September 1989 $5.00 £2.00

STUDIO SOUND

AND BROADCAST ENGINEERING

A LINK HOUSE MAGAZINE

AUDIO RECORDING – TAPE/DIGITAL/DISK & SYNCHRONISATION

For a 16 or 24 track studio owner, the future looks very good.

With MIDI systems and digital outboard, you can already achieve extremely sophisticated productions.

But it's very hard to find a recording console to match that standard, without spending a small fortune.

That's why we've developed the new Series 6000. An evolutionary design that demonstrates how far Soundcraft are thinking ahead.

Behind the classic layout is a revelation in performance and facilities.

For a start, it's equipped with enough buses and routing options to make adventurous production a pleasure, rather than a chore.

It's a full 16 or 24 bus console, plus six auxiliary sends per channel. Each of the tape returns has EQ, which with its 'split' format naturally means they'll double as extra inputs.

We've also provided each input with push-button routing, EQ by-pass and programmable electronic muting that gives you none of the clicks ordinary switches produce.

There's even true solo-in-place, sadly lacking on many more expensive desks.

But it's the 6000's sonic performance which really puts the competition in the shade.

Take our revolutionary input design: 2dB to 70dB gain without a pad, with nearly unmeasurable distortion, cross-talk and noise.

Our new grounding system yields superb hum immunity and a routing isolation of 110dB (1kHz), and our active panpot comes close to theoretical perfection, improving on our competitors' performance by a full 25dB.

So nothing will change your sound, except our acclaimed, four-band sweep EQ.

In a word, purity.

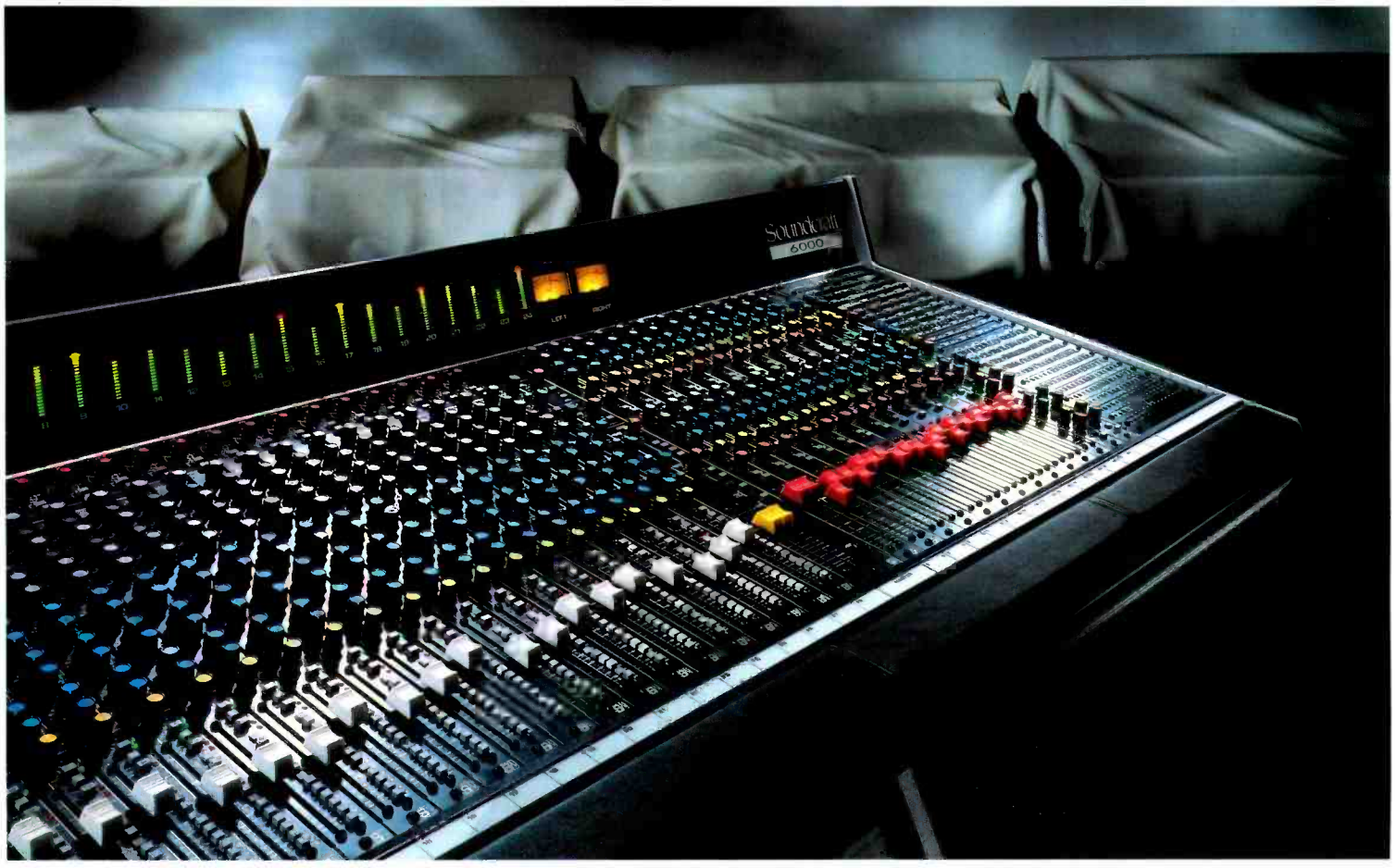
And with options including 16 to 44 channels, a stereo input module and built-in patchbay, you'll find it an affordable slice of progress. No matter what budget you're working to.

The Series 6000 is simply the most comprehensive production console in its class.

Call us today for full information, and the address of your nearest dealer.

Soundcraft
6000

If only more expensive desks performed as well.



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STUDIO SOUND
AND BROADCAST ENGINEERING

Sound-to-picture at Sync Sound, New York

SONY

Sony Broadcast
& Communications

European Headquarters:
Basingstoke
Hampshire
United Kingdom

Dear Reader

Re: 48 channel digital audio multi-track

Sony is proud to announce the latest addition to its DASH family, the PCM-3348, the worlds first 48 channel digital audio multi-track.

Total compatibility with the already successful PCM-3324 means that it works with your existing master tapes. So, if you're already recording and need additional tracks, just move onto the 3348 - it's as easy as that! Whether you're tracking, mixing, overdubbing or simply putting guide vocals on a slave reel, just one tape means total flexibility. Featuring an extremely fast and stable transport to take the best possible care of your master tape, it will also save you studio time.

Unrivalled audio quality is achieved by means of two times oversampling A/D and D/A converters, together with both digital and analogue filtering stretching the usable frequency response to almost 22KHz.

Other unique features include real-time digital track bouncing for two channels simultaneously and a 20 second full resolution sampling memory for spinning sequences back onto tape.

Even a multi-standard timecode generator/reader has been included, plus a unique advance output which enables external processing delays from digital mixing consoles to be compensated for.

To achieve the ultimate in recorded sound, contact your nearest Sony centre now.

Sincerely

SONY

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Lisbon 573046 Madrid 7290988 Milan 618381 Netherlands 02968 81215 Oslo 303530 Paris 49454000 Rome 5290139 Stockholm 7736100 Vienna 61051
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STUDIO SOUND

AND BROADCAST ENGINEERING

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Cover: Otari MTR-100A with autolocate, plus TimeLine Lynx keyboard control unit. Photography by David Darby

We're not planning on going solo

Every year when we come around to the subject of audio recording, the same questions seem to occur. When you consider the recording of audio in isolation from the other aspects of the recording process it seems odd that we would want to assign a separate status to it. So much emphasis used to be placed on the recording machines but as the quality and reliability of machines has progressed we have tended to see the actual recording process become far more integrated within the new prime area of interest—signal processing. Indeed, in some of the workstation/digital editing and storage systems it is very difficult to differentiate the borders between storage and processing.

For example, in some areas of music and sound creation, there is no concept of the storage of a continuous piece of music or sound. The individual samples or sections may be stored and then strung together and presented at the outputs of the device according to the commands of the operator. In this case we have the ability to generate a performance but retain the ability to modify in such a way that would be impossible with a completed recorded performance. In the same way that the move from 'all down to mono/stereo in one take' to multitrack recording extended the creative possibilities, so has the ability of the RAM or disk-based recording system to continue this development in a quite logical manner. Multitrack recording was still a performance in total but an individual track was not necessarily one. The limits of experimenting were confined to varying elements that occurred in parallel and in a linear order.

Disk/RAM-based systems have not removed these capabilities but have freed us from the need to think solely in a linear manner, to work in a linear manner and from the concept that everything is fixed relative to other events that may have happened at the same time.

Factors such as this have meant that disk/RAM-based systems are not so much recording systems (although they may be used as such) as still being part of the creative processing stage of the recording process. The traditional defined equipment areas are dissolving. Even in the more 'traditional' reel-to-reel products we are seeing the arrival of RAM memory usable to timeslip tracks or sounds against each other (as in the *PCM-3348*—traditional only in its use of tape and reels).

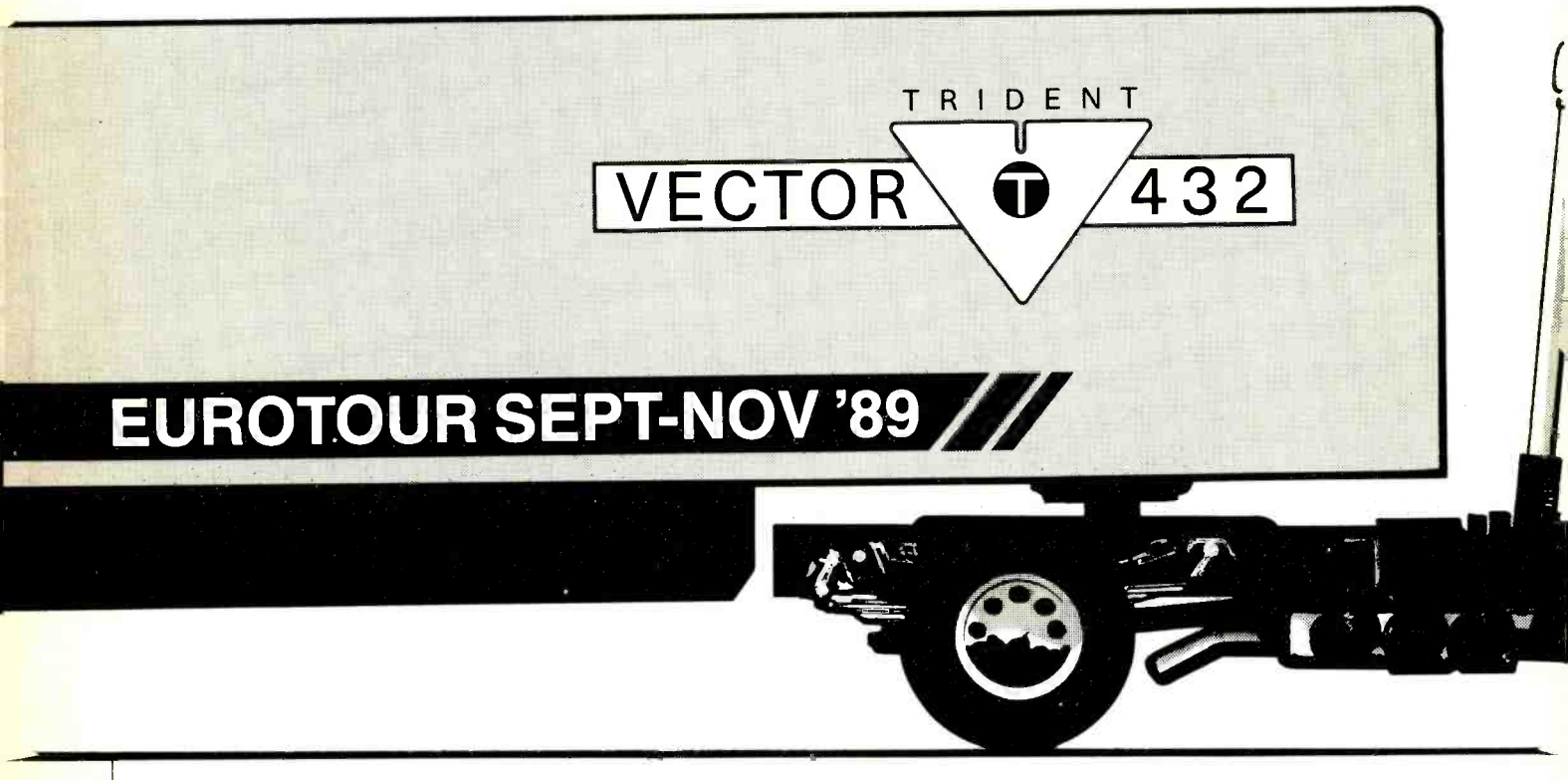
Feedback over the last few months has suggested a slightly increased interest in multichannel disk-based systems from the music studio market. This time last year there was a suggestion that 2-channel systems were of more interest. To me such moves suggest that we are still far from out of the learning process, of coming to terms with disk-based technology in the main stream recording market. When we do, it will be interesting to see if users wish to keep the recording aspects of the studio separated from the actively creative stages of recording.

Should this be the case, the implications are not just a minor change of studio layout or operating practice but a complete change in equipment needs with a large question mark apparently resting over the future of the large mixing console.

If there is a drawback to disk-based systems it may be that they could be looked at as single operator intensive, ie not quite as democratic in the creative process as a mixing console and a stack of processing gear, where there is by its very nature a clear indication to all involved in the project precisely what is going on. Disk-based systems are largely single operator in practice and so require a different relationship between the engineer/producer/artist. There is nothing problematical here—nothing that a few years of artistic and engineering evolution will not sort out.

Keith Spencer-Allen

IS TRIDENT GOING TOO FAR?



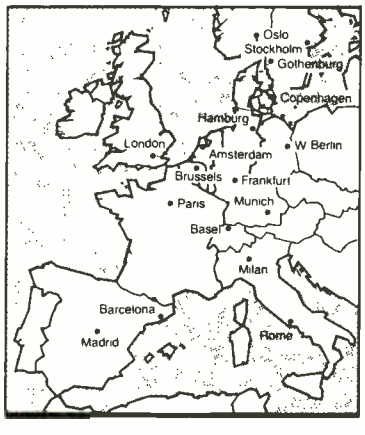
DATE	VENUE	DATE	VENUE
Sept 23-25	London	Oct 12-16	I.B.T.S. – Milan
26-28	Paris	14-16	W. Berlin
29-30	Brussels	18-20	AES – New York
Oct 1-2	Amsterdam	19-20	Frankfurt
3-4	Hamburg	23-24	Munich
3-6	AUDIO VIDEO PRO '89 – Paris	25-26	Basel
4-7	NORDIC SOUND – Oslo (Dolksjo)	29-30	Rome
7-9	Stockholm	Nov 3-4	Barcelona
10	Gothenburg	6-7	Madrid
11-13	BILLED & LYD – Copenhagen	13-15	London

Some might think that hauling a studio fitted with Trident's new ***Vector 432*** *mixing console, a digital multi-track and a load of outboard gear throughout Europe is going a bit far. But then they haven't seen the Vector.*

Surely no one would argue that introducing an ***in-line studio control system for audio and audio/video production*** *which sets a new price/performance standard against which all other consoles pale is going too far. How could they?*

Is it going overboard to offer useful standard features like ***four matrixed stereo busses*** *and* ***32 groups****? Or the flexibility of a centre section yielding the unsurpassed signal control of a* ***stereo buss compressor,*** *a* ***broadcast mode*** *for simultaneous stereo and multi-track recording,* ***two dedicated foldback systems*** *selectable from any combination of console sources,* ***an auto talkback with two reverse talkbacks*** *and more?*

Is it over the top to adopt a "system" approach that lets you create a custom console from a menu of available ***options*** *including on-board* ***dynamics****, a choice of fader* ***automation*** *systems,* ***remote patchbays, transformer balancing, bargraph metering, VCA grouping with snapshot recall****, a highly evolved* ***audio follows video*** *interface,* ***stereo modules****, and an* ***integrated machine controller*** *so sophisticated that it locates points on tape by bars and beats (for musicians) as well as time code (or feet and frames) with full midi synchronisation?*



We don't think so. And we certainly don't think it's going too far to offer the sonic perfection of ***+30dB of input and output headroom, 70dB of mic gain*** *with* ***an EIN of better than – 128dB and balanced inputs, outputs and bussing;*** *or the quality and performance of* ***sealed conductive plastic pots*** *intelligently placed in perhaps the most handsome and ergonomically balanced console design yet conceived.*

The Vector pushes the science of console design to its theoretical limit without sacrificing the art of sonic perfection. And perhaps most important, Trident delivers all this at an attainable price. Now that isn't going too far, is it? Even if we are trekking 6,700 miles (10,720 km) through 11 countries in 54 days to prove it.

See for yourself just how far we have gone – and how far console design has come. Check the tour schedule on the left. Then call or fax us (or your nearest dealer) to find out the exact location of our demonstrations in your area. No appointment is necessary, but it would be going too far to expect you to drive around Europe until you found us. Or would it?

TRIDENT
VECTOR 432

TRIDENT AUDIO DEVELOPMENTS LTD., RODD ESTATE, GOVETT AVENUE, SHEPPERTON, MIDDX. TW17 8AQ. ENGLAND. TEL (0) 932-224665. FAX (0) 932-226721.

AMS Calrec agreement

AMS and original Calrec director Steve Jagger have agreed that Jagger should purchase all assets and goodwill pertaining to the custom analogue console design and manufacturing business of AMS Industries plc. However, standard production analogue consoles such as the *UA 8000* will remain with AMS, as well as the digitally assignable range of consoles, microphones and all digital mixing consoles.

AMS explain that the agreement is an amicable one ensuring AMS and the new company, Calrec Audio, continue with a close relationship in the future.

Calrec Audio will be based in new premises at Hebden Bridge.

NED ready and able for NASA

New England Digital, Vermont, USA, have completed an unusual sale: equipment is on its way to Jupiter! The NED *Synclavier* CPU, the *ABLE* computer, has been picked by NASA to control the all-important, on-board camera for Jupiter probe, Galileo.

NASA wanted a powerful mini-computer for testing and trouble-shooting the camera, due for blast-off in October.

In November 1982 NASA bought an *ABLE 60 model B* and experienced no problems. They had taken the *ABLE*'s basic guts, its processor, memory and I/O cards, and designed some new interface hardware to make the computer perform high-speed digital communications and control for a spacecraft's imaging camera.

NED class themselves first and foremost a computer company but do not intend to market the *ABLE* computer for non-audio applications, not in this galaxy anyway.

Exhibitions and conventions

September 10th to 13th The Light & Sound Show '89, Olympia 2, London, UK. Contact: Clare O'Brien, O'Brien Associates Ltd, 10 Barley Mow Passage, Chiswick, London W4 4PH. Tel: 01-994 6477.

September 18th to 21st Media Visie '89, RAI International Exhibition Centre, Amsterdam, The Netherlands. Contact: RAI Europaplein, 1078 GZ Amsterdam. Tel: (0) 20-20-549 12 12. Fax: (0) 20-461006.

September 30th to October 1st Scottish Music Show, Glasgow's Scottish Exhibition & Conference Centre. Contact: Music Maker Exhibitions. Tel: 0353 665577.

October 3rd to 9th World Broadcasting Symposium Geneva, Switzerland.

October 18th to 21st AES 87th Convention, New York, USA. Contact: AES, USA. Tel: (212) 661-8528.

October 25th to 28th Broadcast '89, Frankfurt, West Germany.

November 7th to 9th Computer Graphics '89/Desktop CAD '89, Alexandra Palace Exhibition Centre, London. Contact: Katherine Lovatt. Tel: 01-868 4466.

November 28th to December 3rd Sound Expo/China '89 Shanghai Exhibition Centre, Shanghai, China.

1990

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

BSS de-powered!

Apologies to BSS Audio for their entry in last month's power amplifier survey. We managed to reduce their model *EPC-780* to a tenth of its power! The entry should have read: **EPC-780:** 1000 W/ch, 4 Ω.

News from the AES

AES/EBU Interface Conference, September 12th to13th, 1989

The Digital Audio Interface is now four years old and like any four year old, it has learned a great deal since the standard was set back in 1985. This conference is not only a progress report from those associated with the birth of the standard, as it features papers from users and equipment manufacturers as well.

All the standards organisations concerned with the interface are represented, as will be all the major manufacturers using interface equipment.

On a lighter note, the evening guest speaker will be Gerhard Steinke from the German Democratic Republic who will be talking about his work on Delta Stereophony.

The conference will be held at the Independent Broadcasting Authority's Headquarters, 70 Brompton Road, Knightsbridge, London, SW3. The registration fee will include documentation of the conference and refreshments, including lunches and evening buffet.

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

Conference Programme

Tuesday September 12th

Session A—Standards 10.00-12.30 Chairman: Chris Daubney, Channel 4

A1 Tutorial on the AES/EBU Interface, John Watkinson, Consultant

A2 The Consumer Interface, John Emmett, Thames TV

A3 Auxiliary Words in the Professional Interface, Neil Gilchrist, BBC Research Dept

Session B—Circuit Design 14.00-18.00 Chairman: Robin Caine, Pro-Bel

B1 The AES/EBU Interface and Audio-Digital Conversion, Mike Story, dCS

B2 A Single Chip Solution for the Interface User, Richard Lawrence/ Simon Wegerif, BBC Designs Dept

B3 Channel Status Implementation, Serge de Jaham, Digitec

B4 Programme Labelling in the User Channel, Alain Komly, TDF

B5 Circuit Designers' Workshop

Evening Lecture 19.00-20.30

Delta Stereophony, Gerhard Steinke, RFZ, Berlin, DDR

Wednesday September 13th

Session C—Using the Interface 09.00-12.30 Chairman: Neil Gilchrist, BBC Research Dept

C1 Installation and Routing, Paul Evans, Thames TV

C2 Asynchronous Routing, Serge De Jaham, Digitec

C3 Measurement and Testing, Bob Metzler, Audio Precision

C4 Signal Analysis, Allen Mornington-West, Quad

C5 Synchronisation, Tim Shelton, BBC Research Dept

Session D—Future Developments 14.00-17.00 Chairman: Steve Lyman, CBC

D1 MADI, Alan Jubb, Neve

D2 Contribution Systems, Christer Grewin, Swedish Radio

D3 Television and SIS, George Davies, Kingston Polytechnic

D4 An Optical Multiplexed MADI Compatible Distribution System, Nick Cutmore/Richard Marsden, BBC Designs and Research Depts

D5 Discussion Forum

Courses and seminars

August 26th and 30th Soundscape. The University of East Anglia, Norwich, UK. Contact: Jane Thorp, UEA. Tel: 0603 592802.

September 9th to 15th International Course for Studio Engineers, University of Surrey, Guildford, UK. Contact: APRS. Tel: 0923 772907. Fax: 0923 773079.

September 12th to 13th AES/EBU Interface. Contact: AES (British Section). Tel: 06286 63725.

1990

May 30th to June 1st International Broadcast Asia Conference, World Trade Centre. Singapore.

SOUNDSTATION II... Now with TIMEWARP™

Digital Audio Disc Recorder and Production Centre

SOUNDSTATION II

SOUNDSTATION II, the unique Digital Audio Editing and Post Production System from DAR, now offers Stereo TimeWarp!

Permitting superb quality time compression and expansion *without pitch change,* TimeWarp complements **SOUNDSTATION's** vast repertoire of rapid and transparent editing capabilities. From simple spotting of sound effects to timecode, to complex dialogue and soundtrack editing,
SOUNDSTATION II offers unparalled power, speed and ease of use.

- Fast *"tapelike"* Recording and Editing
- All Editing on one Display – No Paging or Menus
- Instant Copy, Loop, Cut, Paste, Gain and Crossfade
- Scrolling Preview of Audio
- Digital and Analogue Inputs and Outputs
- 8 Track Hours in 9 Rack Units
- Affordable configurations for every application

See how **SOUNDSTATION II** will give your studio the competitive edge in – Video and Film Post Production – Multitrack Music – Dialogue Editing – CD Mastering.
Phone DAR for a free demonstration video tape now!

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U.S.A. Tel. No: (213) 466 9151

DIGITAL AUDIO RESEARCH
DAR

Letter: What's in a name?

Dear Sir, I am a regular reader of your magazine and I always find it very informative. As a musician/composer I am also involved in recording and producing and, therefore, interested in recording technology and I would say a great fan of every new idea in the hi-tech recording world. I am also a listener and great admirer of classical music despite being involved in pop music.

Now to the point. One of the new products exhibited at the APRS 1989 hy Amek is a console called, to my great shock, *Mozart*. Now things went too far. How anyone dare use the name of such a fine, highly gifted composer, who is one of the representatives of human creativity, for a piece of machinery, however sophisticated, which is only there to function as a tool for creative artistes and is nothing without them. In a growing number of temporary artistes allowing use of their names, compositions and artworks for a commercial purpose, at a time when computerised instruments let the non-creative individuals pollute the music, this should not extend to classical music. At this point I feel I have to stand up for W A Mozart if he cannot. I hope that you will help me to press on Amek for a change in name of their product.

Yours faithfully, Paul Trnavsky, 42 Oldborough Road, N Wembley, Middx HA0 3PR, UK.

Address changes

•**Optical Disc Corporation,** CA, have located their new European office at 10 Rue Vivienne, 75002 Paris, France. Tel: (1) 49 27 98 93.

•**Solid State Logic** have opened a Canadian subsidiary at 36 Toronto Street, Suite 850, Toronto, Ontario M5C 2C5. Tel: (416) 363-0101. Fax: (416) 360-3838.

Agencies

•French signal processing equipment manufacturers **SCV Audio** have appointed Shuttlesound to handle UK distribution of their entire product line. US loudspeaker manufacturers **Gauss** have appointed Shuttlesound as their UK distributor. Shuttlesound, London, UK. Tel: 01-871 0966 Fax: 01-870 9300.

•**Data Conversion Systems** have announced distributors for their *DCS* A/D converter in the following areas. **USA:** Audiotechniques, 1619 Broadway, New York, NY 10019. Tel: (212) 586-5989. Audio Intervisual Design (Aid), 1032 North Sycamore, Los Angeles, CA 90038. **West Germany:** Audio Export, Badstr 14, 7100 Heilbronn. Tel: 071 31 82275. **Scandinavia:** Soundtrade AB, Box 3042, 171 03 Sona, Sweden. Tel: 08 730 04 00. **Japan:** Time Lord, 3-5-10 Shinjuku, Zushi-Shi, Kanagawa 249. Tel: 0468 73 6226.

•Michael Stevens & Partners have been appointed sole UK distributors for **Nemesis** products. Michael Stevens, Kent, UK. Tel: 01-460 7299.

•TGR, Lisbon have been appointed **AMS** *AudioFile* distributors for Portugal.

•Gotham Audio have been appointed US agents for **Audio Design**.

Synton bankrupt

The Synton Group, worldwide distributors for D&R and Axys, and European distributor for Adams-Smith, have gone bankrupt.

When Synton International changed from Ensoniq Europe the situation was not strong but was stable. Synton's bank had agreed to fund the distribution operation of D&R and Axys but a change of management at the bank reversed this decision.

D&R, however, see this development as just a slight hiccup in its company growth. D&R president Duco de Rijk: "Synton was doing the distribution for only a few months, so we were able to pick up where we left off in February. Luckily we have built up sufficient reserve capital to cover the Synton losses."

More on CD-R

Taiyo Yuden (THAT) and Sony have joined forces to develop and manufacture CD-R write and read equipment.

Under the name of 'Start Lab', (Sony Taiyo Yuden Advanced Recording Technologies) Sony and Taiyo Yuden will share the capital investment 50/50. The Sony hardware will be branded 'Start Lab', the software will continue to be marketed under the THAT banner.

Letter: Roland E-660 processor

I thought your readers might be interested in being informed of a solution to the single A/D-D/A converter mono compatibility problem. If you remember we developed the *Propak 2* to produce an 11.3 μs delay in one channel to compensate for the action of the converters in the *F1* format operating at 44.1 kHz.

Although this format is now very much in decline, the *Propak 2* is still available and is being used on CD players with only one D/A converter to correct the mono compatibility.

Even though I believe the Roland works at 48 kHz with a slightly different time shift requirement, it seems likely that *Propak 2* would provide a solution to the problem—raised by Bob Ludwig of Masterdisk (*Studio Sound*, July 1989)—of the *E-660* phase-shifted mix being output in the digital domain with resultant cancellation at high frequencies.

Our US distributors Gotham Audio of New York, can supply the *Propak 2* and will no doubt be pleased to advise on simple component changes, should absolute optimisation for 48 kHz be required.

Yours faithfully, Mike Beville, Audio Design Ltd, Unit 3, Horseshoe Park, Pangbourne, Berks RG8 7JW, UK.

WORLD SERIES

"The EQ makes outboard equalisation a thing of the past, and the computer with its full sized keyboard has transformed our console into the most powerful and flexible music production system currently available."

John Hudson
Mayfair Recording Studios, London

"C'est la première console à me permettre de réaliser toutes les idées et toutes les envies sonores que j'ai pu avoir sans effort et sans stress. Il n'y a plus aucune limite à la créativité. C'est le seul instrument de musique qui traduise exactement mes émotions. Faire du mixage est un réel plaisir."

Dominique Blanc-Francard

"It's great to have been involved in the development of the new computer system and its new software features. The huge increase in speed and flexibility of operation makes it by far the most advanced mixing system available. As for the sound, I'm delighted with the end result. The transparent musicality of the new electronics is a pleasure to experience, whether mixing or recording. I'd be at a disadvantage to have to work with anything e

Bob Clearmountain

今や私には空気のような存在である。——時には、音の発想の手足となりあるときは、複雑な要求にも応えてくれ、いや、もしかしたら求めた以上のものを与え れるかもしれない可能性を秘めている。今や私の仕事空間には必要不可欠なコンソールである。

内沼映二 Eiji Uchinuma

Solid State Logic

Begbroke, Oxford, England OX5 1RU (0865) 842300
Paris (1) 34 60 46 66 • Milan (2) 612 17 20 • New York (212) 315 1111 • Los Angeles (213) 463 4444 • Tokyo (81) 3 320 1101

Trident announce Vector tour

Trident Audio Developments, Middlesex, UK, have announced a European tour for their new *Vector 432* mixing console.

A 40 ft mobile demonstration unit equipped with the *Vector*, a digital multitrack and various outboard equipment will start in London on September 23rd and travel to 17 cities returning on November 12th.

For more details contact Dianne Grapes of Trident on 0932 224665. Fax: 0932 226721.

NED form UK-based distribution company

NED, New England Digital, have formed a UK-based European distribution company as a direct result of record sales growth in the UK and Europe.

NED (UK) Ltd, headed by Mark Terry, will oversee all European sales and provide support for distributors while assuming direct responsibility for sales in the UK.

Harman Deutschland have expanded their territory to include the Netherlands, Belgium and Luxembourg.

NED (UK) Ltd. Tel: 01-379 3398.

Engineers' course from APRS

The APRS (Association of Professional Recording Studios) are holding their annual training course for studio engineers from September 9th to 15th at the University of Surrey in Guildford.

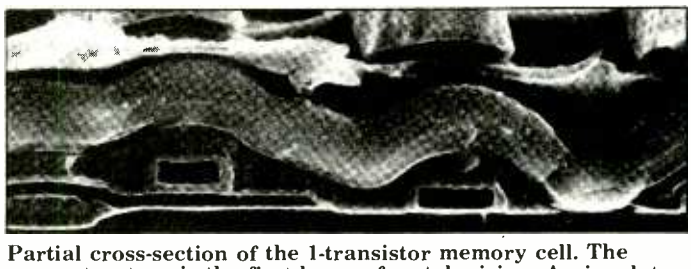
The course comprises seven one-day modules, which may be booked singly to allow maximum flexibility for participants. The contents of the course, which is the only one run by the APRS during the year, has been carefully selected to match what the association believes are the real needs of the industry.

During the seven days the following topics will be covered: acoustics—studio, control room and instrument; final mastering for vinyl, cassette and CD; noise reduction; recording techniques—classical and pop; equipment synchronisation and MIDI; and post-production of sound for video.

