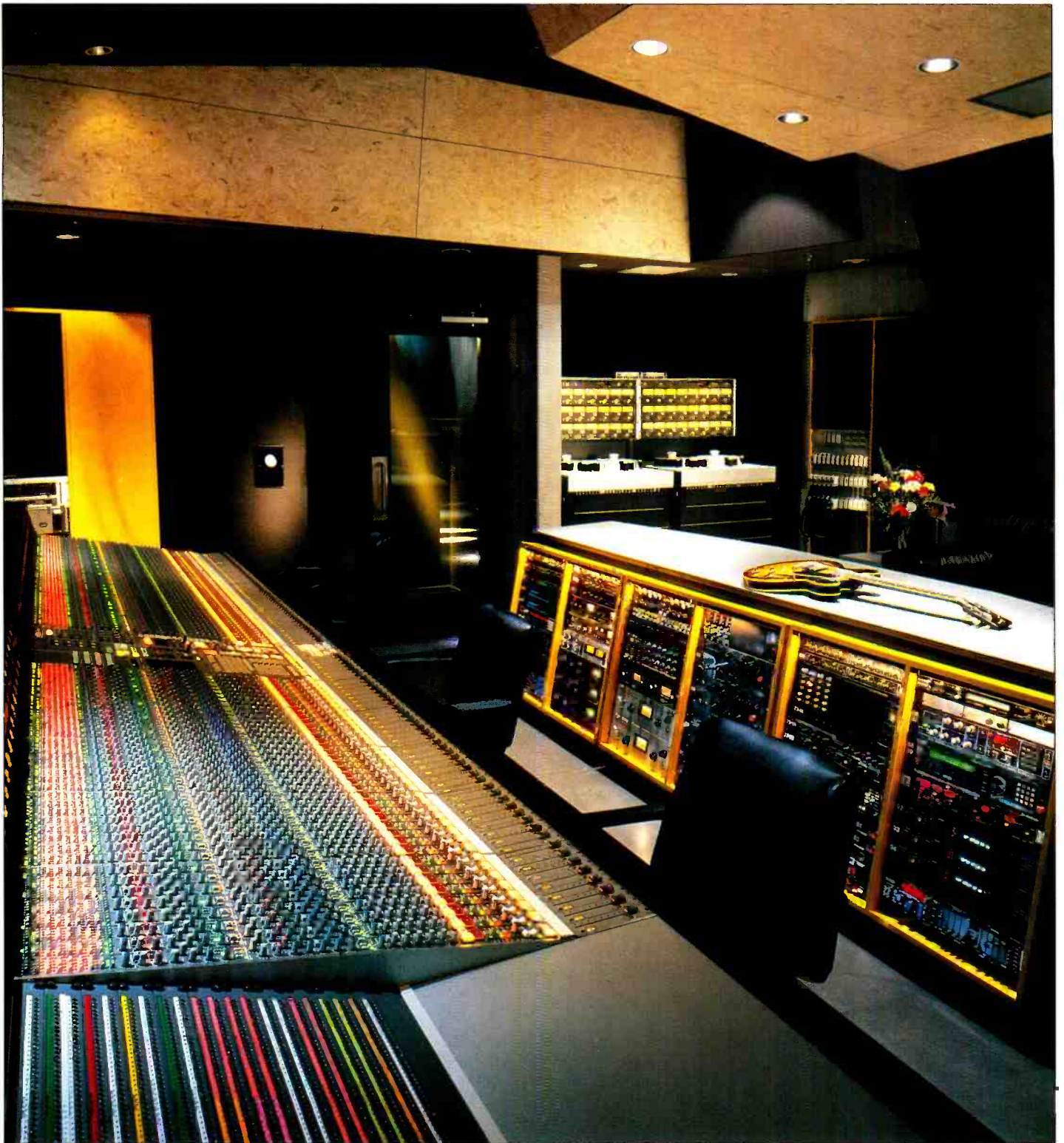
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Side view of SSL1, which houses a 96-input Solid State Logic *SL-8000 G Series* console with *Ultimation*, one of the two largest SSL consoles ever to be installed in an audio facility. The control room measures 23ft x 20ft and is supplemented by a 14ft x 12ft vocal booth

IN PHASE

The extension of the LA Record Plant studios has been dubbed 'Phase II' —Alan di Perna calls it a state-of-the-art recording and production facility for the 1990s

A new chapter in the long and eventful history of the Los Angeles Record Plant began in January of this year with the completion of an ambitious, four-million-dollar upgrade to the facility. Dubbed II, the expansion adds two new state-of-the-art studios to the premises: a mix suite equipped with a 96-input SSL *SL-8000 G-Series* console and a large recording-scoring room outfitted with a 96-input Neve *VRSP Legend* console. These new studios, along with the Record Plant's two previously existing rooms, are complemented by a spacious new atrium lounge area equipped with jacuzzi, billiards table and all the other amenities. Completed under the supervision of architect Peter Grueneisen of LA design firm studio bau:ton, the upgrade has transformed the historic studio into a stylish, luxurious 1990s workplace.

This five-star ambiance is a key element in the operating philosophy of the Record Plant's new owner, Rick Stevens. Formerly president of the Summa Music Group publishing firm, and a man with experience in both artist management and A&R, Stevens decided the new Record Plant would buck the trend toward austerity that has characterised the LA studio business during the lean-and-mean '90s.

'The Record Plant has historically catered to top-echelon rock and roll stars,' says Stevens. 'I very much wanted to continue in that tradition because that's the only segment of the studio business where you're competing on the basis of client service

rather than rates. So many studios in the LA market are competing to offer slashed rates right now, and that's why many of them are struggling. I just realised that most stars come down a notch in their life when they walk into the average recording studio. If they're in from New York or London, they're staying at the Beverly Hills Hotel or the Mondrian or Bel Age, where they're used to a high calibre of service. I wanted to bring that same level of service into the studio. That's what makes us different.'

Background

In many ways, Stevens' words echo the thinking behind the original LA Record Plant, which first opened its doors in 1969, offering a hip alternative to the stodgy label-owned studios and ageing Hollywood independents of the day. Record Plant founders Chris Stone and Gary Kellgren were two young entrepreneurs uniquely attuned to the rising new breed of 'underground' rock star. Under Stone's leadership, the Record Plant became a premier LA recording facility. In 1986, Stone closed the original Record Plant site on Third Street and opened the present-day Record Plant on Sycamore Avenue. Located amid a cluster of Hollywood film facilities, the building that today houses the Record Plant was originally an annex to the historic Radio Recorders. Stone converted the structure into a top-flight, two-studio facility geared to handle a diversified blend of record and film work. In 1989, Chrysalis Records purchased the Record Plant from Chris Stone and ran the studio for several years before selling it to Rick Stevens.

When Stevens acquired the Record Plant in June of 1991, he became the proud owner to two fine Tom Hidley-designed studios. 'But it became evident that a major renovation was ▶



View of NEVE 1, which houses a 96-input Neve *VRSP Legend* console with GML Moving Fader automation and recall. Each of the two new studio suites functions as a self-contained environment with private lounge, bathroom and kitchen, as well as control room and recording areas



View of SSL1, showing outboard rack located behind SL-8000 G series console, and tape machine soffits

G-Series console with a *G-Series* automation computer and a combination of *E* and *G-Series* EQ modules. Both SSL II and Neve II have 25-inch video monitors in their control rooms and projection TV systems in their tracking rooms.

The two new studios—Neve I and SSL I—are also on the

right-hand side of the corridor, more toward the rear of the building. (The dimensions and equipment of these rooms are detailed below.) The right-hand corridor wall also contains a staircase that leads to second-story offices and the space that houses the Record Plant's four *EMT 140* echo plates (two tube and two solid state).

'One of the big logistic problems of the Phase II upgrade was that the studios are all so close to one other,' Peter Grueneisen notes. 'Three of the rooms are only separated by walls. There are no corridors in-between. So we had to build very heavy walls with many layers between the studios. One of them is made out of five independent wall structures, each constructed of wood framing, metal studs, plywood, lots of leaded dry-wall and plenty of air spaces. Each layer floats on rubber mounts. There are no hard connections anywhere: no screws or bolts.'

Grueneisen also deemed it necessary to take out the concrete floor slab in the rear portion of the building to avoid the need for cumbersome access ramps. This offered an acoustical advantage, since it enabled the architect to design floating floor slabs for both the new studios, decoupling them from the other rooms for further acoustic isolation. In addition, adds Grueneisen, 'the air conditioning was redesigned from scratch for the back part of the building, so that there are individual units for each of the rooms. It is all designed to minimise transmission of sound from room to room. There were some cases where we had to put two rooms on one air conditioning unit; but in those instances, we put in muffler boxes and an elaborate system of ducting to make sure no sound travels from one room to the next.'

Another important goal was to achieve maximum 'plug-in-and-play' compatibility among the four rooms, allowing audio, video and synchronisation hardware to be easily patched into any of the studios and ready for action with a minimum of hookup time. The interface design for the whole facility is the work of Ron Lagerlof, the former VP of operations and engineering at Lucasfilm's Skywalker North facility and now head of his own consulting firm, Visioneering Inc. Lagerlof provided each studio with two machine bays, each with ample Alco connectors for patching in multiple audio and video tape machines over and above the room's stock machine complement (see below).

'The interfaces were designed to conform with the existing two studios,' Lagerlof explains. 'Also, while each room is completely self-contained, there are audio and video tie lines among all the rooms, as well tie lines for certain aspects of machine control. Everything is designed in such a way that you can interface the rooms without getting noises and ground loops.'

To satisfy the latter requirement, Lagerlof designed a star grounding (earthing) system for the studios: 'Everything's done in an isolated fashion,' he says. 'There's provision for a separate

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View from Neve 1's spacious recording area, through the window into the main control room. The doorway to the left leads into a voice-over booth and thence to the main studio suite entrance. Above the control room is a private artist lounge

clean ground that can be connected to the console in each room if necessary. But so far that hasn't been necessary, because the AC grounding is so well-distributed.'

And although the Record Plant is—as its name implies—primarily a record house, it is also equipped with mix-to-video facilities for those record clients who might have to do special mixes of their music for film soundtracks, videos and so on. For this reason, distributed house video sync is provided in each room, says Lagerlof, 'to ensure a clean, consistent sync source

for all of the synchronisers, digital tape machines or video tape machines that come into the room.'

Equipment overview

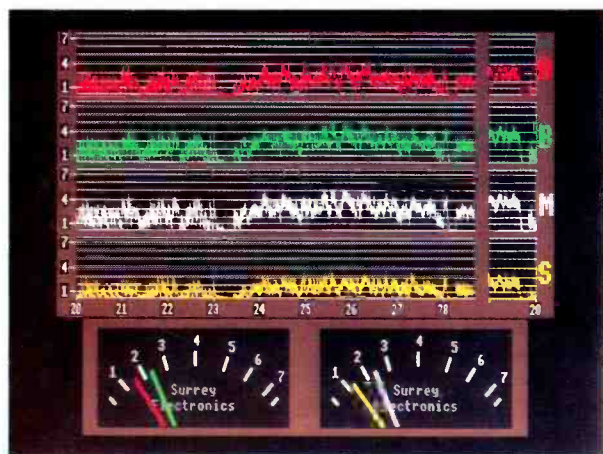
Both the new studios feature identical custom George Augspurger monitoring systems consisting of left, centre and right enclosures. The enclosures are loaded with TAD components: two 15-inch drivers and a 2-inch horn. The high-end components are driven by *Boulder 500* power amps. Australian *1K2* 1.5kW power amps are used on the low end. A modified White Instruments *4000 Series* 1/3-octave EQ-crossover completes the system. JBL *8330s* are used as surround sound monitors for the rooms' Dolby stereo matrix encoding units.

The two older studios have the exact same power amp/crossover/room EQ configuration, installed during the initial three-week upgrade of the Record Plant's facilities when Stevens acquired the studio. In the older rooms, however, the amps drive custom Hidley-Kinoshita monitors and JBL *4312* surrounds. In all four studios, Yamaha *NS10Ms* and Auratones are the standard nearfield monitors; KRK, Tannoy and AR nearfields are available on request. The smaller monitors in each studio are driven by Krell stereo power amps.

The standard tape machine complement for each studio consists of two Studer *A800 MkIII* analogue 24-track machines, vintage Ampex *ATR* half-inch and quarter-inch machines, two Panasonic *SV-3700* DAT machines, two Panasonic VHS Hi-fi VCRs, two Nakamichi *MR-1* cassette decks and one Rotel *955AX* CD player. The Record Plant has a Sony *PCM-3348* digital 48-track machine, a Mitsubishi *X880* digital 32-track and several Studer *A820* analogue 2-tracks that are allocated to the rooms on a floating basis. Additional digital multitracks and other ancillary machines are hired in as needed. The machine bays in each studio are designed to accommodate up to two additional 48-track machines without having to disconnect any of the standard tape machine complement.

Synchronisation is provided by TimeLine *Lynx* modules (one per machine). ▶

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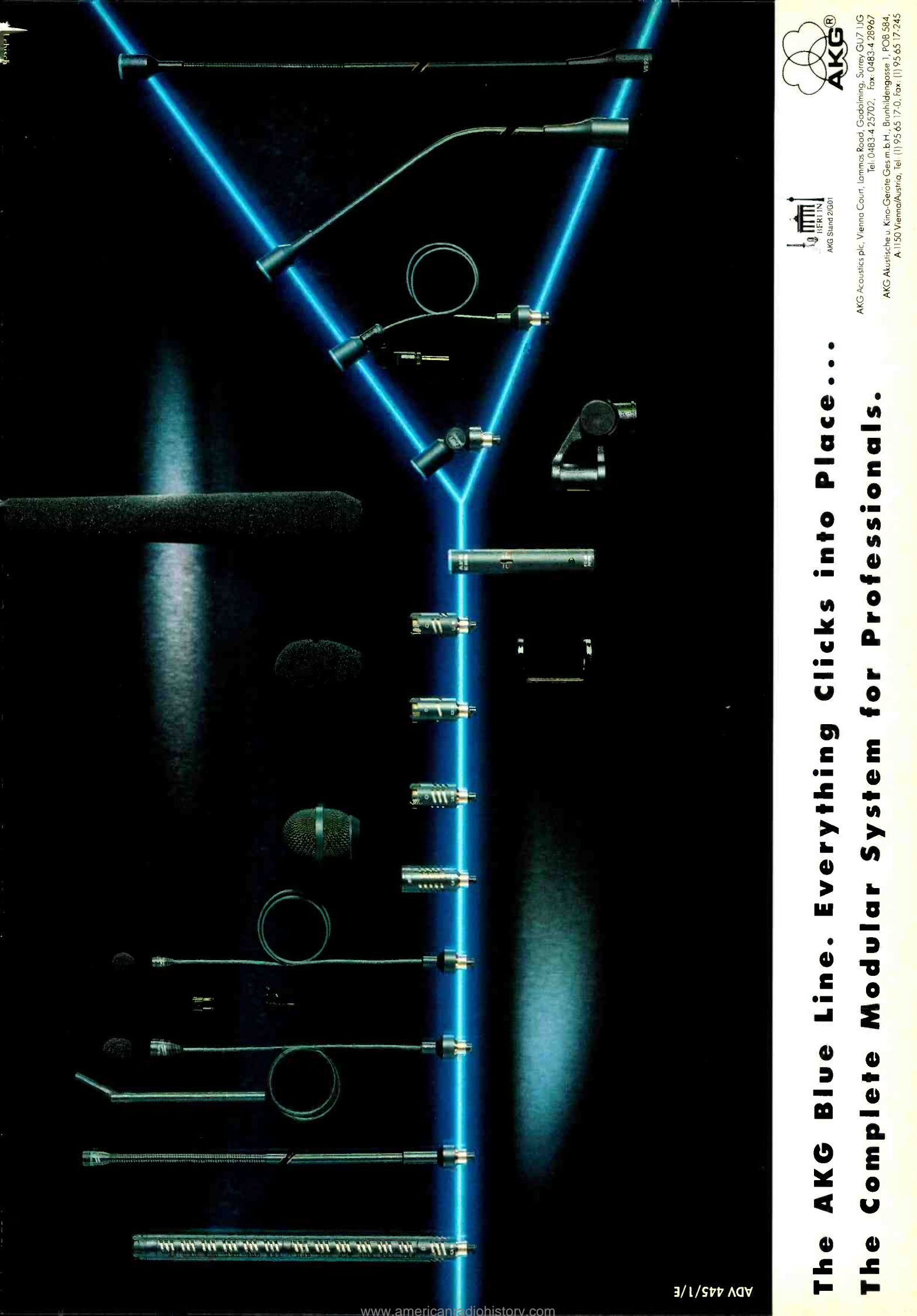
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'The *Lynxes* run in stand-alone mode,' explains Ron Lagerlof. 'The console's on-board machine controls are used to drive the machines, which simply chase-lock via the *Lynxes*. But the rooms are also pre-designed to run with other master control systems, such as a *Lynx* Keyboard Control Unit running the *Lynx* modules in VSI mode. We can accommodate control systems like that, as well as any system that operates on the RS422 [computer interface bus]. There's 422 machine control throughout the rooms.'

The Record Plant boasts an exceptional selection of microphones and outboard equipment, including a fine cache of vintage gear. Much of it comes from the stock of Livingstone Audio, the old Record Plant's satellite rental company. On acquiring the Record Plant assets, Stevens decided to distribute the Livingstone wealth among his four rooms. Thus the equipment rack in each studio comes with a generous selection of Pultec EQs, Fairchild limiters, UREI LA-2As and 1176s, as well as a good supply of modern gear including Drawmer gates, GML 8200 EQs, Lexicon 480 SLs and PCM 70s, Eventide H3000s, AMS RMX16s, dbx 902s and Yamaha SPX90s, 900s and 1000s. Other pieces, such as the Record Plant's EMT 250 and 251 and its two Fairchild 770s float from room to room.



Detail of part of SSL I's outboard rack located behind SL-8000 G-series console. The impressive collection of new and vintage outboard equipment includes Pultec equalisers and Fairchild compressor-limiters

SSL I

SSL I, the Plant's new mix-overdub suite, was the first of the two new studios to be completed—Prince was the room's inaugural client. The centrepiece of the new mix suite is a 96-input SSL SL-8000 G-Series console with *Ultimation*, one of the two largest SSL consoles ever to be installed in an audio facility. SSL I's control room measures 23ft x 20ft and is supplemented by a 14ft x 12ft vocal booth. The design of the room is based in part on the in-house mix room at Summa Music.

'We knew we wanted the console to be very close to the front wall by conventional standards,' explains Rick Stevens. 'That is a formula we just lucked onto in the Summa mix room because space was limited. But the room became a very successful facility when we opened it to outside clients, so we decided to stay with that basic Summa formula in SSL I. With the board that close to the front of the room, we knew the large room monitors would be functioning almost as nearfields. We wanted the front of the control room—say up to the outboard gear rack—to be very neutral acoustically.'

Implementing this idea took a certain amount of design finesse, since SSL I is significantly larger than the Summa mix room. Also, a 96-input mixing console is a rather lengthy ▶

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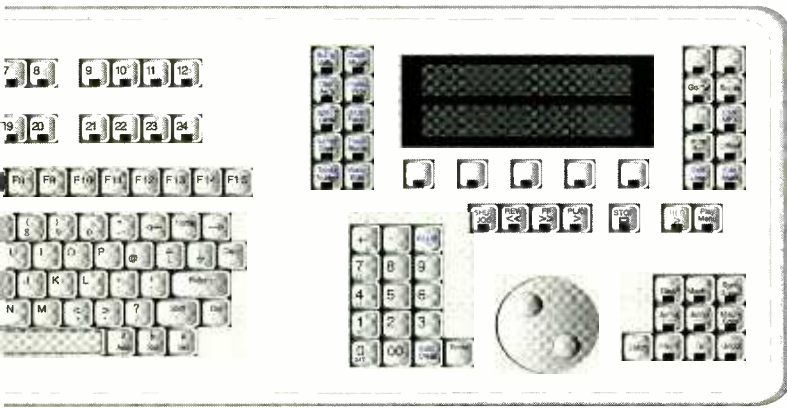
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piece of gear, so it was necessary to maintain a fairly wide 'sweet spot' in the main mix position. Peter Grueneisen worked with George Augspurger and Steve Brandon in designing and fine-tuning the room acoustics. What worked out best, says Grueneisen, 'was to have a soft front wall with fabric on it and RPG diffusers in the rear wall. Monitor placement was critical too.'

The room's Augspurger monitors are mounted in wooden soffits. 'We made soffits that were bigger than the actual speaker enclosures,' Grueneisen explains. 'This way, we had room to adjust the position of the monitors. Once we found precisely the right position, we filled in the gap around each monitor with sand and closed up the soffit. The sand really helps anchor the monitor and helps provide isolation. There's also lead around the loudspeakers, a heavy layering of plywood, a material called MDF (medium density fibreboard) and lots of dry-wall. By making the speaker soffit larger than the speaker we not only provide leeway for positioning the monitor with maximum accuracy, we also give the clients more options for the future.'

The video facilities in SSL I are no less impressive than the audio gear. The front wall of the control room houses three video monitors. The central monitor, a 50-inch rear-projection Mitsubishi 5017-S is mainly intended for mix-to-picture applications. It is flanked by two smaller Mitsubishi AM-2752 video monitors which are set up to provide a variety of displays—everything from local cable TV programming to *Ultimation* and *Macintosh* display screens. Many of these functions can also be displayed as a picture-in-picture window in the lower right-hand corner of the big 50-inch monitor.

'There's a video switcher in the console,' explains Lagerlof, whose Lucasfilm experience made him an ideal person to design the Record Plant's visual display facilities. 'You can select any of four different inputs to that video switcher, be it the cable box, a VHS machine, laser disc or some other video device, such as a 3/4-inch video machine parked somewhere in the room. Alternately, you can switch to RGB mode and the display reverts to the computer screen—either the *Ultimation* or any

other computer display you care to patch in.'

NEVE I

Neve I, the second new room at Record Plant is designed to accommodate a wide variety of tracking, scoring and mixing projects, including mixes to video. 'Knowing we were going to wind up with the largest Neve on the planet, we estimated that probably 70% of our business in that room would be mixing,' says Stevens. 'But because it is a Neve board, we knew people would want to track in there as well; we wanted to accommodate that kind of clientele too.'

Responding to the need for a versatile, good-sounding tracking space in Neve I, Peter Grueneisen designed a 25ft x 40ft room with a sloping ceiling that reaches a height of 35 feet. Room acoustics are fairly live. 'That's the way we like to do all our rooms,' says Grueneisen. 'We feel that's the trend. Also you can always deaden a live room very easily by using drapes. But when a room has been built dead, it's very hard to make it live.'

A large portion of the walls are surfaced with wood panels: 'A substance called strand board,' Grueneisen elaborates. 'It's a very economical material that we treat in a special way by sanding and then staining it. And then we used concrete acoustical blocks in the back corners of the room. Those are raw concrete blocks with slots in them that make them act as acoustical resonators.'

Concrete acoustical blocks were also used in the studio's 14ft x 11ft vocal booth (located off the control room) and to construct two small iso chambers in the two rear corners of the room for miking guitar and bass amps. Details like this, along with the overall room acoustics, make the Neve I tracking room an ideal space for cutting rock bands as well as small to mid-sized orchestral ensembles. To achieve the tracking room's lofty 35-foot height, it was necessary to take out the existing roof trusses and raise the roof by about five feet. According to Peter Grueneisen: 'since we were raising the roof, we decided to construct a second-storey lounge for Neve I and install a window so that the lounge overlooks the jacuzzi and the ►

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whole atrium area.'