IBM produce the world's fastest DRAM

IBM have made the world's fastest 1 Mbyte dynamic memory computer chip at the company's Yasu, Japan, manufacturing plant.

The experimental IBM DRAM (Dynamic Random Access Memory) operates two to three times faster than the current generation of 1 M bit chips, retrieving 1 bit of information in just 22 billionths of a second. It can store the equivalent of about 100 pages of double-spaced typewritten text.



Partial cross-section of the 1-transistor memory cell. The wavy structure is the first layer of metal wiring. An insulator is directly above. The large structures on top of the insulator form the second layer of wiring. The two layers of metal wiring achieve the chip's high speed. Underneath the lower metal layer is the memory cell. It consists of a transistor (rectangular structure on the right) and a capacitor (long, narrow structure on the left). Two layers of polycrystalline silicon underneath the lower metal layer maintain the chip's high density.

People

●**Soundtracs** plc, UK, have appointed Colin Lane-Rowley international sales manager. Lane-Rowley comes from three years with Bruel & Kjaer in Denmark. Soundtracs have also appointed Hugh Armstrong as a non-executive director.

Contracts

●GLW Enterprises Nashville, TN, have announced the sale of a **Harrison** *SeriesTen* with *Mac II X* automation to Eastside Sound Studios in New York City.

●HW International, London, UK, have recently supplied the Who tour with **Shure** *Beta 58*, *SM58* and *57* microphones. HW have also recently provided the UK National Theatre with **Carver** amps for their touring system, via distributors Farrah's of Kingston, Surrey, UK.

●**Solid State Logic** have supplied South American producer/engineer, Mazzola, with a 48-channel *SL 4000 G* series console for a new studio facility in Rio de Janeiro.

Italian television group Videotime Spa have ordered four identical *SL 5000 M* series audio production systems for one of their production centres.

Other recent contracts include an *SL 4056 G* series at BBC Maida Vale, London; *SL 4040 G* series at Prosen, Tokyo, Japan; and an *SL 55112 M* series at Buena Vista Studios, Burbank, CA, USA.

●**Soundmaster Europe**, UK, have supplied a 7-machine *Synchro* audio editing control system to Yorkshire TV's main dubbing suite. A *Synchro* has also gone to Films of Bristol.

●**Soundcraft**, have installed their new multitrack recording console, the *3200*, into Shambles Studio, Bucks; Black Barn Studios, Surrey; and the new White Wall Studios in Birmingham. A series *600* console has been installed in Who bass player John Entwhistle's private studio. For Who's tour, drummer Simon Phillips is using a Soundcraft series *200 SR* for the drum mix.

●**ATC**, Stroud, UK, supplied the BBC TRU with a pair of purpose-built *SCM100As* for the Bath and Glastonbury festivals. Also Peter Gabriel's Real World Studios are now using *SCM50As*.

●**DAR**, Kingston, UK, have made their first sale in Canada with a *SoundStation II* digital audio editing and production system going to Pinnacle Production House, Ottawa. Recent UK sales include Pelican Studios, and Pullman Video post-production, London.

●London Weekend Television have ordered five new **TimeLine** *Lynx* keyboard control units and 21 *Lynx* timecode modules. The sale was handled by the US company's exclusive UK distributor Stirling Audio.

●**WaveFrame** have announced the delivery of their *AudioFrame* digital audio workstation to Aural Design of Los Angeles, USA, a digital sound production house for TV and film.

●Recent **AMS** *AudioFile* sales include Yorkshire TV, UK; National Video Industries. USA; TGR, Portugal; and Audio Consultants, Hong Kong.

●Recent **Fostex** *D-20* sales include BBC World Service; Saunders & Gordon, UK; and Yorkshire TV, UK.

●**Audio Kinetics**, Borehamwood, UK, have sold two *ESbus* machine control and synchronisation systems to Auditel in Paris, France, and the Finnish Broadcasting Corporation.

●Studio Beats, Bombay, India, have installed a 16-track **TAC** *Scorpion* audio mixing console.

●**Sound Broadcast Services** have won the contract to design and build a new studio for London Greek Radio Ltd, the successful Greek applicant for the Haringey incremental radio contract.

●**Amek**, Salford, UK, have supplied Media Business Associates in Hong Kong with a *BCII* to work in conjunction with their AMS *AudioFile* workstation. Amek have also supplied Limehouse TV's mobile; Studio Equipe, Belgium; and Video London, with *Classic* consoles.

●Alhambra Theatre, Bradford, UK, have chosen an **Allen & Heath** *Saber* PA as their new mixing desk.

●FWO Bauch have announced that The Exchange in London are adding a **Neumann** *Direct Metal Mastering* disc cutting system and a **Sonic Solutions** CD preparation system with *NoNoise* software, to their mastering facilities.

●**Eastlake Audio**, London, UK, have been contracted to design and build an orchestral studio and control room for the Ministry of Culture in Tripoli, Libya. Other contracts include the building of a second studio for Spain's first digital recording facility, Trak Studios in Madrid.

●Michael Stevens & Partners have supplied a **Soundcraft** *SAC200* desk to Invicta Radio in Canterbury, UK.

●Sheffield's Red Tape Studios, UK, who run courses for local musicians and the unemployed, have installed a **Soundtracs** *PC MIDI 24* console.

In brief

●**Solid State Logic** are opening a London office, complete with a fully equipped service centre, at 5 Southwick Mews, Sussex Village, Paddington, London W2.

●**Whiteley Electronics**, Mansfield, UK, producers of high technology for the telecommunications, sound broadcast and electronics industries, have been bought by LC Automation, manufacturers of industrial safety guarding systems.

●**ATC** is sad to announce that after a period of association of nearly seven years, **Roger Quested** will no longer be using ATC components in his systems unless he is specifically requested to do so. HHB Communications, however, will carry stocks of reconditioned drive units. A failed drive unit can be exchanged with an overhauled one for the cost of the repair.

●**Citronic**, UK manufacturers of pro-audio equipment, have signed an exclusive distribution deal with the Won IL Corporation, a major Korean pro-audio company. Research showed that Citronic's products had been selling on the Korean black market for up to five times their real value.

●**Good Earth Studios** are closing their doors after 13 years in Soho, London. The studio was particularly famous for mixing the David Bowie *Diamond Dogs* album. Owner Tony Visconti blamed his decision on the number of other studios offering the same service, in the same area.

●Third World charity **VSO** is sending a sound engineer to a new arts and communications project in Belize. Charles Harrowell, 26, who has worked with Elton John and Status Quo is to spend the next two years at the **Sunrise Project** in Belize City.

●**Thatched Cottage Audio**, UK, have launched their own credit card. The 'Thatched Cottage Privilege Chargecard' allows holders instant credit up to £1,000 and special discounts. Tel: 0223 207979.

●**Mayking Cassettes** is a new audio cassette duplication plant opening in London. A sister company to Mayking Records and Videoprint, many of the engineering, sales and admin staff will be shared. The new facility plans a capacity of 5 million units pa rising to 10 million after the first year.

AKG acoustics

ADVANCED MICROPHONE TECHNOLOGY

The C426B Comb. represents the next logical step in the development of a legend amongst professional microphones, the C422, which itself is derived from an eariler microphone that set new recording standards, the C24.

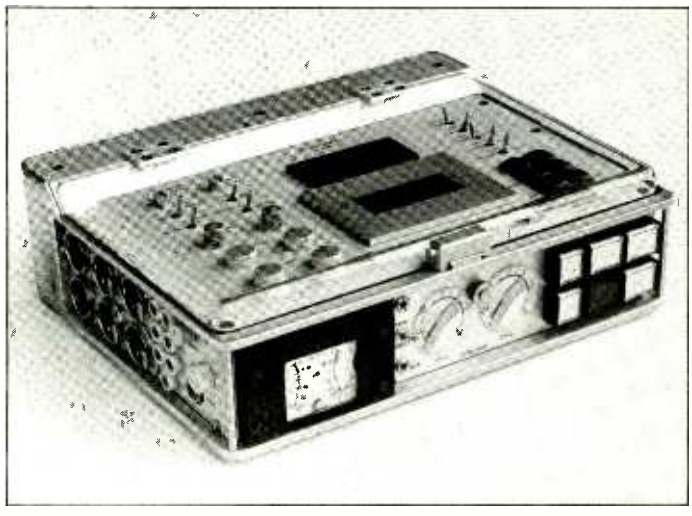
The operating principles of the C426B remain the same - two twin diaphragm condenser capsules which rotate for MS and XY stereo recording, each with individually selectable polar pattens from a remote control unit. But as engineering standards have developed, so has every aspect of the C426B design, which now offers ultra low self noise operation, in-built electronics for the digital age, and a host of physical operating features which make it ideal for busy recording studios.

You might think it presumptious for us to predict a future legend, but with the success of its forebears, the C426B promises no less.

AKG®

AKG Acoustics Ltd., Vienna Court, Lammas Road,
Catteshall Road, Godalming, Surrey GU7 1JG.
Telephone: Godalming (048 68) 25702.
Facsimile: (048 68) 28967.
Telex: 859013 AKGMIC G.

Stellavox Stelladat



Stellavox showed a professional portable DAT recorder at the Montreux ITS. The *Stelladat* preliminary information lists features including all existing digital standards for inputs and outputs (SDIF, AES/EBU, etc); full remote capability through infra-red or serial bus; timecode capability to agreed international standard; software-controlled interface for editing; high quality A/D and D/A converters.

On the more traditional portable machine side, Stellavox claim features such as full metal construction; waterproof and impervious to climatic extremes; extended battery life and pluggable power supplies exchangeable without a break in recording; and a wide range of options for input and output with inbuilt 2- or 4-channel mic mixing facilities.

Digital Audio Technologies SA, Puits-Godet 20, 2000 Neuchatel, Switzerland. Tel: 038 244400.
USA: International Audio Technologies Ltd, 13897 J Willard Road, Chantilly, VA 22021.

Swift dialogue replacement workstation

Replacement of dialogue in film or video production is often necessary for a variety of corrective reasons—a noisy location, poor delivery by the actor, or perhaps because of a technical problem somewhere in the audio chain. There is another case in which extensive dialogue replacement may need to be carried out—when a programme originates from another country with the soundtrack in a foreign language.

Replacing the entire dialogue in a production for the above reason is not a trivial proposition, even with the automation provided by some synchronisers. A system developed by Des Bennett of Telegael—a video production company on the West Coast of Ireland—and Softel—a company better known for their computerised video subtitling systems— aims to make Automated Dialogue Replacement (ADR) a much more efficient process.

Des Bennett previously worked for BBC Cymru, and provided much of the development stimulus for the AMS *AudioFile*. His collaboration with Softel has produced the *Swift* dialogue replacement workstation. *Swift* consists of a central processor and keyboard and RGB video monitor (showing cueing information and a miniature video picture) that can log dialogue cues against timecode, cue an actor or voiceover artist and control up to four video or audio machines.

There are two versions: the off-line and on-line. The off-line system can be used by a producer to prepare all the cues for a production, with a colour-coded sorting system for organising several actors.

At Telegael, the on-line system is currently used with a VCR, an *AudioFile* and a DAT recorder. The complete dialogue track is built up on the *AudioFile*, retaining all takes just in case. The DAT recorder is automatically triggered to back up the entire session.

Telegael currently use the system for converting foreign language programmes into Gaelic for local consumption.

Softel Systems, Horseshoe Park, Pangbourne, Reading, Berks RG8 7JW, UK. Tel: 07357 2151.

An explanation of last month's cover

Epsilon EPQ visual sound monitor

During the design of the Reflexion Arts range of monitoring systems Epsilon was asked to produce a diagnostic visual monitor. The unit was to be capable of monitoring, independently, the signal received by each separate unit of a multi-driver loudspeaker system. Together with an integral phase correlation display, the package was initially intended for use in the continued development of loudspeaker systems. On receipt of the prototype unit it became apparent that a new dimension had been exposed, giving insight into the correlation of the visual and audible patterns of sound.

Anomalies in the recording of many instruments became immediately obvious, furthermore, the unit appeared to fascinate all who saw it in operation. Engineers gained new perception, not only into the workings of the monitoring system, but also into the make-up of the individual sounds themselves. It was soon realised that the visual monitoring unit was a potentially powerful, multifunctional tool.

Although designed primarily for multichannel, actively crossed-over monitor systems, the unit performed equally well when connected directly to the drive units of systems with passive crossovers. Interest in the system was such that Epsilon decided to produce the unit as the *EPQ*.

The *EPQ* is a new type of sound monitor. It attaches directly to the monitor speaker drive units and gives a visual display of the structure, balance and harmonic content of sound.

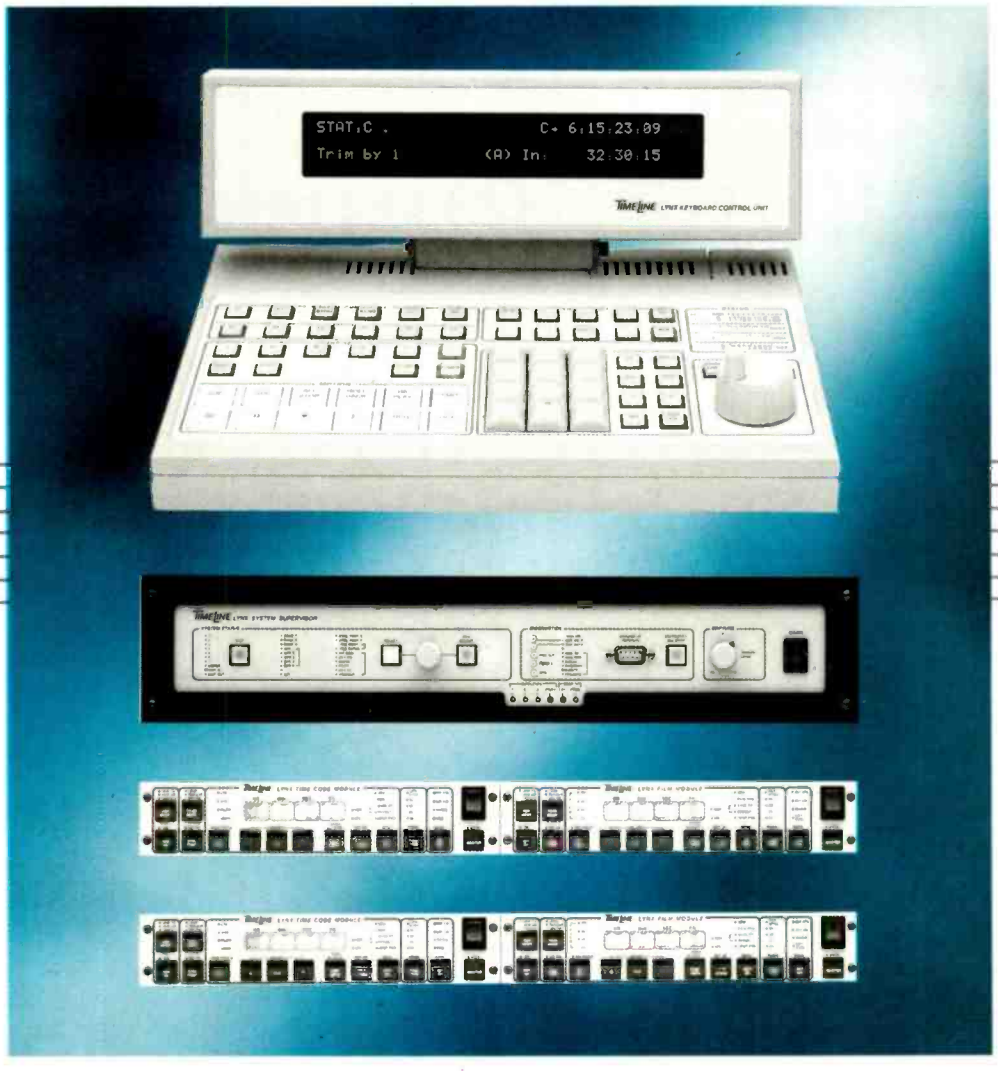
Nine oscilloscope displays are packed into 1U rackmount unit. Two groups of four oscilloscopes look at the low, low-mid, high-mid and high frequency monitor feeds and the centre display shows the relative level and phase of the stereo monitor input.

The purpose of the visual display unit is twofold. Firstly, it gives an accurate indication of monitor signals and problems such as clipping, DC offset and slew limiting are instantly recognised. With digital recording and CD becoming the new standard, it is now critical to know if instability or signals outside the normal range of hearing are being processed. The phase/level display shows mono compatability and overall, relative balance and frequency content. Secondly, by breaking the sound down into frequency bands, and showing directly the relative levels and harmonic content, the engineer soon gets a new 'feel' for the sounds he or she is working with. The spectrum analyser approach fails to get across this relatedness.

Specification:
Monitor output displays
Two channels, each with four inputs, providing continuously sync'ed CRT displays for low, low-mid, high-mid and high frequency ranges (from DC to 50 kHz)
Input impedance: 47 kΩ, balanced, floating
Input: Adjustable from 1-100 V pk-pk
Stereo phase/level display
Visual display of phase/amplitude relationship of left and right inputs. AGC ensures full display from low to high level, with low level spot cutoff to prevent tube damage
Input impedance: 47 kΩ, balanced, floating
Maximum input: +20 dBu
Frequency range: 20 Hz to 20 kHz (−0.5 dB)
AGC range: −30 dBu to +20 dBu
Spot cutoff: −50 dBu
Dimensions: (whd) 19×1¾×10 in/ 482×44×254mm
Connectors: XLR 3-pole

Epsilon, 187 Hamilton Avenue, Halesowen, West Midlands B62 8UB, UK. Tel: 021-501 3351.

TIMELINE.
TOTAL CONTROL.

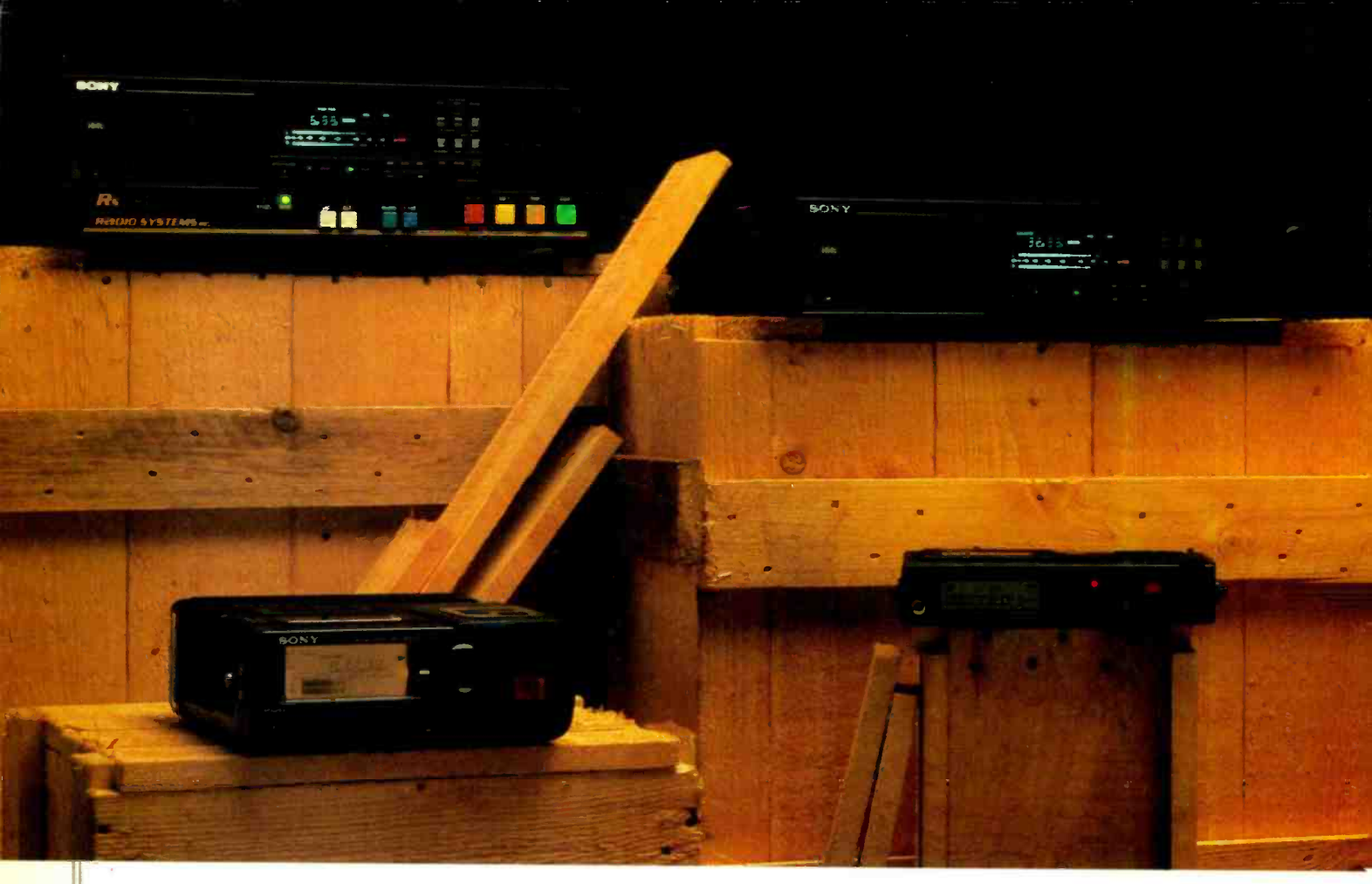


The Timeline post-production system is the most comprehensive modular machine control system yet developed, capable of controlling VTR, VCR, Film and Audio transports. The Lynx Module and Lynx Film Module reliably synchronise serial, parallel and bi-phase controlled machines in any simple or complex configuration. Operation may be controlled from the unique Lynx Keyboard Control Unit, which lets you forget the equipment and concentrate on the production. The System Supervisor further expands control by co-ordinating real-time synchroniser communications, GPIs, MIDI and central timecode generation. Integrated advanced post production control at your fingertips. Call today for full details and a personal demonstration.

TIMELINE

THE TIMELINE POST PRODUCTION SYSTEM

U.S.A. TimeLine Inc. Tel: 212-431-0330 **AUSTRALIA** Amber Technology Pty Ltd Tel: 61-2-975-1211 **BELGIUM** Trans European Music S.A. Tel: 02 569-1823 **DENMARK** AEG Donsk Aktieselskab Tel: 45 2 64 85 22. Studie-& Lydteknik APS (SLT) Tel: 45 1 7133 44 **FRANCE** D.M.2.J. Tel: 331 3957-9044 **HONG KONG & CHINA** Jolly Sound Ltd. Tel: 852-3-620202 **ITALY** Studio Sound System Tel: 39-62-2579-458 **JAPAN** Electori Co Ltd Tel: 81-3-950-6266. Solid State Logic Japan K.K. Tel: 81-3-320-1101 **NETHERLANDS** AEG Nederland N.V. Tel: 31-20-5105-473 **SPAIN** Ampex Trading Company S.A. Tel: 34 1 241 21 94 **SWEDEN** Elfa Studio AB Tel: 46-8-734-07 50 **UNITED KINGDOM** Stirling Audio Systems Tel: 01-624 6000 **WEST GERMANY** Audio Export Tel: 49-71-31-8 22 75



DAT. We think you should seri

We've made the Sony DTC 1000ES the industry standard, but we're committed to offering choice. The world's most extensive selection of DAT equipment, from the only serious DAT manufacturers – Sony and Panasonic/Technics.

Take portable DAT recorders. We now stock four different models, including Sony's TCD-D10 and the new TCD-D10 'Pro'. Another newcomer is the Technics SV 260A, which combines excellent professional features with the best-sounding recording quality we've yet heard from a DAT portable. While our range of studio recorders has been augmented by the new Technics SV 360, the Sony DTC 1000ES, modified by HHB to record at 44.1kHz as well as 48 kHz, needs little introduction.

Broadcasters are now enthusing about RSDAT – the latest device to demonstrate the flexibility of the DTC 1000ES. Converting and interfacing all audio and operational functions to broadcast standards – it brings cart-like control to DAT sources. Sony's PCM 2500 is especially versatile,

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ɔusly consider the alternatives.

offering the added value of digital format conversion.

HHB's knowledge of digital recording is legendary. So is the company's advice and service support. And while we back the best names in DAT technology, we also support our DAT range with Europe's largest selection of accessories. That means a full choice of DAT tapes, tape storage units, head-cleaning tapes, batteries, power supplies and stereo microphones, as well as 19" racks of our own design.

In fact, there's so much to show you in our stunning new demonstration facility, we couldn't possibly fit it into this ad. That's why we've published a new edition of our Digital Audio Times, containing full details and specification data. So send for your copy of HHB's definitive DAT bible now, or phone us on 01-960 2144.

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HHB

In an age of disk and digital, why buy analogue?

We know there are some applications where our 32-channel digital machine, the DTR-900, is the only answer. But if your business is such that you can do anything you want to do in the analogue domain, and at the same time do less damage to your budget, then our brand new analogue 24-channel MTR-100A may be the perfect machine for you.

When you consider that the MTR-100A will literally *change forever* the way engineers interface with audio machines, and

The MTR-100's auto-alignment saves you hours of time by eliminating constant tweaking and re-tweaking between sessions.

that this new way will save you hours spent in non-productive time, the analogue choice begins to make even more sense. You see the MTR-100A features full Auto-Alignment that allows total recalibration of the record and reproduce electronics. This means you can compensate for different tapes in a *fraction* of the time that it previously took, and your studio is not bogged down with constant tweaking and re-tweaking between sessions.

And if you think only digital machines feature high performance transports, think again! The MTR-100A's new transport incorporates reel motors that approach one horsepower – you'll get fast wind speeds of up to 474 inches per second! Of course, the transport is pinchrollerless to give you the legendary tape handling and ballistics of our MTR-90.

What's more, with its optional EC-103 chase synchroniser, the MTR-100A maintains frame-lock in forward and reverse from 0.2X to 2.5X play speed and will typically park with zero frame error.

Reel motors that approach one horsepower are driven by pulse width modulation amplifiers to tape speeds up to 474 ips.

Then, there's the sound. New cylindrical-contour heads built by Otari especially for the MTR-100A result in remarkably low crosstalk and outstanding low-frequency performance. Pre-amps are located directly beneath the heads to further improve frequency response, and HX-Pro™ is built-in for enhanced high frequency headroom. (An optional internal noise reduction package houses Dolby™ SR/A.) Add all these features to gapless, seamless, punch-in, punch-out, which is also built in, and your MTR-100A's sonic performance will rival any digital machine in the world.

So there you have it. With these powerful benefits available in analogue, does it make sense to go digital? Certainly, for some applications, a top analogue tape machine like the MTR-100A is the right choice.

And because we can see both sides of the question, ask us. We have the information that can help you make the right decision. Call Otari (U.K.) Limited on Slough (0753) 822381, or Fax us on (0753) 823707 or call U.K. Main Dealers, Stirling Audio Systems on 01-624 6000.

OTARI®

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Otari (UK) Limited, 22 Church Street, Slough, Berkshire SL1 1PT.

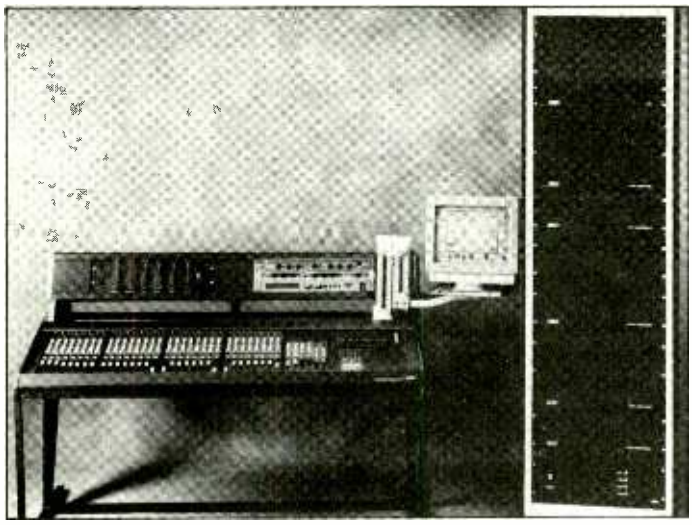
Orion NewsMaker hardware and software options

Orion Research has announced the introduction of three new options for the *NewsMaker* range of software-based consoles. The *FRS* (Fault Recovery System) option protects against power failures with a redundant CPU system and power supply, an automatic switchover module and RAM-based 'last image recall'. The *MM-16* mix-minus matrix adds an additional 16 mix-minus sends to any *NewsMaker* console. The status of all sends is incorporated into *NewsMaker*'s *ReMem* memory files. The third new option is a floor-stand with space for a meter panel and external signal processing equipment.

The *NewsMaker* range of consoles is designed for video production and going live on-air. Their design has been heavily based on similar lines to video production switchers with the console being only a digital control interface connected by serial data cable to rackmounted analogue electronics. They are available in 8-, 16-, 24- and 32-channel configurations. The uses of digital control has enabled the implementations of features such as the *ReMem* Recall Memory system that offers storage, recall and reset of all parameters plus macro keys for often used operations. Other features include a serial data port for interfacing with switchers, editors and newsroom computers and a video prompt system.

Orion Research Inc, 4650 West 160th Street, Cleveland, OH 44135, USA. Tel: (216) 267-7700. Fax: (216) 267-5894.

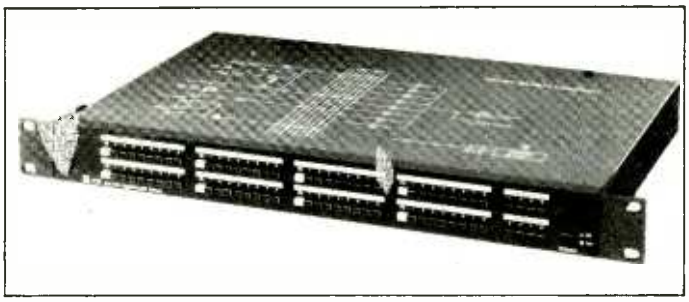
UK: Seltech International Ltd, Bourne End Business Centre, Cores End Road, Bucks SL8 5AT. Tel: (06285) 29131.



Kelsey Acoustics BNC Patchpanels

Kelsey Acoustics have designed a series of 19 in BNC Patchpanels for rack mounting. The K20-BNC contains one row of 20 BNC female adaptors which are isolated from the chassis by plastic stand-off insulators. Construction is black anodised aluminium and is fully braced and supplied with designation strip. Termination on both front and rear panel is by BNC male connectors—choice made on the experienced unreliability of standard female BNC chassis connectors using solder connections.

Kelsey Acoustics Ltd, 28 Powis Terrace, London W11 1JH, UK. Tel: 01-727 1046.



Toa MR-8A electronic patchbay

Toa have announced the introduction of the *MR-8A* matrix assigner/electronic patchbay. Although originally designed to function with the Toa *MR-8T* 8-track cassette recorder the *MR-8A* can be used as a standalone electronic patchbay. With the *MR-8T* it adds patch-free channel bouncing, two mic amps with level control and the ability to allow multiple inputs to be routed simultaneously to the same destination.

TOA Electric Co Ltd, Kobe, Japan.

UK: Toa Electronics Ltd, Hutton Industrial Estate, Tallon Road, Brentwood, Essex CM13 1TG. Tel: 0277 233882.

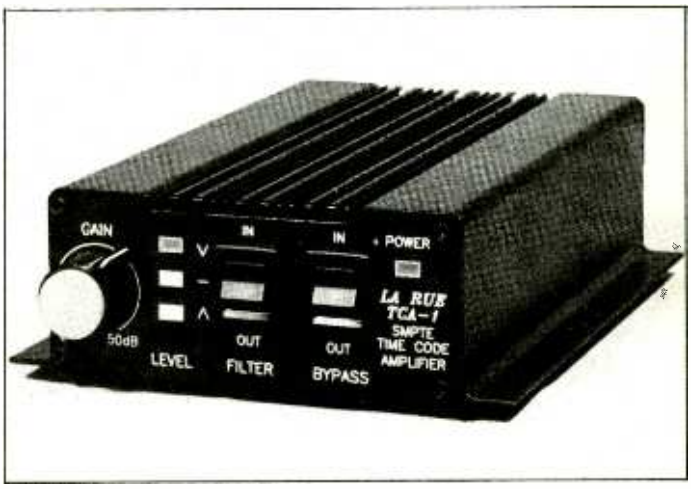
USA: Toa Electronics Inc, 601 Gateway Boulevard, South San Francisco. CA 94080. Tel: (415) 588-2538. Fax: (415) 588-3349.