The focal point of Neve I's control room is its 96-input Neve VRSP Legend console with GML moving fader automation and recall. Ron Lagerlof made some minor modifications to the board to obtain an optimal interface with other equipment in the room. 'We added five full rows of patching to accommodate various configurations of tape machines and outboard gear,' he explains. 'Also the board came with Neve's VRSP section, which does all of the speaker reassigns for film mixing. That added a few more patchbays to the board, which had to be modified somewhat to work with the patching we had added. But, in all, the modifications were very minimal. The beauty of both this console and the new SSL is that they come plug-and-play ready for doing film or surround sound. You just push a button and every bus is feeding the correct speaker. You don't have to turn cartwheels to patch in a left, centre right, surround system. The console does it for you.'

Video monitoring in the control room is provided by two Sony PVM 2530s. 'It wasn't necessary to install an extensive video monitoring system like we have in SSL,' says Lagerlof. 'Because Neve I is designed as a conventional recording studio, most of the front wall is taken up by the control room window. The two

monitors mounted in the wall are strictly for video. We weren't trying to display computer information on those screens as in SSL I. The GML automation and recall have their own monitors and high-resolution graphics.'

Stevens explains that 'the acoustic signature of the Neve I control room is much more like the existing Hidley rooms in the Record Plant, but it's a smaller control room at the front'. He adds: 'Consequently, it's somewhere between the style of SSL I and the style of the existing Hidley rooms.'

'One difference is that the front wall is plaster,' adds Grueneisen. 'So it's a hard, reflective surface rather than a soft one like in the SSL I control room. Also it has more of a soft ceiling in the back, as a result of the harder front wall. So some of the details are flipped, but the goal is the same: to maintain a large reflection-free zone.'

Rick Stevens is currently planning to install a motorised system that will enable the room's small, console-top monitors to move laterally, following the mix engineer as he moves to the left or right of the big, 92-input console. The mixer just has to wear a small 'homing device' that the monitors can follow. This kind of attention to detail is a hallmark of the service-oriented operating philosophy that the Record Plant's new owner has brought to his facility.

'The most basic rule in any service business is to listen to your clients,' Stevens reflects. 'I've discussed this upgrade extensively with my clients, and their wishes have been the single greatest factor in the selection of new equipment. But in a studio like this, great gear is a given. I also said, "What else can we do to make life pleasant for these people?". If you look around this complex, I think you'll see the answer.' ■

ALAN DI PERNA is a Los Angeles-based freelance writer of over ten years standing specialising in the field of professional audio. Born in Brooklyn, Alan graduated from Michigan State University before playing synthesiser and guitar in a number of American rock bands 'that history has, mercifully, forgotten'.

DIGITAL AND ANALOGUE

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The vocal sessions at CTS in London were pig and frog-free

MUPPETS AND DIGITS

A Christmas Carol was a 48-track digital production, reports Simon Croft

Apart from being what the film industry likes to call 'a visual spectacle', the festive Muppet film, *Christmas Carol* was also notable for its crystalline soundtrack and innovative production techniques. It is, in fact, one of the first feature films to have had its soundtrack recorded and edited in the digital domain, a feat that involved technicians on both sides of the Atlantic and the shipping of a DAR *SoundStation* from London to Los Angeles.

Filming took place in the UK but the international nature of the project was in place before shooting. The initial music, written by Paul Williams, was recorded at Blue Moon Studios in LA. From there, it was transferred as synthesiser backing to CTS in London for vocal work, before going back to the US to have a full orchestra put on top.

CTS engineer Steve Price explains: 'The vocals were done in London because most of the characters were here. It was done in a week, which was very fast. We recorded 12 songs and three or four were cut from the final movie.'

'On one song we recorded about 40 separate voices, character by character. We had to do them one at a time because one person might do four or five different voices. The place was full of people

and it was very weird because I knew the characters from the film and, of course, they look nothing like that in real life!

'We were working Sony 48-track digital in CTS Studio 3. The assistant, Andy Taylor, was invaluable in keeping track of the vocals. Because of the speed of working and the number of characters, the logistics of the vocal comps became quite difficult. We couldn't have all of them on separate tracks, so we kept bouncing and had to keep tabs on where everything was. On top of that, we didn't know exactly how it would be used because the film hadn't been cut.

'Then all 40 tracks were reduced to four so that in LA they'd have a chance of working out what was what.'

Production Sound Mixer was Chris Munro who, in addition to his work in location recording, is one of the directors of DAR-based film postproduction facility Twickenham SoundStation.

Munro points out: 'Although the musical segments are shot to a prerecorded playback, few people are aware that for other scenes the Muppet voices are all recorded live, allowing spontaneity and adding realism.'

'Digital processes were used throughout prerecording but for playback purposes the final tracks were transferred to 1/4-inch tape in an 8-track analogue format. This enabled us to use a Fostex R8 as a playback machine that Muppets could lip sync to.'

On many shoots, a Nagra with one or two audio tracks would be the machine of choice but Munro says the Fostex transported between sets easily and meant that the monitor mix could give the best lip syncing conditions to the characters nearest the camera.

Unlike the Nagra, the Fostex is not equipped to lock directly to the crystal generated sync pulse of the camera, so the Fostex was regulated by a 4030 time-code generator which was in turn driven by crystal sync. This arrangement also provided precise autolocate facilities for the Fostex.

Most of the time, monitoring was through easily concealed Bose speakers powered by Amcron amps but at other times, silent monitoring was provided by an induction loop picked up by miniature in-ear phones. Recording the puppeteers' dialogue presented a different set of problems.

'The puppeteers tend to be under the floor of a raised set, sometimes in awkward positions that are difficult to mic. Also there is a certain amount of mechanical noise which you need to avoid, although it tends to occur between their dialogue. I came up with a system using a headband and a little Sony ECM-77 lavalier mic pointed down from their foreheads.'

'Because of the mic's position, it would tend not to get knocked about and maintained the same relative distance from the mouth.'

Michael Caine and other actors were covered with a conventional boom. This was placed on a separate track, as Caine's dialogue and the noisier aspects of the Muppets, working tended to coincide.

Dialogue was recorded onto a Fostex PD2 DAT machine with time code. At Twickenham SoundStation, the 'temp' dub was carried out using a *SoundStation II*. Prior to this the 'mod' or modulation, as audio tends to be called in the film world, was transferred to 3-track 35mm magnetic film, containing the two audio tracks and the original time code.

This formed the 'cutting copy' that is ►



A Dolby SR version was also dubbed for the laserdisc version

traditionally edited by the picture editor at the same time as the optical film. Where the *SoundStation* had the advantage was in its ability to autoconform the DAT audio using an Edit Decision List created from the discontinuities in the time code on the magnetic film.

One practical upshot of this is that the sound editor does not have to laboriously duplicate the mechanical cuts made by the picture editor. But the benefit goes much further, as the 'temp' copy is basically for auditioning purposes. Once feedback has been gained from specially selected audiences, the whole process is begun again to produce the final version.

As the final is invariably a more sophisticated dub, conventional techniques may entail six generations of analogue transfer before reaching the final mix stage. With DAR, there was no need to dub successive generations and no need to throw away all the work that went into the temp.

'We used the *SoundStation* for the temp and we achieved this in less than a month from the end of shooting, which is quite remarkable. That's very fast for the quality level we reached.'

Over in LA, Skywalker supervising sound editor Bobby Mackeston takes up the story.

'Since the final had already been done in England, we wanted to keep with the *SoundStation* they had used. They had the capability to ship the whole system here intact, which meant we could use elements of the temporary in the final.'

So the *SoundStation* system was dispatched from London to California. But there were also effects to add, especially footsteps as Muppet feet are rarely seen on screen, for obvious reasons.

'Most of the effects were done on our Foley stage,' Mackeston explains. 'These were shot direct to Otari *Pro Disk*, there was no tape. They have removable hard disks so we could take it straight to the sound stage. Other effects and background were done on another digital system.'

'These elements went to the sound stage where a pre-dub was made on 32-track one 1-inch Otari and from these a film print master was made in Dolby A and Dolby SR. Disney only wanted one release format and that was Dolby A because that is what most cinemas have.'

However, a Dolby SR version was also dubbed for the Laserdisc version because of 'all the effort that had gone into the quality'.

Skywalker is noted for its progressive attitude to new technology and its high technical standards. As early users of tapeless workstations,

the company uses several systems. Mackeston says that he 'did not care for the user interface' of the *SoundStation* at first, as he is used to systems that have a different way of working. He soon became used to the touch-screen concept though.

'We had a lot of fun doing it. We tried a whole lot of new things. I thought the DAR was good, although the screen should be bigger.'

As an editor, Mackeston is happy with the ability of digital workstations to scrub backwards and forwards over a cue and also finds useful the way a certain amount of pre and post cut information either side of an edit can be stored, allowing some leeway in the positioning of cue points.

Some of the Skywalker sound mixers miss the ability to adjust EQ and levels while the film is rolling backwards when working with digital tape. Traditionally, this feature can be a significant time saver and Mackeston believes that digital recorders will have this facility soon.

Although *Christmas Carol* was released on analogue format for exhibition, Chris Munro believes the effort to keep the production on the digital domain was justified.

'Obviously I am biased but I think the Muppets' film has very good intelligibility, which has been achieved without pushing the effects too much.' He points out that *SR-D* has truly discrete tracks, as opposed to the matrixed solution offered by Dolby Stereo. 'It's a clever trick but there's not a lot of track separation.'

'When the audience gets to hear *SR-D* films — with production in the digital domain from original recording through editing to exhibition — they will really appreciate it. Just like the move from albums to CD, once the audience hears the quality, they are going to demand it. Any film made now where the producer isn't considering digital techniques would be like shooting black and white when colour first came out.' ■



Mackeston: 'The DAR screen could be bigger.'

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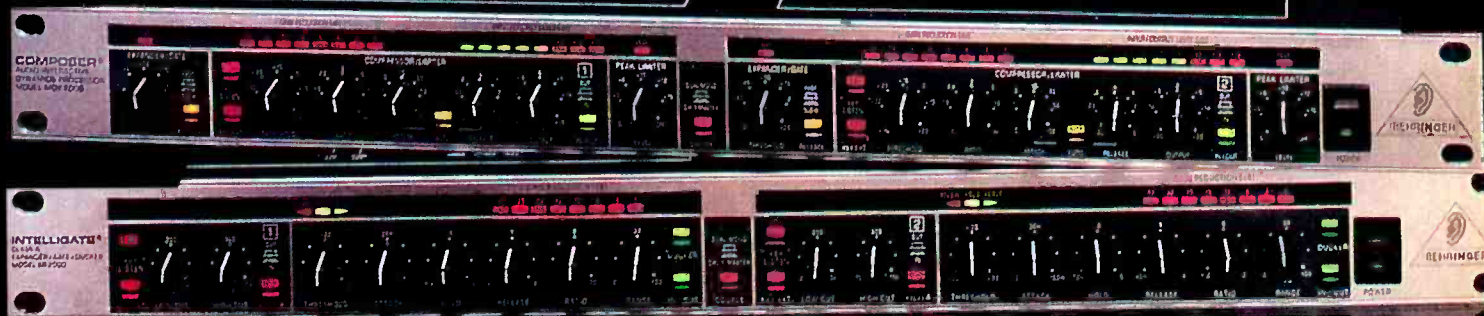
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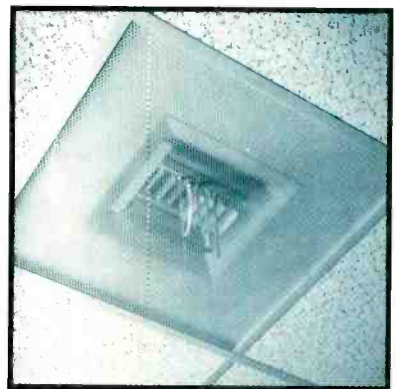
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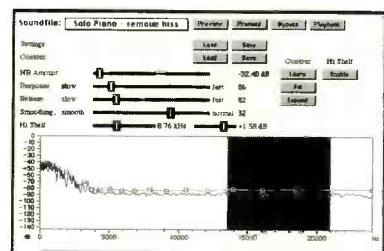
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SIGTECH AEC1000

One developing application of DSP is that of 'correcting' room acoustics—Francis Rumsey studies the theory and examines the performance of the Sigtech AEC1000

Digital signal processing (DSP) has now reached the point where complex filters can be designed, whose characteristics may be quickly adapted either statically or dynamically. In the Sigtech AEC 1000 system, adaptive digital filtering has been applied to the problem of correcting for some of the deficiencies in a loudspeaker-room combination, such that a listener in a chosen position may hear a signal from which many of the most significant colorations due to both room and loudspeaker have been removed. In this report some of the principles are examined, and the Sigtech Acoustical Environment Correction System is put to a subjective test.

Control room acoustics

It is well known in acoustic engineering that signals arriving at the ears within the first 50ms or so after the direct sound, have a significant influence over the listener's perception of sound quality. Although reflections arriving within this time delay may not be perceived as discrete arrivals (it depends on the nature of the signal), they often have the effect of introducing coloration, affecting the timbral quality of the perceived sound. Another important effect is that of such reflections on the perceived stereo image, which may be distorted or made less accurate.

Typically, if good monitoring conditions are desired then one attempts to ensure that the amplitude of such reflections is as low as possible in the control room, and that the loudspeakers

introduce minimal distortions of their own. Modern design attempts to treat the loudspeaker and the room as a lumped system. What is not attempted, though, is to make the control room anechoic, since this is undesirable from all sorts of points of view. Anechoic listening rooms are unpleasant to be in, the sound pressure level required from the loudspeakers for an adequate listening level is very high, and in any case one must balance material for listening in rooms which are not anechoic. If one could control the early sound then one could remove a lot of the coloration and improve the imaging without losing the diffuse reverberation of the room which is still

desired.

To some extent this was the aim of the so-called 'live-end dead-end' (LEDE) design of control rooms, which attempted to have an absorbent area around the loudspeakers and desk, with a more reflective rear end containing means of dispersion. In an interesting recent BBC Research Department project a so-called 'reflection-free zone' has been constructed around the listening position, by angling the walls around the front of the control room so as to direct reflections around the sides of the listener. Nonetheless, mixing consoles are still very large in many cases, and, despite the existence of room treatments and ▶

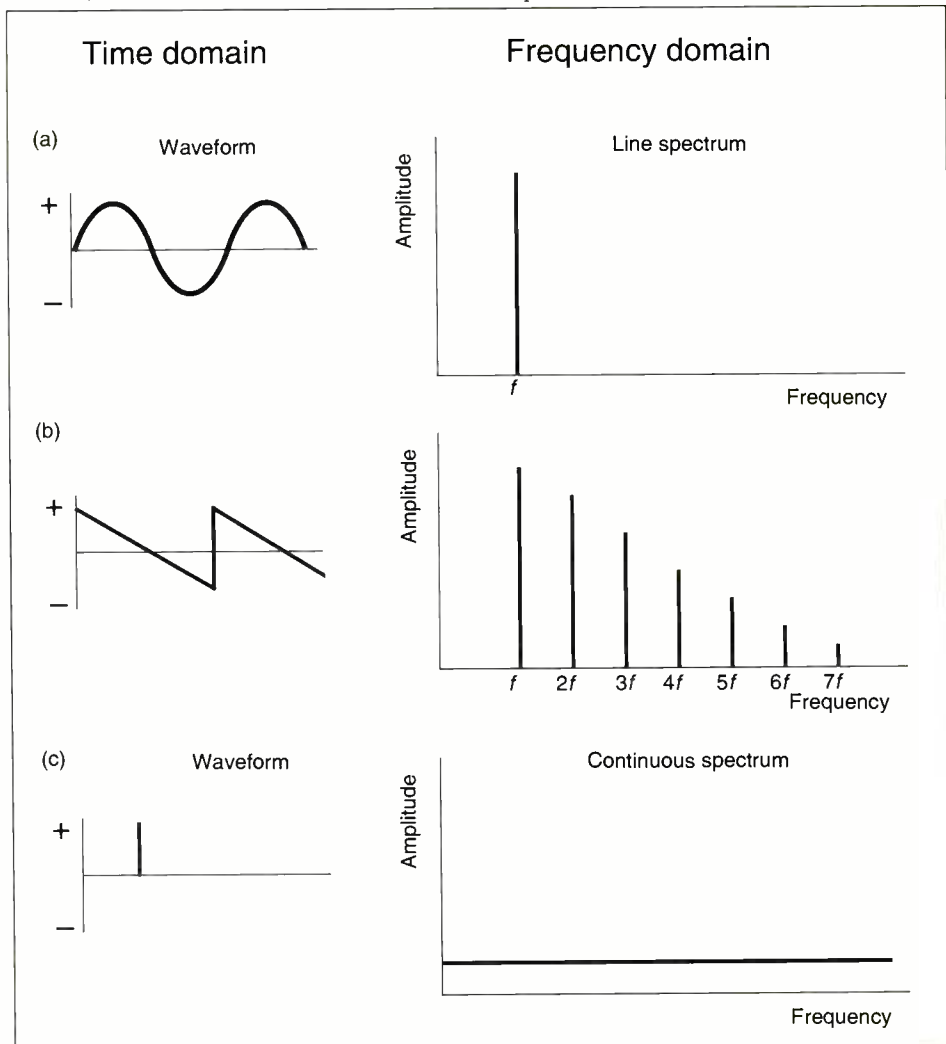


Fig.1: Periodic waveforms such as those shown in (a) and (b) have harmonically-related line spectra, whereas impulses, such as shown in (c) have continuous spectra

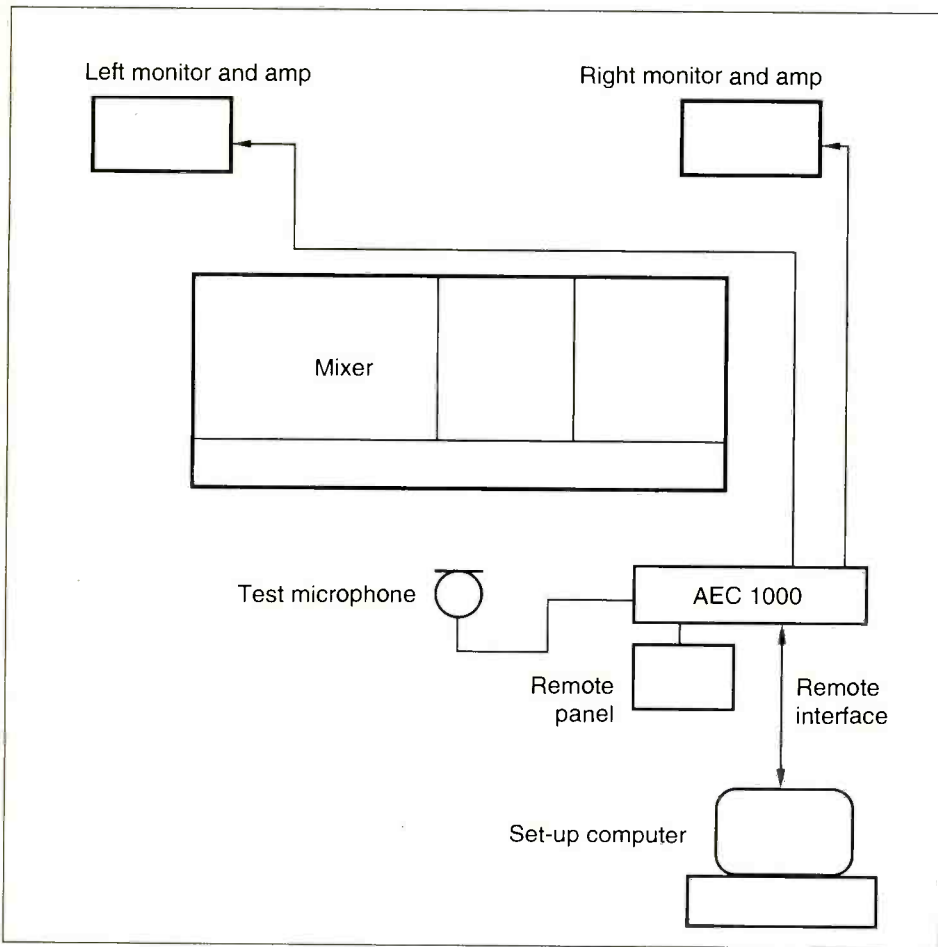


Fig.2: Arrangements of equipment for initial setting up

novel designs, the console represents a large reflective area close to the monitoring position. It is difficult to design rooms to minimise the effect of the console surface, although careful positioning of the loudspeakers with relation to the mixer can help to direct the largest reflections away from the important area.

Time and frequency domains

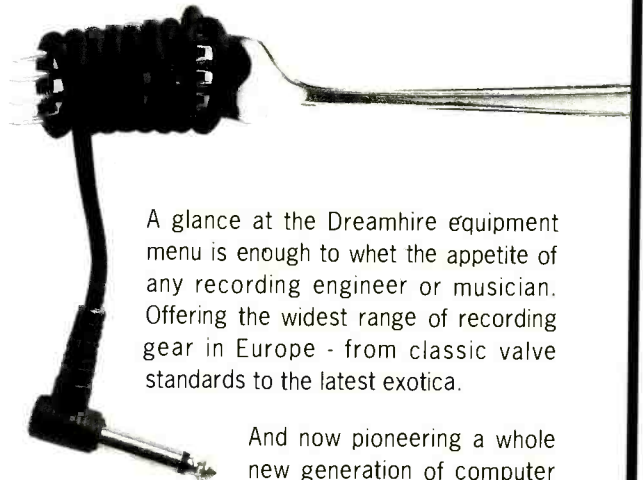
A difficult concept for many to grasp when considering sound signals is that of the equivalence of time and frequency domains. A representation of a signal in the time domain shows how its amplitude changes as time passes, and in the frequency domain the frequency content of the signal is plotted against amplitude. The waveform of a signal is its time domain representation, and its spectrum is its frequency domain representation. Repetitive waveforms have spectra consisting of lines at harmonically related frequencies, whereas random waveforms (such as noise) or impulses (such as clicks) have continuous spectra showing their relative energy at different frequencies (Fig.1). It is possible to look at the spectral content of a segment of a time-domain waveform by performing a mathematical transformation on it, such as a Fourier transform, and this is a technique used in many acoustic measurement systems.

When a signal is emitted from a loudspeaker it may move off in a wide range of directions. Via one path it will arrive directly at the ear of the listener, and after a few milliseconds various reflected elements of that signal may also arrive at the listening position. So a number of ▶

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versions of the signal are received by the listener, separated by short delays. The reflections will not be at the same amplitude, nor will they be quite the same shape as the direct sound. It is easier first of all to consider the situation with a simple repetitive wave such as a sine wave: the listener will be presented with a direct wave and a number of reflected waves in various phases depending on their delay. If a certain reflection were delayed such that it arrived at the listener out of phase with the direct sound then some cancellation would occur, depending on the amplitude of the reflection. Therefore, when listening to a wide-band signal, the reflection would cause a dip in the spectrum at that frequency and its multiples, resulting in coloration of the sound. A number of such dips (and peaks) might be created by different reflections at various frequencies. The colorations of the spectrum will clearly be affected by the position of the listener, since different delays and reflections will result.

A more complicated situation to envisage is when the speaker emits an impulse or transient. If the listener were to be replaced by a microphone, one could measure the arrivals of the various reflections and plot a time-domain representation of the series of events. This would show a large spike when the direct arrival was received, followed by a number of smaller spikes for the reflections. Transformation of this impulse response into the frequency domain could show the instantaneous effect of reflections on the spectrum of the signal, and such transformations are normally carried out over a window of so-many samples, representing a small fraction of time. If a series of frequency domain plots is derived by taking successive windows of samples from time zero (the time when the speaker emitted the

sound) then the familiar 'waterfall plot' may be created, showing how the energy at different frequencies changes over a period of time after the impulse is received.