La Rue Timecode Amplifier

La Rue Professional Systems have introduced a timecode amplifier, TCA-1 which is described as having up to 50 dB of gain. The unit consists of a balanced low noise instrumentation style input; an active filter stage that passes real time timecode data rejecting high and low frequency interference; a voltage comparator to reject extraneous noise and jitter while producing a constant amplitude square wave at its output. The output is balanced and will deliver 1.2 V p-p into 600 Ω.

The TCA-1 is housed in a compact aluminium extrusion with ¼ in tip/ring/sleeve type sockets. Front panel controls are basic with gain control, power indicator, filter in/out, bypass mode and three LED arrangement to indicate optimum level. The bypass mode is complete, removing all TCA-1 circuitry between the connectors. Uses described by La Rue include the restoration of low level, distorted or corrupt timecode as well as allowing the user to routinely record their timecode at a lower level on a regular basis hence reducing adjacent channel breakthrough.

La Rue Professional Systems, 401 Alden Road #11A, Markham, Ontario, Canada L3R 4N4. Tel: (416) 940-1212.



In brief

• **Sennheiser** have announced that the *ME 80/K3U* supercardioid microphone is now offered in a non-reflective black finish.

• **Shure** are offering a free 28-page booklet aimed at the video specialist wishing to achieve better audio quality, which covers a wide range including mics, cables, small mixers and basic techniques.

The *Guide to better audio* is available free from Shure Brothers Inc, Customer Services Dept, 222 Hartrey Avenue, Evanston, IL 60202-3696, USA. Tel: US only (800) 257-4873 or (800) 624-8522 (from Illinois).

• **Linn Products**, Glasgow, Scotland have released advance information on the Linn *Numerik* A/D and D/A conversion system. The system is described as using linear converters in conjunction with proprietary digital filters using digital dither. All inputs and outputs are optimised for 16 bit at either 44.1 kHz or 48 kHz with a choice of AES/EBU (two off), S-DIFF2, Sony/Philips consumer—both electrical and optical. There is also provision for sync inputs and outputs. Availability is being quoted as early 1990.

• **DOD Electronics** have announced that the *DSP-128 Plus* digital signal processor is now available with a foot pedal at no extra cost.

• **Amek** have added a new option for their range of broadcast consoles. A requirement for a *Classic* console with pre-fade meters on all input channels from the Nihon Kogakuin Technical College in Tokyo led to the development of LED meters with a spacing of only 15 mm as some channels are stereo. These meters can also be used for other purposes such as sub-groups, outputs and multitrack monitoring.

Sennheiser K3U/ME 80

• **Fabritrak** have launched a new collection of fabrics for their *Fabritrak* specialist acoustic lining system. This addition increases the collection to nine ranges and 160 colourways. Of the nine ranges, six are over 2.6 metres allowing panel widths of up to 2.5 metres either vertically or horizontally. Fabritrak, Fabritrak House, 21 High Street, Redbourn, St Albans, Herts AL3 7LE, UK. Tel: 0582 854626.

Fabritrack's new range of fabrics

Richardson tubes

Vacuum tube manufacturer Richardson Electronics have introduced a new line of audio amplifier tubes for the music and audio markets. Richardson say that the *National Gold* range of vacuum tubes are specially tested and hand selected using AF spectrum analysers. Each tube is then matched for output, selected for linearity and very low microphonics. The vacuum tubes are available as singles, matched pairs or quad sets. With an increasing interest in vacuum tube equipment another source of tubes has to be very welcome. In addition to manufacturing Richardson are distributors and have 17 sales offices worldwide.

Richardson Electronics Ltd, 42 W267 Keslinger Road, Lafox, IL 60147, USA. Tel: (312) 232-6400, toll-free (800) 323-1770.

UK: Richardson Electronics (Europe) Ltd, The White House, 18 Church Road, Leatherhead, Surrey KT22 8BB. Tel: 0372 379414.

Lexicon Opus enhancements

Lexicon have announced the launch of *Version 2* software for the *Opus* audio production system. *Version 2* is the result of user feedback and is compatible with all currently installed *Opus* systems. Further hardware upgrades include the use of 1.2 Gbyte hard disks that expand system capacity to over 14 hours of audio storage plus the advantages of increased speed and reduced size. There has also been a filter/equalisation option added that employs proprietary 55 bit floating digital processing. Finally *Opus* now has an AES/EBU/SPDIF digital interface to add to the existing SDIF-2.

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

UK: FWO Bauch Ltd, 49 Theobald Street, Borehamwood, Herts WD6 4RZ. Tel: 01-953 0091. Fax: 01-207 5970.

Neotek reframed

Neotek have introduced completely new frame designs for their full range of consoles. The new designs are described as having an appearance that complements contemporary design.

On the constructional side the frames are made entirely from aluminium and polymer alloys with aerospace adhesives, and use no welds, paint or wood. Neotek claim the new frames are exceptionally strong and offer easy customisation.

Neotek Corporation, 1154 West Belmont Avenue, Chicago, IL 60657-3324, USA. Tel: (312) 929-6699. Fax: (312) 975-1700.

UK: MusicLab Sales, 72-74 Eversholt Street, London NW1 1BY. Tel: 01-388 5392.

Nagra D

As mentioned a few months ago in our NAB Convention notes, Nagra was showing an advanced prototype portable digital recorder now known as the Nagra *D*. It is currently being shown as a result of interest in Nagra's digital plans to show that they have a viable technology in rotary head digital audio on ¼ in tape with reel-to-reel, and to gain market feedback.

The current specification is for four digital tracks, one analogue (PWM) cue track and a timecode track. Longitudinal tape speed is quoted as 4.75 cm/s for 2-track and 9.5 cm/s for 4-track. This will give three hours of 2-track recording on a 5 in reel of ¼ in tape (18 to 25 μm DASH or PD-type). Audio word length is 20 bit with 4 bits of aux data and a sampling frequency of 48 kHz.

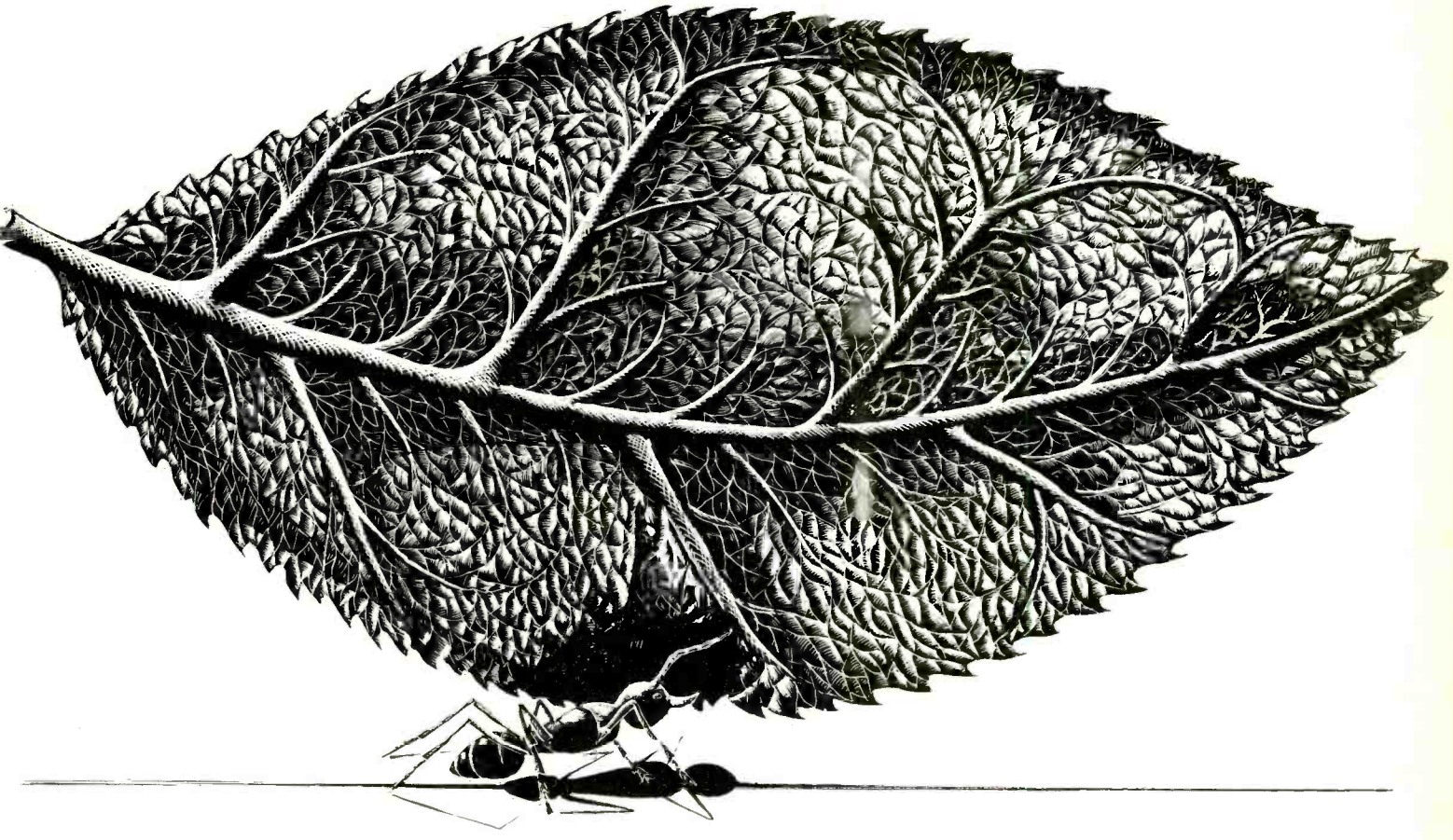
Nagra summarise the advantages of their format over other rotary formats as the use of a wider track width (70 μm without overlap), better signal level on playback and making the system less prone to mechanical errors including inter-machine tape compatibility. The machine will also include full confidence playback with audio monitoring and visual error correction indication. A studio version of the machine will have read-before-write capability for electronic editing.

Nagra have opted for 20 bit operation feeling that this allows for future developments and also gives suitable headroom for unpredictable location use. It is possible within the proposed format to handle six digital audio tracks should the word length be reduced to 16 bits. It is proposed that the studio version of this machine should have variable speed playback and a high-speed copy capability.

Kudelski SA, CH-1033 Cheseaux, Lausanne, Switzerland. Tel: 021 731 21 21. Fax: 021 731 41 55.

UK: Hayden Pro Audio, Hayden House, Chiltern Hill, Chalfont St Peter, Bucks. Tel: 0753 888447. Fax: 0753 880109.

USA: Nagra Magnetic Recording Inc CA, 1147 North Vine Street, Hollywood, CA 90038. Tel: (213) 469-6391. Nagra Magnetic Recording Inc, 19 West 44th Street, Room 715, New York, NY 10036. Tel: (212) 840-0999.



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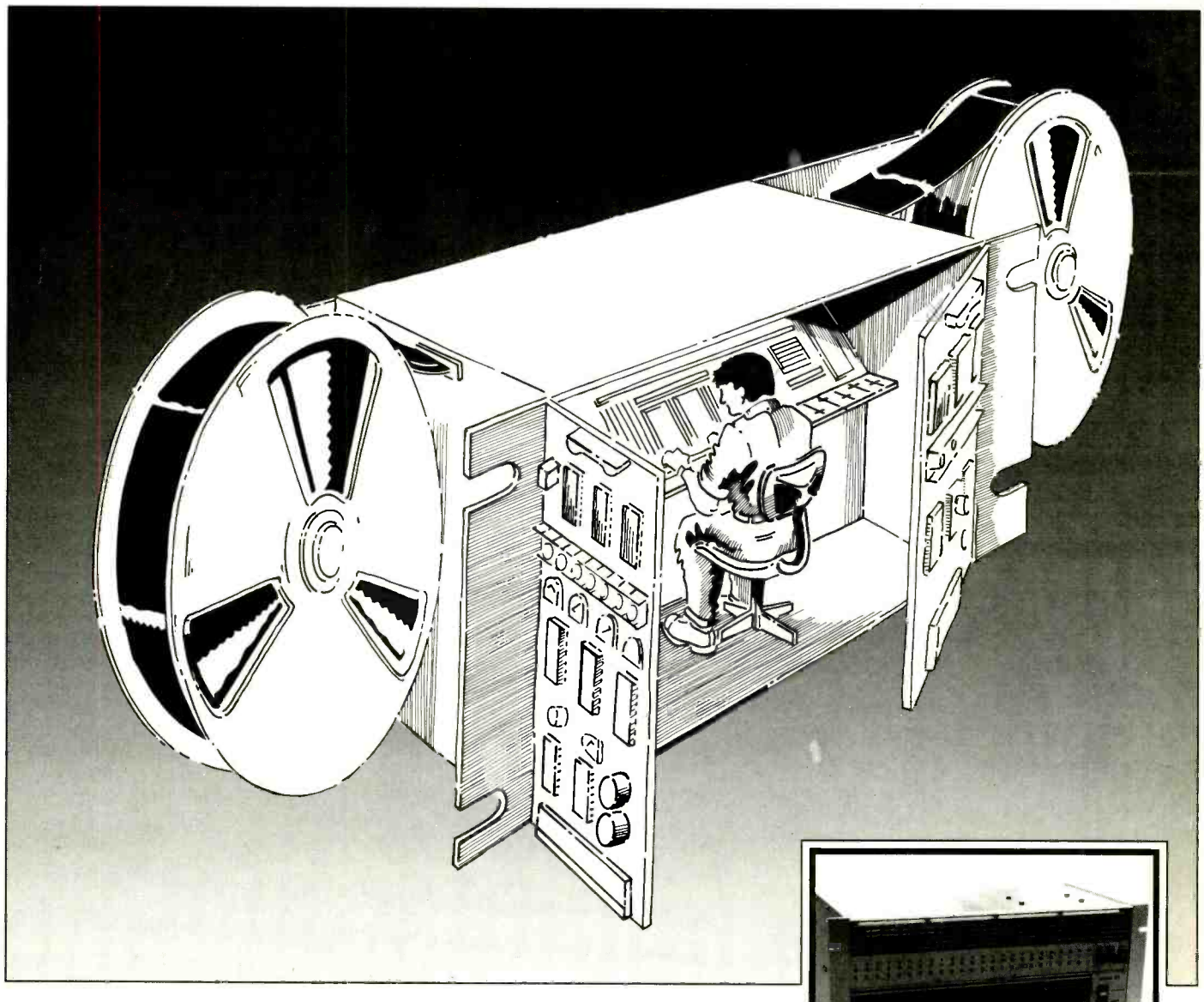

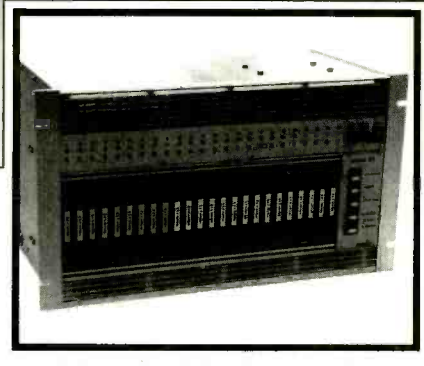

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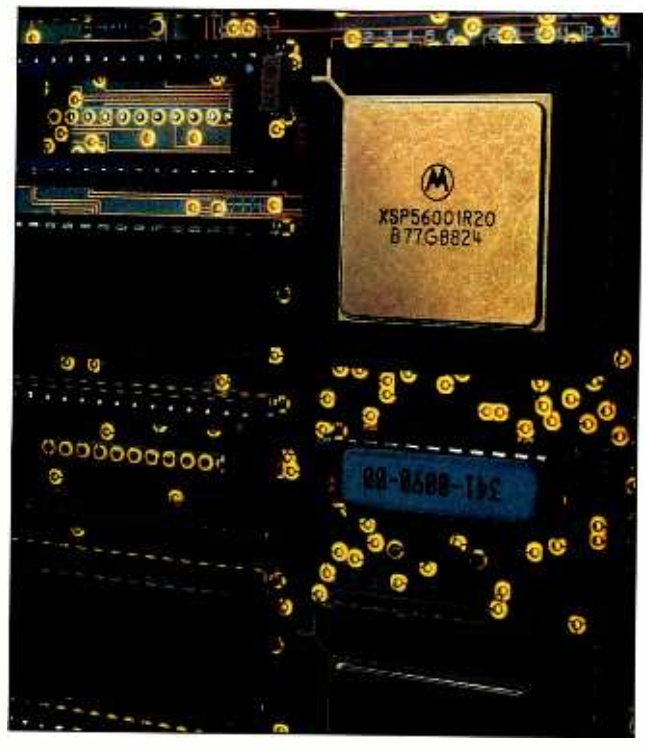

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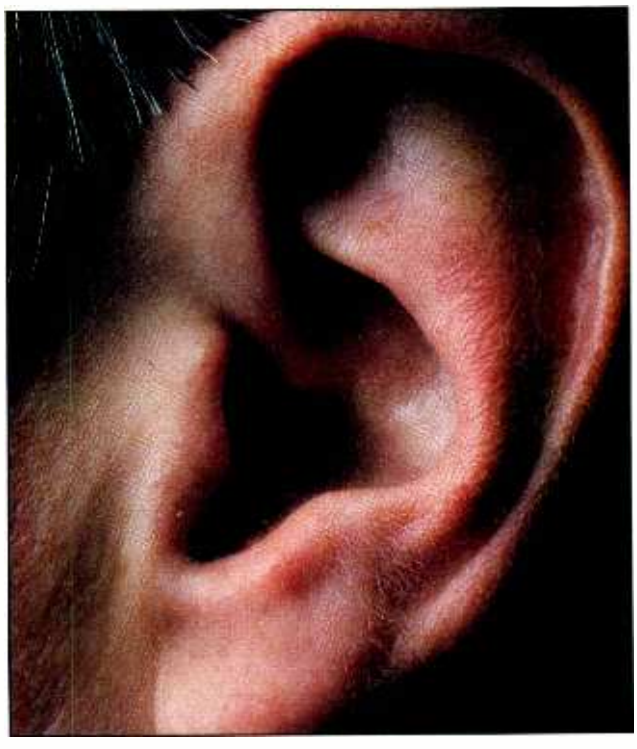

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MODULAR SYNCHRONISATION

TimeLine are specialist synchroniser manufacturers. When their first product was introduced it was a different way of tackling the problems of synchronisation. Keith Spencer-Allen talks to TimeLine's Gerry Block and outlines the Lynx system, while Patrick Stapley talks to some system users

TimeLine are specialist US manufacturers of synchronisation systems. When the *Lynx* synchroniser module was first introduced it took a quite different approach from the practical problems of synchronising different machines with timecode. Firstly it was a modular system in that each machine to be controlled is assigned a *Lynx Time Code* module and the system could be expanded by just adding more machines with modules and their interconnecting cables. It was also versatile in that each module held a machine menu, so it was easy to move a module between machines with a minimum of problems.

What is quite unusual in terms of studio technology is that the current version of the *Lynx* module is virtually the same as when it was first introduced four years ago and will still run all the subsequent software updates.

TimeLine was formed specifically to engineer and manufacture the *Lynx* system. The president and founder of TimeLine is Gerry Block whose background is on the practical side of the industry. In the mid '70s he was involved with the building of the New York facilities for Philadelphia-based Sigma Sound. He worked as a recording engineer there for a short while ending-up in a more managerial role and having a rather more technical bent, he started looking at the manufacturing end of the business.

"Sigma Sound NY was a very successful studio and we certainly had a lot of problems with synchronisers. It seemed that we owned everything and that nothing worked. In those days no one ever made any money on sessions with synchronisers because between paying the maintenance engineers and downtime, you could never make it back. But it was one of those things that you had to have because if you didn't the work would go elsewhere. In those days it was a real *Catch 22* situation. And as a studio we certainly had our share of problems.

"I was looking for a product to become involved in developing and during my research it became clear that we were not the only ones with synchroniser problems. When we worked on designing TimeLine *Lynx* we tried to build a product that was as much for studio owners and maintenance people as for artists and producers!"

Lynx Keyboard Control Unit

System

The heart of the *Lynx* system is the *Time Code Module*. This is a 1U half rack width package that basically contains a SMPTE timecode reader; a multi-standard SMPTE timecode generator; an audio/video tape machine synchroniser and a RS-422 9-pin communications port. The module may be used by itself as a single machine resolver, with two modules in a chase synchronisation capacity or to handle the control of a single machine as part of a larger audio or video production system.

There are two versions of the timecode module although all are very similar. The *Lynx SAL* (Stand Alone) is for standard chase sync applications while the *Lynx VSI* (Video Systems Interface) is for use with the *Lynx Keyboard Controller* or to interface with video edit systems. The *SAL* and *VSI* are electronically identical differing only over the version of software installed.

There has recently been added a *Film Module* version that has the ability to allow control of sprocketed film systems differing from the standard module by the addition of bi-phase capability to the standard electronics. This *Film Module* as the Time Code Module, can run either *SAL* or *VSI* software.

Contained within each *Time Code Module* is software for machine interface. Up to 100 audio and video tape machine interfaces are held in two EPROMs. Over the years new EPROMs with more interfaces have been issued although if you still had the machines you started with when using the *Lynx* there has been no real need to update your software.

Changing *Lynx* modules between machines is quite simple. First they have to be cabled up and then power applied. The menu on the *Lynx* module is then accessed and the correct machine interface selected. There are no internal or external adjustments with the module having the ability to make allowances for variations in mechanical machine alignment. Due to the relative ease of interchange of modules between machines a few facilities where machines outnumber modules have brought all there connectors out on 50-pin D connectors so that they can configure the sync interfaces with jumper

cables without needing access to the back of the machines.

Front panel access is given for the functions including SMPTE generator control, setting sync points, offsets, control of the display etc. There is also provision for selection of reference sync for the master controller from internal, external sources or AC mains.

In normal use the module displays all the selected parameters at power up and always returns to what was selected before the power was removed.

It is apparently possible to interconnect up to 32 modules on the RS-422 bus at distances of up to 1000 yards.

Keyboard Controller

There are a number of limitations as to what is possible with a system based just on modules. The *Keyboard Controller* allows more sophisticated control of up to six machines individually or in groups. Although this will account for the majority of possible applications there are plans to offer options extending this particularly for film applications.

Facilities offered include a keypad for timecode value entry, calculator mode for timecode/frame arithmetic, transport status displays, machine grouping and soloing facilities, large trim wheel, six user soft keys, 99 memories, two GPI events relays and controls for loops, rehearsals and record modes for edits.

The controller is a compact unit with a large number of illuminated buttons and a fluorescent information display. I asked Gerry Block if he did not think that the facilities offered were a little overkill for most users.

"They may be overkill for some customers right now but I feel that for many people involved in sound recording, their lives are getting a little less defined audio only as they slowly become involved in mixed media, video—in fact almost anything that involves more than just chase synchronisation and they will have to do something more about machine control. There are some major film facilities where they don't have to move machines around very much and they run them from the front panel. But anyone doing the kind of post-production work where they are dropping-in effects or machines will need something like the *Keyboard Controller*.

"When the *Time Code Module* was launched it had a number of facilities that were not conceived of as necessary at the time but have now become standard practice such as getting a video reference to the machine—something you need now with a digital machine.

"The controller was a much harder piece of equipment to design than the module. There is a lot less electronics in it but far more software engineering trying to make it a human interface."

Aside from the physical size, layout and spacing of buttons other considerations were chosen. It was decided to reduce the need for menu displays to complete work on the operation in hand. Because of this there are a larger number of buttons of a more discrete nature which is probably quicker to use. Also by making all the buttons illuminated it is possible to use lights to prompt the user as to what he should do next.

System Supervisor

The most recent addition to the *Lynx* system is the *System Supervisor*, a rackmount box that can be used to extend the system in a number of ways. It offers an expansion in the number of machines that the *Lynx* system can handle, up to eight GPI relay closures for triggering events, a click track generator, multiple slaved timecode generators, automatic timecode capture for sound effects positioning, variable speed and MIDI interface for events output and MIDI timecode generation. There is apparently considerable further development within the system supervisor for future expansion that appears to bridge the areas between basic machine control and the more 'creative' areas of MIDI song pointer generation and beat mapping, etc.

I was looking for a product to become involved in developing and during my research it became clear that we were not the only ones with synchroniser problems. When we worked on designing TimeLine Lynx we tried to build a product that was as much for studio owners and maintenance people as for artists and producers

In trying to gain some feel for the *Lynx* system in practise I spoke to four facilities—Marcus, AIR, BBC Cardiff and Metropolis—and they were fairly unanimous in their opinions.

Marcus studios have recently bought a KCU (Keyboard Control Unit) and three modules with a set of SAL and VSI software. The original intention was to use the system to attract more video work but due to a sudden increase in LP projects, they have been using the system almost exclusively for audio machine sync'ing. When I spoke to them the system was being used to lock a Mitsubishi *X850*, a Studer *A800* Mk 3, and an Otari *MTR-90* providing 80-tracks for a block of sessions with Propaganda.

The system at Marcus is flight-cased along with a U-matic video machine, and is moved from studio to studio. In the DDA rooms, where there is no onboard machine control, the KCU is used as a remote providing autolocator functions, etc; when used with SSL it acts more as a machine selector. The system has also been used successfully for synchronising 'spin ins' from 2-track to multitrack.

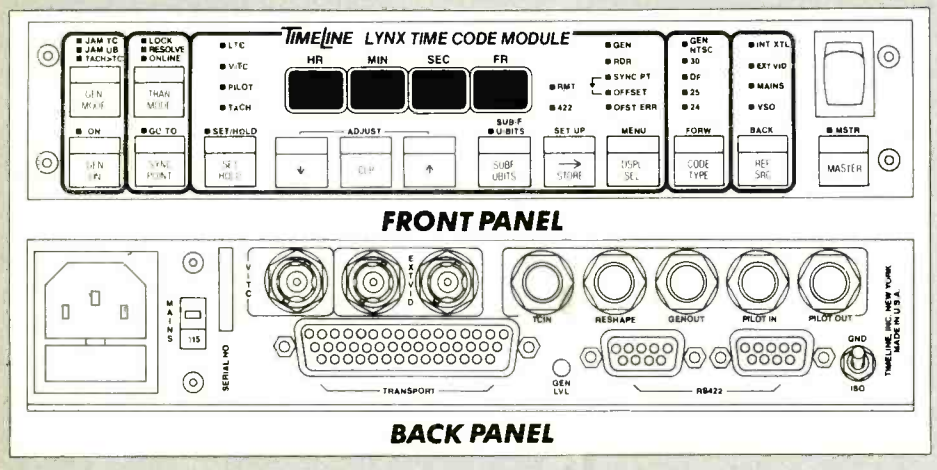
AIR have owned a collection of *Lynx* modules since 1987 and, as studio manager Malcolm Atkins explains they came as something of a surprise:

"The first session we ever did with *Lynx* was a jingle. In the past it wasn't unusual after the fourth or fifth pass for the client to turn round to the engineer and ask why it was taking so long to run the track and he'd explain that it was because they were running to picture. The usual response was 'OK in that case let's switch it off and we'll check it back later'. Now, when we installed the *Lynx* system nobody noticed a thing and we ran the whole session to picture without giving it a second thought. The lock up time is fantastic and I have never seen an approach algorithm like it—you can quote me on that if you like!"

Recently the AIR team have been

experimenting by using the KCU to control offset editing with Mitsubishi *X850*s. Not being entirely happy with the accuracy or the operational side of editing from the *X850*'s remote box, they looked with interest at the possibility of using the *Lynx* KCU with its 1/100 frame accuracy. Although they had a few problems connected with the length of time it took the *X850* to lock to external sync from cold, they nevertheless achieved some impressive results, and Atkins felt that this way of working elevated the *X850*'s offset editing capabilities into the same league as the Sony *3310* (PCM-3324 remote).

"I think the controller has been very well designed—ergonomically it is well put together with a screen that tells you what you need to know rather than confusing you with lots of unnecessary information. We also found the flashing lights indicating which button to press next (reminiscent of Sony editors) were very useful and helped to speed up operation."



The BBC have recently taken delivery of three KCUs and 15 assorted modules for their new film sound dubbing facilities in Cardiff and Southampton. The larger installation is at Cardiff where two new rooms have been built with a shared video/film machine room. Since 1975, Maglink synchronisers and timecode converters had been used but, although still operational, they were considered rather 'elderly' and replacement was necessary. Tony Heasman from BBC Cardiff tells how they investigated a number of systems before going with *Lynx*.

"An important operational factor for us was the central controller, which of course we were used to with the Maglink system, and looking at the various alternatives in the marketplace our choice was narrowed down considerably. Another consideration was the ability to synchronise film transports with timecode formats, which the *VSI Film Module* does very effectively."

Before the new rooms were built at Cardiff, dubbing theatres were specifically equipped to deal with film or video work—with the present arrangement things have changed.

"Until recently our dubbing theatres were split to cater for either film or video use and built accordingly. Now, with the Film Module integrated into the *Lynx* system, there are no longer any constraints on the dubbing theatres, and each can handle film or video or a combination of both. We can lock multitrack to film transport, and even video cassette to film transport, so it's proving an extremely versatile system enabling us to dub on any format using any other format."

An end result of this is that work can now be evenly distributed between the two rooms, making the facility more efficient as well as more cost effective.

Heasman also had praise for the back-up they received from TimeLine.

"Once our operational staff had familiarised themselves with the system there were a few things they thought would make useful additions. Gerry Block came over (from the USA) personally to discuss these ideas, and in a very short period of time he came back to us with revised software. One of these ideas which has proved extremely useful is a 'Return to Last Play' facility, which helps free the operator from constantly worrying about locate points and timecode read-outs. Another facility, soon to be implemented, is a Film Footage Read-out which can be switched in and out in place of the timecode read-out."

BBC Cardiff have on order a System Supervisor to expand their system, and its primary function will be for event triggering.

London's newest and perhaps most extravagant studio complex, Metropolis, have also acquired a KCU, which they are using in the same way as AIR to edit *X850*s; not surprising when you consider their chief technician John Goldstraw, is an ex-AIR employee.

"We use the KCU as a digital editing controller. The master transport is the record machine and the slave transport becomes the play machine. We back-to-back the clocks so that we can go either way via the digital dub cables, and use the KCU as an offset editor. A record drop in is then set up from the keyboard, or the edit can be rehearsed. The beauty of the system is that all this can be done while sitting at the console, including rock and rolling each machine via the jog wheel."

Goldstraw feels that where the *Lynx* scores over other systems, is in its ease of use.

"The thing I really like about the system is it's simple. When I get a phone call from someone at four o'clock in the morning telling me that the master transport has been changed to a different machine, I can sort them out in a few minutes. Because the system is menu driven and everything is in there, you don't end up having to change loads of parameters. To give you an idea of how simple the system is—we've got a young chap who's only been with us for two weeks and never used a synchroniser before in his life, he's picked it up so quickly that he's now going through the motions completely unaided."

As a matter of course, Metropolis reshape the master timecode through a *Lynx* SAL module before sending it to the console and on to a timecode distribution amplifier.

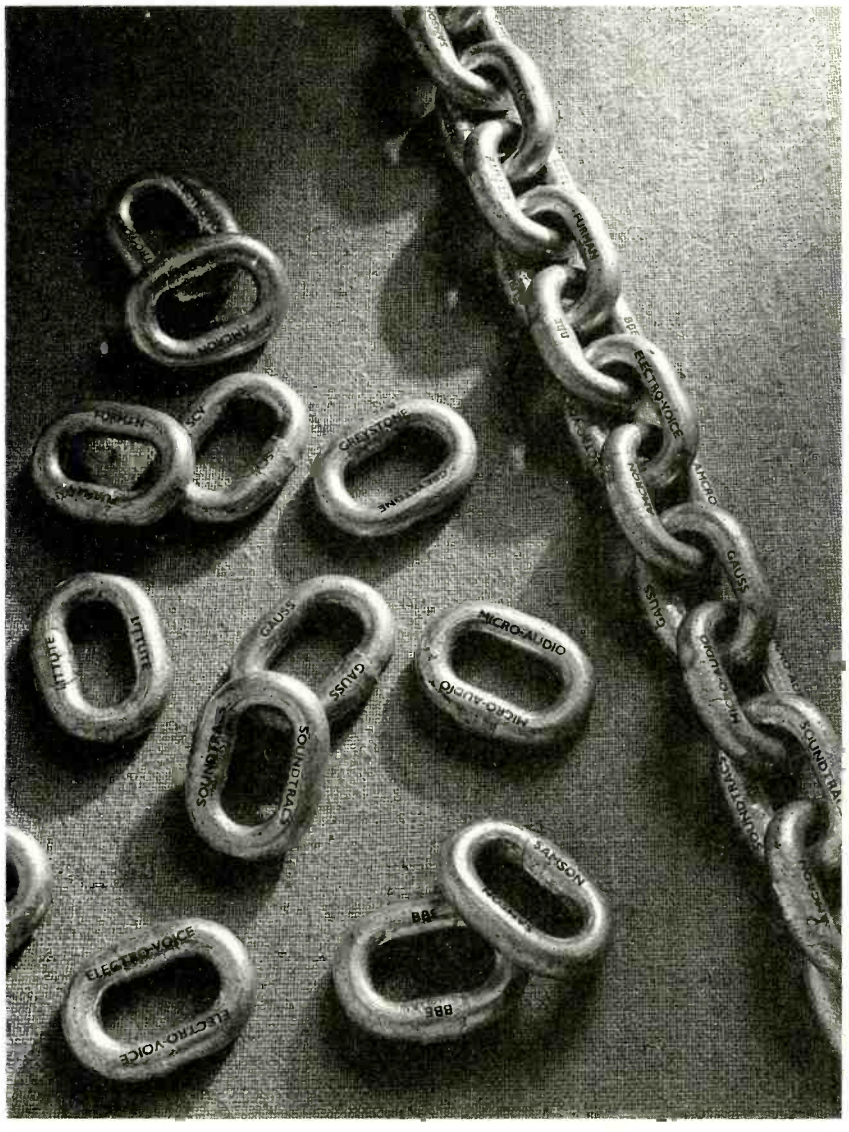
"When driving a number of timecode devices it's important to have the best possible quality code and this method makes sure of that. Also by using the DA, there is no danger of one device shorting the whole system."

An area that Goldstraw would like to see improved concerns the interchanging of software.

"At the moment I have to run the VSI software if I'm using the KCU but if I want to use varispeed I have to change over to the SAL software. Although it hasn't caused me a problem yet with wanting varispeed while using the KCU, as its main use here is digital editing, I'd prefer to see one set of software that could handle both functions."

As far as the System Supervisor is concerned, Goldstraw is waiting to see the outcome of recent developments between TimeLine and SSL regarding parallel machine control, which at the moment is his main interest although, of course, it's capable of doing a lot more.

Apart from those mentioned here, TimeLine seem to have a lot of satisfied customers, which in these days of greater user-awareness and increased demands for facilities and precision, must be viewed as a good recommendation.



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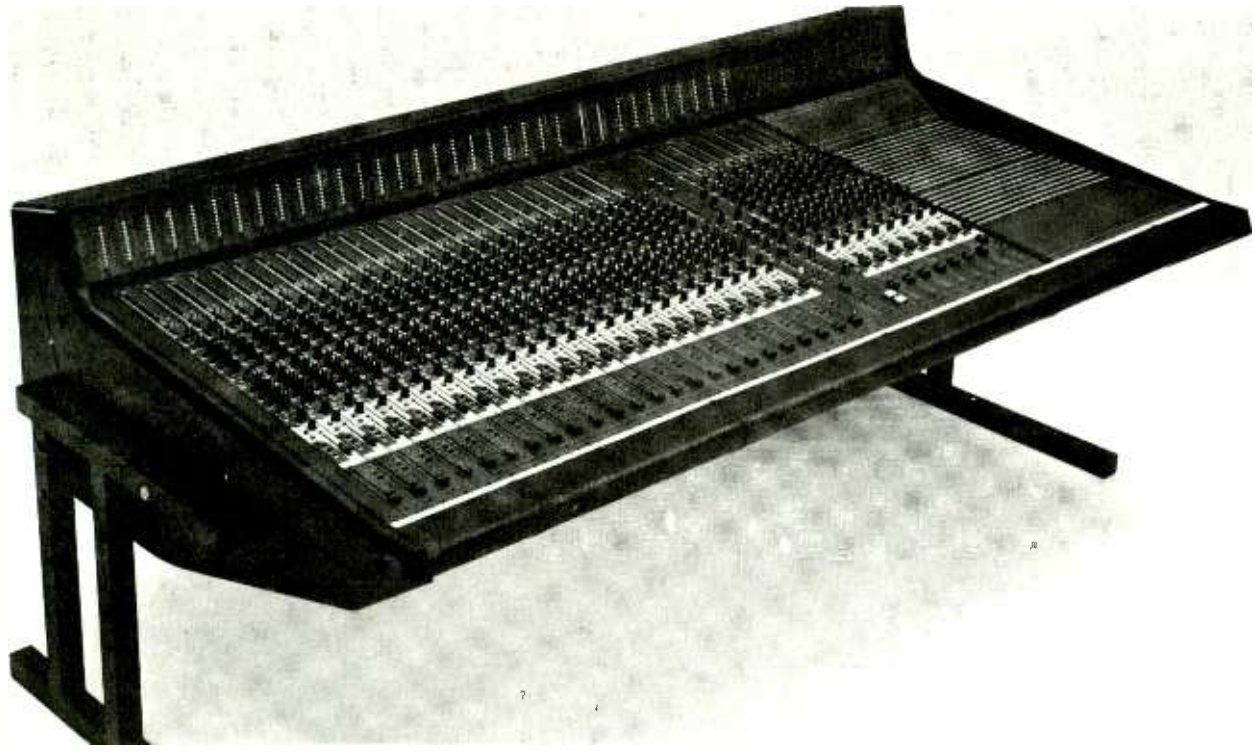

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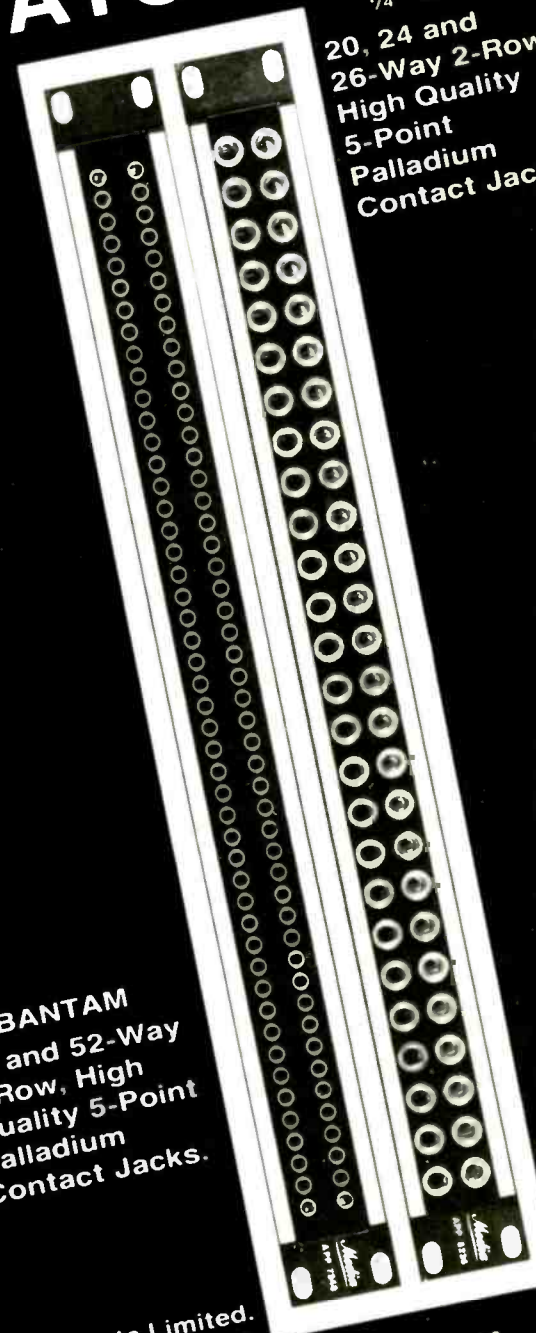

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Media

SYNC SOUND

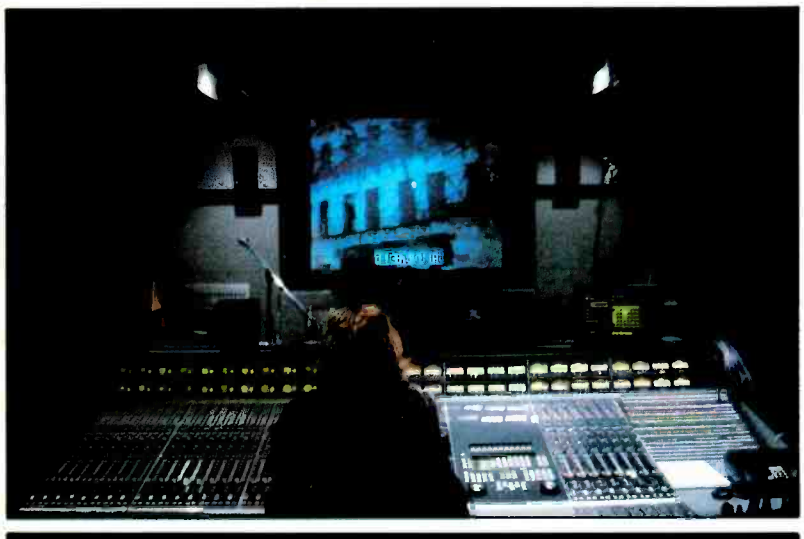
Fritz Lang visits a New York TV audio post-production facility

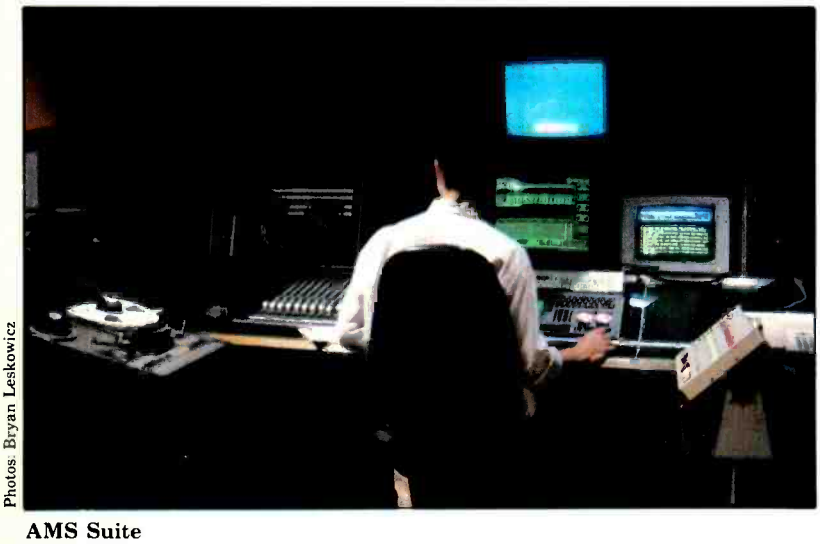
In New York's fashionable Hell's Kitchen is a new concept in audio studios. Based on the ideas and requirements of its owners, Bill Marino and Ken Hahn, Sync Sound is the first audio post-production facility specifically (though not exclusively) for the television arts in New York City, if not the whole of the United States.

Bill Marino, was formerly chief engineer at the late Bob Liftin's Regent Sound in New York. He was also broadcast systems engineer for NBC-TV network. Ken Hahn, is (and has been) a very popular post-production mixer. Working together at Regent they shared a lot of common ideas that later became Sync Sound.

Marino, Hahn and Alan Hale, chief engineer at Sync and former NBC broadcast systems engineer, have done most of the planning and systems design. The construction planning and design has been aided and built by Jimmy Maher, an independent studio builder.

In only four years, the original staff of six has grown to 22. The facility, the people, and their implementation are the important attributes of an efficient and popular studio. Top of the line equipment is useless without these factors. Sync bill approximately 450 hours per week for videos, feature films, commercials, network and public television. Their clients include Polygram, CBS Fox, MTV, HBO and PBS. NBC's new prime time entry, *Tattengers*, and the syndicated show, *Monsters*, keep the new A room almost fully booked at the moment. Judging from their fast growth and number of awards, Sync must be doing 'it' right.





Photos: Bryan Leskowicz

AMS Suite

Originally there were two mix and voiceover rooms and the machine/equipment room. They have since added a mix/ADR/Foley stage, two AMS *AudioFile* digital editing suites, special effects preparation and library with every effects CD available. They also create many of their own custom effects. There isn't a tracking facility at Sync but then there isn't a shortage of tracking rooms in New York anyway.

The recent addition of Studio A and its Foley stage make a complete post-production facility. Beforehand one would have to transfer/sync to kinescope, do the Foley work at a film Foley studio and transfer/sync back to the video format. With this new addition, anything to do with audio-post-for-video can be done at one stop, Sync Sound.

Sync's equipment includes SSL *4000* 32-channel, a SSL *6000* 40-channel and Soundcraft *2400* 24-channel consoles. These are coupled with (in any configuration) two Otari *MTR-90II* 24-tracks, two Sony *3324* digital 24-tracks, Otari mix machines, Sony *2000* and *2800C* 1 in videos for strip and layback. The *2800* is favoured because of its standard C-format and stereo 16-bit, 48 kHz PCM tracks.

Sync also decided on a Nagra *4sTC*. The Nagra was bought because there were certain problems encountered in field play back on a Nagra *4sTC*, of tapes mixed on the Otari centre-track timecode machines. So tapes to be played back with the Nagra *4sTC* are mixed to Sync's *4sTC*.

There are a variety of speakers. Studio B has UREI 813B with JBL surrounds, A has JBL *4430*, C has JBL *4411*, and there is the usual variety of small speakers and tissue for everyone's individual hallucination.

The custom sync system at Sync Sound is designed and exclusively used by Sync. The original application was conceived and designed by Hahn and Marino. The technology to date has been developed by Marino and Hale, and in co-operation with Lee Systems.

Necessity is the mother of invention. Hahn and Marino, when they were first developing the ideas for Sync Sound, wanted a system that could sync many machines, preview, edit, trigger other machines and do many things that the available systems of the time couldn't do. Additionally, the system can be updated and customised for Sync at any time. With a 'store bought' system, they would have had to go with whatever the manufacturers thought was the best package based on the market. Then Sync would have found themselves customising the system anyway. The talent, technology and parts were there, so Hahn and Marino opted for the DIY approach. Over the years, with more rooms and business, the related R&D has become more cost effective.

The original system was Motorola *6809* based. Recently the host computer has been updated to the *286* series/MS-DOS compatible, to take advantage of the many off-the-shelf hardware and software tools available. At the same time the system was rewritten in C language for faster, easier and more cost effective update/customisation.

Data is entered to the host via two keyboards and is seen on an RGB screen. One keyboard is the standard QWERTY. The second is a custom keyboard with two fluorescent displays and two shuttle control knobs. These displays are realtime indicators of what is being entered on the keyboards as well as what device is on line and who's master or slave. This information is also duplicated on the RGB. The shuttle knobs are both soft.

The Master Status Control Processor or MSCP, communicates the host information to each machine's Facility Status Control Processor or FSCP via the Hi Speed Data Link or HSDL. The HSDL handles inter-machine communication for up to 93 devices/machines per bus. The HSDL is fully patchable via 75 Ω coaxial video patchbay. The machines can be up to 2,000 ft from the MSCP with no active middlemen.

Each machine's FSCP *(6809)* translates protocols from the HSDL. There are 24 parallel outputs, which currently handle transport control, 16 parallel inputs handling tallys, two *RS232/422* serial ports to handle synchroniser communications ▷

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◁ or future 'smart' tape machines. Actual synchronisation is accomplished with mostly Adams-Smith hardware; although any addressable synchroniser could be interfaced.

The FSCP can also run any controlled device, any triggered device or indicators, record lights, etc.

There is also a variable DC voltage out that currently shuttles video machines.

When asked if Sync's very advanced and completely customisable synchronisation system would be for sale in the near future, the response was a resounding 'No'. There's plenty to do in running the facility. Marino, Hahn and Hale don't need additional work marketing and maintaining another company. Finally the construction dust has begun to settle and Hahn and Marino want to be able to enjoy the fruits of their labour.

Sync has recently added a balanced line driver/receiver digital patching system. It is wired with 130 Ω 10 MHz twin-ax. this is the characteristic impedance for AES/EBU/Sony standards. It's accessible from a bantam patchbay with very short runs to keep that characteristic impedance as close as possible. Word clock is also distributed but via 75 Ω co-ax.

Being located in noise city, not far from the Duke's (the musician, not the actor) fabled 'A' train subway, makes for much fun in the design and construction of the facility. Jimmy Maher, an independent studio designer and builder was brought in to build all three phases of Sync. Maher's philosophy on room construction is that rock'n'roll rooms are

built to keep the sound in the studio and voiceover rooms (which is what Sync's studios are) are built to keep sound from entering.

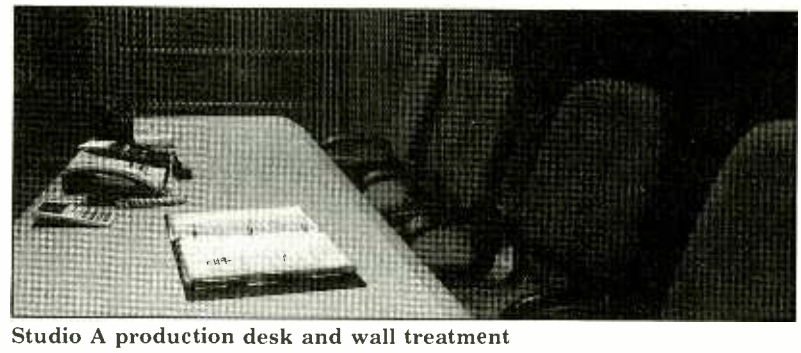
Actually, the 'A' train was not so much a problem as the street noise from busy 10th Avenue, where trucks, buses, taxis, and other rolling wrecks without mufflers, grind, roll and vibrate their way uptown. Sync is located at street level and Studio C is on the outside wall. It is surrounded with 10 in sand-filled concrete blocks and further separated from the world by a two-foot air gap and an 18 in block wall.

Studio B, although in the middle of the interior, was also surrounded with 10 in sand-filled blocks as a barrier against the surrounding interior hallways.

The walls and floors in B and C are floated/isolated on *Neoprene* rubber pads. Typical wall construction used is two layers of ⅝ in sheetrock on steel studs on both sides of an air gap and filled with glass fibre battens.

The ceilings consist of two completely independent layers. First, a sealed sub-ceiling layer of ½ in and ⅝ in sheetrock, with no violations. The air conditioning systems and cabling are below this sub-ceiling. Below this is another two layers of ½ in sheetrock with all electrical and air conditioning outlets sealed. All ceiling spaces are packed with glass fibre blankets.

The floors consist of a floated sub-floor on top of which the wire trough is built. Above this is the top floor made of two layers of sheetrock and a layer of plywood. Again all spaces are



Studio A production desk and wall treatment

filled with glass fibre sound blankets. Additionally, the troughs are packed with *Neoprene* at the entrance to each main area. All studios and control rooms are separated by an air gap, usually a library or storage.

A, the newest room and the Foley area, is different from the other two rooms. For space considerations the control room is treated differently. Sections of the rear walls are treated with *Acoustiwood* oak slats of ¾ in; 50% oak, 50% space. The wood is round faced for random deflection. The slats are backed with rigid glass fibre covered with fabric. The rear corners have bass absorbing diaphragms. A's studio walls are framed, filled with rigid glass fibre and covered with fabric. Spring isolators are used for better isolation.

Since A is in the interior and bound by dead storage and a quiet neighbour's office that also has an 18 in block wall already existing, no further block was thought necessary. Since all Sync's Foley work has been more than successful, there are no plans for elective surgery.

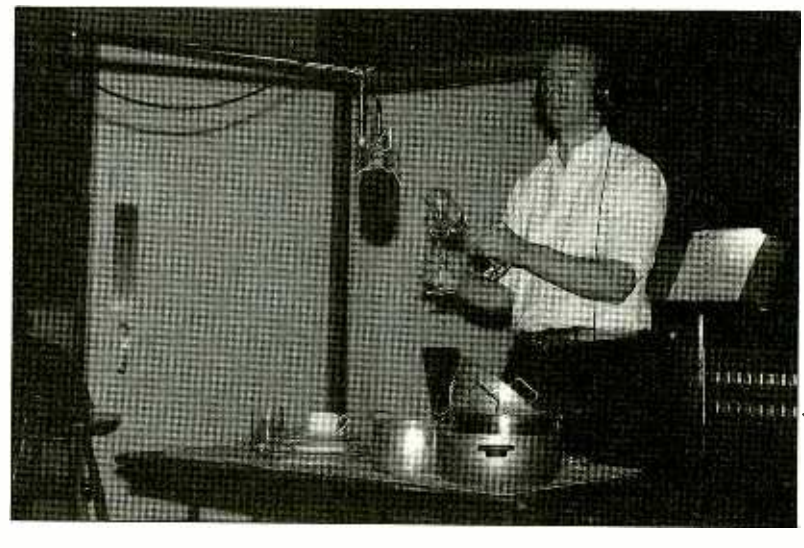
The Foley pits in A go to the slab and are surrounded with 3 in blocks but are isolated from the surrounding studio floor. This makes for 'solid' Foley sounds. Covers for the pits were made so that the slightly more than 250 ft² of A can be used for other than Foley work. These covers rest on the perimeter of the floated floor around the pits so there is no direct contact. There are also optional pit covers for different sounds: concrete, marble, grass, carpet, various woods and, of course, pits with sand and gravel, etc.

The lighting in A is a little unusual too. The track light is recessed to minimise reflection on both sides of the glass. In the control room the recess is also doing some sound absorption. There are glass fibre bails in the studio to maximise absorption. This also allows the mic preamps to be turned up as needed to pick up the minute sound of ants walking across sand. Props are stored in a wall closet system.

Since the AMS *AudioFile* rooms are for editing, the acoustics weren't as critical. The speakers were placed in the proper equilateral triangle and the usual comfort ergonomics of a control room were maintained.

Sync Sound is certainly one of the most innovative studios and has created a whole new market for itself. A new market, that in the not too distant future, others will surely follow.□

Sync Sound, 450 W 56th Street, 10th Avenue, New York, NY 10019, USA. Tel: (212) 246 5580.



Photos: Bryan Leskowicz

ANALOGUE RECORDING

Akai

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

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

AEG

AEG Aktiengesellschaft, Professional Tape Recorder Branch, Bucklestrasse 1-5, D-7750 Konstanz, West Germany. Tel: 07531 862370.
UK: Britannia Row Sales, 35 Britannia Row, London N1 8QH. Tel: 01-226 1226.
USA: Studer Revox America Inc, 1425 Elm Hill Pike, Nashville, TN 37210. Tel: (615) 254-5651. Fax: (615) 256-7619.

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

ASC

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

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

Digitec SA

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

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

Ferrograph

Ferrograph Ltd, Mountjoy Research Centre, University of Durham, Stockton Road, Durham DH1 3SW. Tel: (091) 386 8846. Fax: (091) 386 1727.

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

Fostex

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

E-Series: 8- and 16-tracks on ¼ in and ½ in respectively with Dolby *C*; also ¼ in and ½ in 2-track master recorders with centre-track timecode.

Lyrec

Lyrec Manufacturing A/S, Box 199, Hollandsvej 12, DK-2800 Lyngby, Denmark. Tel: (02) 876322. Fax: (02) 882540.
UK: Lyrec (UK) Ltd, Ardhaven House, Old London Road, Milton Common, Oxford OX9 2JR. Tel: 08446 8866. Fax: 08446 8810.
UK: Britannia Row Sales, 35 Britannia Row, London N1 8QH. Tel: 01-226 1226. Fax: 01-359 1454.

TR533: Improved with slightly altered tape path and optional Dolby *HX Pro*; 16- and 24-track versions on 2 in tape; 14 in max reel size.
TR55: 2-track master recorder on ¼ in tape; 14 in max reel size.
TR55-2/TC: Centre-track timecode version of *TR55*.
FRED: Editing machine with dump mode. Version without built-in scissors and fade in/out.
FRIDA: Sister to *FRED*, 3-speeds, servo-controlled wind, dump mode and variable spooling.

Nagra

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

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

Otari

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

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

Solidyne

Solidyne, Tres de Febrero 3254, 1429 Buenos Aires, Argentina.

GMS-200: 2-track on ¼ in, convertible to 4-, 8- and 16-track on ½ and 1 in tape; full digital control of editing and synchronisation.

Sony

Sony Corporation, PO Box 10, Tokyo Airport, Tokyo 149, Japan. Tel: (03) 448-2111.
UK: Sony Broadcast and Communications, Jays Close, Basingstoke, Hants RG22 4SB. Tel: 0256 474011.
USA: Sony Corporation of America, Professional Audio Division, Sony Drive, Park Ridge, NJ 07656. Tel: (201) 930-1000.

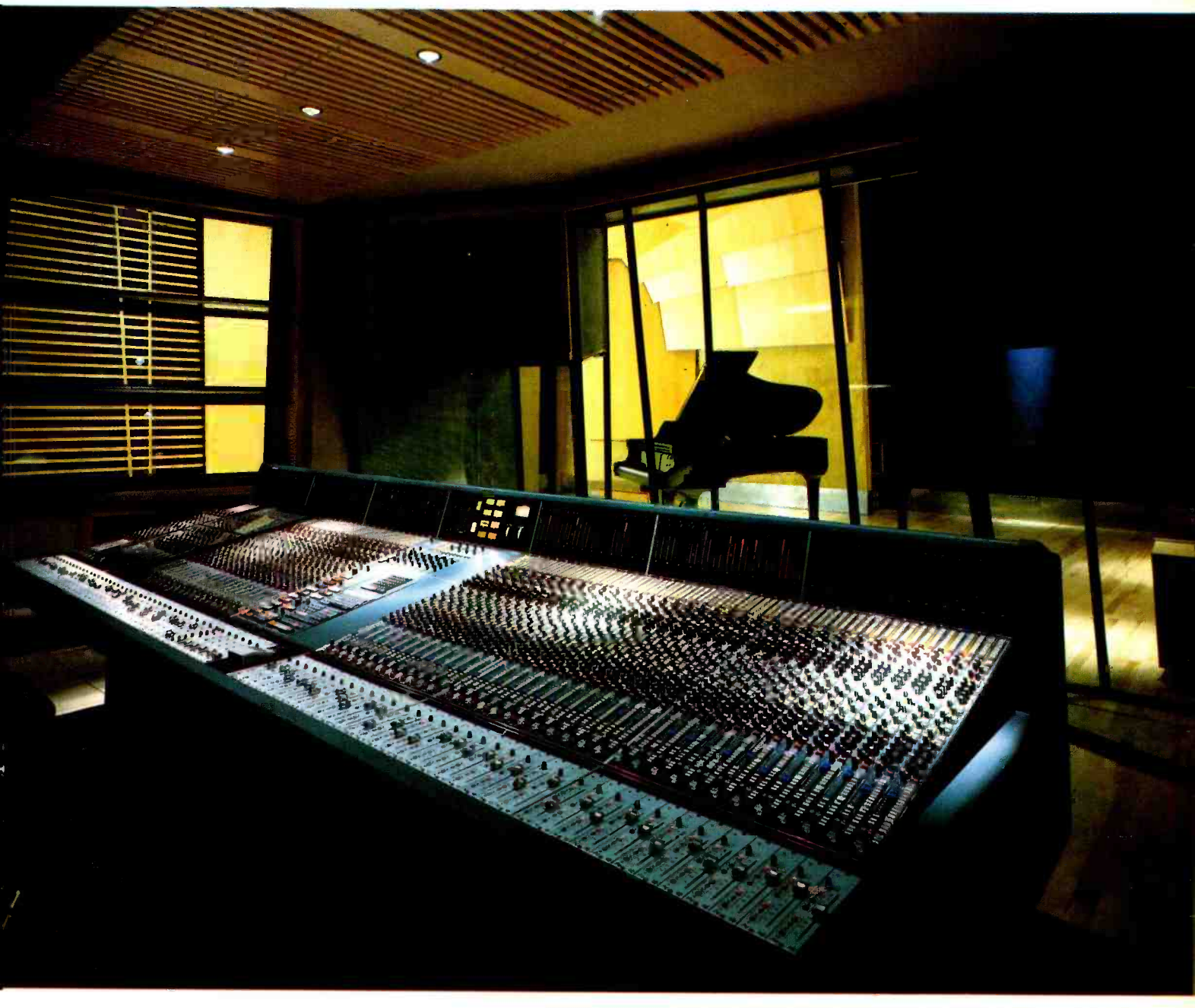
JH-24 series: 8-track on 1 in, 24-track and 16-track on 2 in.
APR-5000: Range of mono, stereo and 2-track mastering machines on ¼ in with stereo ½ in version and centre-track timecode options.
APR-24: 24-track recorder based around a 16 bit microprocessor which integrates transport, audio and synchronisation functions.

Saturn

Saturn Research Ltd, Unit 3A, 6-24 Southgate Road, London N1 3JJ, UK. Tel: 01-923 1892. (Worldwide distribution)
UK: Larking Audio, 15 Cam Square, Hitchin, Herts SE4 0TZ. Tel: 0462 422466.
USA: Redwood Marketing Inc, 820 Redwood Drive, Nashville, TN 37220. Tel: (615) 331-4743. Fax: (615) 832-1275.

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

METROPOLIS



The Neve VR Console with Flying Fader Automation in Studio A Metropolis London

Neve
A Siemens Company

NEVE ELECTRONICS INTERNATIONAL CAMBRIDGE HOUSE, MELBOURNE, ROYSTON, HERTS. SG8 6AU. TEL: 0763-60776. FAX: 0763-61886. TELEX: 81381.

Stellavox

Digital Audio Technologies SA, Puits-Godet 20, 2000 Neuchatel, Switzerland. Tel: (038) 244400. Fax: (038) 253230. (Worldwide distribution)
USA: International Audio Technologies Ltd, 13897 J Willard Road, Chantilly, VA 22021. Telex: 820529.

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

Studer-Revox

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

A820: 8-, 16- and 24-track versions on 1 or 2 in; Dolby *HX-Pro* fitted as standard; optional interface for Dolby *A*, *SR* or *telcom* NR; auto-alignment, 40 assignable functions in memory. ¼ in and ½ in stereo versions with 14 in spool and 40 assignable functions in memory.
A80: Cassette loopbin mastering, QC cassette pancake and video layback versions only.
A807: 2-track, mono and stereo on ¼ in, with centre-track timecode imminent.
A810: Similar to above with CTTC, FM and neopilot code.
A812: Broadcast replacement for *A80*, centre-track timecode in-console with optional VU penthouse.
Revox-B77: Transportable mono, stereo and 2-track on ¼ in.
Revox PR99 Mk III: 2-channel general purpose recorder. 2-speed with two high/low options. Broadcast version with uncluttered front.
C270: 2-channel ¼ in Dolby *HX-Pro* as standard, NAB/IEC plus timecode version.
C274: 4-channel, ¼ in.
C278: 8-channel, ½ in.
A827: Cheaper version of the *A820*, with same tape transport.

Studio Magnetics

Studio Magnetics Ltd, Unit 4, Radfords Field Industrial Estate, Maesbury Road, Oswestry, Shrops SY10 8HA, UK. Tel: 0691 670 193.
UK: MusicLab, 72-76 Eversholt Street, London NW1 1BY. Tel: 01-388 5392.