If such a plot is made of the events within the first 50ms or so after the impulse, one can often see an initial period during which the spectrum changes significantly due to the first few strong reflections that are received, perhaps from the nearest surfaces, including the mixer. As time goes by the spectrum begins to settle down and change less radically with time.

Application in the AEC1000

In the Sigtech product being considered, an adaptive digital filter attempts to model the measured impulse response of the loudspeaker and room over the first 50ms or so, and (in simple terms) to introduce an inverted version of this into the signal fed to the loudspeaker, such that the effects of such reflections are cancelled out at the listener. Some 25 DSP chips are used to process the audio signal, and the signal is broken up into a number of frequency bands, each of which is subjected to filtering. Although people like to imagine filters as acting in the frequency domain, each acting on a particular frequency band and having a certain bandwidth or 'Q', it is more appropriate to imagine this type of filter in the time domain, since it processes the samples of the digital audio signal by 'tapping off' samples and then delaying them by certain amounts and multiplying them by various coefficients before adding them back in to the original signal. The effect is to modify the time domain characteristics

of the signal and thus to modify the instantaneous frequency spectrum. The number of stages of delay and multiplication in each filter is called the number of 'taps'.

The filter is not adaptive in the sense that it is continually changing, but its characteristics are adapted in a one-time operation to the measured impulse response of the monitoring system by setting up a microphone in the listening position and taking a number of measurements to determine the reflections set up by each speaker. The filter characteristics are downloaded to the signal processor, which is capable of storing settings for a number of different listening positions or desired conditions. This signal processor then sits permanently in the monitoring chain.

Setting up

We tested the AEC 1000 in a fairly ordinary control room, with fairly ordinary monitors. The general feeling of those who used the room regularly was that, although there were some bass-end problems, the room was not bad but that the monitoring left a lot to be desired. Since the AEC system acts on the direct sound as well as the reflected sound, it was expected that it would have some effect in correcting for both the monitors and the room.

The signal processor was connected to a conventional MS-DOS PC, containing a special interface card, for the setup phase, during which calibration software was run to assess the nature of reflections in the listening position. A high-quality omni microphone was connected to the unit. It is important that this microphone has a good frequency response, since it forms a ►

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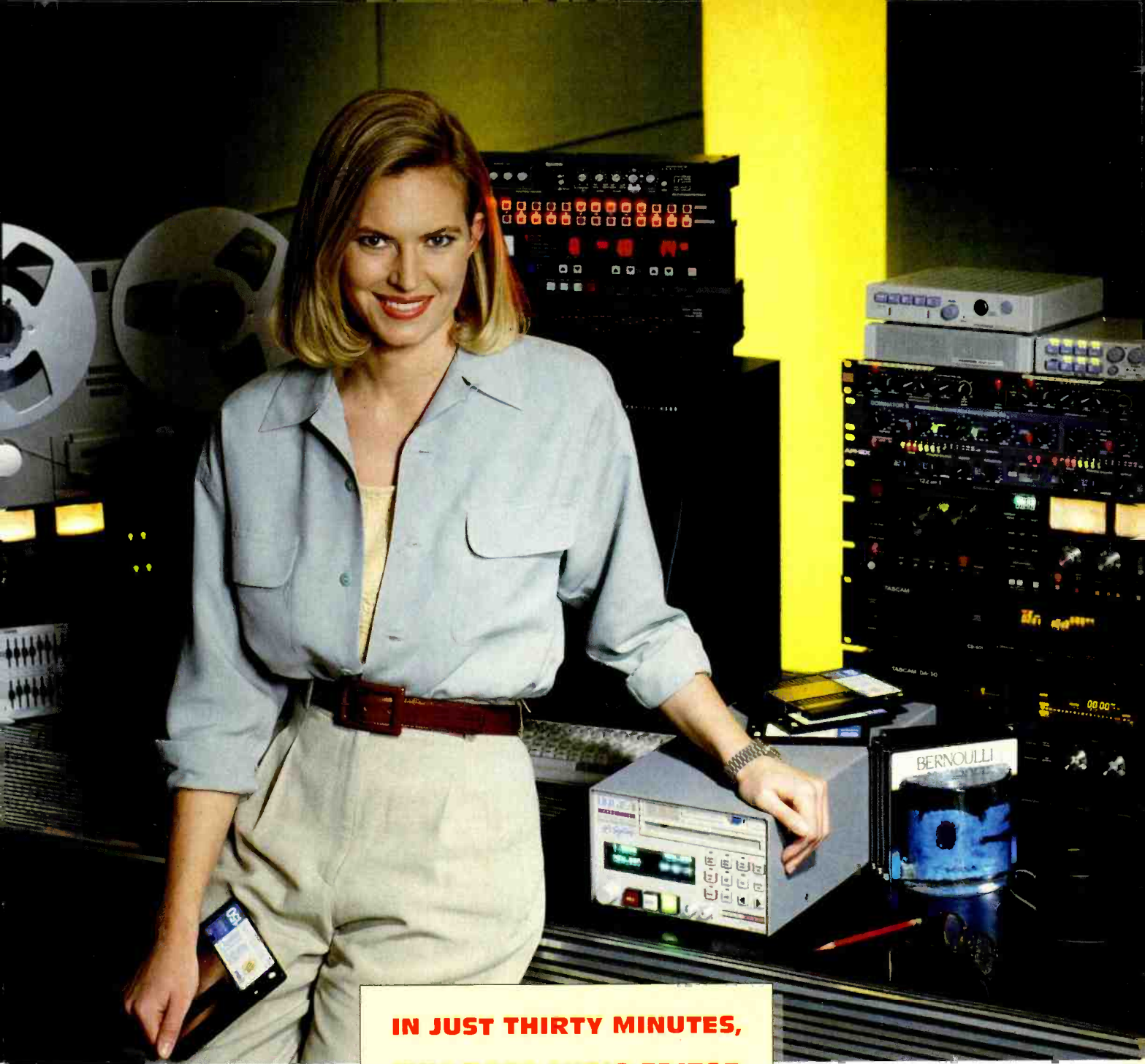
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reference point in the measurement process. We used an AKG C460, pronounced acceptable by Audio and Design (the system's distributors in the UK) although a B&K omni is also a possibility.

In order to measure the conditions at the listening position, the microphone is directed at each speaker in turn and a series of impulses is generated by the system through the monitoring. These are randomly timed and averaged in order to minimise the effects of noise in the room, and to avoid repetitive or cyclical noise influences. The system clearly works better in a low noise environment, and is affected particularly by very low frequency noise — such as that produced by air conditioning or outside vibrations — which although fairly inaudible to the listener is often of a high amplitude and may distort measurements. The system flags an error if it considers the noise to be too high, and various 'tweaks' are possible to make the measurements more accurate in such conditions. In environments with a lot of noise, such as in PA applications, it is possible to limit measurements to a 10kHz bandwidth.

From the initial impulse measurements it is possible to plot both time, frequency and waterfall displays of the signal at various instants, and to get a picture of the behaviour of the system. It is advisable to try a few microphone positions in order to see how the response changes around the listening position, in order to see which frequency domain effects are localised and which are general. The system allows plots to be overlaid in order to compare them, and this proved useful in finding the best position to make the actual filter calculation. In our system some features of the plots seemed fairly consistent between positions, while others changed enormously, and we were advised that better results are often achieved if

one does not attempt to treat very localised problems, since only a very small range of listening positions is affected.

Clearly, experience is needed in interpreting the results of the preliminary measurements, and those who have been working with the system for some time have increasingly discovered which effects are important and which are not. The distributors emphasise the importance of intelligent interpretation of the measurements, and for this reason it is normally assumed that a system would be set up by an expert, after which the setup computer would be removed, leaving only the signal processor and the remote panel. For the inveterate fiddler, it would be possible to purchase the whole system including the test and measurement software, so that regular changes and improvements might be made.

In order to calculate the filter settings the system uses not clicks but a pseudo-random sequence which sounds like noise (along this line of the signal generated by the MLSSA system). This may be bass pre-emphasised by up to 24dB to overcome LF noise. The received signal is then averaged over a number of spectra, and a filter is calculated for each loudspeaker in turn. The characteristics of this filter may be plotted in the frequency domain if required, and this compared with the original impulse responses obtained earlier. If everything has worked well then the two should be fairly similar. One should realise that the frequency domain picture of the filter is really an idea of what the frequency response will look like after a relatively steady state has been reached, and this is given because users are likely to be able to relate to it more readily than they would to pictures of the rapidly changing spectrum which occurs in the first few

milliseconds. (A constant problem of the designers has been in creating meaningful visualisations of the action of the system which relate closely to the audible impression.)

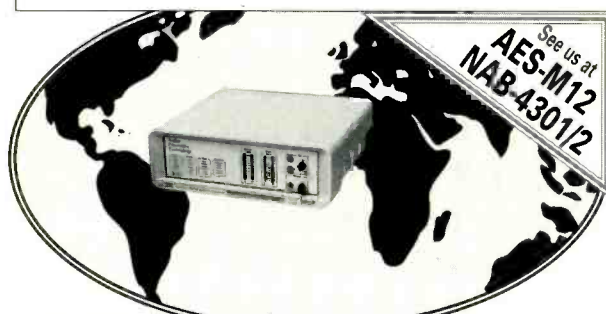
Once the filter has been calculated it is possible to modify it manually, and this is often necessary to lessen the severity or abruptness of the correction in some bands. Coefficients can be scaled, and the number of taps in each band altered. The number of taps is also translated into approximate 'filter bandwidth' in an attempt to relate to conventional parametric equaliser terminology. As with many listener-position-dependent digital filtering systems (such as those found in transaural stereo processors), it may be found that results may be spread over a wider listening area by smoothing the filter curve to some extent.

Subjective results

Once the calculated filter was downloaded to the signal processor and stored in its memory, it was possible to listen to the effect and compare it with the unprocessed signal. This we did using a variety of programme material. Although having started out somewhat sceptical, we noticed immediate improvements to the perceived sound quality in a number of respects. Firstly, the somewhat unsatisfactory frequency response of the monitor loudspeakers had been improved enormously, such that the perceived spectrum sounded much flatter. Secondly, the stereo image changed markedly.

The changes in image that were noticed in our room tended typically to be that the width increased and the image became less 'mono'. Phantom sources which were imprecise in the ►

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unprocessed signal were sharpened up considerably in the processed version, and the whole image was more 'lifelike'. Furthermore, the impression of space and depth improved. The problem with assessing whether or not the image was closer to the 'correct' image was discussed, since this question assumes that it is possible to say what the 'correct image' should be! It was agreed that, having heard certain items of the programme material on better monitors in better rooms, the processed image was probably truer than the unprocessed. Certainly we preferred it.

The effect did not change markedly when one moved off the 'correct' listening position, although it was best at this point. It was proposed that this was possibly because the predominant improvement in sound quality was due to the equalisation of the direct sound from the loudspeakers, and that the secondary room effects were less marked because the room was not the main problem. Had the speakers been better to begin with it is likely that a less marked effect would have been noticed and that it would have been limited to a narrower range of positions. Experience in other control rooms suggests that in good rooms the system gives little improvement, which is what one would expect, since there would be little to correct in such a case.

Not only does the system have an effect on the perceived frequency response, but it also attempts to equalise the phase response of the monitor chain, since this will be shown up in the measured characteristics and may be modelled in the time domain filter. This will have a clear effect on the quality of sound, and was most probably an important factor in the improvement of the stereo imaging and perception of a clean sound.

Having listened to the filter's effect we decided

that some improvements could be made to the sound quality, since we were not happy with a small amount of coloration in the 2kHz-5kHz region. Looking at the filter curves on the computer it was noticed that some particularly large deviations in the response occurred at this point which we attempted to make less severe. The result was a noticeable improvement in the sound, showing that experimentation is still valuable after the initial automatic measurement and calculation. One could continue making small adjustments until the optimum result is achieved.

Features

The processor consists of a 2U-high rackmounting box with a remote control panel. The system may be fitted with high quality A-D and D-A converters and/or digital inputs to AES or consumer formats, and there is a meter on the remote to indicate the signal level. The remote allows the user to switch between four stored filters, each of which may either represent a different listener position or an alternative characteristic, and the filters may also be bypassed altogether. The processor also has a phantom-powered input for the reference microphone.

In order to set up and measure the room it is necessary to connect a PC, which can be anything from an XT-compatible upwards with 640k of RAM, at least 2Mb of disk space and a half-width expansion slot. If you do not envisage making any changes to the filters after the system has been set up, you do not need to purchase this additional equipment.

A basic system could cost around £4,000 in the UK, while the full-blown rig might cost around

£8,000. In Europe this depends of course on things like the prevailing exchange rate, since Sigtech are an American company. The prices are therefore comparable to the purchase price of a good-quality pair of monitors, and one might say that the money could be better spent in this respect, but it is likely that modifications to the acoustics of the control room would cost considerably more than this, and thus money might be well spent on such digital correction. Since most people cannot get rid of their mixing console, some compensation for reflections from its surface could be considered valuable. It is also possible that mobile control rooms could be improved considerably by using such a system, since these can be very poor acoustically.

Conclusion

The AEC 1000 system is intended to correct for certain deficiencies in the acoustics of the monitoring environment which are known to be key factors influencing perceived sound quality. When tested in an average control room with average monitors, it appeared to make significant improvements in the quality of the perceived sound. Whether it would do so equally well in other studios is something which must be assessed on an individual basis, but these initial tests bode well for at least some improvement in many rooms where the conditions are less than perfect. ■

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UREI LA22

The LA22 is a new stereo compressor-limiter from Urei—their first new model since the 1178. I wonder if there is a single mainstream recording engineer in the Western world who has not used or at least heard of a Urei 1176 compressor or its stereo counterpart, the 1178? Launched back in the 1970s, these peak limiters have been largely impervious to the tide of industry fad and fashion and are still firm international favourites.

There has long been a number of cheaper, smaller alternatives to Urei's products on the market but it seems that, though simple in concept, the task of designing a compressor that is quiet, easy to use and transparent is far from easy—certainly on a budget basis. Though not exactly cheap, (at £714 plus VAT in the UK) the LA22 is very reasonable by Urei standards and offers many more features than the 1178 (at £1200 plus VAT). The first question to address then, is how the saving has been made—have Urei been cutting corners?

Certainly, the LA22 does not look or feel anything like its legendary kin. It is only half the size (1U-high) and is covered with small, rather lightweight plastic knobs and buttons, with small inscriptions that require both good lighting and good eyesight to be discernable. Simply put, it is not as serious looking. The initial reaction to this tends to be one of disappointment for those of us expecting something as spacious and robust as the older models. I am assured, however, that the internal components are of the 'highest quality', and with rack space generally at a premium in modern control rooms, the compactness is arguably worth the price of having to look before you twiddle.

Smart slope

It seems that Urei are using the term Smart Slope to mean soft knee, and indeed, in the great American tradition, this unit is a soft-knee-type device. This is not to be confused with the entirely different issue of peak and average detection

circuitry: a new and strangely titled knob has appeared on the face of the LA22 between the Threshold and Attack controls which allows continuous adjustment between average and peak detection. This intended to allow the engineer to match the transient-legato nature of the programme—and it works, making it possible to trade off between smoothness and peak suppression when leaning on a sound.

Continuously variable Threshold, Attack, Release, Ratio and Output controls are all in place as would be expected, and there are a couple of extras. One is an Auto setting engaged by moving the Ratio pot counter-clockwise through a switched position. This simply fixes the Detector, Attack and Ratio settings as some generally useful values and makes the Release time dynamically programme dependent. This is unlike some other compressors where the Auto mode will involve automatic adjustment of both attack and release times, and allow user control of the ratio. This latter arrangement seems a more comprehensive one, but I have to say the LA22 sounds very good.

Metering is via two large, clear, horizontally-mounted LED bargraphs per channel. One for gain change, the other switchable to show input or output level. If it is showing input then an associated LED glows green, if showing output, red. All very good.

Each channel of the LA22 has a parametric filter that can be switched in and used in the side chain to trigger full-bandwidth compression, or it can be applied so that only that part of the spectrum is compressed, allowing the rest of the programme to pass unaffected. This latter facility allows a much more subtle and creative control of programme material. Obvious applications would be de-essing or tightening the bottom end of a mix without pumping the mid and top. A momentary push button allows you to listen to the output of the filter, as with frequency-conscious gates.

Another unusual feature is that, at the touch of a button, the compressor can be turned into an expander and whatever you were squashing gets lifted instead. In conjunction with the filter, this

Smaller and cheaper than its popular predecessors, Urei's latest compressor-limiter drops into the signal chain of Jim Betteridge

allows dynamic enhancement of part of sound's spectrum giving an effect unlike EQ or normal spectral enhancement. This I found very appealing as an overall control of a individual sound or a mix.

A peak limiter sits at the end of the chain to catch any spikes that get past the compressor. The threshold for this is alterable via a small, recessed, uncalibrated screwdriver adjustment on the front panel. For permanent PA installations this is no doubt a good idea as it largely precludes casual tampering—although you can always use a pot lock with an ordinary control. For a studio it rather depends on how you operate. If you have a maximum peak line level that you want to allow, then it makes sense to simply cap the line source in question at that point. If you are looking for flexibility, however, the lack of quick access and calibration may prove problematic.

Odd buttons

A particularly odd piece of design is the positioning of the STEREO LINK button on the rear of the unit. Again, this is okay for 'set and leave' applications in clubs and in-house PAs and so on, but the thought of ferreting around the back of the rack and forcing my arm through a tangle of audio, MIDI and mains leads in search of said button when I simply want to inhibit a few peaks in a mix brings tears to my eyes. The other odd thing is that, unlike with most other modern designs, even with this button pushed, both sets of controls remain active and the manual tells you that you must set both identically to achieve a true stereo performance. Odd.

Apart from the STEREO LINK button already mentioned, the rear panel houses a standard ▶



Urei LA22: Obvious applications would be de-essing or tightening the bottom end of a mix without pumping the mid and top

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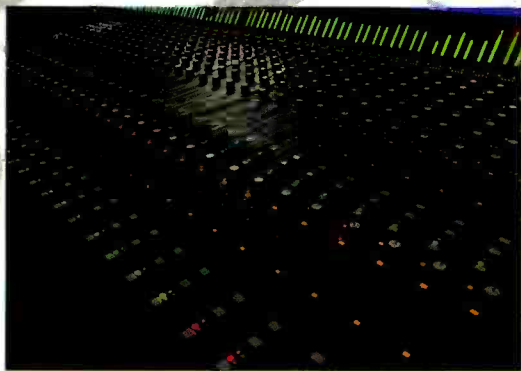
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IEC mains socket two electronically balanced XLR inputs and two transformer balanced outputs—plus a pair of barrier strips providing EQ outputs and key-side chain inputs. As most of us have opted to use 1/4-inch jacks for such things, this comes as something of a surprise. The idle majority will undoubtedly think at least twice before bothering to make up a pair of strip looms to try these facilities. On the other hand, what user of racks does not hate jacks? It is so horribly easy to inadvertently tug one very slightly out if its socket while making other adjustments to the rack setup, and then to find something is wrong without realising where the trouble is likely to be. Not so with barrier strips. Once they are screwed down they are screwed down, and in balance I have to say I fully approve. (While on the subject, the current trend towards using non-latching female XLRs on the rackmount units—such as the LA22—negates one of the big advantages of XLRs over jacks—they do not slip out.) If you want the filter to act in the side chain, the relevant terminals must be linked. This does present a certain lack of flexibility in that, if you want to use the filter for limited band compression, the link must be removed. A switch would have been a better alternative, although squeezing it onto the front panel would be difficult without going to a 2U-high unit. Of course, taking everything via a patch bay is the solution.

The range

For the sake of completeness I should tell you that the LA22 is the top of a new range of three units that also includes the LA10 and LA12. What differentiates it from the LA12 is on-board filtering, while the LA10 is basically a mono

‘The LA22 is quiet and transparent in operation; though perhaps not quite as see-through as the more expensive Urei 1178’

version of the LA12.

In summation, the LA22 is quiet and transparent in operation. It is noticeably better in both these respects than the standard cheaper alternatives, though perhaps not quite as see-through as the more expensive Urei 1178—but then, I am a fan.

Also on the positive side, the frequency-conscious compression is definitely interesting to play with and offers such obvious advantages as being able to tighten up a rampant bass end without pumping the mids and highs, plus other wilder effects that might be experimented with for individual sounds. Also, being able to flip from compression to expansion of a frequency band opens up all sorts of possibilities for accentuating certain ‘spectral events’ in an individual sound or (possibly) a mix. The average-peak detector adjustment is also a definite plus and far from esoteric—you can hear the difference and make a trade-off between smoothness and peak suppression.

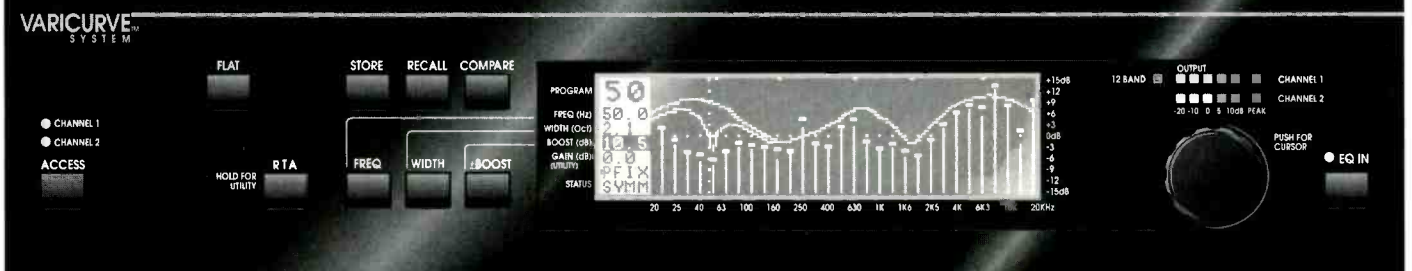
On the down side, having the STEREO LINK

switch on the rear panel and then not being able to control both sides from one set of controls is off-putting. Also, having the peak limiter threshold on an uncalibrated recessed screwdriver adjustment is a bit unnecessary. If you want to stop tampering you can always use a pot-lock and the screw-on perspex cover supplied by Urei should discourage all but the most tenacious fiddler. The knobs are also a bit flimsy and the dual concentric covers tend to come off in your hand (a common problem). These points are the more frustrating because it is otherwise so able. It is much more than just a dual-stereo compressor-limiter and undoubtedly is very useful item to have in the rack. You might also want to have a simple and immediate stereo-capable limiter below, however, so you can quickly knock a few dBs of a mix when the client's screaming that the cab's waiting.

Otherwise, this is a great little unit with just a few flaws, which may or may not be important to you depending on your application. ■
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JIM BETTERIDGE has been in the audio industry for over 18 years, which have been divided between time as a professional musician, training at Advision Studios and time as Odyssey Studios' Operations Manager. He also helped set up the first City and Guilds recording course (at the Polytechnic of North London) and now runs his own Copper Blue postpro studio in London England.