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

Tascam

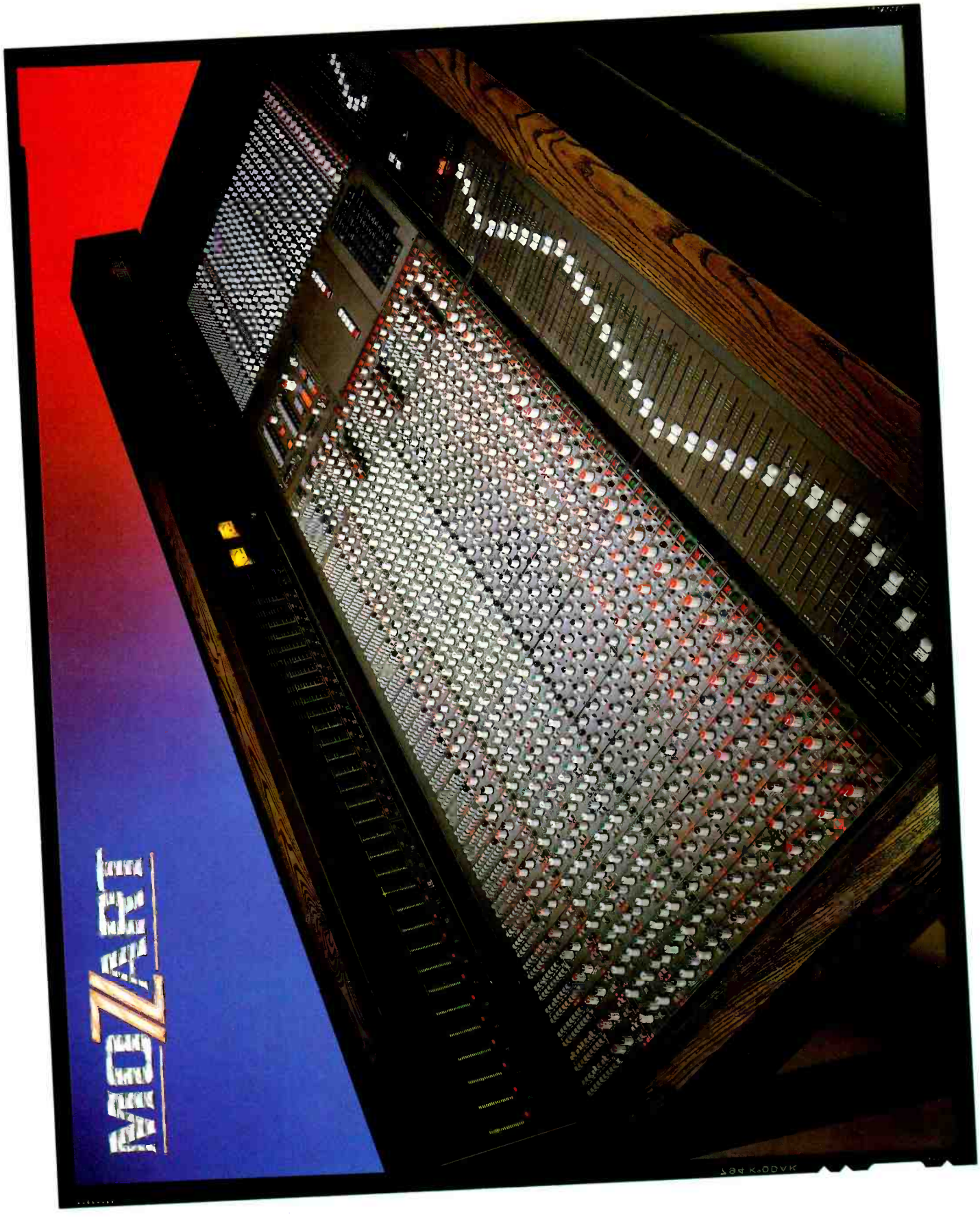
Teac Corp, 15-30 Shimorenjaku, 4-Chome, Mitaka, Tokyo, Japan. Tel: 0422 45-7741.
UK: Teac UK Ltd, 5 Marlin House, Marlins Meadow, The Croxley Centre, Watford, Herts. Tel: 0923 225235.
USA: Teac Corp of America, 7733 Telegraph Road, Montebello, CA 90640. Tel: (213) 726-0303.

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

Uher

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

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



Integral Automation: the mixing computer as an essential part of the console. A Cue List with multiple SMPTE and MIDI events. Get deep into the faders and switches on 40, 56 or 80 channels and reset to 1/4 frame precision. Mix like you've never mixed before with master status setups that you design. And then there's the sound, which will tell you why we had to name this console after a musical genius...

AMEK

1985 1986

Head Office, Factory and Sales:
AMEK Systems and Controls Ltd.,
New Islington Mill, Regent Trading Estate,
Oldfield Road, Salford M5 4SX, England.
Telephone: 061-834 6747.
Telex: 668127. Fax: 061-834 0593.

AMEK/TAC US Operations:
10815 Burbank Blvd, North Hollywood,
CA 91601. Telephone: 818/508 9788.
Fax: 818/508 8619.

PCM VIDEO-BASED RECORDING SYSTEMS

Akai

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

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

Audio Design

Audio Design (Recording) Ltd, Unit 3, Horseshoe Park, Pangbourne, Berks RG8 7JW, UK. Tel: 073 57 4545.
USA: Gotham Audio, 1790 Broadway, NY 10019-1412. Tel: (212) 765-3410.

Digi-4: Two modified Sony *PCM701ES* processors with video encoding equipment enabling 4-channel phase coherent recording/playback.
PRO 701: Professionalised version of the Sony.

By The Numbers

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

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

Denon

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

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

JVC

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

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

Sony

Sony Corporation, Tokyo International, PO Box 5100, Tokyo 100-31, Japan.
UK: Sony Broadcast & Communications, Jays Close, Basingstoke, Hants RG22 4SB. Tel: 0256 474011.
USA: Sony Corporation of America, Sony Drive, Park Ridge, NJ 07656. Tel: (201) 930-1000.

PCM-1630: 2-channel PCM processor 16 bit with switchable 44.1/44.056 kHz sampling frequency. Fully compatible with *PCM-1610* format. Optional read after write, digital delay and AES/EBU boards.□

DIGITAL REEL-TO-REEL RECORDING

Mitsubishi

Mitsubishi Electric Corporation, Mitsubishi Denki Building, Marunouchi, Tokyo 100, Japan.
UK: Mitsubishi Pro-Audio Group, Travellers Lane, Hatfield, Herts AL10 8XB. Tel: 0707 276100.
USA: Neve North America, Berkshire Industrial Park, Bethel, CT 06801. Tel: (203) 744-6230.

X-880: Successor to the *X-850*, with which it maintains full tape compatibility, but with reduced size and weight, and claimed improved sound quality and reliability.
X-400 16-channel PD format multitrack plus two analogue tracks, timecode track and one aux digital track for user data. 30 in/s tape speed with ½ in tape and 14 in reel capacity. 16 bit at 48/44.1 kHz switchable sampling.
X-86: 2-channel PD format mastering machine plus two analogue tracks, timecode and aux digital track. Standard version 15 in/s tape speed with 14 in reel capacity, switchable 48/44.1 kHz sampling rate and future upgradable. Version *X-86LT* as standard but with 7½ in/s tape speed.
X-86HS: Similar to the *X-86* but with 96/88.2 kHz sampling rates giving possible audio response up to 40 kHz. Also records and replays at 48/44.1 kHz sampling rates when it becomes fully compatible with standard *X-86*.
X-86C: Offers full playback compatibility with *X-80* series format tapes enabling replay on *X-86*.

Otari

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

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

Sony

Sony Corporation, PO Box 10, Tokyo Airport, 149, Japan.
UK: Sony Broadcast and Communications, Jays Close, Basingstoke, Hants RG22 4SB. Tel: 0256 474011.
USA: Sony Corporation of America, Sony Professional Audio Division, Sony Drive, Park Ridge, NJ 07656. Tel: (201) 930-1000.

PCM-3324A: 24-channel DASH format plus two analogue tracks, control track and one user data track. Tape speed 30 in/s for 48 kHz sampling rate on ½ in tape with 14 in reel capacity. 16 bit with switchable 44.1/48 kHz sampling rate.
PCM-3402: 2-channel DASH format mastering machine. Will operate at 7½ in/s (DASH-S) and 15 in/s (DASH-M) using Twin DASH format. Switchable sampling 44.1/48 kHz with 16 bit operation. Full electronic editing capabilities with pair of machines.
PCM-3348: 48-channel DASH format multitrack.

Studer

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

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

Tascam

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

DA-800-24: 24-track digital recorder in the DASH format. Electronics include Tascam ZD circuitry in the A/D and D/A converters. Features include sampling frequencies of 48, 44.1 and 44.056 kHz, SDIF-2 digital I/O and optional AES/EBU digital I/O.□

DAT

Here we include equipment we believe has some professional application, plus machines in pro use and information on prototypes shown at exhibitions

This is a very difficult product area in which to be fully comprehensive. Being predominantly a format designed for consumer use, until recently there has not been a great deal of choice when looking for machines suitable for professional applications. Consumer machines have found much use in standard or modified form although other models have been distributed around the world.

This year we have seen the first of a new generation of DAT machines designed for professional use and prototype machines and editors have also appeared from several other companies. Further developments are dependent upon final agreement on the DAT timecode format. With this in force expect to see many new models and DAT editing systems.

Audio Design

Audio Design Ltd, Unit 3, Horseshoe Park, Pangbourne, Berks, UK. Tel: 07357 4545.
USA: Gotham Audio Corp, 1790 Broadway, New York, NY 10019-1412. Tel: (212) 765-3410.

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

Casio

DA-1: A small portable consumer-type machine. To the best of our knowledge Casio do not distribute this unit outside Japan.
DA-2: Slightly more sophisticated than the *DA-1* and the cheapest DAT player available.
Both machines are being directly imported into certain territories through a variety of dealers.

Fostex

Fostex Corp, 560-3 Miyazawacho, Akishima, Tokyo, Japan. Tel: 0425-45-6111.
UK: Harman (Audio) UK Ltd, Mill Street, Slough, Berks SL2 5DD. Tel: 0753 76911.
USA: Fostex Corp of America, 15431 Blackburn Avenue, Norwalk, CA 90650. Tel: (213) 921-1112.

D-20: Rackmounting professional machine. Uses Fostex-developed timecode format to allow full slave and master applications.

More features, more power more flexibility

''Last year I completed 1138 sessions that could not have happened without AMS AudioFile. No other single piece of equipment has ever generated the client response of AudioFile and with Version 8 software we can now even go after business that we couldn't before. This client response means CRC are now looking to buy a fourth system.''
Tim Butler, *Chicago Recording Company*, Chicago.

''To be fair to AMS I must have been AudioFile's biggest sceptic and it took me a long time to decide to purchase my first system. I now own three AudioFiles and for anyone who knows me, that more than speaks for itself.''
Dennis Weinrich, *Videosonics*, London.

''Version 8 software has so rapidly broadened our user base to include many top recording artistes throughout Europe that it was inevitable we had to buy another AudioFile.''
Andy Hilton, *Hilton Sound*, London.

''The AudioFile is a powerful device in any audio application, but its ultimate strength is that it gives us a total system approach. Engineering and facility service can be achieved like never before in terms of quality and budget for the client as well as the studio.''
Jimmy Dolan, *Streeterville*, Chicago.

''We bought our first AudioFile in 87, added a second in 88 and have now just added our third. Of course we looked round at the competition each time before we bought, but each time decided there was still nothing faster or more flexible than AudioFile.''
Steve Cook, *Magmasters*, London.

''As our knowledge and business has expanded, we've added our second AudioFile and we know our clients and ourselves are now ready for a totally digital post production suite.''
Alek Goosse, *Videaudio*, Brussels.

''Barcud's experience in post production proves that it is possible to be successful with AudioFile outside Soho. Having one AudioFile convinced us of the need to obtain a second machine, because of the enormous amount of time saved in a dubb and the cost effectiveness of such a facility.''
Hywel Wiliam, *Barcud*, Caernarvon.

''We went to NAB 87 to check out disc based systems and bought an AudioFile. At NAB 88 we ordered a second and at NAB 89 we just ordered our third. The power of the latest AudioFile upgrades makes me even more convinced that we have chosen the right system for our needs at Sync Sound.''
Bill Marino, *Sync Sound*, New York.

Satisfied

More customers

Music Recording Consoles | Hard Disc Editor | Digitally Assignable Consoles | DMX/RMX Digital Audio Processors | Calrec Standard and SoundField Microphones | Custom Broadcast Consoles | Digital Mixing Consoles

AUDIOFILE

AMS Industries plc

AMS. AMS Industries Park, Burnley, Lancs. BB11 5ES. Tel (0282) 57011 Telex 63108 AMS-G. Fax (0282) 39542.
AMS. **USA**. 3827 Stone Way North, Seattle, WA98103 USA. Tel (206) 633 1956. Fax (206) 547 6890.
Demonstration systems available throughout the United States

The Queen's Award for Export Achievement to Edendeck Ltd 1984/85 and AMS Industries plc 1986. In July 1985 Edendeck Ltd became AMS Industries plc

OVER 200 SYSTEMS IN DAILY OPERATION
NOW WITH TIMEFLEX

Nakamichi

Nakamichi Corp, Shinjuku Daiichi Seimei Bldg, 2-7-1-Nishishinjuku, Shinjuku-ku, Tokyo, Japan.
UK: Nakamichi/B&W UK, Marlborough Road, Churchill Industrial Estate, Lancing, West Sussex BN15 8TR. Tel: (0903) 750750.
USA: Nakamichi USA Corp, 19701 South Vermont Avenue, Torrance, CA 90502.

1000: Nakamichi's first DAT player uses a unique transport system and a separate processor, *1000p.*

Panasonic

UK: Panasonic UK Ltd, Panasonic House, Willoughby Road, Bracknell, Berks RD12 4FP. Tel: 0344 853176.
USA: Panasonic Professional Audio Division, Matsushita Electric Corp of America, 1 Panasonic Way, Secaucus, NJ 07094. Tel: (201) 348-7000.

Fully professional DAT system with rackmounted recorders running DAT SMPTE timecode based on NHK proposal.

Edit controller also being shown in early prototype form as well as a fully professional portable recorder.

Sony

Sony Corporation, Tokyo International, PO Box 5100, Tokyo, 100-31 Japan.
UK: Sony Broadcast & Communications, Jays Close, Viables, Basingstoke, Hants RG22 4SB. Tel: 0256 55011.
UK: HHB Communications, 73-75 Scrubs Lane, London NW10 6QU. Tel: 01-960 2144.
USA: Sony Corporation of America, Sony Drive, Park Ridge, New Jersey 07656. Tel: (201) 930-1000.

PCM-2000: Portable professional robust DAT recorder with linear timecode track. Line and mic inputs. Phantom power. AES/EBU digital I/O. Switchable 44.1/48 kHz sampling frequency.
PCM-2500: Studio DAT recorder. 44.1/48 kHz switchable sampling frequency SDIF and AES/EBU digital I/O. Balanced 600 Ω analogue (+4 dBM level). Wired or wireless remote control. Records and edits START and SKIP ID's.
DTC 1000ES: Switchable sampling frequency 44.1/48 kHz. Same transport as the *PCM 2500.*
TC10D-PRO: Professionalised version of the *TC10D* portable.

Sony are also understood to have a range of professional recorders under development. Full-featured 4-head professional recorders with integral buffer memories for editing purposes and running at present on a version of NHK proposed timecode format. There is also apparently an editor for controlling the machines that simplifies the editing process but is not as sophisticated as the *DAE 3000.*

Stellavox

Digital Audio Technologies SA, Puits-Godet 20, 200 Neuchatel, Switzerland. Tel: 038 244.400.
USA: International Audio Technologies Ltd, 13897 J Willard Road, Chantilly, VA 22021. Telex: 820529 (Audio UD).

Stelladat: Portable machine designed for professional use currently being shown in prototype form.

Tascam

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

DA-50: Uses Teac ZD circuitry in D/A A/D stages. 48/44.1/32 kHz sampling.

Technics

UK: Panasonic UK Ltd, Panasonic House, Willoughby Road, Bracknell, Berks RD12 4FP. Tel: 0344 853176.
USA: Panasonic Professional Audio Division, Matsushita Electric Corp of America, 1 Panasonic Way, Secaucus, NJ 07094. Tel: (201) 348-7000.

SV-360: Mains powered semi-pro machine.
SV-260: Portable semi-pro recorder.□

DISK-BASED RECORDING SYSTEMS

This survey looks at systems that record audio in a digital form on to hard disk. We have not made a distinction between storage devices and workstations for audio editing and manipulation since, where these systems are under software control, the manufacturer may modify parameters at short notice. Further, the developing nature of products means that some of those included may have a wider application

AKG

DSE 7000: Not a hard disk based system but a RAM workstation with full memory offering 70 mins of storage and features normally associated with hard disk systems. A hard disk will, however, be offered as a library storage medium for audio within the system.
AGK GmbH, Brunhildengasse 1, A-1150, Vienna, Austria. Tel: (43222) 95 65 17-0.
UK: AKG Acoustics Ltd, Vienna Court, Catteshall Wharf, Catteshall Lane, Godalming, Surrey GU7 1JG. Tel: 04868 25702.
USA: AKG Acoustics Inc, 125 Walnut Street, Watertown, MA 02172. Tel: (617) 924-7697.

Alpha Audio

Boss: Advanced information on a hard disk system for interface with *Boss* editing system.
Alpha Audio Automation Inc, 2049 West Broad Street, Richmond, VA 23220, USA. Tel: (804) 358-3852. Fax: (804) 358-9496.
UK: Stirling Audio, Kimberley Road, London NW6 7SF. Tel: 01-624 6000.

AMS

AudioFile: Hard disk-based 16 bit record, edit and playback system. Can be configured mono, stereo or multitrack.
AMS Industries plc, AMS Industries Park, Burnley, Lancs BB11 5ES, UK. Tel: 0282 57011. Fax: 0282 39542.
USA: AMS Industries Inc, 3827 Stone Way North, Seattle, WA 98103. Tel: (206) 633-1956.

Ariel

A line of low cost digital disk recorders based around PC-type computers together with digital signal processing systems.
Ariel Corporation, 433 River Road, Highland Park, NJ 09804, USA. Tel: (201) 249-2900.

Audio Design

SoundMaestro: Hard disk-based recording editing system designed around the Atari *Mega ST* computer with 16 Gbyte storage capability. 2-channel 16 bit with 44.1 and 25.5 kHz sampling rate. Plans for multichannel versions and specialist software versions.
Audio Design (Recording) Ltd, Unit 3, Horseshoe Park, Pangbourne, Berks RG8 7JW, UK. Tel: 07357 4545.
USA: Gotham Audio Corp, 1790 Broadway, New York, NY 10019-1412. Tel: (212) 765-3410.

CAS

Di-Rec-T: Recording editing system expandable up to 32-channels with the addition of removable hard disk packs (up to eight). Capable of editing and recording functions.
Coach Audio Sales, Schuren 12, D-6670 St Ingbert, West Germany. Tel: 06894 4717.

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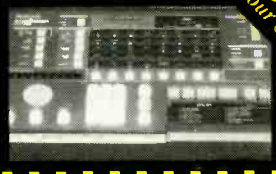


A NEW STUDIO STANDARD?

We are offering the acclaimed BEYER MC-740 Studio Condenser Microphone at a saving of over £180. With 5 polar patterns, a low cut filter and 10dB pad, the BEYER MC-740 has more facilities than the Neumann U87 and AKG C414, and in our view sounds sweeter.
So does the price at £595
For a limited period only.

QUALITY SQUEEZE

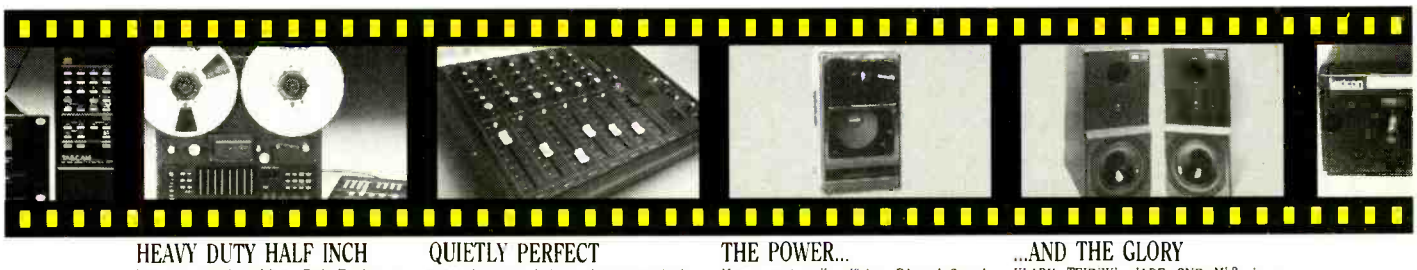
The all-British OMNIPHONICS S-50 is the most impressive sounding amplifier we have heard, and many of our customers agree. A very much 'quicker' amplifier than some of its more famous competitors, offering more faithful reproduction of transients in both analogue and digital recordings. The S-50 delivers 2 x 100W into 4ohms. The S-100, delivers 2 x 200W. Only 1U high to save you pounds in weight and money.

THE MASTER OF R-DAT

TECHNICS have defined the Studio R-DAT Standard with their SV-360, our most popular professional R-DAT option. It has 19" rackmount, balanced XLR analogue and coaxial digital in/outs as standard. It can be used to make CD masters, as it records and plays at 44.1kHz as well as 48 and 32kHz. We have a wide choice of special deals on this unit so contact us for details.

3-INTO-1 WILL GO

The unique MIDI-IZER from TASCAM, conveniently brings together Machine Remote Control, SMPTE Synchronisation, and MIDI Control. Interfacing to your TASCAM MSR-16, TSR-8 or 238 Cassette via its RS232 port, MIDI-IZER is the ideal choice for control and synchronisation.
At only £1300, it's sure to be a winner, especially if included in one of our generous 8 and 16-Track Packages.



HEAVY DUTY HALF INCH

The new TSR-8 TASCAM Eight-Track is a worthy successor to their legendary 38 and with significantly more features: In-built DBX Noise Reduction, Synchroniser Control Interface, and TASCAM's superb auto and gapless punch-in/out facility. The TSR-8 is a rugged, reliable professional recorder, ideal for general music recording and video post-production where budget is limited. See our current Offers List for package-price details.

QUIETLY PERFECT

A popular mixer choice at the moment is the REVOX C279 with its unique switchable mono or stereo channel format, ideal for both direct-to-DAT recording and AV/Video production. An extension module is also available to add DBX Noise Reduction, RIAA Turntable inputs, plus Fader-Start logic and 1kHz test tone oscillator. Ask for our current Offers List for a very attractive price.

THE POWER...

If you want really efficient PA and Sound Reinforcement loudspeakers that sound stunning, at low-to-medium cost, then COMMUNITY is the name to choose. 20 years experience of loudspeaker design in the US has resulted in a superb range starting from as little as £260. The 3-way Coherent Wavefront RS-327i is just one of many gems from their collection. Hearing is believing. You can't fail to be impressed - so book a demonstration today.

...AND THE GLORY

KLARK TEKNIK's JADE ONE Mk2, is a powered Studio Monitor designed by one of the industry's leading acoustic specialists. Unlike many high quality powered monitors on the market the JADE ONE Mk2 is of similar cost to a medium-priced separate speaker and amplifier system, but with the added benefits of a totally integrated design. JADE ONE Mk2 therefore gives you a self-contained precision calibrated sound system at an attractive price.

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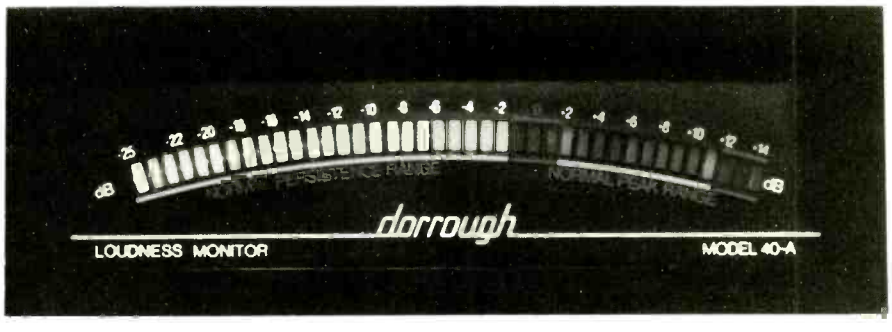
Simultaneous display of peak and average on a single scale

The new Dorrough 40-A from Plasmec Systems is unique, offering simultaneous display of peak and average sound levels ON A SINGLE SCALE to give you more complete information than any combination of peak hold, VU and PPM meters!

The first gain riding display capable of showing what is taking place, both acoustically and electronically, the Dorrough 40-A will allow you to see a one-half cycle excursion at 15 KHz and help to keep audio peaks within headroom.



And it's just one of a new and comprehensive range of Dorrough loudness monitors now available from Plasmec, including models with straight scales, vertical scales, stereo test sets and twin display packages.

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Model 642B (Same in both channels.)	25-500Hz	80-1.6kHz	315-6.3kHz	1-20kHz

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(Same in both channels. Limited frequency range for speech processing, forensic work, notch filtering/feedback suppression, and similar applications.)				
Model 642B/SPX Frequency ranges of 642B in channel A; 642B/SP in channel B (For combined full-frequency range broadband shaping and restricted-range narrowband notching.)				

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orban

LISTEN TO THE DIFFERENCE.

Cedar

Cedar: Acronym for Computer Enhanced Digital Audio Restoration—a computer-based system for removing unwanted noise from audio recordings that uses hard disk storage before processing as not realtime. Currently only available as a processing service and not for sale.
Cedar Audio Ltd, National Sound Archive, 29 Exhibition Road, London SW7 2AS, UK. Tel: 01-589 6603.

Denon

DN-052ED: Hard disk-based 16 bit recording system operating 2- or 4-channels. Part of comprehensive editing system intended mainly for music editing.
Nippon Columbia Co Ltd, 14-14, 4 Chome Akasaka, Minato-ku, Tokyo 107, Japan. Tel: (03) 584-8111.
UK: Hayden pro audio, Hayden House, Chiltern Hill, Chalfont St Peter, Bucks SL9 9UG. Tel: 0753 888447.
USA: Denon Digital Industries Inc, 1380 Monticello Road, Madison, GA 30650. Tel: (404) 3432-0637.

DAR

SoundStation II: Hard disk-based digital recorder/editor. Basic system is 4-channel expandable to eight. Full range of interfaces for storage systems and inputs. Touch-sensitive screen operation.
Digital Audio Research Ltd, 2 Silverglade Business Park, Leatherhead Road, Chessington, Surrey KT9 2QL, UK. Tel: 03727 42848.
USA: Digital Audio Research (USA), Suite 802, 6363 Sunset Boulevard, Hollywood, CA 90028. Tel: (213) 466 9151.

Digidesign

Sound Tools: 2-channel system based on *Mac II* or *SE*. Recording time dependent on size of HD selected. With *Sound Designer II* software offers full editing, EQ, FFT analysis, time compression and sample rate conversion.
Digidesign, 1360 Willow Road, Menlo Park, CA 94025, USA. Tel: (415) 327-8811.
UK: Sound Technology plc, 6 Letchworth Business Centre, Avenue One, Letchworth, Herts SG6 2HR. Tel: 0462 480000.

Fairlight

Series III: A development of the series *III* it is a disk recording system recording 16 bit at sampling frequencies up to 96 kHz which can be used with the *MFX* controller.
Electronic Sound and Picture, 30 Bay Street, Broadway, NSW, Australia 2007. Tel: 212 6111.
UK: Stirling Audio, Kimberley Road, Kilburn, London NW6 7SF. Tel: 01-624 6000.

Ferrograph

Model 9000: Compusonics *DSP-1500*—write once, read many (WORM) 5¼ optical disk format.
Model 9500: Compusonics *DSP-1500*—magnetic disk in cartridge format for broadcast use.
Model 9200: Compusonics *DSP-1200*—playback-only version of *DSP-1500*.
Ferrograph Ltd, Mountjoy Research Centre, University of Durham, Stockton Road, Durham DH1 3SW, UK. Tel: 091-386 8846.
USA: Gotham Audio Corp, 1790 Broadway, New York, NY 10019-1412. Tel: (212) 765-3410.

For.A

Sirius-100: Hard disk-based record/replay system with up to eight channels of audio available. Capability to handle a number of control panels simultaneously on the same system.
For.A Company Ltd, 3-2-5 Nishi-Shinjuku, Sinjuku-ku, Tokyo 160, Japan.
UK: Cameron Video Systems, Station House, 4-8 High Street, West Drayton, Middx UB7 7DJ. Tel: 0895 446661.
USA: For.A Corporation of America, Nonantum Office Park, 320 Nevada Street, Newton, MA 02160. Tel: (617) 244-3223.

gtc

Digiton: System designed principally for post-sync recording for film and video. Up to 16-tracks with full eight hard disk units. Also time compression/expansion ability. 16 bit with 32, 44.1 and 48 kHz sampling.
gtc Film and Fernseh-Studiotechnik GmbH, Wohrendamm 19, D-1070 Grosshansdorf, West Germany. Tel: (04102) 62 0 62.
UK: gtc Ltd, Unit 40, Sheraton Business Centre, 26-28 Wadsworth Road, Perivale, Middx UB6 7JD. Tel: 01-991 9152.

Hybrid Arts

ADAP II: Atari customised *Mega-4*-based system offering 100 track mins with up to 2-channels. Six sample rates and full editing capabilities.
Hybrid Arts Inc, 11920 West Olympic Boulevard, Los Angeles, CA 90064, USA. Tel: (213) 826-3777.
UK: Syndromic Music, 24-26 Avenue Mews, London N10 3NP. Tel: 01-831 9489.

Image Video

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

IMS

Dyaxis: Full editing/recording system based around *Mac II*.
IMS, 1370 Willow Road, Suite 201, Menlo Park, CA 94025, USA. Tel: (415) 326 7030.
UK: The Home Service, Unit 2, 12 William Road, London NW1 3EN. Tel: 01-387 1262.

IXI

MS-60D: A mastering and editing system based on a 60 min (expandable to 120 mins) stereo capability on user selectable optical/disk format.
IXI, 211 Kenton Road, Harrow, Middx HA3 0HD, UK. Tel: 01-907 3636.

Lexicon

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

NED

Direct-to-disk: Recording system that can be run up to 32-track. Designed to work in conjunction with the other synthesis and sampling aspects of the system although not necessarily so. Expandable in time capacity.
New England Digital, Box 456, White River Junction. VT 05001, USA. Tel: (802) 295-5800.
UK: New England Digital (UK) Ltd, 114-116 Charing Cross Road, London WC2H 0DT. Tel: 01-379 3398.

PrismSound

HDE1000: System based on *AT* PC with extra plug-in cards. Full digital and analogue interfaces with 20 track mins as standard (expandable). Editing capability and optional drive.
PrismSound, Intercell Building, 1 Coldhams Lane, Cambridge CB1 3EP, UK. Tel: 0223 464739.

Real World Research

The Audio Tablet: Hard disk-based editing/recording system. Pressure-sensitive screen operation with dedicated software for differing working environments. Two-channel system with tape streamer back-up.
Real World Research, Bath, UK.
Worldwide: Syco Systems Ltd, Kimberley Road, London NW6 7SF, UK. Tel: 01-625 6070.

Sonic Solutions

The Sonic System: Based on *Mac II* computer and designed mainly as an editing/mastering system running 4-tracks. Full dynamic control of EQ and dynamics and sophisticated editing abilities. Further option is *NoNoise* digital noise removal system for restoring or cleaning old or substandard recordings.
Sonic Solutions Inc, 1902 Van Ness Avenue, Suite 300, San Francisco, CA 94109, USA. Tel: (415) 751-8666.
UK: FWO Bauch Ltd, 59 Theobald Street, Borehamwood, Herts WD6 4RZ. Tel: 01-953 0091.

SSL

01 Digital Production Centre: Integrated 8-channel mixer with signal processing containing hard disk recording editing/recording system configured to work as three stereo machines. Designed for mastering applications.
ScreenSound: Product developed for sister company Quantel as part of their *Harry* system. Uses graphics tablet operation with 8-channel recording and editing capability in conjunction with *Harry*.
Solid State Logic, Begbroke, Oxford OX5 1RU, UK. Tel: 08675 4353.
USA: Solid State Logic, 320 West 46th Street, New York, NY 10036. Tel: (212) 315-1111; 6255 Sunset Boulevard, Los Angeles, CA 90028. Tel: (213) 463-4444.

Steinberg

Topaz: Modular system based around a *Topaz* system unit containing 360 Mbyte hard disk and built-in tape streamer. Modules may run 2-channel mono, stereo or up to eight modules for 16-channel. *Mac II* acts as system controller offering mixing, EQ, level and other processing.
Steinberg Digital Audio GmbH, Billwerder Neuer Deich 228, D-2000 Hamburg 26, West Germany. Tel: 40-78985-16/-66.
UK: SDA Steinberg Digital Audio, 73 Princedale Road, London W11 4NS. Tel: 01-229 2041.
USA: Steinberg Jones, 17700 Raymer Street, Suite 1001, Northridge, CA 91325. Tel: (818) 993-4091.

Symetrix

DPR100: Preliminary data only on hard disk storage/editing system.
Symetrix Inc, 4211 24th Avenue West, Seattle, WA 98199, USA. Tel: (206) 282-2555.
UK: Sound Technology plc, 6 Letchworth Business Centre, Avenue One, Letchworth, Herts SG6 2HR. Tel: 0462 480000.

WaveFrame

AudioFrame: A digital audio workstation that currently is heavily screen-based in operation. Will expand to include longer recording times although currently based around sampling-type systems.

Just announced is a disk recording module *DRM-4* for the *AudioFrame* system. Also there will be a *DRM-8* 8-channel module. This may be expanded to 32 channels with full range editing features. Operates 16 or 24 bit capability.
WaveFrame Corporation, 4725 Walnut Street, Boulder, CO 80301, USA. Tel: (303) 447-1572.
UK: Syco Systems Ltd, Kimberley Road, London NW6 7SF. Tel: 01-625 6070.□

SOUNDS LIKE A VERY EXPENSIVE CONSOLE

The M-700 is TASCAM's new top of the range console. This sophisticated, automation ready, in-line console has been designed for the highest audio quality and engineered to fulfil the most demanding production tasks with ease – but without costing the earth. Before you check out the price however, check out these features:

40 channel, 32 group output in-line architecture ■ Quad panning, 2 stereo and 8 mono Aux send busses per channel ■ Two signal paths in each module ■ 4-band equalization per module ■ Variable HPF ■ EQ section assignable to Channel or Monitor signal path ■ FLIP switches locally swap channel microphone in/line in and monitor source/return signals (overridden in the master console mode) ■ SUB switches on the channel modules allow the corresponding channel to be used as a sub-group master ■ Post/pre EQ switchable insert points ■ Switchable in-place or AFL/PFL solo modes with in-place solo defeat switches on the channel modules permit solo monitoring of multiple channels ■ Master console mode switches (REC, PB, MIX) select eight channel input, monitor input, group input and meter input combinations ■ Three group mute switches on the master section logically linked to channel module mute select switches ■ Flexible control room/studio communication facilities ■ Integral patch bay.

Now give us a call to arrange a demonstration and check out what is arguably the M-700's best feature – its price.
You'll make your accountants as happy as your engineers.

TASCAM

5 Marlin House, The Croxley Centre, Watford, Herts. WD1 8YA
Tel: 0923 225235 Fax: 0923 36290

SCREENSOUND
A DIFFERENT INTERFACE

David Mellor describes Solid State Logic's ScreenSound digital audio editing, mixing and recording system for video and film post-production and audio for video applications

We are now beginning to see the emergence of second and third generation digital computer hard disk-based editors. The obvious changes are in the area of the interface and these tend to follow one of two routes.

The first is to design a completely new interface, hopefully taking advantage of all the computer's control and display capabilities. The second is to base the interface on a manual system that exists already and is familiar to many engineers. While the first option may seem to be the most ultimately promising way to go, the second has many advantages—a shorter operational learning curve being just one.

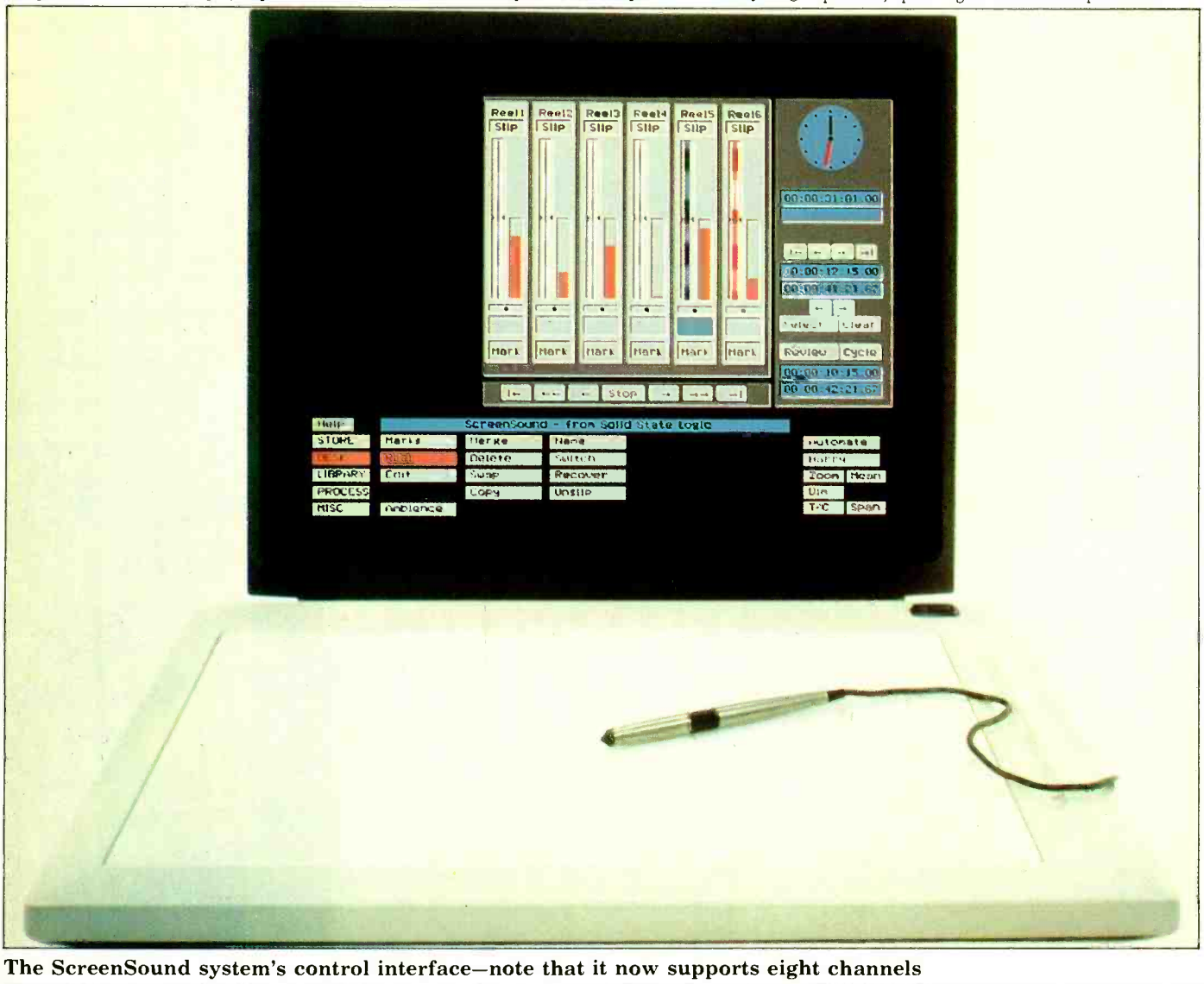
There has been in existence for some time a system of synchronising audio to picture offering considerable powers of manipulation—namely mag film. Mag film is like photographic film but has a magnetic coating instead of photographic emulsion. It has traditionally been used by the motion picture industry for all stages of audio post-production after the original sound recordings come in from the shoot.

The great advantage of mag film is that it is mechanically synchronisable to the picture film. Sync can be adjusted by simply slipping frames forward or backward over the sprockets. Multitrack playback, with integral time slipping capability, is possible by having a number of mag reproducers running in a synchronous lock based on the correspondence between the sprocket holes in the sound and picture films.

The more modern alternative to mag film is a timecode-based system, as seen in the video field. Timecode, as you will appreciate, is number intensive. It certainly gets the job done but is it as elegant a solution as mag film? I think not.

Moving away from audio for a moment, Quantel (a sister company to Solid State Logic) has developed *Harry*—a video editor based on a simulation of film 'clips' and 'reels' on a video monitor. The clips are made up into a continuous reel exactly as though they had a physical presence on film. *Harry* can be used to edit video material directly, or film by generating edit decision lists referring to the original film frame numbers.

HarrySound was developed by Solid State Logic to provide the audio complement to *Harry*'s pictures, operating on the same clip and reel ▷



The ScreenSound system's control interface—note that it now supports eight channels

IT'S THE LITTLE THINGS ABOUT THE IL SERIES THAT YOU'LL APPRECIATE.

Take a close look at the Soundtracs IL Production console. An outstanding console that's achieving acclaim amongst commercial recording studios around the World. Designed to meet a production climate that's radically changing with engineering that matches efficiency with vision.

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Combine these attributes with a sensitive yet effective equaliser section to create one of the sweetest sounds to be found anywhere, perfect for high quality track laying.

And while our crystal clear layout is free of gimmickry, we've included a number of unique features and sophisticated circuit designs which, together with Soundtracs Tracmix fader automation, provides versatility to set your creativity free.

Little things in themselves. But in the Soundtracs IL, add up to a rather special production console.

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◁ principle. *ScreenSound* is the standalone offshoot of *HarrySound* and works in exactly the same way.

System

The *ScreenSound* system consists of two parts: the control centre and a processor rack, which may be situated out of the way in a machine room. Separate processing racks are becoming so commonplace that studio machine rooms—and their air-conditioning systems—are just going to have to expand to cope.

The control centre consists of a matrix bitpad tablet, operated by a light pen, and a conventional RGB video monitor. A separate monitor is required for the video picture (unless working in conjunction with *Harry*). There is also a QWERTY typewriter keyboard that will be used to provide keyboard short cuts for many of the functions and for naming sound files.

At the other end of the interface cable, the processor rack has one 6U box housing the *ScreenSound* processor and hard disk, and another 3U package containing a 5¼ inch WORM (Write Once Read Many) optical disk drive for library sound effects and music. It also contains the Video 8 cassette-based *Exabyte* long term audio storage and back up system.

The hard disk can store up to 50 minutes of mono sound, 16 bit sampled at 48 kHz. This is expandable to 150 minutes mono. The optical disk is double-sided holding one hour per side. There is also a floppy disk drive for loading the system program.

Analogue and digital (AES/EBU) inputs and outputs are provided. Machine control is currently available using the Sony 9-pin interface. Other interfaces, VPR 3, ESbus, are under development. The demonstration system had an interface for a WORM video disc player recorder.

Operation

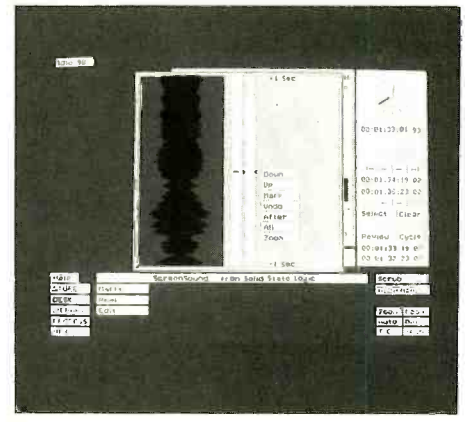
Sitting at the *ScreenSound* tablet with what looked like an oversized ballpoint pen was an unfamiliar experience. But the techniques of stabbing (analogous to mouse clicking) and dragging soon become fairly easy. When the pen is touching the tablet's surface, or is within a couple of inches of it, a cross-hair cursor appears on the screen. Positioning the cursor over any box on the screen and stabbing, provokes *ScreenSound* into some form of response. It is a highly interactive system.

The principal screen display, the Desk screen, consists of eight Sound 'Reels'—a graphic representation of film on mag reproducers. In *HarrySound* the space to the left of the six Reels is currently used to display three small video pictures of Reels being edited in *Harry* itself. In *ScreenSound* they have added two extra Reels.

'Behind' each Reel is a 'Bin' containing an alternate Reel, so there can be 16 Reels in use at any time but only eight can be played simultaneously. Reels and Bins can easily be swapped.

Sound 'Clips' can be taken from the hard disk 'Store', or the optical disk 'Library' and inserted in the Reels one by one. Let's move over to the Store page for a moment. (You can see the Store box just below 'Help' towards the left of the screen. Position the cursor and stab.)

The hard disk Store may contain any



combination of sound effects, music and dialogue. These may have been retrieved from the Library (the optical disk) or recorded directly into *ScreenSound*, using the Record screen display. The Clips in the store are very well indexed by a Sort function. Sorting can be performed automatically by Name (alphabetical), Length (duration), Type (sound file or system file), Sequence (chronological), either in a forward or reverse direction. If Name is selected, all the sound clips on the disk will be listed in alphabetical order. The display shows 16 Clips but the rest can be viewed easily by using the scroll bar to the right.

All important here is the naming of the Clips, which is of course down to the operator. Clips can be found quickly by a 'Keyword Search' routine. This means that if you wanted a sound effect to match a car door slam, you could remove all effects other than those including the word 'car' from the display. Then the field could be narrowed down by using the key word 'door', which would leave a short list including perhaps 'Car Door Close', 'Car Door Slam' and 'Loud Car Door Slam'. Note that the word order is not important.

When the list has been whittled down to a few 'possibles', effects can be auditioned straight from the disk, with a delay of around 0.5 second. Compare that to taking a trip to the tape store and finding the right effect manually!

When the appropriate effect Clip is found, the 'Fetch' function transfers the Clip to a Reel. There can be a number of Clips on the same Reel as long as they don't overlap. The Clip can be Fetched to the Reel in several ways: to the current position of the Sound Reels, to a specific timecode value stored with the Clip, or to be joined on to the last Clip on a particular Reel.

Desk display

Each of the Sound Reels on the screen has a Tape Window, Fader control, Pan control, and Slip, Group and Mark buttons and Name area. The Tape Window represents 8 seconds of sound (the default value, which can be Zoomed from 125 ms to one hour) and shows alternating light and dark patches, each representing 1 second of audio. The Reel appears to move—in sync with the other Reels—when the Play button is stabbed with the light pen. At the centre of the Tape Window are two arrows, which represent the Playhead.

To the right of the Tape Window is the Fader. Stabbing and dragging with the light pen effects a gain change, which is graphically mimicked. The Pan control works in a similar way.

Other Sound Reel features are:

As shown in the screen photo, the names of the Reels default to 'Reel 1', 'Reel 2', etc, until ▷

Other ScreenSound features

Ambience: A choice of delay effects can be applied to the output. This is pretty basic at the moment but SSL hope to develop this feature into a full digital reverberation processor.

Scrub: Sound Clips can be scrubbed against the Playhead in a similar manner to analogue tape and edit points marked. A waveform display is provided for visual feedback. This feature is working but still under development.

Harry: If used in conjunction with a Quantel *Harry* video editing system, selecting Harry returns the user to the *Harry* screen display.

Zoom: The Tape Window defaults to displaying 8 seconds of audio. This can be adjusted from 125 ms to one hour.

Mean: Mean changes the alternating light and dark patches of the Sound Clip in the Tape Window to a display of RMS level. This is an aid to accurate editing as it helps the operator place Marks accurately in the Clip.

Auto: Produces a pop-up display to control the automation system.

Dim: Dims monitor level.

T/C: Produces a pop-up timecode calculator.

Span: Shows the amount of slip a Reel has been given and in which direction. This also displays the total length of the selected section.

Marks: Calls up menu selections for altering or using Marks:

Rubout erases a selected Mark;

Preview cycles a 3 second section around a Mark, playing only up to the Mark, muting afterwards;

Postview cycles a 3 second section around a Mark, muting before the Mark, playing afterwards;

React adjusts reaction time for creating Marks 'on the fly'.

Reel: Calls up menu functions which relate to individual Reels:

Merge superimposes two reels, as long as Clips do not overlap;

Delete erases an entire Reel;

Swap exchanges the positions of two Reels;

Copy creates a duplicate of a Reel;

Name allows a Reel to be given a 5-character name;

Switch exchanges a Reel for a back up Reel in the 'bin';

Recover takes a Reel back to a previous state, undoing the effects of a change;

Unslip returns a Reel to the position it was in before it was last slipped.

Edit: Calls up a menu of editing functions:

Undo reverses the effects of any editing operation;

Remove erases a Clip or a selected part of a Clip, replacing it with an equivalent length of silence;

Split separates a Clip into two parts at a Mark point;

Copy copies a Clip or a selected part of a Clip to another position, in the same Reel or in a different Reel;

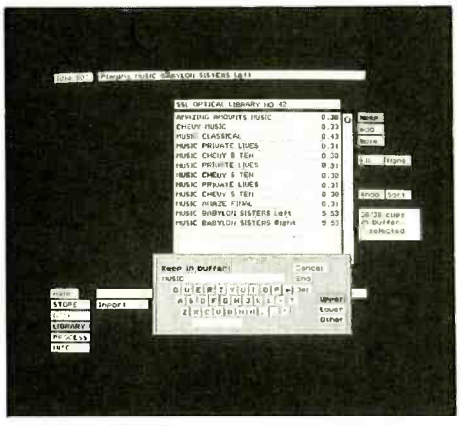
Move is like Copy but leaves nothing behind;

Shift moves a Clip to the same position in time on another Reel;

Join to head joins a Clip to the head of another Clip with a crossfade;

Join to tail is similar to Join to head;

Xfade sets crossfade time.



◁ changed.

When Slip is active, a Sound Reel can be slipped back or forward in time in relation to the other Reels by grabbing it with the light pen and physically moving it up or down. When Slip is deactivated, all Reels will run in sync once again.

The Mark button is used, obviously, to mark reference points in the Reel.

Grouping can be done by stabbing on the Group button on two or more Reels. The levels of Reels in the group are controlled by vertical motions of the light pen. Crossfading is done by moving the pen horizontally—a very neat feature.

Beneath the Sound Reels is the Motion Control panel, which provides, from left to right, Reverse End Stop Locate, Reverse Play, Reverse Jog, Stop, Forward Jog, Forward Play and Forward End Stop Locate. It was only slightly confusing to have to hit the double arrow (which I automatically associate with Fast Forward) to Play. The whole process of level changing, pan positioning and mute can easily be automated.

To the right of the Sound Reels is the Control Display area. The timecode display is in the form of a clock with proper hands. Don't confuse it with time of day! The exact timecode value and any offset currently applicable are shown in the numerical boxes underneath. If the light pen is dragged in a circular motion on the clock face the hands will move—and with them the position of the Sound Reels. Timecode values can be entered digit by digit using a Time Code Calculator, which pops up on the screen on command.

The area in the centre of the Control Display is used to select a portion of a Clip (whole Clip, between Marks, silence between Clips, top of Clip to Mark, Mark to end of Clip, etc) for manipulation. The arrow buttons adjust the synchronisation of the selected portion.

Further down, Review and Cycle provide playback between the two timecode values indicated, with pre- and post-roll. Review mutes the pre- and post-roll segments to do this, Cycle does not.

In use

A demonstration by an experienced *ScreenSound* operator (SSL's Dave Collie) convinced me of the speed of the system (although it must be noted that he was working on material that was already familiar).

Sound effects are very simple to sync up. First, locate the correct frame of video where the effect should start. This is quickly accomplished using the marking and jogging facilities of *ScreenSound*. Next, go to the Store and find the appropriate effect. The keyword search and auditioning facilities make this straightforward. 'Fetch' this to a Reel and it will automatically line up to the point where you had previously stopped. In all probability, when you return to the Desk screen, you will find that the effect is exactly in sync, at worst requiring just a couple of frames shift backward or forward. Accuracy, of course, depends on the operator's correct judgment in the first place.

Sceptical that the system was being demonstrated using excessive levels of skill, I had a go myself and found that with a little prompting I was sync'ing up effects and dialogue with ease.

Of particular interest are the editing functions. Whole Clips or segments of Clips can easily be selected (the selected part changes in colour from blue to red) and removed, slipped, copied or Joined with crossfades. The Copy function would be very useful for a repeated effect like footsteps. Once selected, the Clip can be copied to any position in the Reel as indicated by the light pen.

Even for a novice user, *ScreenSound* is very straightforward. In fact, one of my conclusions was that there didn't seem to be a lot to it. This is of course as it should be. All the complications should be kept out of the way and looked after by the software. The operator should be solely concerned with getting the sound right and getting the sync right. As a post-production system, *ScreenSound* is extremely capable. As a man-machine interface, it gives the feeling of 'getting your hands on' the material without the normal barrier imposed by computer-style operation.□

Martin Polon

Our US columnist believes there's a job out there for everyone

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"I have a wife and two kids. I'm 39 years old and I cannot find a job in recording. I had been a mill worker until steel went soft. I saw an advertisement for the Academy of Recording and I thought it would buy me a future. I spent $6,000 and 14 months. We lived on unemployment benefit and my in-laws. I was a star student and won the 'Academy Award'. But out on the street, all anyone wants is young kids to sweep up at minimum wage. I talked to 200 studios all over the country. Nothing. What am I going to do?"

The programme here at College of the Rivers is designed to give you an Associate in Arts degree with an emphasis in music recording. You will be prepared to work in any recording studio in the country. Of course, as with all Community Colleges, you will earn a two-year college degree. Our modern facilities and our newly remodelled studio will give you experience similar to that found in the music industry.

"My wife and I are writing to you about our son. He has a strong desire to get a job in music—working in recording. He wants to record artists like Prince and Bobby Brown. First he took a mail order course. Then we sent him on a programme in the city. It cost $8,000 and took most of our life savings. He then applied all around the country. Nobody would offer him a job."

The four-year recording curriculum at the University of East Dakota is designed to provide maximum experience in recording technology and creativity combined with the academic validity of music study and performance. Virtually an American Tonmeister programme, this course of study will almost guarantee successful students a place in the world music industry.

"I took a four-year course in Engineering, I minored in Music and audited all of the recording classes offered at the Community College our University runs. I have sent out 1,000 résumés to all the major studios in the *Billboard Directory*. I have called over 200 studios. I have not been offered one job. Not one job."

Here at the Sounds Institute, we take our job seriously. Our job is to train you to be the best mixer possible. Our studio facilities are located in professional recording studios and all our staff work in the professional recording industry. If you receive an unsatisfactory grade in a course, that is our fault—not yours. We are not doing our job properly. You may retake any course with a grade lower than a C again and again if necessary—at no charge. That is our guarantee to you.

"I spent four years in the music and recording programme. I didn't learn enough music to be able to teach music and I didn't learn enough about recording to be able to record. They wouldn't let anybody but the seniors work in the big studio and even then you only had 10 hours to mix your final project. I feel like I got absolutely nothing from the programme. I would have been better off taking the $64,000 that my four years of state college cost and building myself a home studio. After four years, I might have had a full card at $35 or $40 per hour and learned an infinite amount more about recording."

Although you couldn't prove it from the opening preamble above, this column is not directly about the trials and tribulations of those who either run or attend audio schools. The problem with such schools, at all levels and in all locations, is that they are of varying quality. But, to lay the problems of a burgeoning marketplace of audio job seekers at the doorstep of the schools and not of the audio industry is just not a valid approach. A recent survey of payback problems with Federal student loans in the United States shows that graduates of audio programmes fare about as well as other trade school graduates, even when the schooling is at a four-year institution. The problem is that when a student of a truck driving course graduates, that person will start earning at the $10 (£6) per hour rate. In recording studios, graduates, if they can find a job, will be earning little better than minimum wage in many cases.

Now the root of the problem may be that the perception held by those who educate and those who are educated is that the ideal job to strive for in audio is as a studio employee in a 'top' recording studio. One problem with this outlook is that the number of studio jobs available is one of the smallest categories in audio and is shrinking compared to past availability of studio employment. The other issue is that the wages paid begin extremely low and rise much more slowly than other kinds of audio positions. But, even over the broad spectrum, the availability of audio-related employment just cannot match the interest it is getting in terms of the number of schools and the number of students depending on the audio industry for employment. This column is more directly an attempt to slay the myths of endless job availability in recording and in audio in general. Each of the forces working to reduce job availability are analysed below, to provide perspective for those currently working in the audio industry and those who would if they could.

The consolidation of the world audio industry

AKG, dbx, Focusrite, Mitsubishi, Neve and Orban are all prominent audio companies that have recently been on one side or another of the tide of consolidation that seems to be sweeping the audio industry. We are witnessing dramatic changes in the structure of businesses and of doing business in audio. Companies are combining to increase efficiency and to decrease costs. Eight to 10 companies today contain the roots of 30 to 40 companies that were in business 10 or 15 years ago. Unfortunately, whatever the efficiency gains of amalgamation, jobs are always lost in the process. The decline in jobs when companies are part of a consolidation is inevitable but is certainly a painful side effect. Fortunately, a so-called 'friendly' consolidation usually finds every effort made to place 'surplus' staff. It is estimated that as many as 50% of all audio companies in business in 1980 has been or will be affected by some kind of consolidation effort before the 1990's are over.

Mergers and takeovers involving audio jobs

The '80s trend towards the merging, hostile takeover and leveraged internal buyout of a broad range of American and world companies has affected employment in audio within these companies. In the vast majority of cases, these transactions place a significant burden on the surviving organisation to cut expenses in order to cope with the debt incurred by the pivotal transaction. The need to cut costs invariably focuses within a company on support services and corporate A/V has been one of the principal targets.

Research and development labs have also suffered under new management and the demise of the notable audio lab facilities run by CBS, EMI, RCA and other companies are an unfortunate side effect of this kind of market force. If a company directly involved in the audio business is the target of a hostile takeover, the job reduction issue may not be any more severe than in a so-called 'friendly' transaction.

Off-shore manufacturing and domestic audio job loss

Through a two-fold process of attrition and replacement, domestic audio manufacturing has declined in the US and Canada, and in the UK. In the first category, the return from audio manufacturing has not met the financial expectations of domestic management, who have either written the operation off or replaced domestic manufacturing with an off-shore facility or a foreign OEM arrangement. In any case, the domestic jobs are lost. In the second grouping, replacement takes place as foreign manufacturers provide a high quality replacement for domestic products at a lower price. That has been the fate of the American console industry. In 1970, virtually all small and medium-sized mixing desks and the vast majority of large consoles were manufactured domestically. Nearly 20 years later, the vast majority of consoles sold in the US are made abroad. So are the jobs. ▷

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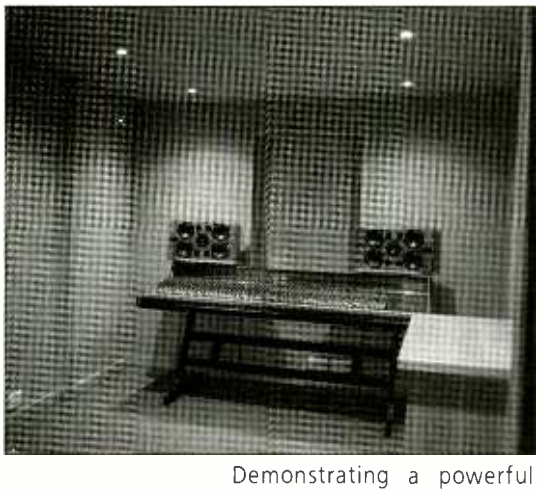

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The decline in government funding for audio jobs

Within the broad arena of local, regional and national government, the unfortunate effect of inflation and strong pressures to keep ratepayers from revolting over rising tax rates has significantly decreased audio-related employment under the government banner. Staff positions in audio installation, equipment operation and repair have been eliminated at scores of facilities on both sides of the Atlantic Ocean and private enterprise substituted. The private vendors are on call, so the staff positions that were maintained like a fire department 'to be of service when needed' are not. It was not unusual for hospitals, universities, military bases, research facilities and office facilities to have large and relatively under-used audio and visual staff. In today's era of lean, mean government the tax funds are just not available for in-house facilities at the levels held in the past. A combination of limited staff and outside vendors serves today.

Direct job replacement by automation

In constructing and remodelling public assembly facilities today, sound system designers are frequently receiving one message from facility operators: design for minimum operator involvement! In auditoriums, conference centres, arenas, theatres and hotel facilities, the sound systems are designed to operate from a central control centre or to be under the control of remote operators 3 feet, 3 miles, or 3,000 miles away. One major hotel chain in the US have all their sound reinforcement systems set up with automatic mic mixers and complete redundancy with remote diagnostics and switching available by telephone line. All facilities of another hotel group are designed to use automatic mixing and require only the connection of microphones via custodial personnel. In this way, a large percentage of the jobs provided in meeting services, conference activities and conventions have been downgraded or eliminated.

Indirect job replacement by automation

The relentless flow of technological advancement within the audio and electronics industries has done much to eliminate many audio jobs by making equipment so stable and easy to use that trained operators are not necessary. Consider the enormous volume of recording done by corporate entities and government agencies of meetings and other gatherings. In the past, an audio specialist brought in a mixer like an Altec *1567* and set up four Shure *Unidynes* on table stands and fed an Ampex *601* open-reel tape recorder. The recording was a major project. Today, somebody at the table pulls a small Sony microcassette recorder out of a briefcase and flicks it on. The machine has automatic thresholding and starts and stops when the conversation does likewise. Nobody gives it a thought. High schools, colleges and universities all over the world used 16 mm film as a standard tool for providing programming in the classroom. These machines required an operator and many institutions kept a large staff to service the faculty. Today, the faculty themselves, or even the students, place a VHS cassette in a video cassette recorder (VCR) hooked up to a TV set. No sweat—piece of cake.

You can even consider the option of the classical recording session. Remember the days not so long ago when it took three men and a small boy to lug the ¾ in U-matic video recorder with *PCM-F1* adapter, tape, mixer, microphones, cables, etc. Today, one person takes from the pockets of a coat a portable professional DAT recorder, hangs an MS stereo microphone in position *vis-à-vis* the orchestra, runs two lightweight cables, pops in a cassette smaller than a pack of cigarettes and away we go. In yet another example, consider the business meeting with an audio conference call. In the good old days, one to two operators would sweat over a mixer, multiple microphones, telephone lines coupled by repeating coils to line amplifiers, power amplifiers, speakers, balancing networks, etc. Today, a small suitcase disgorges an automatic mixer using pressure zone microphones with a digital hybrid and tiny speakers. No fuss—no muss, and no audio operators needed. This kind of reliable equipment has substituted the microprocessor with instructions on ROM chip for human operators. As the use of this kind of gear has become widespread in the late '80s, so has the reduction in the need for audio operators.

> New jobs in audio have become a very much endangered species. It takes more preparation now to get an audio job and there are more people trying to enter the field than ever before. Talent is the determinator

Union problems and audio employment

Certain jobs in audio are limited by the requirement of union membership; usually but not always in the appropriate union associated with stagecraft such as the IATSE. Jobs in motion picture and television production, theatrical performances, symphonic concerts and some musical touring performances fall into this category. Although it was tough to get in the union, opportunity did occasionally strike because sound work required more time and effort than any other task for the generically 'jack of all trades' membership. Today, the unions are under assault worldwide for a broad range of issues and the number of jobs being performed in all the areas of electronic entertainment by union members is shrinking. To keep the 'brothers' off the bench, sound work is being done by existing union workers and growth of the union workforce is out of sight.