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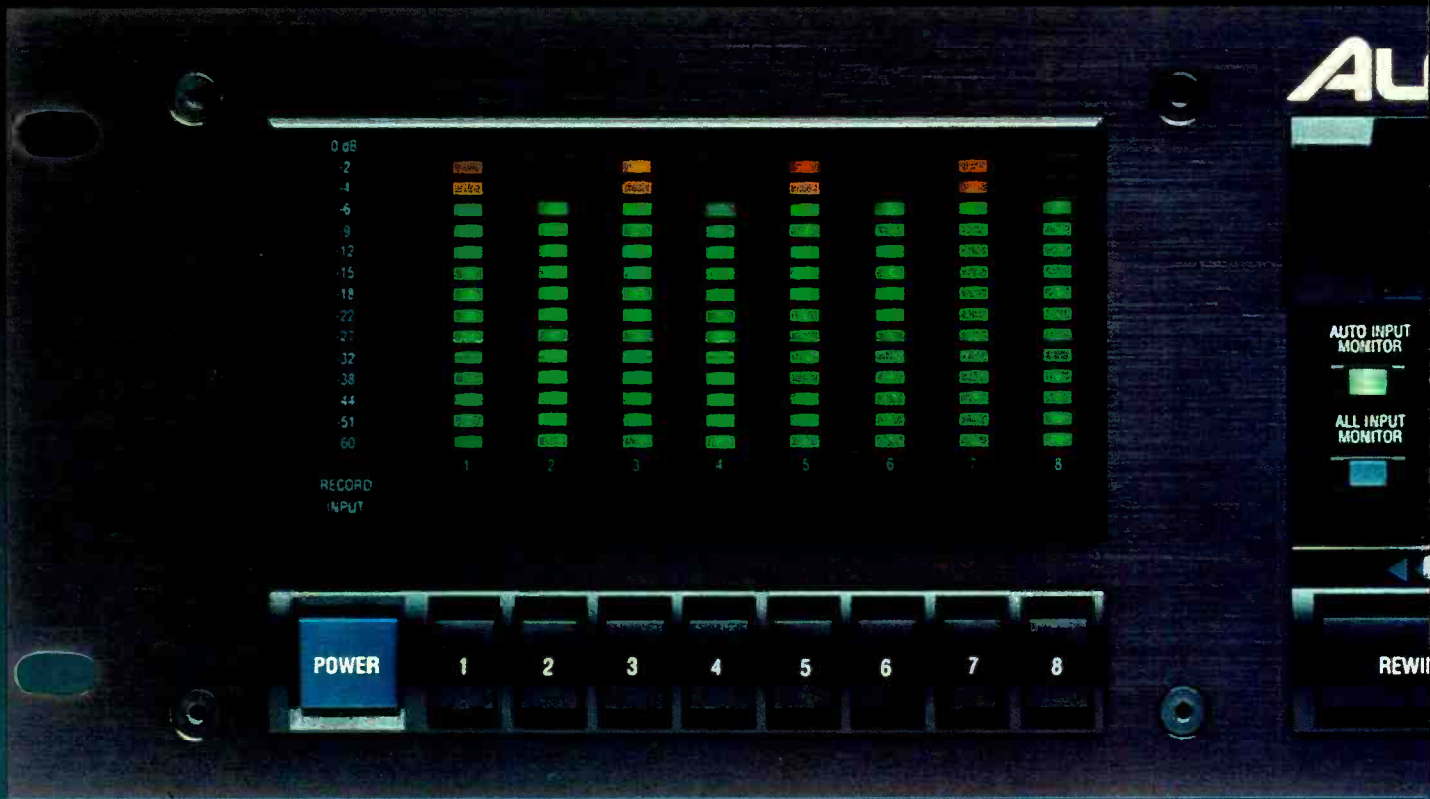
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DOWN HOLLYWOOD WAY

Yasmin Hashmi and Stella Plumbridge tour the postproduction facilities in Los Angeles to take stock of their experiences with current direct-to-disk recording systems

Tim Chau runs Earshot Inc and rents space in film postproduction studios Hollywood Way. At the time of our visit he was using Soundfirm's *EDI-Tracker* on the film *Free Willie*—a story about a boy and his relationship with a killer whale. In his capacity as supervising sound editor, Chau was using *EDI-Tracker* to cut the whale vocals, from above to beneath the water. He maintains that the system is very useful for auditioning, finding the best sound and quickly syncing it to picture. This, he adds, greatly helps in demonstrating his work to the director.

Chau is originally from Australia and is no stranger to tapeless technology. Back home he used *Sound Tools* for cutting gunshots for the film *Quigley Down Under* (starring Tom Selleck) and he may be considering purchasing *Pro Tools* for sound design applications. There are, however, inevitable differences between making films in Australia and in the USA. For example, Chau points out that in Australia crews tend to be smaller but have more time to edit and fewer subsequent changes are made. By comparison, in Hollywood nearly half the time is spent changing what has already been done; Chau suggests that this leads to inefficiency, particularly if conventional editing methods are used. However, he believes that systems such as *EDI-Tracker* are at least able to considerably ease the burden of constant changes, although

Chau notes that there is still a fair amount of resistance to the technology—mainly due to reservations concerning operational control. He argues, therefore, that if a system is to appeal to the film sound editor, that it must be designed by someone who understands how sound works with film.

Hence his enthusiasm for *EDI-Tracker* and its touch screen, which he claims is almost like handling film. Furthermore, the terminology and layout have been designed to be familiar to sprocket film editors—Chau only took around three hours with training assistance (no manuals) to become sufficiently conversant with the system to start editing. He adds that no time was wasted in having to adjust to new terminology and that the storage capacity of his system (nine hours) was more than sufficient.

At the time of our visit, Chau had had the system for four months and was acting as a beta tester for Soundfirm. Having his system connected via modem to the company's head office in Australia meant that should he experience any difficulties, the office could call up the same screen and diagnose the problem, send notes and/or transmit a software update.

Hollywood Recorders specialise in TV commercials, movie trailers, ADR and sound for film and some of their better-known clients include Saatchi and Saatchi, NBC Colombia Pictures and Paramount. The company was started in 1981 with just one room—they now have seven production rooms as well as transfer rooms and, as one would expect, have built up an enormous sound effects library over the years.

Their first *AudioFile* was purchased in 1989 and has since been upgraded to a 16-channel *AudioFile Plus*. This was followed by the addition of a further two 16-channel *Pluses* and the company was the first in the USA to purchase the *Spectra* user interface as well as the *Exabyte* archiving system.

Hollywood Recorders' President Barry Skolnick maintains that the *AudioFile* was chosen because of its proven track record and because it has become the industry standard. As a result, the company have stopped buying tape and virtually everything is now done digitally and transferred to DAT, which is increasingly being used by clients. *AudioFile* operator and engineer Sonia Castro has a background in music and had no problems in moving across to random access editing. She points out that the pressure to change over to digital comes from the competition—the technology provides clients with more choice and they are increasingly demanding to use it. Castro voices her enthusiasm for the new *Exabyte* backup system which she claims is the best update so far, being much faster and allowing selective loading.

In addition to the *AudioFiles*, Hollywood Recorders also have three 8-channel Digidesign *Pro Tools* systems which are operated with JL Cooper's *CS-10* and are located in other rooms. Skolnick explains that these are used on less demanding sessions for advertising and simple sweetening applications. He adds that, although his personnel can operate both *Pro Tools* and *AudioFile*, it is usual for them to specialise in one or the other since each operates differently and requires a different approach. Editor John ▶



An AMS Spectra has gone to Hollywood Recorders

Brady was working on a TV commercial during our visit and was using a *Pro Tools* in conjunction with an Otari *MTR90* 24-track tape machine. He stresses, however, that he tries to keep as much of the work in the system rather than lay-off to tape, but in some cases this is necessary if the work consists of multiple versions, for example.

Skolnick suggests that the choice of *Pro Tools* had as much to do with the fact that the system is *Mac*-based as with its capabilities. The company already has experience with the Apple *Mac* and clients often use them for typing scripts. Furthermore, the company use a *Mac* network for scheduling and billing purposes (including emergency scheduling by top management from home) and, at the time of our visit, Skolnick was planning to install a high-speed network for real-time transfer of sounds from the central library database to local systems.

Also at the time of our visit, Hollywood Recorders were the only facility to have an ISDN line, which they had just had installed in order to use *EDNet*. This is a networking service provided *EDN* (Entertainment Digital Network) who are based at Skywalker Ranch. It allows compressed audio to be transferred in real time to other users on the network via digital telephone lines, and Hollywood Recorders intend to use it instead of the more costly satellite uplink. Skolnick explains that Los Angeles has a large talent pool and the usual procedure is that the talent comes to Hollywood to perform and last minute changes to commercials which are then transmitted to regional radio stations simultaneously via 15kHz analogue signals using satellite.

Skolnick goes on to describe how, since the introduction of satellite, strategic alliances have been formed between various companies across

the USA and he envisages that these will increase once a common format has been agreed. As far as using *EDNet* is concerned, Skolnick cautions that using highly-compressed audio can have unpredictable results if used with editing systems such as *AudioFile*, however, the *AC-2* format used by *EDNet* uses less compression and can be edited without problems.

David Cantu runs a company called New Wave Productions and permanently hires two rooms at the Sound Research Corp (SRC). He works almost exclusively for Disney, postproducing versions of commercials for their films. He was also instrumental in the decision by SRC to purchase two *SSL ScreenSounds*, one for each room. Cantu explained that he opted for *ScreenSound* because of its screen display which he describes as having a similar feel to a *Moviola* (due to the tracks moving in a vertical rather than horizontal direction) and because the system's display and operation is client interactive. He stresses the importance of this instilling confidence in clients because they like to know what's going on.

He added that *ScreenSound's* ability to provide automated level control and internal mixdown has reduced the cost of his operation—he only needs a cheap mixing console and his 24-track tape machine is only used for archiving. Both rooms are almost identical and linked via *SoundNet*. This allows each room to work on a different version of the same project at the same time, which Cantu finds essential since Disney are currently producing around 40 feature films a year and sometimes require as many as 45 commercials per release, plus versions for Europe and the rest of the world. Cantu describes how the system has increased the speed with which he can get work done, and also provides him with the flexibility to

try more things out and get a better result. He adds that clients now expect to work faster and that on average, he can turn a 30-second commercial around in just two hours.

Cantu maintains that, although eight tracks are enough for his needs, they do require tighter editing and premixing. He adds that this discipline reduces the demands on the final mix which is transferred to one 1-inch and two 3/4-inch tapes at the same time. Furthermore, the use of *SoundNet* means that a major synchronising system is not necessary for this purpose. Another advantage of *SoundNet* is that it allows him to take advantage of the total recording capacity (currently 12 hours) of his multiple disks, which apparently are constantly full, since projects are usually handled over a two to three-month period.

Cantu's particular configuration uses four disks in total. In order to avoid confusion, each *ScreenSound* is assigned a working disk and each pulls information off a third disk which is common to both and is reserved as the source disk. The fourth disk is reserved for emergencies where a client may unexpectedly require unusual material to be loaded quickly. Cantu stresses that the system's background loading is a bonus and means that operation does not need to be interrupted. He adds, however, that loading does take a certain amount of discipline and anticipation and in order to simplify the organisation of his archive, he uses one backup tape per project.

Cantu also reveals that he is currently involved in developing a proprietary modem called *Land Pass* in order to transfer video and audio directly to Disney for immediate approval, rather than waiting up to 30 minutes for a courier to make the drop. This may seem like a display of impatience,

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but Cantu explains that deadlines are tight—for example, they have to get their satellite uplink before 1pm in order to avoid an additional charge of \$40,000. He adds that *Land Pass* could also be used for remote narration, rather than having to wait for talent to turn up at the facility. With today's economics, the emphasis is strongly on producing the same amount of material in less time and/or cutting costs. Cantu underlines this by claiming that *ScreenSound* has halved the time it takes to complete a job and, at the time of visiting, Disney already reckon to have saved around \$2 million by using Cantu's service.

Pacific Sound Services is part of the Lower Pacific Media Corp and currently uses 12 *WaveFrame 400* systems (aka *CyberFrame*). The Corporation provides 70–80% of the services to the TV show, movie of the week and sitcom market, the majority of such services being picture-based. Pacific's Manager of Operations and Engineering, Ethan Bush, explains that part of the Corporation's plan is to expand its postproduction facilities and to apply new technology to motion picture product. When the electronic postproduction of audio was examined, there seemed to be nothing appropriate to their type of work available, so they specified a product for which Cybermation were to design the user interface to run on *WaveFrame*'s existing system—hence the development of *CyberFrame* and Pacific's use of the system. Bush goes on to describe how the system employs tried and tested film postproduction techniques and is tailored to the customer's needs, rather than expecting the customer to learn something completely unfamiliar.

Bush explains how the EDL from the picture editing process is used to autoconform the

dialogue track, eliminating the need to lay off to tape. The supervising editor and ADR editor sit with the client and spot the show (which sounds are to be used, which dialogue is to be replaced and so on) and then programme the ADR, Foley and handwritten notes into the system. The programme is then given to the dialogue editor and sound effects editor(s) who cut exclusively on the *WaveFrames*. The system is also used to record directly using preprogrammed ADR and Foley notes and as the primary playback device on the dubbing stage. Bush admits that there has been a degree of resistance to the technology, however, once editors see what it can do and are willing to learn, they are quickly converted and can quickly master the system's operation.

For offline spotting and preparation purposes, Pacific use a couple of IBM PCs which only run the editorial software and have no audio capabilities. These are networked and can transfer editorial data, spotting sheets and cue sheets to the other *WaveFrames*. The three systems on the dubbing stage are usually arranged so that one will play sound effects, the other ADR and dialogue and the third backgrounds. Bush points out that this allows access to individual cues so that they can be quickly moved if necessary. In addition, if a large number of simultaneous replay channels are required, any of the systems can be tied together in the machine room.

As far as the takeover of *WaveFrame* Corp by Digital F/X is concerned, Bush is confident that the system will benefit from the new company, since they have cut manufacturing costs, increased development funds and have better marketing.

Brian Banks, on the other hand, has a little less confidence in his system. Banks owns an NED

Synclavier and *PostPro* and is perhaps one of the most experienced *Synclavier* users in the world. In conjunction with British producer Steve Levine, Banks is currently building a new studio which consists of two main rooms, each with the same mixing console and sharing a machine room. Banks will specialise in sound design while Levine will be geared towards preproduction and arrangement for film and TV. Banks suggests that had he had warning of the company's troubles, he would not have purchased the *PostPro* and will probably look for an alternative disk-based system. He is, however, heartened by the fact that the system's development may be continued by the new owners consortium, but warns that if it is not, it may only have a competitive life for another couple of years.

In the meantime, he is still happy to use his *Synclavier* because he maintains that there is currently nothing on the market to match the system's audio quality and creative sound design capabilities—the only effects he occasionally has to buy are real sounds such as those of animals. Since the system's purchase in 1982, it has been kept completely up-to-date by regular upgrades. This, Banks argues, has given him continuity of operational control while maintaining the most powerful creative platform available. ■

Under the name Sypha, YASMIN HASHMI & STELLA PLUMBRIDGE operate a UK-based independent consultancy to manufacturers and users of disk-based audio-video editing and related systems. Sypha was established in 1988 and has published *The Tapeless Directory* and various market studies, as well as regularly contributing to *Studio Sound*.

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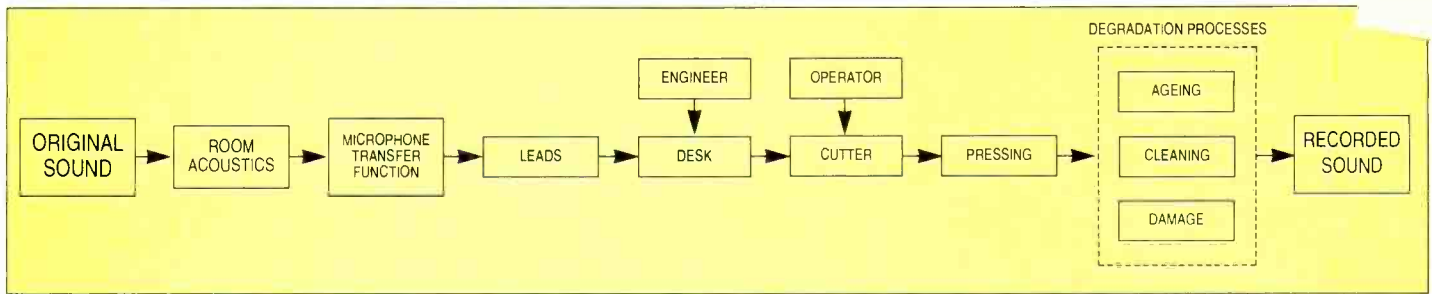


Fig.1: An example of the process history of a sound recording

DSP AND AUDIO RESTORATION

How can DSP be applied to audio restoration and how does it improve on analogue processes? Dave Betts & Gordon Reid of CEDAR explain

There are an infinite number of processes which affect human perception of sound; what, then, should be the aim of the audio restoration engineer? The archival viewpoint suggests that we should present the listener with the most authentic reproduction of the original sound that can be obtained. With more modern recordings, the ensemble sound often never exists except as reproduced off of the recording medium—many parts of it have

probably never been through a microphone. Therefore the objective of the commercially minded restoration engineer is to generate a recording more appropriate to the intended use. This use might be to please the public palate, or to accurately represent the sound of an era. Every restoration has its own criteria.

The algorithm designer is responsible for creating the facilities with which the engineer generates new recordings from old. He does this by developing and implementing algorithms which remove unwanted sounds and effects present on the old recording. (The stage after restoration is enhancement, where the algorithm gives the new recording desirable characteristics not contained in the old one.)

Algorithm Design

Any degradation process can be conceptualised into the elements shown in Fig.2. A restoration algorithm uses assumptions about the behaviour of these elements to restore the good signal from the corrupted signal and the quality of the restoration depends upon the quality of the assumptions made in the algorithm. Consequently, if you can glean more information about a recording, you can devise a better

restoration algorithm. For example, if the uncorrupted signal is a violin solo, you may wish to include the sonic characteristics of a violin in your algorithm. Such assumptions should then enable the algorithm to differentiate between the effect of the degradation process and the good signal, and these differences can be used to regenerate the good signal from the corrupt. Problems will arise when your assumptions fail. The assumptions therefore limit the number of recordings to which your algorithm can be applied.

A musical signal is random in nature, as are most degrading processes. Information theory tells us that the mixing of two random signals represents a loss of information, and that a perfect restoration is then impossible. A restoration algorithm therefore has to generate the 'most likely' good signal given the information available. Curiously, such an algorithm represents an additional loss of information about the degrading action—it has removed most of it. This has important implications for further reprocessing should a better algorithm become available: it is almost always better to work from the original recording rather than from an earlier processed version. A good example of this is found when restoring the crackle found on 78rpm records: while the signal may only have a bandwidth of ▶

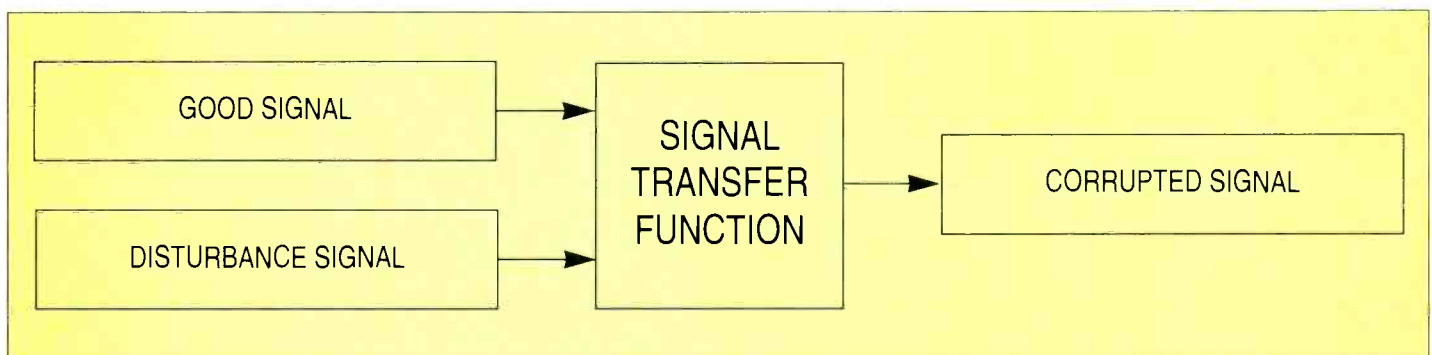


Fig.2: Degradation of a sound signal

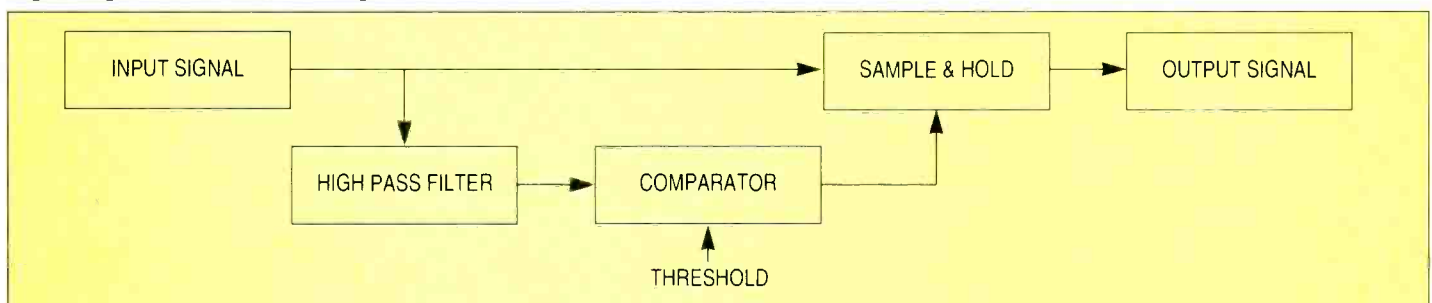
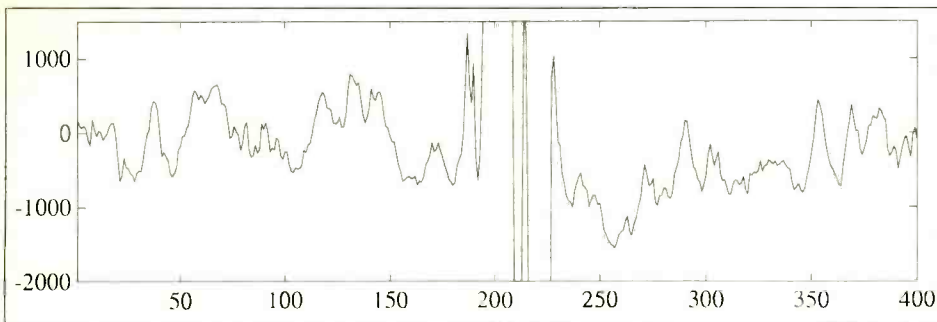
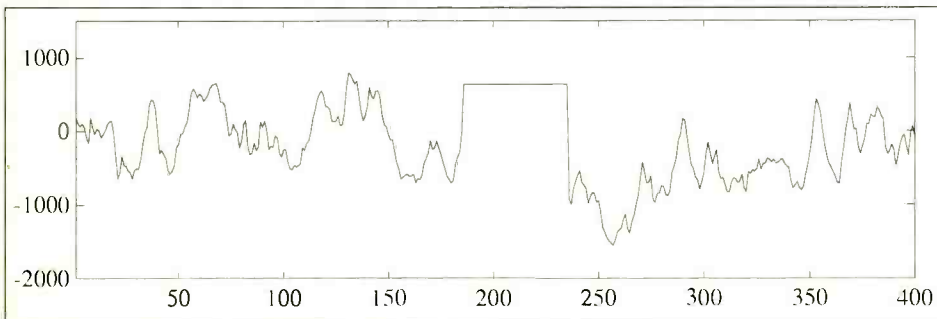


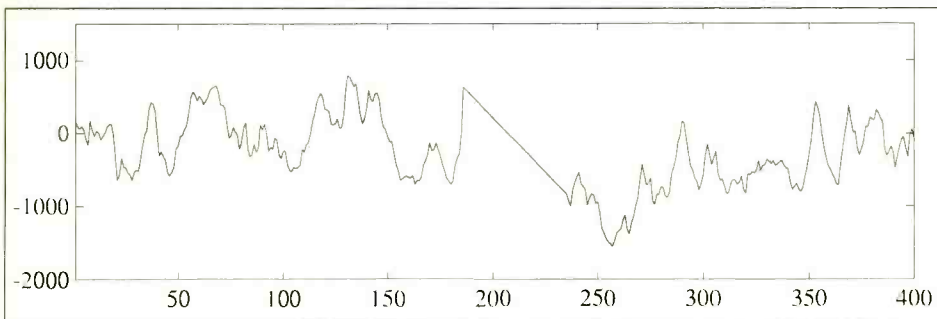
Fig.3: Simple analogue declicker circuit



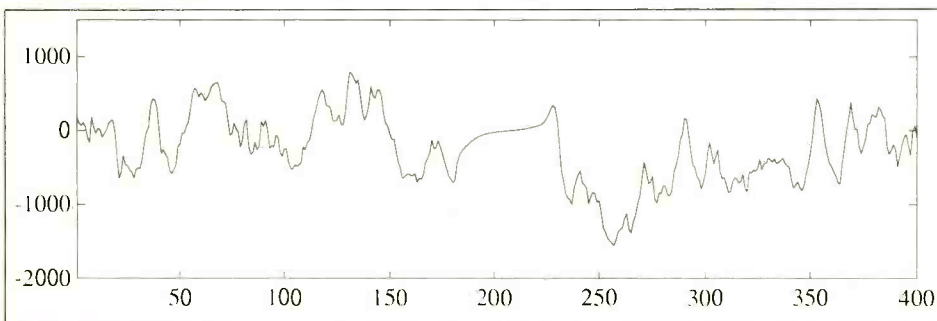
Original



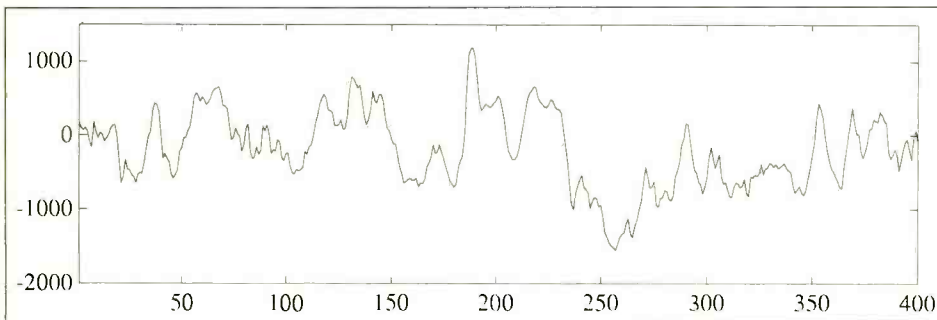
Example 1: 'Sample and Hold' with high-pass click detection.



Example 2: Straight-line interpolation following scratch detection algorithm.



Example 3: Low order interpolation following click detection algorithm



Example 4: High order interpolation following click detection algorithm.

12kHz, the crackle will have a full 22kHz bandwidth, so low-pass filtering (which may offer a subjective improvement in signal quality) removes a lot of information that the restoration algorithm can make good use of.

The final test for any algorithm is the human

ear. The questions to ask are: (i) Does the algorithm affect the perceived signal quality? (ii) Upon what range of material will it successfully work? (iii) Have the disturbances been removed-reduced? (iv) Have any processing artifacts been introduced? (v) Is there an

acceptable trade-off between the above points?

While a digital sound signal can be made into a perfect reproduction of a band-limited analogue signal, there are sonic processes that are native to each domain, and each can only approximate to the other. For example, the digital implementation of a simple RC filter only approximates to the theoretical analogue response. The advantages of the digital implementation are: (i) That it is well behaved. (ii) That the mathematical theory involved is more representative of what happens in the real world whereas the mathematical language developed for analogue circuitry is itself only an approximation to the response of the components.

There is an enormous range of DSP devices available to the algorithm designer. They can be divided into two classes: fixed-point processors and floating-point processors, each with their own benefits and disadvantages. However, there are some algorithms that cannot be efficiently implemented on a fixed-point DSP, and a floating-point processor is then more applicable. The basic performance measure of a DSP is its processing power, measured in MIPS (Million Instructions per Second) or MFLOPS (Million Floating Point Operations per Second) for fixed and floating-point processors respectively. A more powerful and more flexible DSP can be used to implement more algorithm ideas than a less powerful or flexible one, but the developer pays for this extra usability in price and complexity.

The most easily understood example of signal restoration is 'scratch and click removal'. Many methods exist to remove these degradations: signal muting; channel swapping; sample and hold; linear interpolation; and complex interpolation. Each of these offers a balance of advantages and disadvantages.

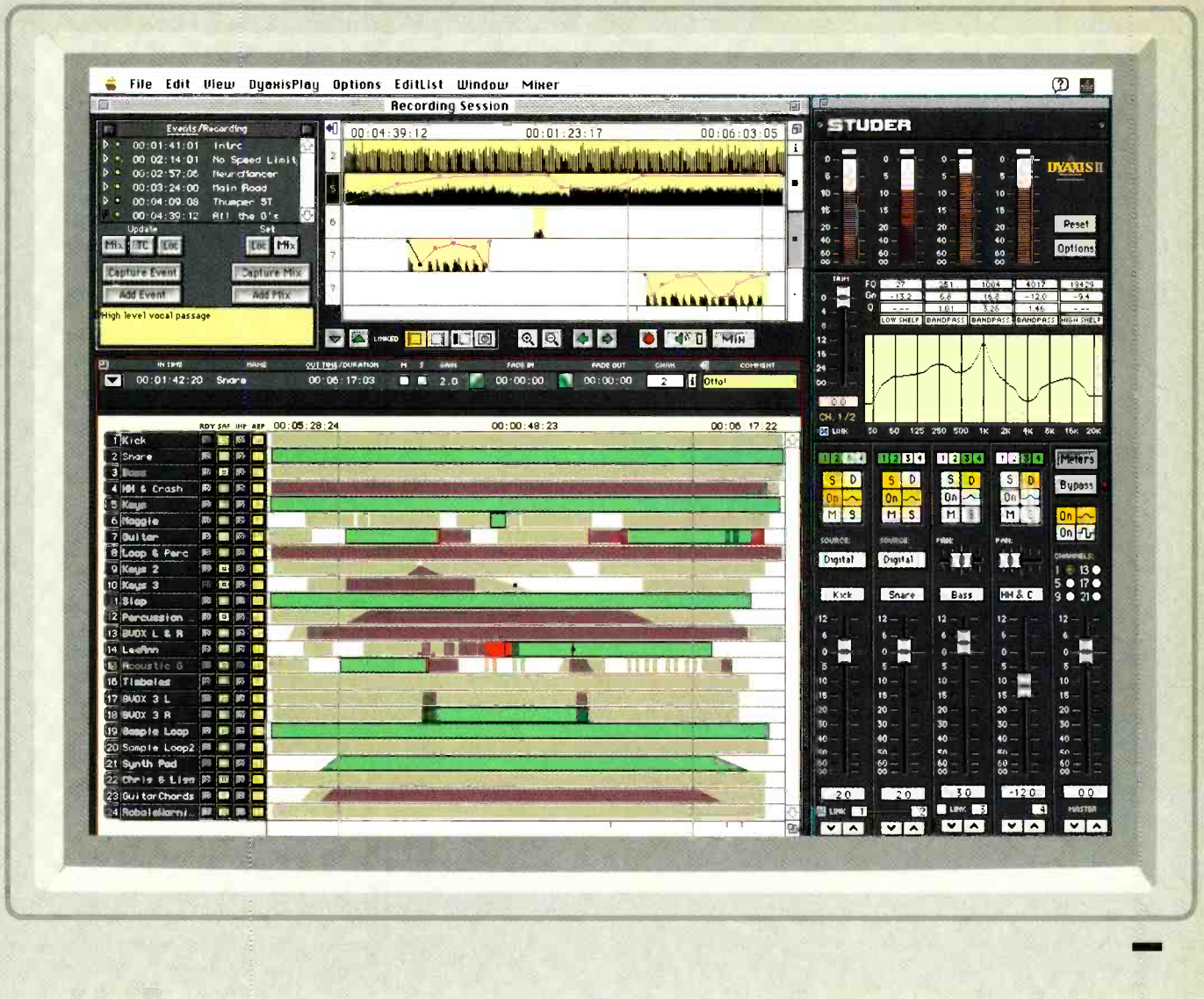
Declicking: a case history

Perhaps the most trivial declicker is a thorn needle, but this exhibits too many deficiencies to be of interest to a modern audio engineer. Two more acceptable analogue devices that have successfully addressed the declicking problem are the Garrard *MRM-101* and the Packburn *Switcher*.

The simplest analogue solution is embodied in the Garrard *MRM-101* Music Recovery Module. Developed in the mid-1970s, this uses an electro-optical fader which, at the precise moment that a click is detected, attenuates both channels, thereby reducing the volume of the click. (This approach has also been utilised in the digital domain. When an error correction system is unable to cope with high density or long data errors in a signal, many digital systems, such as the Sony *PCM-701*, will mute.)

The duration of the Garrard 'mute' (actually a high-speed fade-out and fade-in) is a minimum of 2.5mS and has to be greater than the scratch length. Therefore, even a small number of mutes affect perceived sound quality and, since the method only seeks to reduce the total energy of the degraded signal it does not restore the underlying signal. In addition, it is only applicable when the energy contained within a click is very much greater than the energy within the signal.

The most sophisticated analogue click-removal algorithm currently available is used in the Packburn *Switcher*. Using two sources of nearly identical signals (the opposite groove walls of a monaural record replayed using a stereophonic



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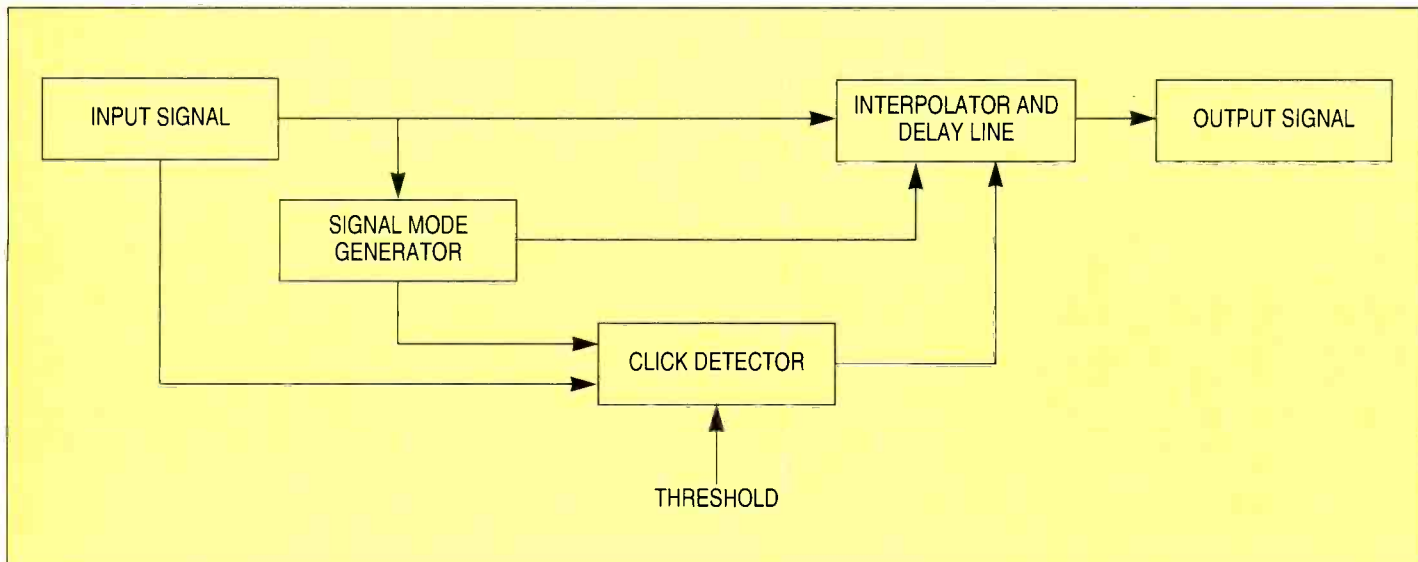


Fig.4: CEDAR click removal system

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cartridge) the Packburn monitors for the cleanest signal, and switches the output source between groove walls as appropriate. This removes larger clicks but, like all non-digital solutions, is unable to distinguish small ticks from genuine signal components. Also, the Packburn assumes a perfect monaural source. If the groove walls differ significantly, or suffer degradation simultaneously, then the assumption (and therefore the Packburn) fails. Any stereophonic content in a recording will also seriously reduce the effectiveness of the Packburn.

With the advent of digital technology it has become possible to implement ideas that could not be realised using analogue electronics. The simplest of these is sample and hold (s&h). In many ways s&h is the same algorithm as used in a perfect muting system. However, instead of creating a signal plateau at zero amplitude, it assumes that a plateau at the level of the most recent valid signal will be closer to the true signal. But while s&h removes the largest manifestations of clicks and scratches, the resulting waveform contains many audible 'bumps' and 'pops'. Many digital audio devices use s&h in error correction, and many of us are well acquainted with the pops and thumps produced by domestic CD players (which switch to s&h if large amounts of audio data are corrupt). While these low-amplitude thumps may be preferable to the high-amplitude clicks of the untreated data, the signal will show signs of severe break-up if the density of errors is high. Many listeners complain that the artifacts and side effects of s&h are more unpleasant than the clicks that they have replaced.

Whereas CD data corruption is detected using an analysis of the error status bits, s&h click removal can also be implemented as a single ended application, with click detection based upon a simple high-pass filter which detects high-frequency transients above a amplitude threshold. (Fig.3)

This detection method is most suited to large clicks, and at low thresholds is prone to mistaking genuine high-frequency components for clicks, causing the algorithm to suppress high-frequency components within the signal. Perversely, it is the large clicks (which the system can most easily identify) which least fit the model of the s&h restoration process. (Example 1.)

It is worth noting that CD players have four levels of error correction. Perfect correction is possible in many cases through analysis of the ►

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TABLE 1

Algorithm	Computational information requirement used	(Samples)
Muting	0.4 MIPS*	0
Packburn	2.0 MIPS*	n/a
Sample & Hold	0.4 MIPS	1
Linear Interpolation	0.6 MIPS	2
Low Order CEDAR	2.0 MFLOPS	6
High Order CEDAR	25.0 MFLOPS	120

*Estimates of the equivalent digital implementation.

error status data; linear interpolation is used for short duration errors that cannot be perfectly corrected; sample & hold is used for severe degradation; and audio muting is applied in the very worst cases.

The next simplest computational calculation

—and the next conceptual stage following s&h—is linear interpolation. In this algorithm the corrupted data is replaced by a straight line between the last good sample and the next available good sample. This method is impractical in the analogue domain, but relatively

straightforward in the digital domain.

Example 2 depicts such an interpolation. The audible result of this method, known as ‘concealment’ or ‘averaging’, is less offensive than the sample & hold method, but suffers from low frequency artifacts and a reduction in audio bandwidth over the interpolated region.

The CEDAR *DC-1* Declicker uses the principle of signal causality: a good signal waveform is influenced by what comes before it and influences what comes after it. Clicks, however, are not predictable in this fashion. The *DC-1* can measure the influences around a click and then use them to replace the damaged signal with the best possible approximation to the original signal. However, this assumption is only good for resonant sounds: the CEDAR declick algorithm could be used to replace digital errors from CD's, but could not be used to replace damaged bits in a fax transmission. The degradation mechanism in these two examples is the same, but the fax signal does not fit the assumptions used by CEDAR.

Fig.4 shows a schematic of the CEDAR Declicker. The Signal Model Generator is the process which measures the local influences, and this information is then used to detect clicks (signal which does not fit the model), and then replace them with generated signal which does fit the model.

The more information that can be analysed, the better the interpolation and detection can be. The *DC-1* has a parameter called ‘Order’ which determines how many samples are used in creating the local signal model. For the purposes of comparison, we will consider two ‘orders’; 3 (6 samples used) and 60 (120 samples used); and presented the results below.

The low-order interpolation (**Example 3**) is visibly and audibly better than the previous examples. However, the imperfections in the interpolation are still audible, so while this is an improvement, the results are still far from perfect. The algorithm's performance is better on short clicks, and, for small numbers of clicks per second, the process is nearly inaudible.

Example 4 shows an order 60 interpolation of the signal. This interpolation is nearly indistinguishable from the surrounding signal, and is good enough to fool the human ear in almost all cases. So, while the algorithm is not perfect, the results are good enough for many applications.

Table 1 shows the estimated computational requirements for the various algorithms outlined above, assuming they are all performed in real time.

Conclusions

The advent of digital audio technology and DSP has made it possible to implement audio signal processing algorithms which are not possible using analogue technology. These algorithms are capable of modifying a signal for many restoration and enhancement purposes and, as shown in the case history, offer significant improvements over earlier analogue techniques.

Further developments in DSP technology will lead to increased processing capabilities, higher throughput speeds, audibly better, and more cost-effective solutions. ■

This article has been extracted from a paper presented at the AES DSP Conference (14-15th Sept 1992) by Gordon Reid and Dave Betts.

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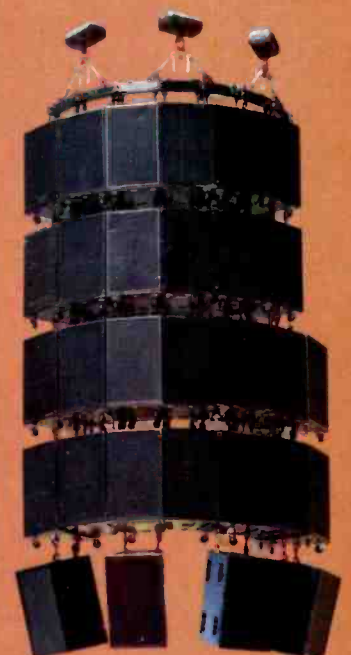
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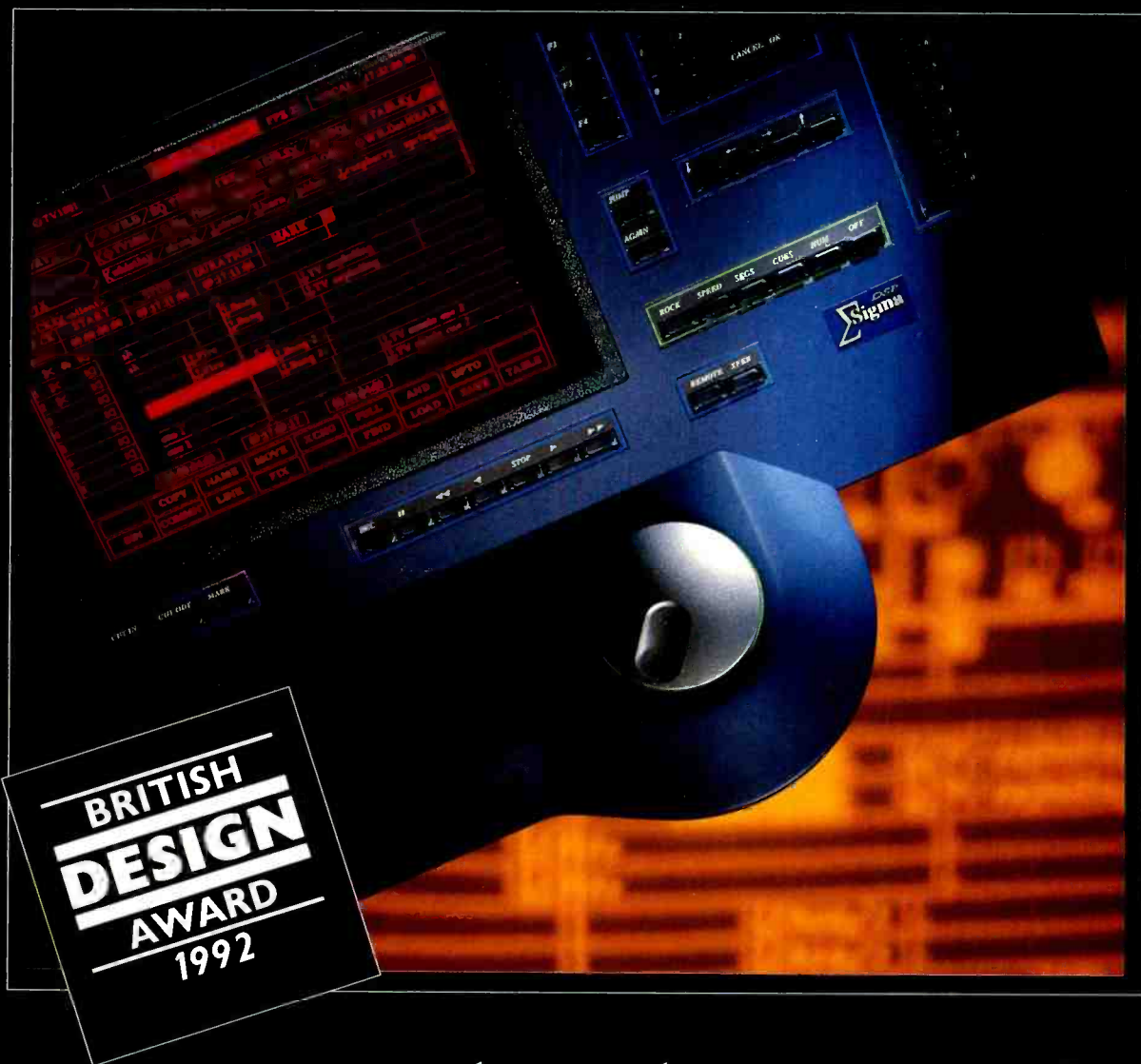
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MiniDisc on Location

Dear sir, no doubt many sound engineers and producers are viewing the domestic format war between Digital Compact Cassette and MiniDisc with professional disinterest, and would dismiss outright the use of either for professional recording purposes. But having myself used a MiniDisc machine as a tool for certain professional acoustic music recording purposes for the last couple of months, I can report that it can in fact have a part to play. Its potential stems from the nature of the tape-free recording format—I would ask you to focus for the moment on that before making comparisons with DCC or DAT sound quality.

I work with the more cost-conscious classical musicians, agents and record companies, where much of the bread-and-butter work consists of



Sony MZI

preparing demo tapes from recitals and short location sessions. These are mastered direct to stereo on DAT but distributed on analogue cassettes, which are still the most widely acceptable medium. Additionally, a modest number of session are for CD release. In either case, it is of course prudent to have some form of backup of the master tape. While this must be a second DAT if a digital release is envisaged, for other purposes the last word in backup sound quality is not so crucial. My initial purchase of the MD machine was to replace a miniature portable DAT machine I had been using in this role whose sound quality was perfectly adequate for the purpose, but the backup tapes (reused once a project is completed) deteriorated quite rapidly and had to be binned after just a few outings. This was especially true if the backup machine had frequently to be rewound for playback purposes during the sessions to avoid the risks inherent in rewinding the master—who has never in their career forgotten to relocate to the end of the recording before the next take? Noting the claim that MiniDiscs can be reused at least a million times, the format seemed ideal for this purpose, and so it has indeed proved to be. After an initial purchase of a few boxes of discs (which I will augment with the longer-playing versions when they become available), I do not envisage further consumable expense.