The home studio revolution

No other element of change has so shaken up the *status quo* of audio employment as has the home studio revolution. We have seen the number of professional studios in North America and the UK—estimated conservatively at 12,500—cut in half, only to be replaced by the approximately 6,000 to 7,000 home studios now in competitive existence. The use of computers, MIDI bus equipment and musical instruments, mass produced high quality consoles and affordable recorders (some of them digital) plus digital signal processors and equalisers has stolen much of the conventional recording business and with it about half of all jobs available in recording studios. Enough has been written here and elsewhere about home studios but suffice it to say that the home studio is usually run by an owner operator with friends and family for unpaid staff. As one pundit put it recently, "if you want to make money from home studios—build one yourself".

Shifts in record industry patterns

Another inhibitor of employment has been the current trend of record production reflecting the transfer of existing titles to CD. It is estimated today that only 20% of the studio activity at major recording facilities is related to recording for eventual record release. Likewise, group touring under the sponsorship of record companies has decreased considerably from its peaks experienced at the end of the 1970s and in the early 1980s.

1990s economics

Many audio jobs in the past involved providing support for executive staff and managers within companies, government agencies, etc. In the financial environment of the '90s, managers fly coach class instead of first class, eat sandwiches at their desks instead of gourmet meals on their expense accounts and operate audio and visual equipment for their presentations instead of being catered for by an operator. So these jobs too, have proven to be expendable.

Conclusion

Now there are several points worth remembering here. There are still well in excess of 150,000 jobs in professional audio in the UK and North America. Some areas are still booming. Professional audio equipment sales, contractor sound reinforcement sales and installation, top end (esoteric) stereo component sales, consumer audio manufacturing, radio, stereo television, concert class system rentals, telecommunications, computer-related product development and law enforcement are a good sample of the audio and audio-related job areas that are still in a positive flow. Even the downgraded areas of employment and negative trends listed above do not apply to everyone, although they impact virtually all those without past audio industry experience. The point does remain that new jobs in audio have become a very much endangered species. It takes more preparation now to get an audio job and there are more people trying to enter the field than ever before. New entrants to the audio community need to realise that it is a privilege to work in audio and not a right. Talent is the determinator. It is a lot like being a diamond cutter. Hard work and practice reward the talented. So it shall remain in the audio business. □

It's a pity that more retailers don't copy our ideas (instead of just our ads). free courses with packages, faulty goods replaced and money refunded are all part of a service to which customers are **entitled**. It is a shame that more retailers do not realise this.

By the way, have you noticed how some shops are incapable of giving you a price on the telephone? (Frustrating, huh?) Next time a shop responds with "How much have you been quoted already?" say "Why - are you too thick to think of a price yourself?" They'll soon learn!

NEW STOCK

Whilst we do not pretend to carry EVERY item from EVERY manufacturer. *(as some shops seem to - ever tried putting it to the test?)*, all new equipment is tested in our of our three working studios, and if we like it, our buying power can usually ensure that we have it in stock at all times (even when your local dealer might have run dry!). In addition, if we recommend an item, we will REFUND YOUR MONEY if you do not agree with us.

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To be honest though, if you spend all afternoon on the telephone the chances are you might find someone somewhere who will undercut us by a pound or two. The difference at THATCHED COTTAGE is if your E16 breaks down on a Sunday morning or your Drum Machine blows up on a Bank Holiday Monday you CAN ring us, we'll be here and we WILL do something about it — 365 days a year. Have you ever needed help and advice outside shop hours? if you are serious about your music you will know that it is quality of service that makes the difference and at THATCHED COTTAGE it's only a phone call away!

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TRIERISCHE TONPOST

Andrew von Gamm visits Trier's studio for the blind in West Germany and reports on their modern computer aids and specially adapted equipment

Trier's studio for the blind, the 'Trierische Tonpost', celebrated its 20th birthday by putting on a display of modern computer aids for the blind and displaying how sighted and non-sighted sound engineers can use the specially adapted equipment.

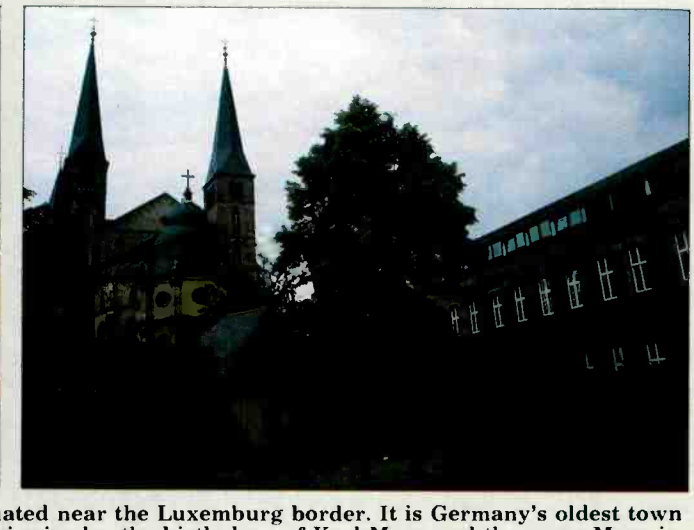
Five years ago, the studio was situated in a dingy cellar complex underneath some offices. The cellar arches were rather low and one of the blind assistants who was taking me around walked straight into one. He cleared his head and told me that he did that all the time. This was obviously a serious problem.

At that time the equipment was either old stock that had been begged off the local public broadcasting station or of cheap amateur quality. Since then things have improved greatly. Now in their newly installed studios behind Trier's cathedral the standard of the equipment is of a much higher quality. The only equipment that remains the same are the consoles. These were designed by studio manager Richard Meyer and built by a local firm. At that time, Meyer was blind himself and so he knew what a blind person's needs are. Today after a gruelling series of operations he can see, although somewhat imperfectly.

The studio's main task is to produce sound plays for the blind. They also produce talking books and other information services on cassette. This is done in a suite of three studios; one is just for reading, the second can also be used for plays and the third is fully equipped with various types of flooring and even gravel and loose stones. There is also a variety of bits and pieces used to create sound effects; for example, a collection of chains is used for Christmas plays to provide either Santa's sleigh or ghostly rattles. Each studio has its own control room and the recorders can be remote-controlled from the studio so that simple book-reading can be done without needing to have an engineer in attendance.

The mixing desks are made from six or eight Uher hi-fi mixers that have been linked together in Meyer's exceptionally complicated design. As a blind operator cannot see which way a twist button is pointing and as sophisticated equalisation is not required, all the controls are faders or toggle switches. We who are sighted tend to forget that we take scattered information and group it visually; for example we can scan right across a desk and selectively pick out just the monitors or the routing buttons and organise them into a pattern in our heads. The blind cannot do this and so Meyer placed functions together in groups so that they can be scanned with the fingers eliminating the tedious process of counting off from the left and down from the top every time a single button has to be twiddled.

The rest of the complex consists of three offices, a postal room and a duplicating room, which not only works for the blind



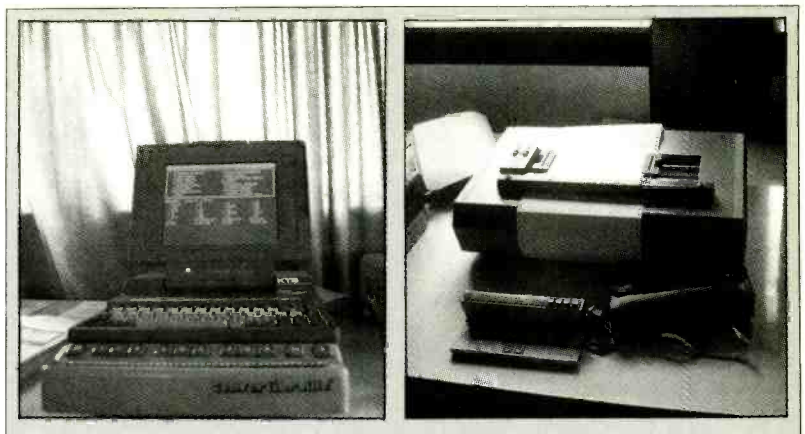
Trier is a town with a population of about 80,000 and is situated near the Luxemburg border. It is Germany's oldest town and celebrated its 2,000th birthday a couple of years ago. Trier is also the birthplace of Karl Marx and the name Marx is still fairly common here. At the centre of the town is Trier's cathedral that dates back over 1,000 years. The studio is in a courtyard directly behind the cathedral. The studio building is shown above left. The beer stand was for their 20th birthday celebration.

The duplicating room. A row of M10s to the left and A77s to the right are linked, via the mixer at the back, to all three studios

customer but also takes in a fair amount of local business for their realtime cassette duplication service.

The Trierische Tonpost is financed mainly by government grant; the German social system is generous to those at a social disadvantage and is under an obligation to provide the disabled with the necessary education and finances to gain employment. German companies above a certain size must employ a proportion of disabled people, or must pay a monthly penalty for not doing so.

In June 1981, *Studio Sound* reported on blind sound engineer John Cunningham, at Compact Video System, Burbank. He was quoted as saying, "Being blind doesn't interfere with doing my job—only with finding one." Humble as their equipment may be by industrial standards, the Trierische Tonpost proves his point. **Trierische Tonpost, Hinter dem Dom 1, 5500 Trier, West Germany.**



When talking to sighted members of our business about possibilities for the blind audio engineer, most considered this to be very difficult in practice. A growing argument was that more and more equipment is software based and only exists in conjunction with a keyboard and a screen. At their 20th birthday party, a collection of computer interfaces for the blind was demonstrated by the studio. Although the 'Qwerty' studio is beyond the budget of the Trierische Tonpost, it does show that the future will bring more, and not less, opportunities for the blind.

In front of the conventional keyboard above (left) is the braille writer and braille reader. The reader works by six pins that pop up through holes to give the same pattern as braille-stamped paper. (Right) In front of the printer is a braille 'organiser', similar to Psion.

MONITOR SYSTEMS-
MID-RANGE HORNS
PART TWO

Philip Newell continues his series on Monitor Systems investigating the potential of mid-range horns

There is a tendency among recording studio personnel to tolerate horns, rather than wholeheartedly accept them. They seem to be regarded as a necessary evil used under certain circumstances, really belonging to a different world of public address and cinemas. There is an irony in this: most horns in use in recording studios *were* designed for public address and/or cinemas, whereas almost all direct radiator monitor systems were specifically designed as studio monitors. Some of the bad press for horns almost certainly comes from their 'secondhand' application. Horns suffer from a general lack of understanding and from many charges against them that are simply not true.

There are six major differences between horns and direct radiators: sensitivities; phase dispersions; mouth reflexions; non-linearities; mechanical alignment; directivity patterns.

Sensitivity

The HF horns of dual concentric drivers—Tannoys and Altec *604*s for example are probably the only horns in common use not used primarily on the grounds of sensitivity. In these co-axial designs, the concept of a horn HF unit was the most practical means of achieving the closest approximation to a three-dimensional point source. In most other instances, horns are used in studio monitor systems for their sensitivity and efficiency: the acoustical power out for electrical power in. Just why we achieve this extra efficiency appears not to be widely appreciated but it is more a case of the very poor efficiency achieved by direct radiators—cones and domes (the non-horn designs)—rather than any special magic being attributable to the horns themselves.

Think of the silencer on the exhaust of a car. If we look at the exhaust system in profile, we see a series of narrow pipes, interspaced with larger diameter pipes—the silencers. Within the silencer boxes are absorbent and heatproof materials but the prime effect of the silencer boxes is to create a series of abrupt changes in the cross-sectional area of the exhaust system. Each time we encounter an abrupt expansion in cross-sectional area, we encounter a power loss in the transfer of sound from one section to the next. This is due largely to the reflexions from the acoustic impedance change at the boundary. It is rather like the effect of the springs on a motor car. Were the wheels attached rigidly to the body, each and every bump on the road would be transmitted to the seat of the driver with very little loss. This resistive coupling—that is, in phase—would transmit each bump in the road instantly and most uncomfortably. By placing springs in the coupling from the wheels to the body, much of the energy is not transmitted by this reactive coupling of the wheels to the body. Another effect of this reactive energy absorbing system is that the instantaneous coupling is lost. A shock impact at the wheel will be time delayed by a small amount before reaching the seat of the driver. The result of this loss of intimacy between the road and the driver, nevertheless provides the driver with a generally more comfortable ride as the reactive coupling absorbs and reflects much of the energy of the impact.

In each of the above cases—the silencer and the spring—the wave of input energy meets a coupling that gives it less to push against: the coupling absorbs the shock. In a conventional room, a loudspeaker suffers a sudden change in cross-section—say from a 5 inch cone to the cross-section of the room. The match is very poor and as a result, the efficiency of the power transfer suffers. Many direct radiator loudspeakers are lucky to achieve a power transfer of even 1% between the electrical input power and the acoustic power delivered into the room. 99% of the output power of the amplifier, turns to heat within the loudspeakers themselves. Imagine a cyclist, pedalling down a steep hill in a low gear. He can pedal like fury, expending an enormous amount of energy and working up an incredible sweat but contributing a pitifully small amount towards increasing the speed of the vehicle. He has little pedal resistance to push against in order to transfer the power from his legs to the machine.

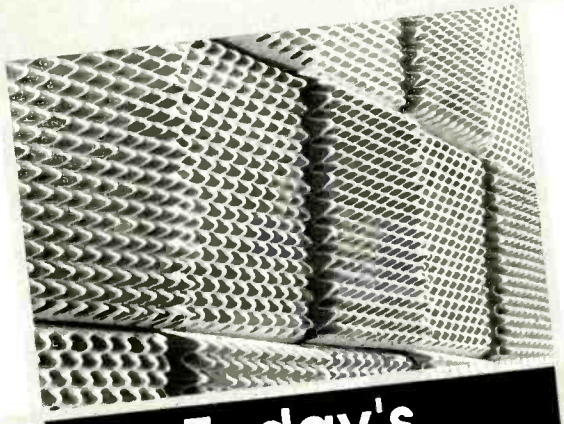
Horns are acoustic transformers, impedance matchers, gearboxes! If our cyclist can change to a higher gear, he can make the pedals present more of a resistance to his furious pedalling so more power will be transferred from his legs to the wheels, via the pedals. Despite his downhill roll, significant further acceleration may now be achieved. A horn provides a gradual taper, from the small size of the driver diaphragm, to the large mass of air in the room. It gives the diaphragm more to push against: a more resistive coupling less springy and energy absorbing. Horn loading can achieve practical energy transfer efficiencies of around 50%. At the extremes of both cases, a direct radiator could require over 100 times the input power of an equivalent compression driver/horn combination, to produce the same sound pressure level in a room.

In practice, the differential between the efficiencies of studio quality horn/driver combinations and direct radiators, is more likely to be in the order of 15 dB but even this represents a power differential of 32 W into the direct radiator for every 1 W into the horn. The importance of this in current studio design is that direct radiators are being operated at the very limits of their capabilities. The sound source of any loudspeaker driver must take into account the wavelength of the frequencies that driver will be expected to handle. With the wavelength at 1 kHz being just over 1 ft, the sound source diameter should be significantly less than 1 ft to achieve coherent, in-phase, wide dispersion, point source radiation. Conventional cones and domes, with diameters of 6 in or less, are usually employed in non-horn studio monitoring systems. With drivers of this size, 200 W, give or take 2 or 3 dB, is the maximum input power that can currently be handled without severe thermal overload problems. Most of us are aware of just how hot a 100 W light bulb can become after a few minutes use. From this it will be appreciated that twice this power into the small voice coil of a midrange driver, will produce considerable heat within that driver. Remember, a 1% efficient driver would convert 198 W of the 200 W input, into heat within the driver itself.

Confining such heat into a small space will have certain predictable results. Obviously, sufficient heat input will cause the whole thing to burst into flames unless the voice coil melts before the onset of combustion! These are the absolute upper limits and are self-evident, catastrophic failures. Before such failures occur, however, other problems can manifest themselves. Drivers experiencing repeated cycles of heating and cooling, are more prone to deformation, premature failure and impaired long-term consistency of performance. Large temperature changes in the voice coil also cause increases in the voice coil impedance. A voice coil of nominal 8 Ω, can easily become 16 Ω when running very hot. This impedance rise reduces the available power that can be drawn from the power amplifier, resulting in a power compression, with the input to output no longer having a linear relationship. Thermal compression at high drive levels can be one of the reasons why certain direct radiator monitors can be considered smooth at high levels. They compress! While the bass, and thus the apparent power, rises linearly the mids wind themselves down. One feels more power, yet it doesn't seem to hurt; at least until the onset of gross distortions!

If we still insist on a capability, of 120 dB at the listening position in a control room then, as we have seen, the larger rooms are already on the upper drive limits of midrange direct radiators. Hence the use of horn systems.

The mass of the moving diaphragm assembly of a typical studio compression driver, is in the order of a mere few grammes. In certain circumstances, it can even be less than a gram. Although these drivers are frequently rated at 100 W or more of continuous music, typically they would be asked to handle only 5 or 10 W peak in a studio environment. In a conventional 4-way studio monitor system with horn-loaded upper-mid and ▷



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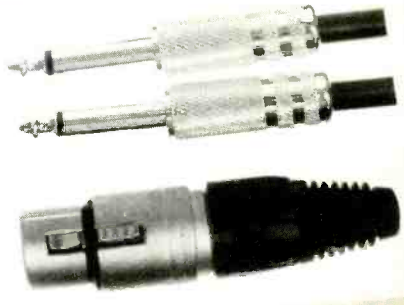

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◁ HF drivers, the main power requirements would be largely at the bottom end. With crossover frequencies at 300 Hz, 1200 Hz and 6 kHz, producing 110 dB in the room would require a power split in the order of 200 W low frequency and 35 W in the lower mid. A mere 4 or 5 W peak would be required for the upper-mid horn, and less than a single watt into the tweeter. Given the massive magnet assemblies of the most frequently used mid-range compression drivers, the temperature rise under all normal operating conditions would be insignificant. One obvious advantage of the increased sensitivity is from this isothermal operation. A long, consistent working life is assured, together with an absence, in practice, of power compression due to voice coil heating. The light weight and largely resistive loading of the diaphragm allows for very fast and accurate response to transients. The other significant advantage of the higher sensitivity is headroom. For any SPL the headroom will be higher for a horn, compared to equally power-rated direct radiators, by the margin of the sensitivity advantage. Once again, this bodes well for cleaner, faster, transients at high sound pressure levels.

Phase dispersion

The second major area of difference between horns and direct radiators, is in the characteristic phase dispersions. All frequencies do not travel down horns at equal speeds. Below cut-off, the low frequencies do not really travel at all. They sort of yo-yo backwards and forwards without going anywhere. This is virtually a definition of the cut-off frequency, the frequency below which, effectively, nothing travels down the horn. Once again, this is rather similar to our friend on his bicycle, rolling down the hill. This time, however, the chain has broken, so no matter how fast he pedals, there is no loading, nothing to push against, no coupling, so no power can be transmitted to the wheels.

The approach towards this cut-off point has great ramifications in respect to phase response. Effectively, below cut-off, the speed of sound is zero; it cannot travel. Strictly speaking, the speed of sound in horns does not directly correspond to the speed of sound in air. There is a direct, finite relationship in air, between wavelength and frequency. Within a horn, this does not quite apply in the same way. Phase speeds are frequency dependent and are affected by two major aspects of the horns. The first is the cut-off effect and the second is due to reflexions from the impedance change at the mouth. The separation and individual analysis of these two sources of dispersion are currently the subject of intense research to determine the precise, audible effects of each source. In the case of the dispersion related to the cut-off, difficult high Q phase shifts begin to take place in the octave above cut-off. For high linearity systems, it would seem wise to avoid using the horn in this area by using a high slope crossover at least an octave above the cut-off. There is nothing, however, in this range restriction that places horns at any disadvantage to direct radiators. They too can exhibit wild irregularity at their range extremes, which in terms of phase and amplitude, cannot be accurately corrected by electronic means. The old philosophy of ensuring that drivers have an octave of smooth response on either side of the crossover frequencies is still as valid today as ever it was.

Phase speeds are also influenced by the reflexions from the mouth discontinuity, these continuing to occur at higher frequencies than the cut-off related dispersions. As with any other type of loudspeaker, it is difficult to make horns to cover, phase-accurately, more than two or three octaves. Within the central design range, however, a section usually exists that exhibits an acceptably tight range of dispersion. One crucial factor relating to the range of spread, is the length of the horn. The greater the distance from the diaphragm to the mouth, the greater the length of time the waves spend in the dispersive section of the horn. There is a measure of compromise here as too short a horn can increase the mouth-related dispersions, due to a less desirable termination from too rapid a flare.

With careful design, phase dispersion in horns need not be significantly greater than in direct radiators. In many cases, however, horns have been used over too great a range of frequencies, pushing too far down towards cut-off, and too high up into the beaming range. Designing to published frequency response limits has been all too frequent an occurrence, without giving due regard to the full implications of dispersive tendencies. Phase dispersions will show up in an impulse response but are unlikely to be seen on a spectrum analyser. Too many horn loudspeaker designs have been used far too close to their response limits. This is just one example of horns gaining a poor reputation from uninformed misapplication, often by companies from whom we would be entitled to expect better.

Phase dispersion does occur in direct radiators, especially around the cone break-up modes. The speed of sound through the cone is greater than the speed of sound in air. Sounds travel up the cone and are reflected back from the edges, back towards the coil. These break-up modes are dispersive when they cancel or reinforce the airborne vibrations. One reason for complex, soft, cone surrounds, is to absorb these waves as they reach the edge of the cone and hence prevent their reflexion back towards the coil. Cones used in uncontrolled break-up are not of minimum phase character. So once again, a horn, carefully designed and equally carefully applied, is not ▷

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◁ necessarily at a disadvantage to direct radiators. Horns are, however, subject to misapplication, but don't blame the horns for that!

There is another area where direct radiators and horns may have differing phase characteristics. Richard Small published a paper in 1970 on 'Constant-Voltage Crossover Network Design'. He stated that while direct radiator diaphragm motion is mass controlled, horn driver diaphragms are resistance controlled. The result is a constant phase difference of 90° between the transfer characteristics of the two types of drivers. As previously stated, the reactive and resistive loading are the prime reasons for differing sensitivities of direct radiators as compared to horns. We are currently re-assessing this situation, especially in the area of reflected impedances. These have possible implications for differing phase characteristics, depending on whether the units are crossed over passively, with any resistance in circuit, or actively, where the units are effectively driven from a constant voltage source, ie the output terminals of a power amplifier. There are obvious implications here for the overall phase response of any system of which they form a part (see **Fig 1a to 1e**).

Mouth reflexions

Here we have one area almost exclusively in the domain of horns. The problem should occur with direct radiators but, as we have already seen, the coupling from the cone (the mouth) to the air is so poor that reflected energies are too weak and travel over too short a distance to have any noticeable effect on the overall output. In the case of horns, the distance for mouth reflexion to travel back to the throat is sufficient to be of consequence and the power in the reflexion can be proportionately quite high. Poor mouth design will cause improper termination and significant reflexion. The wave reflecting back down the horn will eventually arrive back at the throat, where it can add to, or subtract from, the subsequent direct waves. These compressions and rarefactions in the negative direction, superimpose themselves upon the throat pressures and hence modify the throat impedance and the loading on the diaphragm. As we saw from the bicycle analogy, impedance (gearing) and effective loading and coupling (the pedals and chain) have a great bearing (no mechanical pun) upon the power delivered to the wheels. In the same way, a varying throat impedance will have a great effect upon the diaphragm loading and hence the output power. In turn, the output power from the driver, modified by the directivity of the horn, will translate into the pressure amplitude response, or frequency response of the horn/driver combination. Reflexions from the mouth have a bearing, therefore, on the frequency response and on problems of phase dispersion. The size of the mouth dictates the lowest usable frequency for a flat response, while the shape of the mouth has a bearing on the directivity. These facts must be borne in mind by the designer while attempting to build in characteristics for minimising the reflexions.

It is worth pointing out here that the low frequency coupling limit determined by the mouth size, is not to be confused with the cut-off frequency. The former determines the coupling from the horn to the room, the cut-off is determined by the loading presented to the diaphragm by the throat of the horn. The cut-off frequency is entirely a function of the rate of flare of the horn, irrespective of the length or the mouth size. Saw through a horn half way down its length and you won't affect the cut-off frequency. The smaller mouth will no longer couple low frequencies to the room, so the frequency response will not go so far down but otherwise the horn will remain substantially the same minus any effects of lips or other mouth paraphernalia. The only other significant effect of this truncation would be that the different mouth of the short horn, would inevitably cause different mouth reflexions, as compared with the longer horn. These would inevitably superimpose a different pattern of waves to affect the throat impedance so would subsequently manifest themseves as a different series of ripples upon the pressure amplitude or frequency response plot (see **Fig 2**).

Only with an infinitely long horn, can mouth reflexions be totally avoided but with careful design, the disturbances caused over the preferred frequency range can be minimised and reduced to relatively insignificant proportions. Poorly designed or obstructed mouths can develop cross modes, which in turn have a bearing on reflexions back down the horn. Once again, however, this is a function of bad or inappropriate design, so should not be a criticism aimed at horns *per se*.

Non-linearities

In other words—distortions. Many have probably heard the comment that 'they get harder as you wind them up' with reference to horns. To some degree they do but the effect is sometimes noticed well out of reasonable context. Horn systems are often capable of much higher acoustic output powers than comparable direct radiator systems. The extra cleanliness at relatively high levels, often allows a horn system to exceed the levels at which direct radiator systems would be incurring severe overload distortions. This can occur without the horn systems necessarily appearing subjectively louder. In other words, the absence of gross distortions often tends to fool the ear into being unaware of just how loud something actually is. When horns apparently become harder in or above this region, comparative criticism *vis-á-vis* direct radiators is somewhat unfair as the ▷

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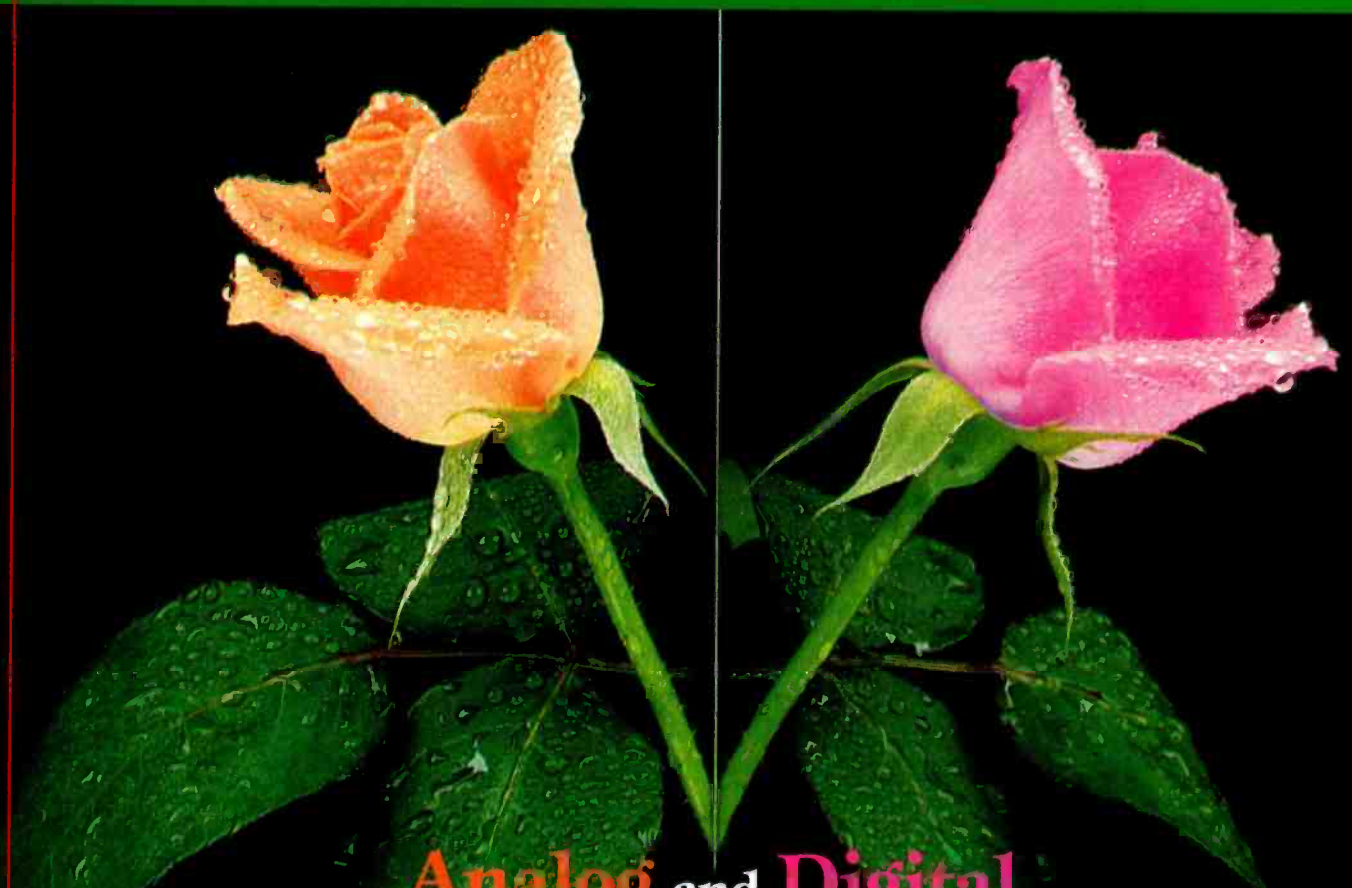

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◁ latter may well have failed or grossly distorted 10 dB earlier.

Notwithstanding this, there are certain horn characteristics that can tend towards non-linearities at high levels. Electro-thermal effects of voice coil heating, should not be a problem in studio situations. The thermal capacities and radiation losses of the magnet systems are large, when compared to the heating effect of only a few watts in the voice coil. Heating, however, can play a part in non-linearities due to the heat caused by air compression adjacent to the diaphragm.