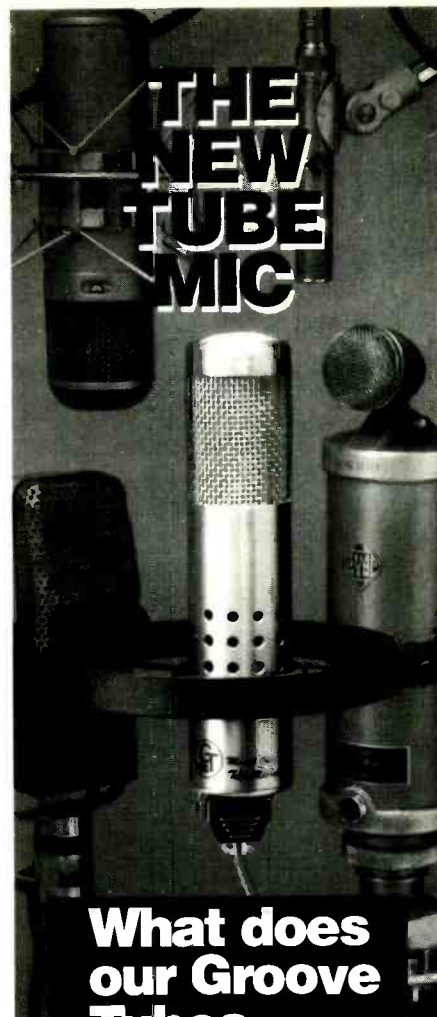
In this role I have found the little MiniDisc machine much more useful than I had expected.

For session work, it makes even the rapid access times of DAT seem slow when replays are required. When time is money, clients appreciate this saving; furthermore, when wanting quickly to compare takes, either during the session on location or at a subsequent listening session back at base, the speed of access is a real aid to the selection process. The MD machine appears to allow up to 999 index points per disc, whereas most DAT machine allow only 99 unambiguous index points per tape; so one can index every few staves of music or so on MD adding further efficiency to the review process. Meanwhile, the DAT master need not be rewound. You have to work quite hard to over-record the MiniDisc, which automatically relocates to the next free location on the disc when the record button is pressed. I have also used the MD to rapidly produce compilations from sessions, putting related takes side-by-side on analogue cassette for the musician to consider at home. This is done far more quickly with MiniDisc than even the use of DAT would allow one to achieve. For CD sessions, I now use a pair of full-sized DAT machines for master and backup, but replay on location is from a third recording made on MiniDisc, once the balance and quality have been established by DAT replay. The DAT machines and the MD machines both record the time of day and, if their internal clocks are synchronised before starting work, one can correlate a point identified on one to the same point on another.

The aspect of the MD machine which was totally unexpected, and which seems not to be generally appreciated, is that it has an editing function made possible by the buffer intended to avoid skipping when the machine is jogged. If the machine is programmed to play, say, tracks 1 and 3, the jump from one to the other is instant, inaudible and glitch-free—one can often hear the slight whirr of the laser relocating up to ten seconds in advance of the jump.

I suspect that a short crossfade is performed in memory. The track IDs to allow this can be inserted when recording—helpfully, the machine accounts for reaction times and inserts the IDs about a second earlier in the program than the point at which the button is pressed, by use of the same buffer memory. They can also be inserted later, during replay, when the point can be identified to within about a quarter of a second by hitting the pause control—there is no noticeable delay in this response. Unlike DAT, track renumbering is instant; deletion and re-insertion to adjust location is quick and simple.

In practical use in the context of recital recording, this has enabled me non-destructively to edit out tuning between works or movements, and those periods when the artist recovers briefly backstage from the rigours of performing one work before tackling the next, directly on the recording medium itself (the MiniDisc) without having to resort to lengthy copying operations from DAT to DAT or via an editing system. This facility can cut this particular part of the job down from a couple of hours to a couple of minutes. Short of heaving around a full-size hard disk recording system (with about 1.2Gb disk) to locations, there has >



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hitherto been no other way of doing this. I have also used this editing feature on speech with quite acceptable results, and even on music on one occasion in order quickly to prove to a performer that an edit I was suggesting would work in terms of tempo and dynamics, prior to executing it properly on a computer-based editing system back at base.

Of course, none of the above would be of any use if the sound quality of MiniDisc was unacceptable for the purpose. My more golden-eared colleagues might disagree, but I would be very surprised if they could reliably identify material copied to analogue cassette using Dolby B from DAT as

opposed to material copied from MiniDisc. When it comes to replay at sessions direct from MD, none of the musicians I have worked with so far have objected to the sound quality of the MD replay, once the basic sound quality and balance have been established direct from DAT. After that point, they are listening to the accuracy of the performance and quality of interpretation rather than to the finer points of the sound quality, in my experience.

There is a downside—I have to say that I am disappointed in the level of background noise, which seems to be equivalent, subjectively, to a chrome tape with Dolby C, and passages such as

those involving prominent brass can sound grainy in the upper frequencies. Occasionally the machine develops a mind of its own and refuses to co-operate, and on a single non-critical occasion it lost its 'table of contents', effectively erasing the whole disc (a hazard with any hard disk system). I have experiences nothing equating to a dropout but did once experience a half-second skip, which was probably preferable to the former if one had to have a fault at all.

Perhaps we may soon see full-sized MiniDisc machines allowing the use of higher grade components to improve the sound quality and with larger connectors (perhaps someone will offer retrofitted balanced inputs and outputs). Until then I take the view that the present machines are remarkably cheap when viewed as a portable hard disk recording and editing system; they take up very little space on location or in the studio and can perform a role which is very costly to accomplish in any other way. Just think what could be done if the same magneto-optical technology was applied to full-sized recordable CDs without data compression.

Peter Nicholls, London, England

Channel Crossing

Dear sir, I hope you will find the following comments of interest with reference to the article in the December 1992 issue concerning the recording of Verdi's *Don Carlo*. I began to read the account of the Sony Classical recording of *Don Carlo* with interest, but the more I read the more confused I became.

It seemed that David Smith didn't know whether the recording was multitrack or two track! For the sake of clarity and to end any possible confusion, I can tell him that the recording was definitely not two track. There is a simple way of telling (and I hope it is of use to him): count the number of meters on the recording machine. That will usually give you the number of tracks available; assume that if it is more than two, then you are probably recording on a multitrack system!

Come on, Mr Smith, you can't have it both ways—either you balance the sound properly on the sessions, or you hedge your bets and do it afterwards. It is common knowledge that you need to have a certain commitment and lots of experience if you choose the 2-track option, since alteration of the sound balance just isn't possible afterwards.

The recording Sony made is not effectively a two-microphone recording; it is, by a simple counting procedure, a 16-microphone mix. So we have a multi-microphone setup. Isn't it strange that with all this equipment being available and being used, only once is there mention of the really important people on this recording, and that is of the conductor.

I note that the final balance was decided by a committee, and we all know what committee came up with when designing a horse!

Thank goodness this wasn't one of the more difficult operas. It is rare in my experience for so much misleading hype to be written about a run of

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Allen E Stagg, Classical Music Audio Consultant

P.S. I wouldn't have used two microphones either, although I would probably have used two tracks—but then that's experience.

David Smith Replies:

Thank you very much for your response to our detailed description of the recording of *Don Carlo* in the January '93 issue of *Studio Sound*.

The article was intended to be somewhat neutral, touching on both the artistic and technical aspects of the recording procedure but leaning toward the more developmental aspects of orchestral digital recording. Unfortunately the tone of your response conveys several misunderstandings.

While I cannot vouch for the degree of controversy that exists in Europe with respect to the subject of two track recording versus multitrack recording, I can tell you that it is a very sensitive and heated subject in the United States. It is for this reason that my discussion dealt with this point in depth. At no time did the tone of the discussion take on a demeanour of shame or pretence. The reason for the use of multitrack technique on a project like this can be elicited from any major recording artist or executive, and that is insurance. With this project costing some six figures to record and produce, a multitrack backup is an automatic given.

As the assistant engineer for this project I can accurately inform you that the orchestra has been recorded and appears on the CD through two microphones and two microphones only. Yes the soloists have their own microphones, but the intent of the 2-microphone discussion centred around the fact that the orchestra in the room was recorded with a single pair of *TLM 50s* quantised to almost 19 bits.

The actual balance is established by the engineer with the approval of the producer. The conductor is listening more for performance than balance so the actual balance is arrived at traditionally, not by committee. As for the question of experience, the producer (Michel Glotz), and engineer (Christian Constantinov), have extensively produced and engineered recordings by Herbert Von Karajan, Maria Callas, Sir Thomas Beecham, Placido Domingo, Jose Carreras and Edith Piaf.

I hope that this brief missive has cleared up some of the points that you found unclear.

David Smith, Director of Recording Operations North America, Sony Classical.

Letters should be addressed to:
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My meetings with Andy Ishizaka, Managing Director of Taiyo Yuden's European HQ in Nuremberg and Ryosaku Sudo, Managing Director of Taiyo's Sales Division in Tokyo, turned up some interesting insights into how Taiyo came into the audio industry out of nowhere and, having arrived, where they are likely to go.

Taiyo are a components company, supplying resistors and capacitors (not microchips), to electronics factories around the world. The company employ 10,000 people worldwide, 3,000 in Japan, with plants in Singapore, Taiwan, Korea, the Philippines and USA, as well as Japan. Taiyo have seen the consumer electronics industry shrink and are looking for new opportunities. The company introduced the oddly named That's brand of audio tape in the 1980s and began work on a recordable CD in 1985. The CD-R was announced in late 1988. The trick was to make a disc with dye polymer coating which deforms during recording in such a way that the disc then plays like a pressed CD on any CD player which meets the Red Book standard set by Philips and Sony. The deformation are not reversible so the disc is 'write once' and will not erase.

Taiyo's move followed a few months after a promise made by Tandy to sell an erasable CD, called *Thor*. Tandy never delivered and quietly gave up on the project in mid-1992.

Taiyo successfully delivered its write-once system, secured patents on the technology and struck a co-licensing deal with Philips and Sony. The Philips-Sony Orange Book standard defines the physical method of recording. Philips make Orange CD-R mechanisms which they sell on to other manufacturers for badging. All the discs on the market (such as those from TDK) are based upon Taiyo's technology, and all are compatible with the Philips recorder.

Kodak's *Photo CD* is also based on the same technology. It is an 'application format' designed by Kodak and Philips which builds on the Orange Book physical format, and the Frankfurt Logical format (a data layout agreed by the computer industry to allow the exchange of data between incompatible computer systems). Blanks for the *Photo CD* application will not work on Orange Book audio decks, because the vital pregroove (which guides the laser during recording) is coded with different software from that on an audio blank.

Taiyo are clearly greatly interested in Kodak's activities—wanting to know, for instance, where Kodak make their discs and how they look alongside Taiyo's patent claims. Surely Kodak would not risk a rerun of the horrendous legal action in the US which followed Kodak's infringement of Polaroid's patents on instant picture cameras? That action cost Kodak over a billion dollars and forced the company's withdrawal from the instant picture camera and film market.

Taiyo see that Kodak are going all out to create a domestic market for *Photo CD*, and are thus obliged to set a very low price point for blanks. But Taiyo are clearly appalled at Kodak's pricing policy and what it does to their own. Taiyo's pricing policy is muddled because there is no recommended price. Sales are through local distributors (such as

Barry Fox

Power games behind the scenes and power-hungry MiniDisc machines

Harman in the UK), because Taiyo do not know the size of the market yet and have not set up their own distribution chain.

Discs are pregrooved in three time-lengths, 18, 63 and 74 minutes. But Taiyo's engineers are working on a disc which matches the maximum time allowed by the Red Book standard for CD, 79 minutes 59 seconds.

Taiyo are also watching the DCC-versus-MiniDisc struggle very closely because they are developing an erasable version of the write-once disc.

'We have to do it,' says Andy Ishizaka. 'We are pushing our engineers. Because then all ball games change'.

How soon?

'That is still up in the air.'

But no doubt is left that once the technology is ready Taiyo will launch it, because once either DCC or MD gains a foothold the window of opportunity for CD-E will have closed forever.

Both the new digital audio recording systems—Philips' Digital Compact Cassette and Sony's rival Mini Disc—reached the shops before Christmas. Sony only just made it for December 15th with very limited stocks of *MZ-1* recorders (at £500) and pressed Mini Discs (around 30 titles rattling around in large racks, for between £13.49 and £14.29). The *DCC900* came in during November at £550, and by mid-December there were around a couple of hundred titles at between £13.99 and £14.79.

Both systems showed obvious signs of being rushed onto the market to try to get ahead of the other. But neither company dared trust the other to hold back until the technology is more refined.

Although the systems are quite different and wholly incompatible, both Sony and Philips face one common technical problem: DCC and MD rely on data compression, which reduces the number of

digital bits needed to record the play stereo by at least 75%. The first generations of coding and decoding microchips are very power-hungry, and neither company have yet been able to produce the small, light and reasonably-priced portable units which the record companies see as a new opportunity to sell yet more prerecorded music to play on the move.

Philips have solved the power problem by offering only a large mains-powered DCC recorder while Sony are selling a portable, but it is too large to fit in anything other than an overcoat pocket. Sony's MD also runs for only a short time on one charge of its nickel-cadmium cells. Exactly how long varies with use.

In the US, Sony vaguely promise playing times of 'Up to two hours' and a recording time of 'Up to 1.5 hours'. In the UK Sony are paying safer, and promising 75 minutes of continuous playback and one hour's recording, from fully charged batteries. These times are reduced if the player is stopped and started. As the NiCads develop memory effect from use, the times will fall further.

Sony UK are also playing safe and claiming that the MiniDisc portable is 'shock resistant' no 'shock-proof' as previously claimed. The digital decoder inside the MD portable player incorporates a 4Mbit solid state memory store, which acts as a buffer when the player is knocked. This holds 10 seconds of music—if the player is knocked for more than 10 seconds, the music stops because the buffer has not been able to re-fill.

Recording onto disc is more convenient than onto tape because the player can search for musical passages faster. But users must pay for this. The cost of the blank magneto-optical discs on which MD records is now set at £9, instead of the £7 planned, and the recording time has fallen to 60 minutes, from the 74 minutes promised. This makes disc recording around twice as expensive as tape recording.

Sony promise 74-minute discs in the spring, but no price is yet set. Sony's engineers say the extra 14 minutes can only be achieved by coating the 64mm disc to the extreme outer periphery, and running the disc slightly more slowly. At reduced speeds, however, any blemish on the surface of a disc becomes more likely to causes errors in the read-out.

The technical bugs will, of course, be ironed out, given time. Who knows which system, if either, will survive. But already the die is cast. Things in the audio industry will never be the same again.

As systems, DCC and MD have another thing in common: the ability to make perfect digital copies of CDs. There is a strong incentive to do this because prerecorded DCCs and MDs cost as much or more than the equivalent CDs. Sony own record company CBS and, quite naturally, do not want to be seen encouraging people to pirate music. Consequently, the company are playing down this benefit. Philips, however, are blatantly advertising that 'with a blank DCC, you can make a digital copy of your favourite CD, or make your own customised 'best of DCC'.

Philips say they feel safe to do this because the Athens agreement on copyright and SCMS amounted to a clear promise by the hardware companies not to oppose any claim from the record companies for a tax on blank tape. ■

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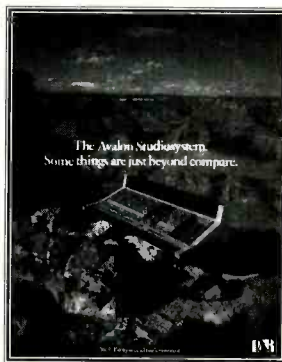
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It is all but certain that the majority of pro audio equipment prices will increase from 1992 levels but that the increases will accompany significant improvements in capability. The use of dedicated PCs and/or digital audio workstations creates an area vulnerable to price increases of computer components. And computer components are headed up in price. Demand for high speed and wider 'bit' pathways in CPUs has seen more powerful and more expensive microprocessors become the norm.

Similarly, the demand for on-board RAM has increased with the popularisation of computer graphics, DTP, photographic and video applications as well as for digital audio. With these demands has come official scrutiny of chip 'dumping' by South Korean chip makers. US government action at the end of 1992 targeted Korean memory chips for additional tariffs, causing a significant rise in the street price of RAM. Possible action by the new President Bill Clinton, could further complicate matters, as Japanese chip makers fall under increased monitoring and possible action by Washington. European Community action against chip dumping is also waiting in the wings. As one Brussels-based Eurocrat put it: 'it is naive to assume that our Asian friends are dumping chips solely in the US'. Hard drive prices are also on the rise as increased user capacity demands and unprecedented computer product demand come into play.

This year will see the advent of the most powerful desktop processors yet. The Intel *P5* or *Pentium* will emerge initially as a plug-in option for certain 80486 PC systems and could appear in stand-alone PC products. Such a *P5* computer system could offer operating speeds approaching 100MHz. The *Pentium* chip and succeeding generations of 'P' chips will also offer new pathways for digital audio without the need of DSP arrays on silicon. The DSP-less *P5* will use software to configure the microprocessor to perform digital audio tasks at speeds in excess of anything available today.

The *P5* family will probably 'max out' in the 100–150MIPS (Million Instruction Per Second) range, but successive 'P' developments are in the pipeline. Intel's longer-term goals include reaching 2000MIPS at 250MHz by the year 2000. Sources within the company suggest that 400MHz at levels greater than 2500MIPS may well be achieved at that time. The Micro 2000 chips may well exceed 100 million transistors, while the *P5* consists of millions of transistors. Contrast this with the 8086 chip (on which IBM built the original PC) which comprised about 25,000 transistors. Operating speeds were under 2kHz without hard drives and only 64Kb of RAM.

Similar advances are occurring in the world of Macintosh computing and beyond, as Apple and IBM work with Motorola to create the *PowerPC* chip for future desktop products. Others such as Apple founder Steve Jobs' NeXT Inc. may also collaborate. The *PowerPC* will be the basis for Apple's new product lines and will include the architecture necessary for future IBM developments. Previous relationships involving IBM have provided access to the MACH kernel

Martin Polon

Our US columnist takes a look at 1993—and beyond

that is the basis of the NeXT-Step—and IBM are considering that microkernel for the *PowerPC*. That would mean a chip providing access to the most attractive operating systems and architectures in the industry for the creation, recording, manipulation and editing of audio, video, multimedia and graphics. Apple are expected to present a *PowerPC* product with UNIX-like capability operating at speeds approaching 100MHz in 1994. Full *Macintosh* operation would be available as emulation on the system but the *PowerPC* operating system would also be available.

The impact of all of this on the audio community is clear. Virtually unlimited interchangeable mass-market operating platforms priced from under \$5,000 with speeds unfettered by DSPs and/or A–D or D–A converters. This will allow approaching audio performance six to ten times faster than that achieved in 1990, depending on the platform. Since 1990 chips were capable of MIPS operations in the 'teens and the new chips will allow MIPS operations in the hundreds, the potential for audio recording when coupled with the progress in large hard drives, tape backup systems and large-scale RAM stores is more than significant.

One business issue that will continue to significantly affect everyone is a continued shortage of credit. Loan money for those in the entertainment technology sector is seriously limited for all but the most cashworthy customers. Ever since the banks found themselves in a deflating real estate market and suffered the ill-humoured punishment of the Federal bank examiners and regulators at the end of the 1980s, studios, postproduction facilities, multimedia houses and other similar production venues have paid the price. Some audio equipment makers have lost all or most of their open credit lines to finance expansion, R&D or just to fund parts purchases necessary to fill large equipment orders. In 1993, despite the resurgence of financial health at most banks, the priority of loan extension still works against those in the audio industry. For most, the terms 'assets' and 'collateral' are frequently measured in such intangibles as

There is a sense that rock music has regained its musicality

'goodwill' and 'reputation'. These are unlikely to elicit more support from loan officers than they did in 1992.

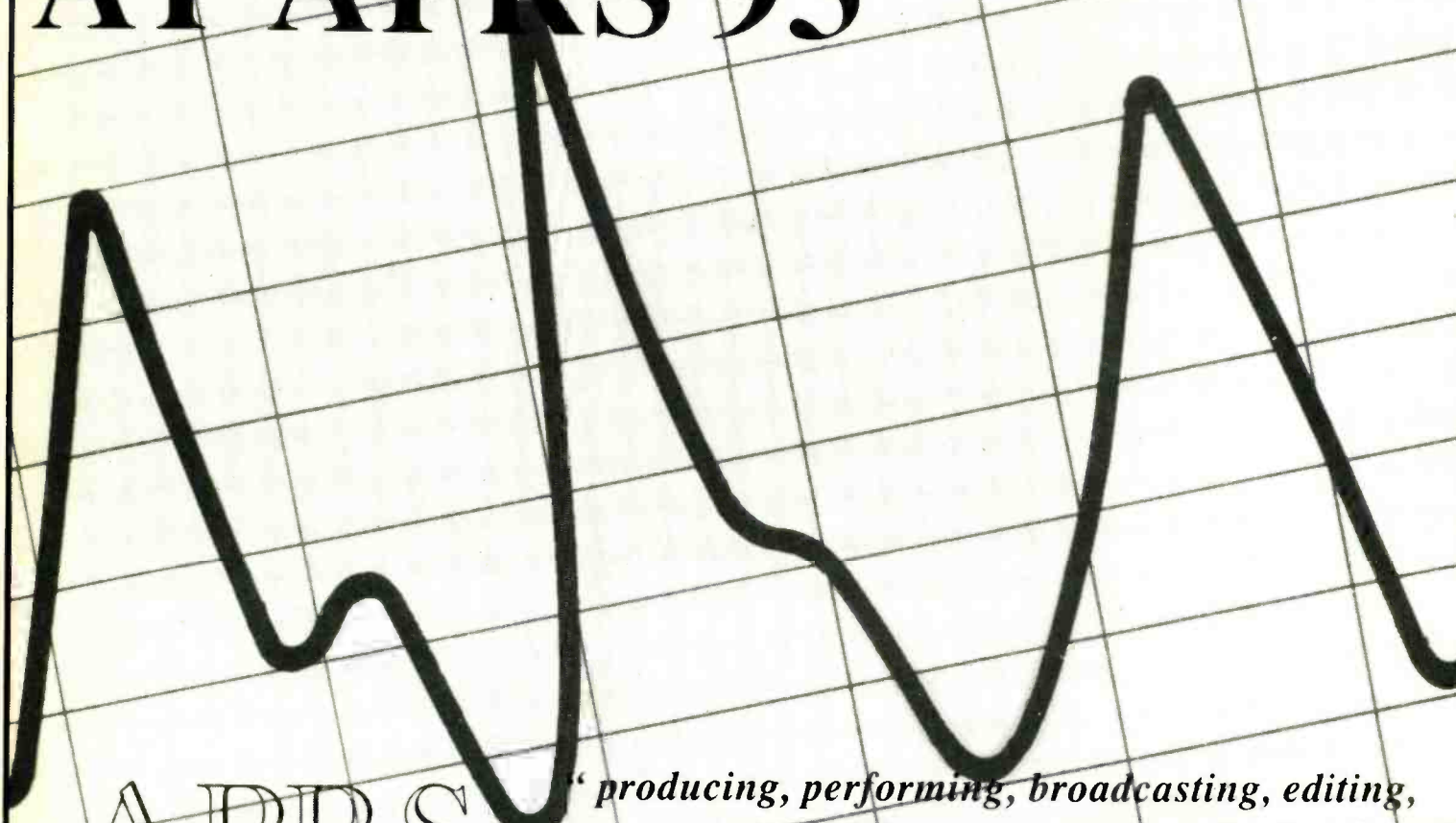
In the US, the impending ascent of a new President from a long out-of-power political party, with new ideas for the nation's economic ills has significantly inflated public confidence from studio owners to studio users. Ditto the posting of improved retail returns during the Christmas season, cheering many and increasing advertising spend. This increase translates into more radio 'spots' and, hence, more studio time. Similarly, consumer electronic retail reports from Christmas were good and that should mean more public demand for recorded music and more recording sessions. However the economic outlook for 1993 remains mixed—although many 'seers' are convinced that the economic recovery is really on the way.

Nevertheless, the outlook for studios is much better than in recent years, and it is likely that total studio billings will increase by approximately 10% from 1992. This figure comes in some degree from increased activity with syndicated and network programming for on-air television plus increased numbers of cable and other transmission system channels. As an example of how expanding markets for TV programming benefit recording complexes, consider that there are five new science fiction television shows beginning early in 1993 on US network television or via satellite syndication to local stations, including a spin-off, *Deep Space Nine*, from *Star Trek: The Next Generation*. These shows are important to audio service houses since they are frequently one hour in length with audio production budgets closer to that of made-for-TV movies rather than of half-hour comedies. All have substantial post on sound and effects tracks and an unusual (for television) appetite for elaborate mixes and post sessions. Even if such work stays within the smaller loop of established film industry facilities, displaced projects will find their way to new venues.

In addition, there is a sense in the greater music industry that rock music has regained its musicality; one critic calls it 'message over distortion'. The beginning of the 1990s saw huge contracts awarded to established pop icons for relatively few projects. The \$200m plus committed to Michael Jackson, Prince, Madonna and others could have subsidised 10,000 new groups at an average development cost of \$20,000 each. Assuming the likelihood of a 2% to 3% success ratio, 200 to 300 new records would represent a more satisfactory return. That would have provided the recording studio community with 10,000 sessions initially and another 300 album projects. And it would appear a safer investment than that of aging superstars. One message of the 1990s is that the so-called supergroups or superstars whose relative absence has been mourned by record company moguls since the demise of the Beatles and the Stones, no longer sell 10–15m albums.

Today's 'heavy hitters' are fortunate to top 1m units. Needless to say, this is partly due to the music-buying population being nearly half of what it was in the 'boom' years at the end of the ▶

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1970s. Especially encouraging is the development of a kind of musical 'narrowcasting', curiously similar to the sci-fi surge in TV. In 1993, record labels will place significant effort into reaching the specific buying populations. The music audience has fragmented by distinctions of age, economic achievement, regionalisation and interest. Alternative labels are capable of having a resurgence in 1993 and so are major label 'sub-culture' ventures. The under-\$10,000 album can succeed. Whether the new 'mix' of pop music consists of do-it-yourself Eric Claptons or Nine Inch Nails, the music industry has a future that encompasses diversity and that means more work for the recording studios.

There are many indications that the CD in its many current incarnations will withstand whatever assault DCC and MD may mount during '93. It is important to note that the CD has achieved complete acceptance in the American home, with nearly 50 million players installed including portable and automotive players. What is even more significant is that the CD is on the way to achieving virtual commodity status in non-audio storage of data, games, computer programs, photographic images and educational information. Some analysts estimate that by 1995, there could be as many non-musical CDs sold as are presently sold in various record outlets in the US. Foremost amongst new uses is the Kodak Photo CD system—

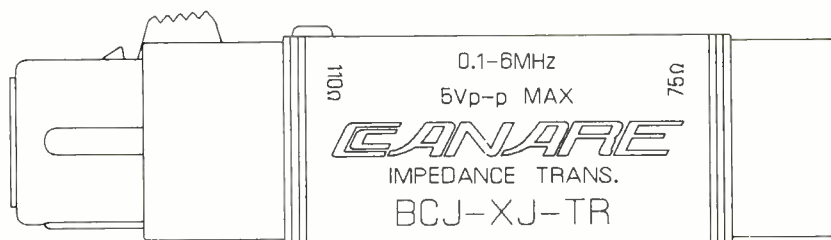
Photo CDs can be played on players which also have digital audio

with a sixth system waiting in the wings. The Photo CD Master is for consumer storage of 'taken' photographic images. It can accommodate audio, text, graphics and interactive branching. Pro Photo CD Master is for medium and large-format images captured by professional photographers. The Photo CD Portfolio holds 800 images and/or one hour of sound or a combination thereof. The Photo CD Catalogue has the same options as the Photo Master plus including Browser software to allow its multiple-image capacity to replace large printed catalogues. Photo CD Medical can store a variety of medical images plus optional text, audio and graphics. And Photo CD Record has been announced to provide 'economical' desktop imaging.

Photo CDs can be played on Kodak players which also have digital audio, as do the new Philips CD-I multimedia players and on CD-ROM Multi-Session-XA compatible drives such as the new Apple CD-300. The Apple drive can play audio CDs

directly to any stereo system (or as digital information transferred to computer for editing), HFS format discs, High Sierra discs, multi-session Photo CD, CD-XA discs, CD+G and CD+MIDI discs. Quicktime video 'movies' can also be installed on the computer via the drive for viewing or editing. Similar capability is available on other CD-ROM drives for DOS, Windows and OS-2 based computer systems.

The bottom line is that the CD is becoming a one-format, one-drive commodity in America in '93 that will allow you to watch movies on your computer, load and play educational games, edit your holiday photographs and record a commentary, listen to Louis Armstrong, sample a Rolling Stones song to put on your answering machine and so on. The impact of the CD beyond 1993 will probably include full-motion video-for-TV playback and the ability to record and play back both audio and video in addition to the computer options available today. This flexibility and compatibility is a steamroller that cannot be stopped, and it should propel the CD well into the next century. The bottom line is that neither MD or DCC can do any of these things and if the qualitative audio differences between these new systems does not tip the scales in CDs favour, the quantitative power of the CD outside conventional music reproduction will. ■



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250 Hz
500 Hz
1 kHz

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2 kHz
4 kHz
8 kHz
16 kHz

125 Hz
250 Hz
500 Hz
1 kHz

NAGRA D

Sam Wise tests the Nagra D digital location recorder

Kudelski with their Nagra series recorders, ruled the world of serious location sound recording for film, TV and many forms of sound documentary. The machines are reliable, produce quality rivalling the best studio recorders, and Kudelski are known for product support. I believe that parts for the earliest recorders can still be obtained. But time has moved on, and with the advent of digital recording, the winner of the prize for location recorders has yet to be determined. Only a few months ago, we reviewed the Fostex PD2 DAT recorder—a fully finished product developed especially for this use. Stella—who have been the main alternative to the Nagra—introduced their *StellaDAT* some time ago. We await an opportunity to examine that machine in the near future. Recently, Kudelski have launched their digital recorder, the *Nagra D*, which is the subject of this review.

DAT has become the *de facto* standard for master recording and field recording over the last few years, though many are still concerned about the delicacy of the tape medium. Tracks widths are very small, approximating the thickness of the human hair. And the best tapes, when new, are made of a material which can oxidise (rust to the layman), though at least one manufacturer has a solution to this. And the whole system is very susceptible to condensation when taken into extremes of temperature. Over the next two months we are examining these problems for a future review of DAT tapes.

Kudelski, in designing the *Nagra D* have stepped away from everyone else and produced their own digital recording format. It resembles DAT in that a rotary head recording method is used, but in most other respects is different. The main reason given for this is the relative delicacy of the DAT format, rendering it unsuitable in their opinion for location recording. The question is, will they succeed with a product which is a lone ranger, compatible with no-one else? Is the machine good enough in other respects to repel the competition, and does the potential increased reliability from having a lower data density on tape actually bring benefits in practice? The open-reel format is not as easy to use as the DAT cassette, and recording times are similar. Does DAT tape inside a cassette perform less well than an open-reel tape with wider tracks? Will the

Nagra tapes last longer when stored, making them preferable for archiving material? Even if storage is better, do you want your material in a format which no-one can replay except another *Nagra D*? It is totally non-trivial to produce your own digital replay machine, compared to the relative ease of making an analogue recorder that works, though it may not be the best of quality.

The other benefit which the *Nagra D* brings is a 4-channel recording format. A year or two ago, this may have seemed unimportant. But now, with proposed HDTV formats having four sound channels, it will become increasingly necessary to record ambience and surround material in the field, along with the principal sound source. This will bring nightmares to many film crews and directors, who have trouble enough yet with mono, but the need will arise as time passes. With four channels, doing this is possible, with two it is not. However, for the price of one *Nagra D*, two Fostex PD2 recorders can be purchased. And the Fostex machines can be synchronised, making 4-track location recording possible using two machines, while providing a spare for stereo recording, and

using a recording format compatible with many other suppliers.

First impressions

When the *Nagra D* arrived, I almost gasped. The machine is nearly 50% larger than previous Nagra machines and the Fostex and Stella alternatives. It is also heavier, weighing in at 7.5kg, compared to the 4.2kg of the competition. The *Nagra D* reeks of Swiss precision engineering, being constructed of the same beautifully machined parts that have always been the hallmark of *Nagra* recorders. But there is not even a clip point provided for the attachment of a shoulder strap. This is definitely not a machine designed for shoulder operation.

Internals

The machine is opened by loosening two retained screws at the front of the case, allowing the top plate to pivot upwards around two hinges at the back. A simple brace keeps the machine open. Internally, the machine is beautifully constructed with watch-like precision. PCBs are securely mounted, and clearly legended. Most electronic components are surface mounted, with the multiple PCBs connected by latching plugs and sockets. The battery is mounted internally, therefore, though the machine is well sealed against the entry of dust and water, the entire internals are risked if a battery must be changed. With only 1 hour 45 minutes of battery life, this must be expected. The battery is one of two types used with Sony Betacam recorders, so should ▶



Going it alone—the *Nagra D* and its proprietary digital recording format

be easily available. Though the charging system is said to be intelligent, a user changing a battery has to know its state of discharge and inform the machine via menus for correct charging to take place. Unless this is correct, the manual says 'battery reserve indication will never be right'. Replacing the battery itself is relatively easy. I was told, though the manual specifically warns against it, that the unit can be connected to standard battery belts, relieving things somewhat. To me, this machine can be compared to the mains powered laptop computers referred to as 'luggable', it can be carried and run off of internal batteries, but in a rather limited fashion.

Operation

Generally, the machine is simple in layout and operation. Two stereo AES-EBU digital audio and four analogue input connectors of the XLR variety are located on the left side, with matching output connectors on the right-hand side. RS422 serial remote control and Extension sockets using female D-type connectors, a BNC for Video sync input, and a 5-pin Lemo for time code complete the left-hand side input connectors. Each analogue input is provided with a four-position rotary switch which is used to select microphone powering options. All have the same gain including the one marked Line.

The right-hand side of the machine is completed by two 6.35mm monitor headphone connectors which share a five-position gain switch, and another Lemo connector used for the connection of external power supplies. The front edge of the machine contains a PHASE reverse switch for each channel, and a three-position filter switch having LF attenuation correction for close directional microphone use, and a speech band limiting position. The resulting curves are shown in Fig.3. The top of the machine contains the main works. In normal use 5-inch diameter 1/4-inch spools are used loaded with metal oxide tape, the same type as is used on PD and DASH stationary head digital recording formats. The tape path is

virtually straight, with one tape guide and tension roller on the left, which is used as a tape counter. The tape then passes over a full-track erase head, and on to a record-playback head which handles the Cue Control and Time Code tracks. The tape remains in continuous contact with this head. It then passes over two guides which are used to wrap the tape around the rotary head mechanism, and past a final tension roller on the right end of the tape path. When the rotary head is spinning, tape start takes about one second. When the scanner (as Kudelski call it) is stationary, start time is extended to about four seconds. The scanner has four heads on it, two record and two replay. However, unlike the Fostex DAT machines, read-before-write is not provided, making bounce-down of previously recorded material impossible. Transfer or copying of material from tracks 1 and 2 to tracks 3 and 4 can be done using external connections via the AES-EBU ports.

It is possible to rotate the reel motors within the housing to allow 7-inch spools to be fitted, doubling recording time. However, end-of-reel sensing will no longer work, and a special cover is needed which overhangs the machine, making it larger. In addition, the machine can be switched into 2-channel half-speed mode, doubling the recording time.

A moulded plastic lid with weatherproof seal can be closed over the whole mechanism, not only protecting it from the elements, but also quietening what might be an otherwise excessive noise level generated by the scanner. Transport operation is smooth, and controlled by a row of six push button switches. Pressing PLAY waits for the scanner to reach operating speed if it is stopped, then activates the tape loading guides, wrapping the tape around the scanner unit. Forward motion then begins. Pressing FF or REW while in play will move the tape forward or backward at four times nominal speed, while monitoring takes place via the cue track. Pressing EXE and PLAY together enters edit mode, whereby turning the channel-4 digital gain control into a transport jog control,

winding forward or backward at up to nominal speed while monitoring on the cue track. Record operates conventionally, with RDY being used to start the scanner in preparation for a fast play or record start. End-to-end fast wind time on a 5-inch spool of tape is 90 seconds. The quality of audio from the cue track is very poor, serving its purpose for cueing but is unsuitable for any other use.

Four analogue-type meters are provided, but these are actually driven from a signal internally derived from the digital systems. The response is PPM-like, with a fast response and slow decay.

Meter range is 50dB, calibrated with respect to digital full scale. The meter scale is acceptably accurate, reading within 1dB of calibrated level over the full range. Illumination is provided, controlled by a three-position toggle switch, which also controls LED brightness. Above each meter is a green CAL LED indicating 0dB gain in the channel digital gain control; a red REC LED indicating active record mode; and a yellow OVERLOAD LED, which illuminates when digital full scale is exceeded. The meters also retain the maximum level, which can be read by setting another toggle switch to HOLD MAX. Pushing this same switch up to RESET HOLD clears the stored maximum level on all meters.

Channels are switched to record ready in pairs, with further switches to select the cue and time code tracks to ready. Normally, time code and cue are recorded with the first recorded tracks, and would be set Safe when the other two tracks are added. Finally, there is an ASS-INS switch. In assemble mode, the initial tracks are laid, and the full-track erase head is active, erasing any previous cue, time code, control and digital audio tracks. Even with all of the above switches in Safe, it is possible with ASS mode selected to erase everything. The REC LEDs do flash to warn that something is happening, but it could be a bit late by then. In INS mode, the cue and time code tracks must be Safe for Record to be activated. It is not possible to punch-in or out on either pair of tracks while recording.

Monitor selection switches allow the headphone jacks to be fed from Cue, St (stereo), or Mono and to be selectable between input and off-tape signals. Cue can either be created from a mix of input signals, odd channels appearing left and even channels on the right, or an additional cue microphone can be plugged into the right side of the machine overriding the other cue input sources. In stereo or mono modes, individual tracks can be selected on or off of the monitor, or soloed in-place. Having both record and playback heads, a further switch allows the machine to be selected to monitor either inputs or off tape. A further Auto position selects inputs on record and off tape on playback automatically in the conventional manner.

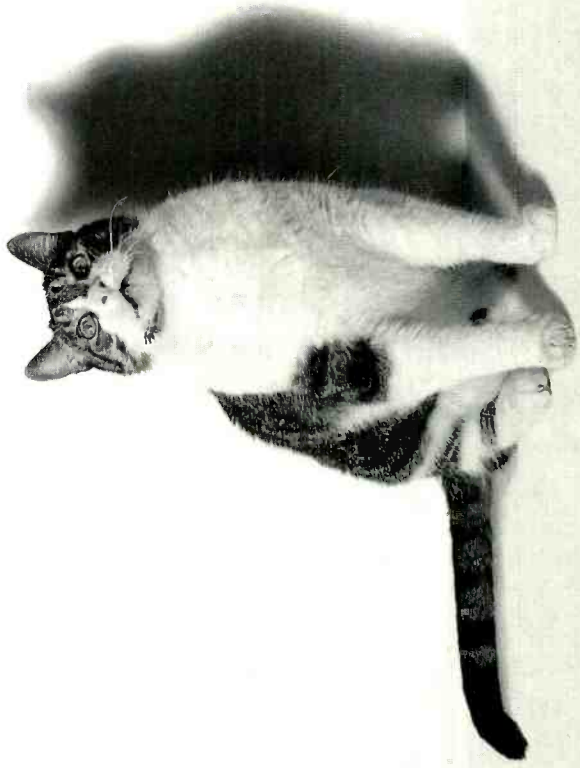
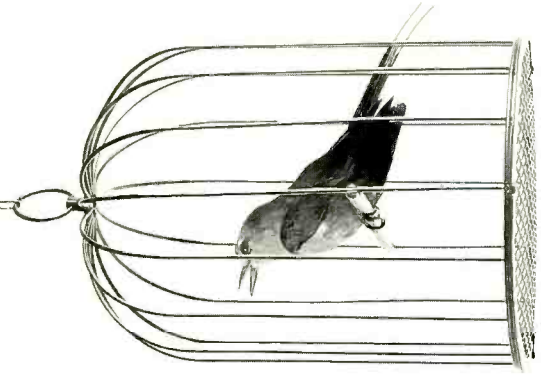
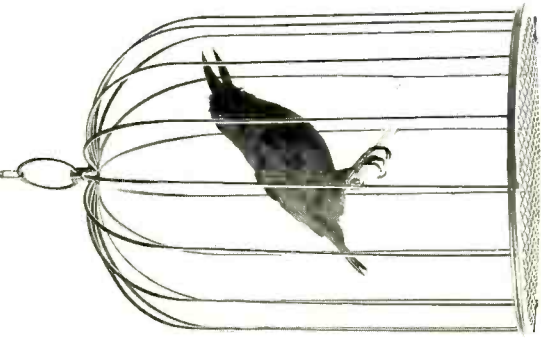
Menus

An 8-character alphanumeric display and two-cursor control keys provide a menu system. This is used to do things like select sampling rate, time-code-type, analogue or digital inputs, setting of counters and so on. Unlike a conventional menu system which uses four cursor key functions L-R and Up-Down, this system only allows selection of right and down. Pressing both together executes escape. Even after several hours use, we found this menu system remained confusing, requiring constant reference to the manual. While this might be reasonable when setting unusual things, it gets irritating when selecting between inputs, or changing sampling rate. When considered with ►

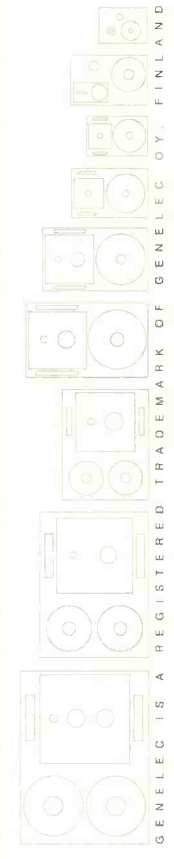
MANUFACTURER'S SPECIFICATION

TAPE FORMAT / TRANSPORT		INPUTS-OUTPUTS	
Recording system	Rotary heads and 3 longitudinal tracks	Analogue inputs	Switchable line or microphone
Monitoring	Read after write	Microphone	4 XLR connectors (switchable, 12V 'T' power, phantom +12V phantom +48V)
Tape type	1/4-inch (6.35mm) digital tape	Line	Symmetrical, transformerless (Zin >8kΩ)
Tape speed	49.6mm/s for 2 channels 99.2mm/s for 4 channels	Analogue outputs	Symmetrical, transformerless on XLR connectors 3.1V max (Z out = 50Ω) AES (standard mode) SMPTE-EBU
Recording time	5-inch reel (346 mm) 2 Ch = 2hr 4 Ch = 1hr 7-inch reel (692mm) 2 Ch = 4hr 4 Ch = 2 hr	Digital I-O	symmetrical (balanced)
Variable speed	approx ±10%	Time code I-O	PAL, SECAM, NTSC, EXT, AES, TC
Search method	using longitudinal analogue Cue track from READY to REC better than 2 sec	External sync	RS422 9-pin
Start up time	90 secs for (5-inch reel)	Serial communications	2 x stereo (Z out 2 x 47Ω) with stepped level adjustment (1.45V @ 0dB no-load)
Winding speed		Headphone outputs	
AUDIO PERFORMANCE		GENERAL	
No. of channels	2 or 4	Power requirement	Internal battery pack
Sampling frequencies	32, 44.1 or 48 kHz	Battery type	Betacam (4.5Ah 12V)
Analogue In-Out	18 bits	Battery duration	1 hour 45 minutes
Signal-noise ratio	Better than 98dB	Consumption	STOP = 24W REC = 29W
Frequency response	20 Hz to 20 kHz ±0.5 dB at 48kHz sampling	External Dimensions	13 1/8 x 13 1/8 x 5 1/8 inches (332mmx347mmx43mm)
Total harmonic distortion	less than 0.05%	Weight (inc battery)	8.5kg (18.7lbs)
Wow and flutter	below measurable limits		
Channel separation	80dB		
Digital In-Out	24 bits (AES)		
Error correction	Reed Solomon (38,34,5) (12,9,4)		

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**TABLE 1: WIDE-BAND NOISE MEASUREMENTS
DYNAMIC RANGE TO ANALOGUE OUTPUT**

Gain-source	AVG 22Hz to 22kHz	RMS 22Hz to 22kHz	RMS A wtd	468-3 Unwid	468-3 Wtd
-34dB sensitivity analogue input	92.0dB	91.0dB	93.6dB	87.0dB	80.3dB
0dB sensitivity analogue input	96.0dB	95.0dB	98.0dB	90.9dB	84.7dB
0dBFS digital output	104.1dB	103.0dB	105.3dB	98.5dB	98.5dB

the fact that a discharged battery will result in the loss of all settings, and that changing a battery must be done within minutes to prevent loss of data, it becomes even worse. Admittedly, the buttons are larger than on the Fostex, which certainly could not easily be operated with gloves on, but there is room on the panel to fit something better.

Input performance

The analogue inputs are provided with switches to select microphone powering options. The Line position does not in fact affect the gain, but provides an input without powering. Other options are 12V AB powering for Sennheiser microphones, 12V and 48V phantom powering.

The gain adjustment for the inputs is located on the outer ring of the top plate-mounted channel gain controls, one for each input channel. These provide gain adjustment from +3 to -34dBu at the input terminals to achieve a full-scale recording level. For a full-scale recording, the level from the analogue out is +12dBu, giving a maximum system gain of 46dB and providing an output level which equates well with standard professional practice. Obviously, an effective sensitivity of -34dBu may be inadequate for use with dynamic microphones, however, there is a reason for this. Assuming 18-bit conversion, the machine has a theoretical dynamic range of 108dB. A 200Ω resistor has an equivalent input noise level of about -130dBu over an audio bandwidth, being a

fair representation of the minimum noise a microphone could generate. Amplifying this will soon generate sufficient noise to degrade the machine's dynamic range. The logic is that there is no noise penalty in allowing the recording of low-level signals to fall—the benefit being additional headroom. On replay, digital gain of up to 32dB can be applied to bring the output up to the required level. Adding digital gain on replay will raise the output noise level proportionally, but no more so than by increasing the input gain.

When we used the machine with a Shure SM58, typical recorded levels with maximum gain were -20dB, with -15dB recorded as the Max Hold reading. This implies a total microphone gain of about 50dB for full modulation. Assuming a typical equivalent input noise for an analogue mixer of -127.5dBu (average reading rectifier) for a 200Ω source, this would result in a recorded noise level of -77.5dBu. Examining the Nagra D 108dB design specification, we would be led to assume that with maximum gain on the Nagra input, a further 12dB in the digital chain in calibrated position, and a recorded peak level of -15dB, that the signal-to-noise performance off tape would be 81dB.

We tested the residual wide-band noise of the inputs by setting the sensitivity at -34, and terminated the input in the prescribed 600Ω. This gave the dynamic range figures in Table 1. Subtracting the 12dB gain in the digital chain, the recorded dynamic range using an average reading rectifier was 104dB, approaching the theoretical

108dB dynamic range at the A-D conversion stage. While the manual mentions this 108dB figure, the spec only says that signal-to-noise is greater than 98dB, which is nearly met for system noise when measured using an average reading meter. The specification does not state the noise measurement method.

Looking at this another way, taking the -15dB recorded level into account we have a recorded signal-to-noise performance of 77dB, matching the performance of a good mixer. So far, so good.

Gain calibration markings are quite accurate on both the input gain and digital gain controls. Input overload occurs at a maximum input level of +3dBu at minimum gain. There is no pad built into the unit, better bring along an attenuator for use under high signal level conditions.

The digital gain section has no effect on recorded signal level, though the resultant internal digital level is indicated on the level ▶

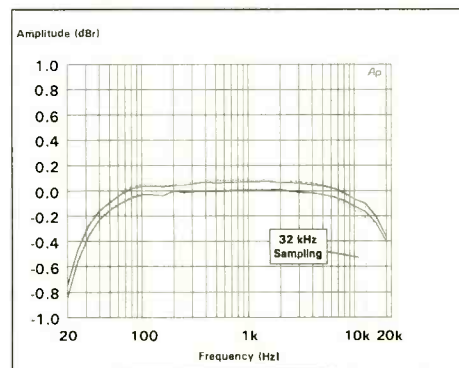


Fig.2: Analogue into analogue out frequency response. Output level is referenced to 1kHz left channel output level. Level at -4 on meter, line input. All sampling frequencies are shown

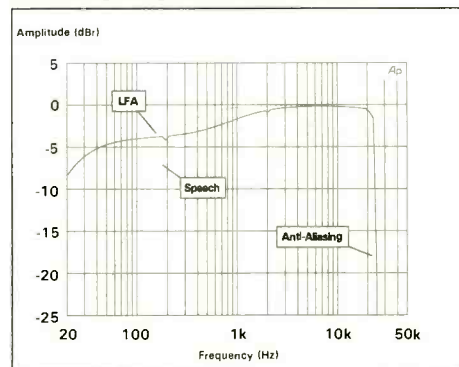


Fig.3: Effect of channel filters. Analogue input, 48kHz sampling

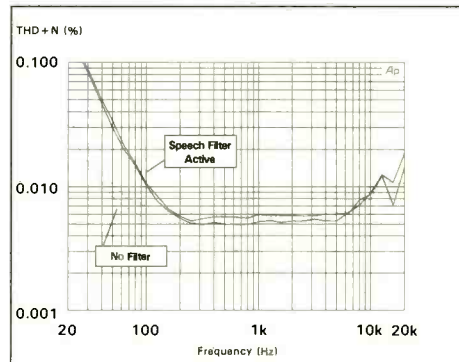


Fig.4: THD+N vs Frequency, 80kHz bandwidth. Analogue input to analogue output, channels 1 and 2. Input at full scale, 48 kHz sampling. Note rise in distortion at LF with the Speech filter in. Distortion is mainly second harmonic —musically pleasant

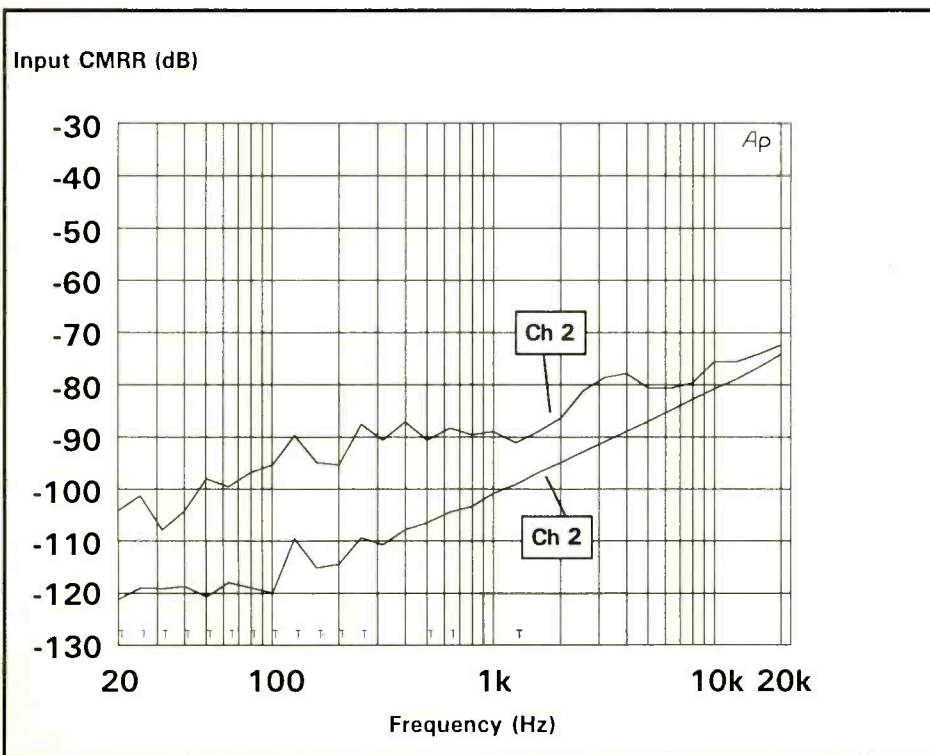


Fig.1: Input common mode rejection ratio (dB), line input

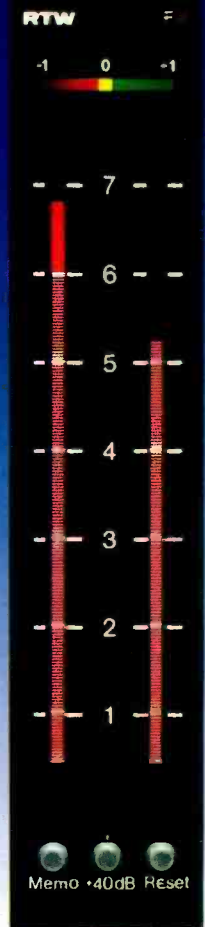
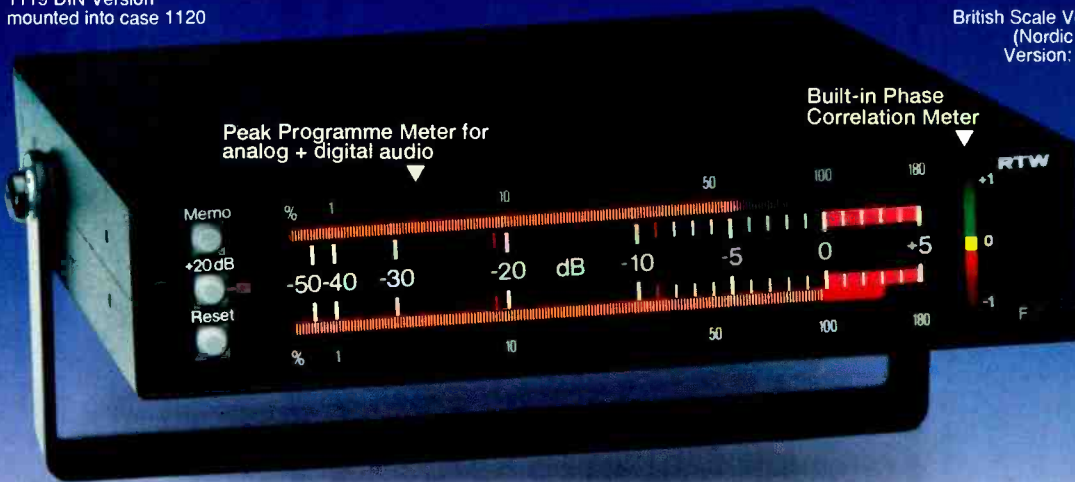
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eters. The gain set on the digital gain controls recorded on tape separately from the programme material allowing later adjustment without alteration of the recorded programme signal

While I can see some point in attempting to protect the user from accidentally degrading performance by setting the gain too high and risking overload, it could be highly irritating to anyone mixing or transferring the resulting tapes when the replay levels are all over the place. A conventional option allowing the user to drive the tape harder would not worsen signal-to-noise performance, and would provide a more consistent off-tape level. In a way, this can be accomplished by making up the gain using the digital gain controls, but then the tape modulation level cannot be monitored via the meters.

When higher output microphones are in use, there is no protective limiter available on the machine, nor are there any built-in pads, so the risk of overload under these conditions is worse than on a conventional machine. Input Common Mode Rejection is shown in Fig. 1, reaching -120dB at mains frequencies. This is only slightly degraded by any phantom-powered setting and is an excellent result.

Output performance

The Nagra D will deliver a maximum output level of +12dBu into high impedance loads, reducing by 1.2dB into 600Ω. The headphone level as delivered will appear low to many users. This is set low to prevent risk of lawsuit to Kudelski from users damaging their ears. Internally, a link may be altered to increase the gain if necessary to allow for noisy recording conditions. A five-position switch provides a variation in headphone listening level.

Frequency response

As shown in Fig. 2, the frequency response is excellent, as would be expected from a machine of this quality, reaching about -0.8dB at 20Hz and -0.4dB at 20kHz from analogue input to analogue output.

Fig. 3 shows the effect of the standard Nagra low frequency (LFA) and Speech filter. These are nominally identical to the filters used in Nagra recorders for several generations. LFA usefully corrects for the bass boost produced when working close to a directional microphone, while Speech gets rid of all low-frequency energy outside of the voice range.

Group delay measurements were somewhat strange, giving a series of unidentifiable dips. Disregarding these, the delay is about 3.855ms, remaining constant up to 20kHz. The filters are truly linear phase in the sense that there is no difference between the average delay of low or high-frequency signals.

The units provides no emphasis setting, not needing to be compatible with any prior standard and having a theoretical 108dB dynamic range; nor is any limiting provided. The Phase reverse control works as expected.

Distortion and noise

The Nagra D has a THD+N which rises at low frequencies as shown in Fig. 4. Note that this is worse when the FILTER switch is in the Speech position. It is mostly second harmonic, so is unlikely to be noticed. SMPTE intermodulation

distortion is below noise until signal levels reach -5dBFS, rising to a maximum of 0.016%—no problems here.

Modulation noise is low, as shown in Fig. 5, the distance between curves remaining less than 3dB except for the lowest signal input. Quantisation distortion is interesting, and unlike anything we have tested to date. From analogue input to output, channel one showed signs of minor misadjustment, rising at lower signal levels. The digital in to analogue out path, through the D-A convertors only revealed several steps, one occurring at about -56dB below full scale, where the change might be audible in the presence of signal. This is shown in Fig. 6.

A 1/3-octave band noise sweep produced little of interest, only a minor blip at 130Hz. An FFT noise spectrum reveal evidence of clock noise at several frequencies, but remaining below -108dB below full scale in level.

Linearity and crosstalk

Fig. 7 shows the result of a linearity test from analogue input to analogue output. This gives an excellent result, being within ±0.5dB down to -105dB signal levels.

Crosstalk is excellent, being below -90dB worst case between any pair of channels at any frequency.

Synchronisation and time code operation

A good selection of clock synchronisation facilities are provided, allowing the machine to be locked to video, external time code, external AES-EBU signals, or a full range of internal timing options.

Though the machine will record and replay time code, a synchroniser allowing this machine to slave to a master video machine for editing purposes is not yet available. When it is, it is supposed to be relatively easy to install. A serial control port is provided which is downward compatible with AMPEX protocols. The test machine was provided with a RS232 to RS422 adaptor and software called NADFACT which runs on an IBM PC compatible. This allows remote control of transport functions, the selection of some items such as sampling rate, and the display of various system diagnostics. Installation of the remote control software was trouble-free, and operated well. Unfortunately, the most of the menu selections are not available via the remote control link, and these are the most troublesome to operate from the machine front panel.

Summary

Technically, the Nagra D performs well, certainly as well as other location-type recorders, but operationally, we found it disappointing. It is large, has limited battery life with risky access for battery changing, a mediocre menu system, and unconventional gain control facilities with little apparent benefit. Purchasers also have to weigh up the risk involved with the single source nature of this recording format. Having internal microprocessor control, it should be possible to modify the software to improve menu item selection, and to provide some additional safety interlocks on the recording system.

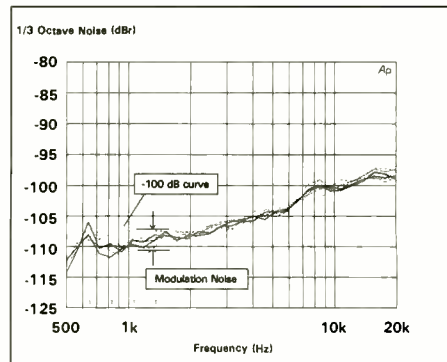


Fig. 5: Modulation Noise. The 1/3-octave bandwidth noise level in the 500Hz–20kHz region generated by a 60Hz tone. Each curve represents a 10dB step in input level ranging between -100dB and -40dB. This exercises the D-A through various combinations of bits. The result indicates good linearity and dithering

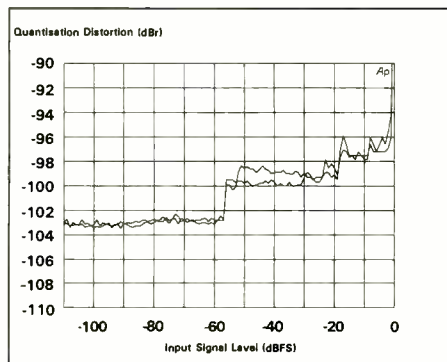


Fig. 6: Quantisation distortion 22–22kHz, digital input to analogue output. Input is from digital generator with triangular dither on the 18th bit. Note that steps indicate that noise generating bits cease to be active as the signal level drops.

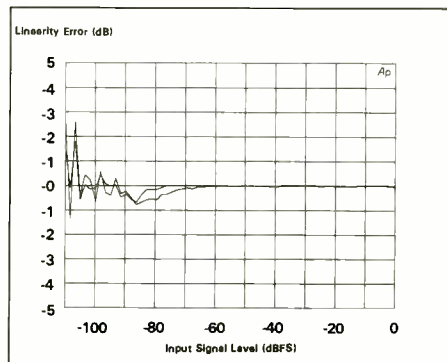


Fig. 7: Analogue input to analogue output linearity error. A very good performance

On the plus side, this is the only location recorder presently available with 4-track recording, and our forthcoming tests of DAT tape and a comparison with the Nagra system, combined with the reality of field use may prove that the recording format has a robustness worth having. If so, it will pay Kudelski to be cooperative with anyone wishing to bring out a competitive and compatible machine. ■

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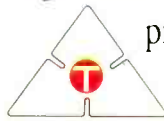
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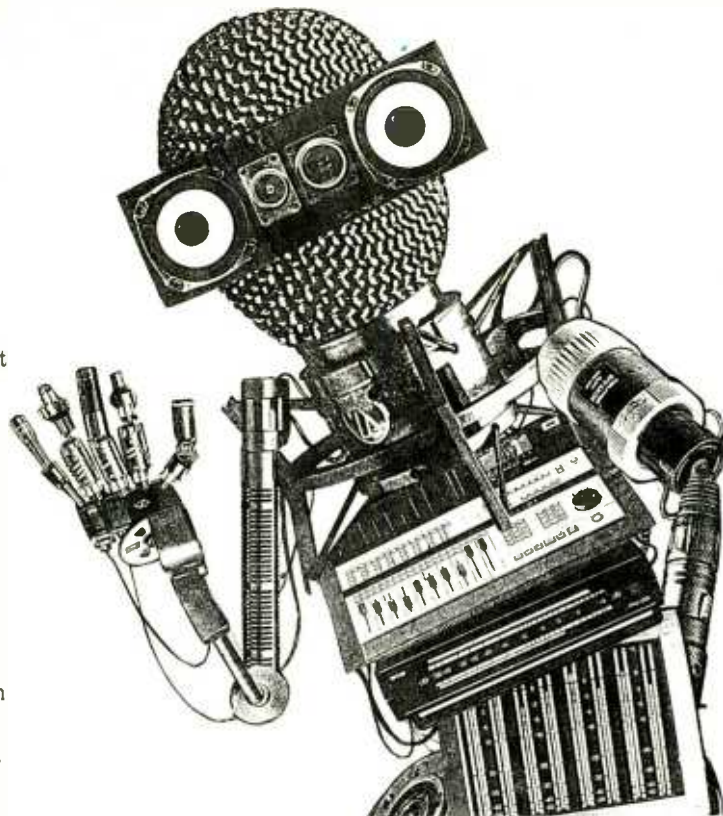
There are many things that you can do to try and familiarise yourself with a given monitoring situation, and how you choose to do it depends on the type of work and the way that you use monitors.

I normally look for anything in the studio that I know well and start building from there. For example, if I know the main monitors but not the console or power amps, I am at least familiar with 50% of the system, its potential and dispersion patterns. It then becomes simply (?) a matter of becoming familiar with the acoustic and the equipment chain.

Nearfield monitors have made life much easier as there is a strong chance the studio will have a pair with which you are familiar. In this case you only have to deal with secondary reflections from the desk. Alternatively, you could request that the studio fit monitors you wish to use, but they may not suit the room and a multitude of other problems can unfold. Perhaps the best solution is bringing your own monitors, preferably an active midfield type that means you are fully independent of the studio's own monitoring system.

Bringing something of your own is the best answer—either to use or to provide a point of reference—is a worthwhile activity. Your own source material makes a good starting point, but life still is not simple. Using an analogue tape of tracks you are familiar with is okay, but what is it you are then listening to? In fact, it is the complete signal chain from tape machine equalisation line-up, maybe the console, power amps and crossovers, monitor EQ, speakers and room.

A better choice than analogue would appear to be CD or DAT, but there is still a difference in sound between machines (certainly between



Keith Spencer-Allen

on achieving the familiarity with your recording environment that is so essential to your work

cheaper domestic types and professional units). I have generally found it better to take my own machine—it does not matter that it is not the world's best as long as I am familiar with it.

Then what do you play? I normally use tracks of different types that I have worked on over the years and are most familiar with. Sometimes, however, I have not used my material when it might prejudice or influence the session to be undertaken. In these cases, I have turned to a set of three commercially available CDs that I have become familiar with (see footnote). My portable CD player can then be plugged directly into the monitoring system.

Although I have not done it yet, I think that making my own CD-R compilation of evaluation sounds would be useful and preferable to a DAT as access is faster.

There is also the possibility of using sound samples, although this may not be quite so convenient. If you are only working with samples and synth patches, then becoming familiar with the monitoring system is of less importance as the input signal is already a known quantity.

Some have suggested that the ideal

source for evaluating a monitor system is one's own voice, the argument being that it is a sound you are most familiar with. I do not agree—I am not very familiar with the recorded sound of my own voice. Also, a voice will clearly show monitor character in the mid range, but give little indication about how it will sound with more percussive instruments.

Evaluating monitors at a trade show or demo room is horrendously difficult. After years of listening in these conditions, I think that about the only thing you can say is that other than gaining an approximation of the speaker character and seeing how much level it will take, it is almost worthless. Sometimes a manufacturer will provide a listening environment that is giving you a slightly better experience against impossible odds, but generally you cannot tell much. Even taking your own material is really just a depressing experience.

I have, however, found what works best for me: after playing my CDs through the studio monitoring and getting an approximate feel for the room, I start work. At the earliest point I run off a cassette of the

recorded material and check it outside of the studio—on a portable cassette radio, a Walkman or in the car. That separation from the studio allows you to be objective. Best of all is checking it at home on a system that you know inside out and making notes for the next session. I think that this is the only true way of familiarisation.

The rules for listening to these recordings is exactly as you would for a mix—listen anywhere that you are familiar with. There is something about being outside of the studio environment that causes you to listen in a quite different way and those errors that just did not seem a problem are obvious.

As monitoring systems have improved considerably over the years, there are likely to be fewer major problems about moving between rooms that are due to the monitoring. Instead, problems are more likely to be due to the room acoustics or a combination of room and monitors.

Personally, I have always had a great dislike of monitors that are placed high so that they fire down very steeply and you have to raise your head to hear properly. There was a studio I had to work in for a week or so like this that I could never get used to, even though others were able to produce good sounding work there. The other occasion was when I was working at a studio where the monitors were two-way, working with passive crossovers which apparently presented a demanding load to the power amplifier. The amplifier was changed for an increased rating model of a different brand. There was also a small alteration to the focus point of the stereo. Unwittingly we had altered just about every monitoring parameter—sound character, level, and coverage within the room. It quite simply took weeks to become familiar with the revised system, even though there was virtually no visible difference from the studio we knew so well! ■

Reference CDs

The CDs that I have found useful as mentioned above are: *The Sheffield Track Record-The Sheffield Drum Record*, Sheffield Lab CD-14/20; *Anechoic Orchestral Music Recording*, Denon PG-6006; *Studio Reference Disc (SRD)*, Prosonus. Next month I will look at these CDs and how they may be used in more detail.

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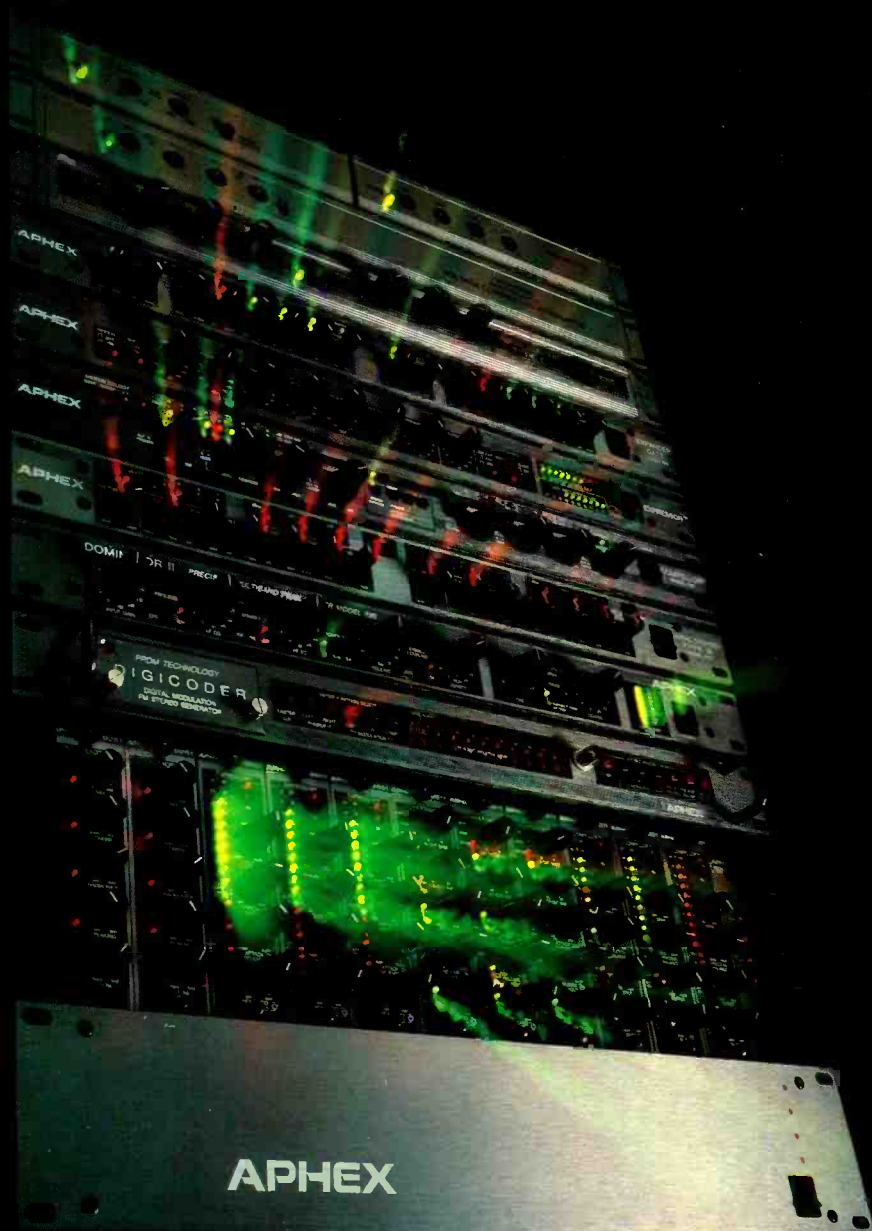
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