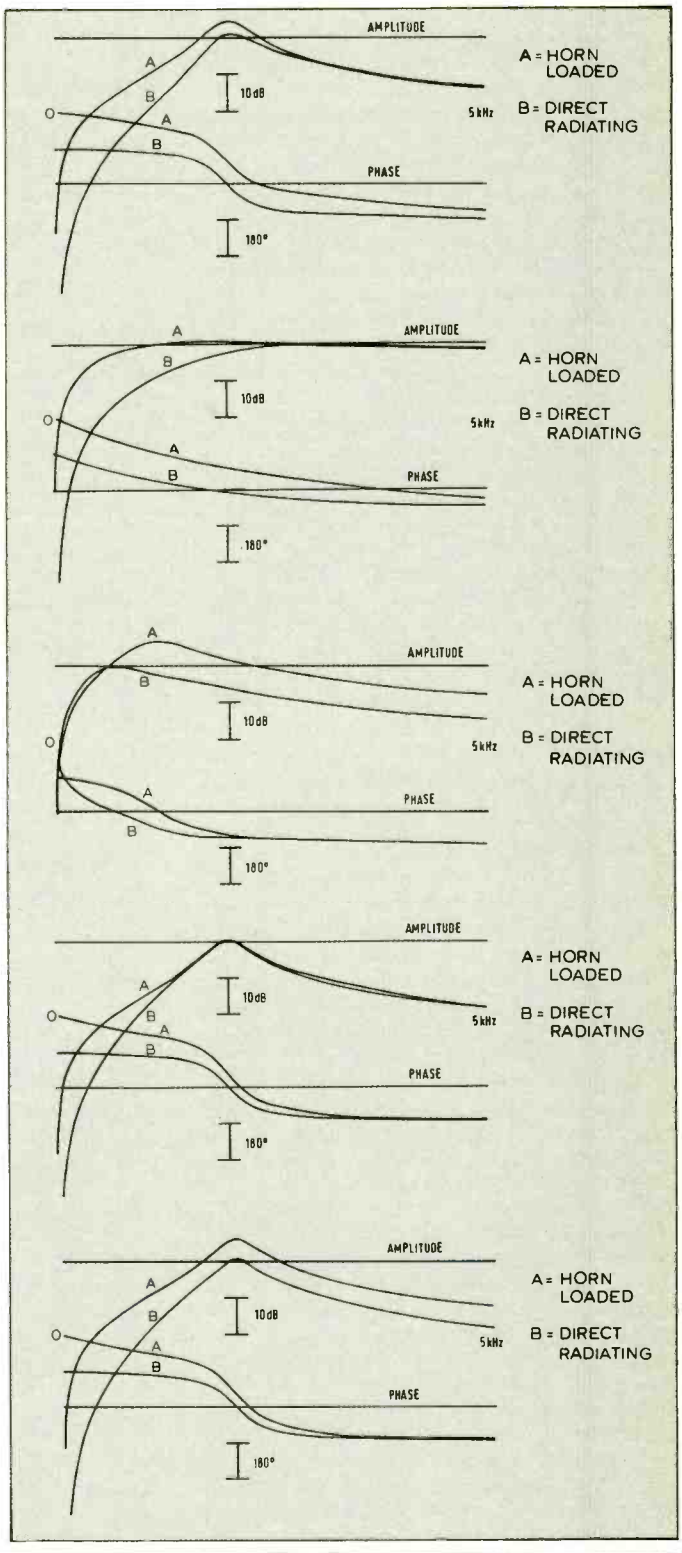
Classic air overload distortion has long been known to be a function of horns when operating at high intensities. The cavity between the diaphragm and the phasing plug is of a relatively small volume. At high intensities, the very rapid movement of the diaphragm, compresses the air in this cavity when forward-going and rarefies the air in the cavity when moving backwards. Any given unit force of compression, will cause a smaller change in air volume than that same unit force in rarefaction. For example, a given volume of air, say 1 cm^3, acted upon in compression by force X, would compress to say 0.82 cm^3. In rarefaction, that same force would expand the air to a volume of, say, 1.22. The volume change on compression would be $1-0.82\ cm^3=0.18cm^3$, the volume change in rarefaction would be 0.22 (see **Fig 3**). As a result of this, the positive-going half of the ouput sizewave, would be smaller than the negative-going half cycle, producing non-linear distortion in the output. This begins to happen at levels above which the air can no longer move out of the way quickly enough, as the diaphragm moves back and forth.

Going back to the point on heating, another form of distortion is currently being investigated at the ISVR (Institute of Sound and Vibration Research). These are the results of the very high SPLs encountered close to the diaphragm. When producing 120 dB behind the mixing console, a monitor system can be producing say 130 dB at the mouth of a horn. This, in turn, can be up to 150 dB at the throat of the horn and around 170 dB at the diaphragm. 195 dB is one atmosphere so, as can be appreciated, we are dealing with very large pressure changes in the phasing plug region. At these SPLs, air is not a linear fluid.

Some years ago I was very surprised, on witnessing the launch of an Atlas-Centaur at Cape Canaveral, to hear the same distortions I had heard while watching launches on television. I had always put the crackling sounds down to microphone or amplifier overload, certainly originating somewhere in the recording/reproducing system but those searing, tearing, crackling sounds are as apparent near to the rocket, as they are on television. They are also far more evident than one would expect, even at a range of five or 10 miles from the rocket. The significance of this was pointed out to me by Dr Morfey, at Southampton University. Dr Morfey had studied the noise footprints of rockets and had found that the high frequency components of the sound, relative to the low frequencies, were not falling off with distance according to general expectations. Non-linear air acoustics were thought to be at the root of the problem, and as the blunt end of a Saturn V can generate a good 200 dB on lift-off we are certainly well into the non-linear regions.

At these SPLs, the compression half-cycle generates such localised increase in the temperature and pressure of the adjacent air, that the localised speed of sound is higher than in the

Fig 1: Diaphragm comparisons



(a) 2 in diaphragm direct radiating (b) and loaded by 'perfect' horn (a) without mechanical damping

(b) 2 in diaphragm direct radiating (b) and loaded by 'perfect' horn (a) with mechanical damping

(c) 2 in diaphragm loaded by 'perfect' horn (a) and 8 inch direct radiator mounted on a baffle (b)

(d) 4 in diaphragm without mechanical damping

(e) 4 in diaphragm with mechanical compression damping

Courtesy of Keith Holland BSc

◁ ambient air. On the rarefaction half-cycles, the localised temperature and pressure drop creates the condition for a lower than ambient speed of sound. The speed of sound in air is a function of density. The speed of sound at sea level is higher than the speed of sound at 30,000 ft, which is why aircraft flying fast and high, carry Machmeters as opposed to air speed indicators scaled in knots. Mach 1 is the local speed of sound, irrespective of the actual value in knots, or miles per hour.

The result of this (see **Fig 4**) is that at SPLs of, say, 155 dB+, the positive going half-cycle will travel faster than the negative (rarefying) half-cycle. For as long as the sound wave propagates above the non-linear threshold, the positive wave will catch up on the negative wave, till the sinewave tends towards becoming a sawtooth. It is this sharp edge on the low frequency sawtooth that keeps the rocket noise from dulling even at great distances. The sinewave can never fold-over, as in **Fig 5**, as that would mean it could have two values at one point in time, which is clearly impossible. Instead, the waves tend towards the production of shock-waves. This is similar to an aircraft breaking the sound barrier, the waves piling up on top of one another, creating the shock, or sonic boom.

Even if direct radiator loudspeakers were capable of producing 170 dB at the cone, the expansion, and hence the pressure reduction into the room, would be so abrupt that the wave would have no effective distance to propagate at high levels of intensity. The positive wave cannot catch up on the negative wave, if it has no distance in which to catch up. You can't have an Olympic 0 metres sprint, for with no distance there can be no race! In horns, however, the pressure reduction is much more gradual. As we have already discussed, it is the gradual taper from the diaphragm to the outside air, which enables horns to achieve a better acoustic impedance match and consequently a significantly greater efficiency. Effectively, over whatever distance exists from the diaphragm to the point where the SPL drops to the 150 dB region, non-linear propagation distortion can be considered a potential problem.

To maintain a smooth response, it is necessary to maintain a flare, all the way from the mouth to the diaphragm. Any parallel section of the flare, or abrupt changes in cross-sectional area, can produce wild irregularities in the response. Maintaining the loading all the way to the diaphragm frequently requires tiny flared tubes which, adjacent to the diaphragm, often causes the phasing plug to look rather like the top of a pepper pot. With 120 dB in the room, all squeezing through the top of a pepper pot, it's no wonder that things become a little loud inside those holes. We are currently researching phasing plug design for high-level horns, to achieve a compromise between efficiency and any tendencies towards the above effects.

Once again, at reasonable, or even quite loud, studio levels, these non-linearities should not be very likely to occur. They are, however, relevant in cinema and public address systems and, yes, they can get harder as you turn them up.

Another aspect of these tiny holes or slots in the phasing plug, is that in attempting to transmit such high energy through such a confined space, the wave motion can become a turbulent flow in the small tubes. This can produce noise (or non-harmonically related distortion) in the ouput, which is a function of the air flow, which is in turn a function of sound pressure levels. Dr Wolf at NASA's Langley Research Station in Virginia, tells me that there are formulae to calculate length/diameter relationships for minimum turbulent noise flow generation. With the tapered holes required in phasing plugs, this is somewhat difficult to calculate but Keith Holland is working on this at the ISVR. This is also tied in with venturi effects, where the flow speed changes with the change in cross-section. This is the effect which causes the lift on the aeroplane wing and the atomisation of petrol within a carburettor. As the tube diameter decreases, the flow speed increases and the pressure drops.

These are all problems uniquely associated with horns and compression drivers but they are ▷

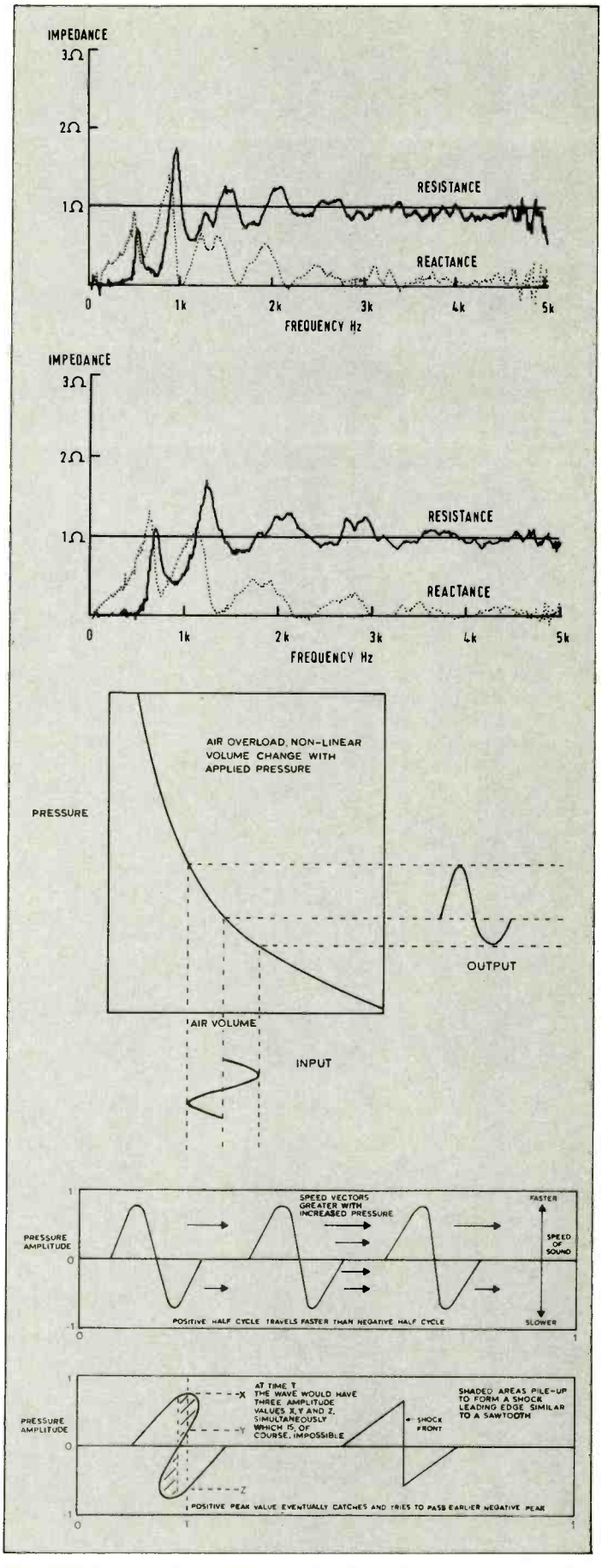


Fig 2a: Throat impedance of horn—representative of its frequency response

Fig 2b: Throat impedance of same horn but with outer lips sawn off. Note significantly differing pattern of reflexions, hence differing anticipated frequency response

Fig 3: Conventional air overload distortion

Fig 4

Fig 5

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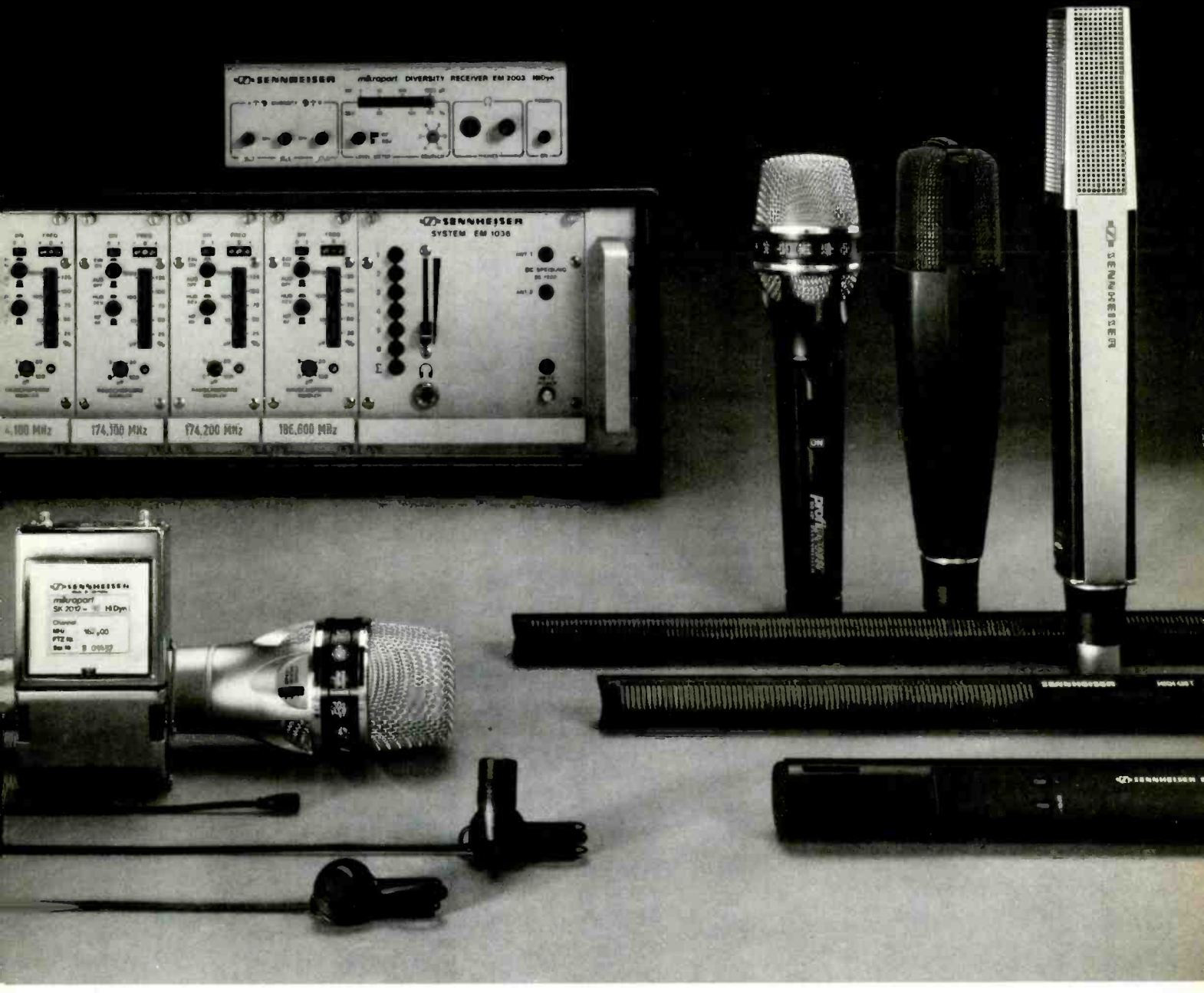

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◁ usually only encountered at SPLs where equivalent direct radiators have long since given up the ghost. I don't think that the problems are insoluble; we are working on them.

Mechanical alignment

In the mid 1970s, there was a sudden surge of interest in so-called time alignment. The precise application of the principle was somewhat convoluted and I believe that many misconceptions were applied to some designs. The fundamental principle was to synchronise at the listener's ears, the arrival time of the impulses from the individual drivers. This was usually attempted by vertical, depth alignment, of the individual voice coils (see **Fig 6**). Somewhat arbitrarily, the voice coils were deemed to be the location of the sound source, putting horn midrange units at something of a disadvantage (see **Fig 7**). As can be seen, aligning the voice coil of the compression driver with the voice coil of the bass drivers, could wind up with the horn protruding 2 ft from the front of the baffle. Certain companies using long horn designs have resorted to delay lines to electro-acoustically re-align the system. In my experience, however, there has sometimes been over compensation. This has been due to not taking into account the group delay effects in the crossovers and the propagation delays in the drivers themselves.

Taking these into account, and considering the group delay affecting the lower frequency drivers, the shorter horns may be more desirably constructed than direct radiators. The necessity for pushing back the mid and high units into separate enclosures is, in the case of short horns, dispensed with. The horn would also not suffer the diffraction problems of the awkwardly mounted cone and dome units. What is more, we are currently working on electronic systems that re-constitute the impulse response in the listening area. This would remove any advantage direct radiators may have had over short horns in particular. Long horns can be compensated, but somewhat more expensively and less precisely.

Directivity

One advantage of midrange horns over direct radiators, is the available range of polar pattern control, or directivity. While the overall expansion of the area of the horn, must closely follow the desired mathematical curve, eg exponential, hyperbolic, catanoidal, hypex, the relative dimensions of width and height can be varied. This variation in mouth shape can be used to cause the output to spread out over a considerable range of areas. Conventional horns are likely to cover 60° to 120° in the horizontal plane while narrowing the pattern to between 30° and 60° in the vertical. This capability can allow horn systems to direct the sound to cover a desired area rather than being restricted to the symmetrical polar patterns of a cone or dome. As frequencies rise, pattern control is eventually lost as the high frequencies beam out in a narrow pattern as though the horn were not there.

This beaming problem can be overcome by the use of constant directivity horns, which are usually exponential/conical hybrids, maintaining their polar pattern with relative disregard for frequency. The price paid for this advantage is that the total available amount of high frequency power, falls off as the frequency rises above the point where the diaphragm mass begins to take effect. In a conventional horn, the total power at higher frequencies, where beaming begins, is also reduced. However, the tightening pattern of the beam, concentrates the energy on axis, thus the on-axis response can remain flat with a reducing high-frequency response off-axis. The total power of the two systems remains the same, so if the constant directivity horns spread a reducing power over the whole area, the electrical drive at those frequencies must be increased in order to compensate. If the roll-offs are still in the minimum-phase domain, the electrical equalisation will restore the phase response as it restores the amplitude response. Should the roll-offs not be minimum phase, the price for constant directivity would also be paid for in terms of phase accuracy. Personally, I prefer to use the conventional type of horn, due to my inherent wariness of the audibility of equalisation circuits in monitor systems. Once the pattern control has fallen below acceptable limits, I prefer to cross over into a matching, complementary HF driver.

Conclusions

Horns used in studios have frequently been borrowed directly from public address and cinema applications. In many cases, this has been done without due regard for the different requirements of the different disciplines. In cinema, PA and studio usage, the compromises lie in different areas because the problems and priorities lie in different areas. Studios do not have to contend with the reverberant conditions of cinemas, or with the problem of projecting the sound to a balcony 200 ft away. Similarly, in the largely reverberant field of that balcony, less importance is placed on the absolute transient integrity so necessary in studios. Just because a horn has been used for 20 years from 800 Hz to 20 kHz in one particular situation, does not automatically mean that it is a suitable horn for the same range in a different application. There is a great deal that must be taken into account.

Much of the criticism of studio horns should really have been reserved for the manufacturers and designers who have misapplied the technology. There is tremendous potential in studio midrange horn/driver combinations: very low distortion, very fast transients, high output potential, high reliability and consistency relative to acoustic output, facilitated pattern control, and many other advantages. These potential benefits have been abused by attempting to use the horns either to cover too great a frequency range, or use in an inappropriate frequency range. They have been employed with a degree of misunderstanding, and a lack of a comprehensive awareness of their strengths and weaknesses. They must be carefully interfaced with the other drivers in the system and their relationship with the room.

Only a very small percentage of horns have been specifically designed for studio monitoring. Horns can be costly, both to develop and to manufacture. Studios account for less than 1% of professional loudspeaker sales so it is probably understandable that large manufacturers apply more of their resources and expertise in other directions. I have felt for some time that too little attention has been paid to the potential of horns and that they have been maligned unfairly, due to misapplication. The previous discussion has largely been on what the text books either do not tell you, or fail to explain lucidly.

Recently David Hawkins of Eastlake Audio was quoted as saying he believed that the hi-fi industry was now leading the studio industry in innovation and research. I tend to agree with him. The commercial recording industry has not really effectively re-invested in the development of its most basic tool. It would be unreasonable to compare directly the worlds of studio monitoring and hi-fi as the requirements are different. Domestic systems are not designed to cope with a solo bass guitar at 115 dB, nor the concentrated high frequency output of a solo synthesiser. It is also impossible for the studio industry to produce systems that mimic in every way, the wide variation of what is accepted as right in hi-fi. Historically, however, studio systems were looked up to as the basic standards of reference. What the advances in domestic hi-fi have done is to make people more critical and aware of just what they are listening to. The demands for accurate monitoring are now greater than ever.

Carefully designed midrange and HF horns, correctly and carefully applied, have much to offer in precision monitoring above 1 kHz. Contrary to much popular belief, clean hi-fi in this range is not the exclusive territory of direct radiators. New generations of horns will be a force to be reckoned with.□

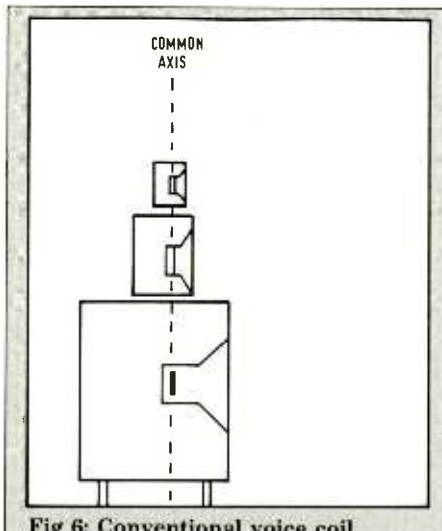

Fig 6: Conventional voice coil alignment intended to produce phase-coherent wavefront, obviously ignoring effects of mechanical propagation delays or electrical group delays

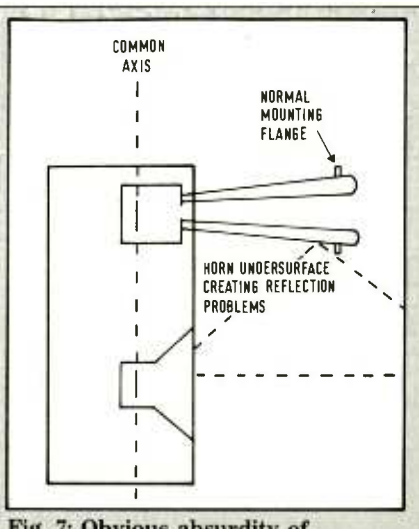

Fig. 7: Obvious absurdity of alignment similar to Fig 6 when using long horns. Conventional mounting with the normal flange aligned with the baffle would produce a delay of around 1 ms for every foot of voice coil misalignment

VCAs INVESTIGATED PART FOUR

In this final part of this series, Ben Duncan details his test procedures and gives measurements of nine of the VCA schemes featured throughout

Test 1: Bandwidth

Bandwidth plots were carried out first, to confirm the Device Under Test (DUT) was operational and to identify any frequency response aberrations that might have a bearing on the subsequent noise and distortion figures. At unity gain, most of the VCAs gave a substantially flat response, being −1 to −2 dB down at 100 kHz. *MAT-04* was the exception; the extra compensation needed for stability set the response down −3 dB at 40 kHz.

At the −50 dB gain command, most of the VCAs exhibited a moderate change in bandwidth, except the *VCA-1001* and the *202X*, where the bandwidth remained constant, or at least its inflection stayed well beyond the AP's own 200 kHz roll-off. The *MasterMix* module exhibited significant HF feed through between input and output, leading to the appearance of a −2 dB dip at 40 kHz on the −50 dB bandwidth plot, beyond which the plot shot upwards. The parallel path of an adjacent plot, showing the 'bandwidth' when muted, confirmed the effect had nothing to do with marginal RF instability. However, at −50 dB, the *MAT-04* circuit exhibited a 2 dB peak at 40 kHz, signifying just that.

Test 2: Noise

Before delving any further, one point needs making: the small quantities being measured are easily blurred by environmental noise. When two units exhibit residuals below −100 dB and within 1 or 2 dB of each other (or ±12%), the level of uncertainty created by air currents, a single misplaced wire and countless other minutiae, mean it's sensible to consider the two DUTs as equals. Naked PCBs were tested inside a grounded enclosure that also shielded the DUTs from draughts. Broadband plots of RMS output noise *versus* frequency were then made for each VCA in dBu, from 10 Hz up to 200 kHz, at gain commands of 0 dB and −50 dB. Made in this order, the spectral plots served to verify that the distortion measurements (made straight afterwards) wouldn't be corrupted by surreptitious noise, caused by a hook-up error or loose shielding, for example. For self-verification, the residual noise with the DUT *in situ* but with its output shorted, was plotted on the same graph.

In general, noise was uniformly lowest around 20 Hz. In the 50 to 300 Hz range, the picture is confused by magnetic and ripple harmonics. **Figs 1a** and **1b** show typical plots (note the scales differ by 10 dB) for the two main classes of VCA. When the electricity supply's 'magnetic spikes' are mentally subtracted from the picture, noise is pretty constant between 20 Hz and 1 kHz. Around this latter point, there's a noise corner, beyond which each VCA develops a steady climb of +3 dB/octave as the irreducible thermal (white) noise comes to predominate. VCA comparisons are based on the 'spot noise' at 1 kHz, a good median point.

Looking into **Table 1** (which also lists the approximate frequency of each VCA's noise corner) differences in the noise figures showed close corroboration with biasing levels. At unity gain, the Class A-B and ASB units were between 7 dB and 15 dB quieter than all but the most sophisticated Class A VCAs. At −50 dB, the difference closed, there being only 4 dB between the noisiest Class A and quietest Class A-B specimen. Within each classification, noise levels vary depending on differences in internal source impedances, hence topology, transistor geometry and current noise, and any current gain in the cell or core.

At unity gain setting, the *MasterMix* module, working in Class ASB was the quietest overall. It was closely rivalled by Hawksford's prototype. Working in Class A, this result is all the more remarkable. The *202-XL* and *2151* are equal third. At −50 dB, the scene changes: the *MasterMix* and *202-XL* are the quietest, with the *2151* and *2014* equal second. In the 'A' Class and excepting Hawksford's VCA, the *TA-101* is quietest at −50 dB, closely followed by *VCA-1001*, while at unity gain, the *2014* registered the lowest noise. Then again, as we saw in Part Two (*Studio Sound*, July 1989) VCA noise can change as signal is applied.

Test 3: Noise Modulation

To set the different classes of VCA into full perspective, all but one of the DUTs were subjected to a modulation noise test, by applying heavily filtered DC to the input (**Fig 2**), with unity gain command (0 dB). The large capacitance across the input approaches a short circuit at most audio frequencies. Broadly speaking, 2.75 VDC simulates the noise that's present when a 0 dBu RMS signal is passed, or a +4 dBu programme that's heavily compressed. The test also demonstrates what happens if there's a substantial DC offset voltage present at the VCA's input, typically due to an aging and leaky coupling capacitor. On the one hand, noise modulation is supposed to be masked by programme under most practical conditions. On the other, it's bound to mask the lower THD residuals, by increasing the '+N' component. In other words, noise modulation is quite a good thing if a VCA's noise floor lies below its own distortion residual.

If noise modulation is accounted for, the order of merit changes. Simply reading how the residual noise increases seems fair, as the added noise caused by the DC stimulus is just more of the same, rather than coming from a new and uncorrelated noise source. Turning to the scorecard in **Table 2**, noise modulation (subtracted from the no-signal noise level) is uniformly low in the Class A, CRT-type VCAs. The *VCA-1001* is the quietest, closely followed by the *MTA-1537* and *SSM-2014* (**Fig 3**). *MAT-04* and Hawksford's VCA had comparably negligible (<2 dB) mod noise above 300 Hz but the noise increased to 10 and 5 dB respectively at low frequencies. This says more about the quality of the cell transistors and their LF noise ▷

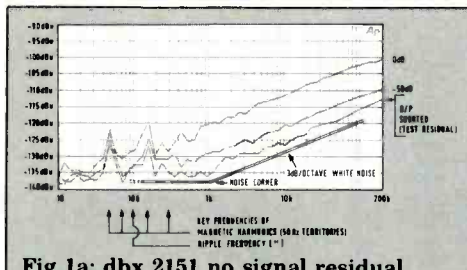

Fig 1a: dbx 2151 no signal residual noise
Example of Class A-B log-antilog behaviour

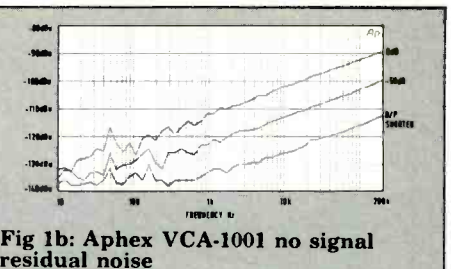

Fig 1b: Aphex VCA-1001 no signal residual noise
Example of Class A 'AGC' behaviour

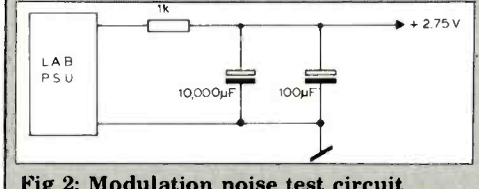

Fig 2: Modulation noise test circuit

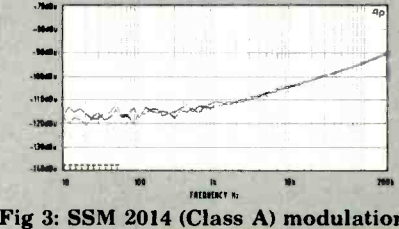

Fig 3: SSM 2014 (Class A) modulation noise

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◁ characteristics than about the topology employed. Valley's *TA-101* (**Fig 4**) was the least quiet performer in Class A, returning 10 to 13 dB above 30 Hz and up to 20 dB at 15 Hz, with the control input shorted. With the jump-lead removed (so the CV port remains effectively 'shorted' at signal frequencies, by the capacitors seen in **Fig 8** Part Three, *Studio Sound* August 1989) the mod noise rises further, by up to 5 dB.

The Class A-B VCAs exhibited up to 30 dB of mod noise. Presumably because it's a hybrid of log-antilog and CRT topologies, the *2014*'s noise rises only 8 dB at high frequencies (>2 kHz), only 2 dB below 200 Hz and less than 2 dB between 200 Hz and 2 kHz (**Fig 5**). The *202-XL* varies between 15 dB at extreme audio frequencies, and up to 23 dB at mid frequencies. The *2151* **Fig 6** exhibits up to 30 dB in the midband if the CV port is connected normally, falling to 10 dB if shorted. This behaviour demonstrates the sensitivity of log-antilog VCAs (particularly the *2151*) to source impedance and residual noise appearing at the control port. Capacitors of reasonable size provide finite noise attenuation below 100 Hz, below which noise levels in 'industry standard' (TLO, LF and NE series) op-amps begins to increase sharply[1,2]. For lowest mod noise, control circuitry should be built around precision op-amps with an LF noise corner below 3 Hz, like *LT-1007* or *OP-27*.

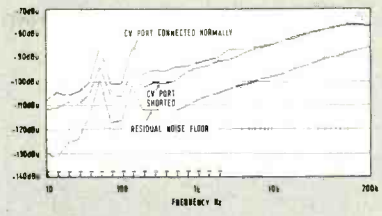

Fig 4: Valley TA-101 modulation noise

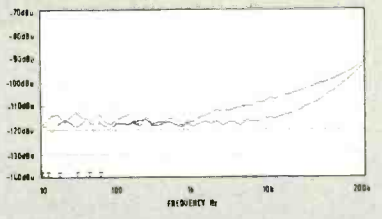

Fig 5: SSM 2014 (Class A-B) modulation noise

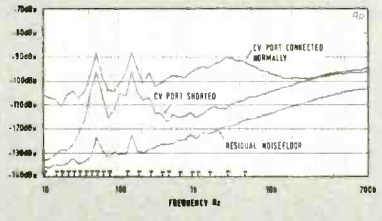

Fig 6: dbx 2151 modulation noise

Test 4: THD vs frequency

THD+N (harmonic distortion+noise) was plotted against freqency for the nine VCA assemblies over a 50 to 60 dB range of gain and attenuation.

TABLE 1 No signal noise
1 kHz spot figure
Environmental noise residual ranges −133 to −135 dBu
±2 dB repeatability

Unity gain command

Model	Class	Noise figure	Noise corner frequency
MasterMix	ASB	−132 dBu	1 kHz
Hawksford	A	−122 dBu	1 kHz
2151	A-B	−120 dBu	300 Hz
202-XL	A-B	−120 dBu	200 Hz
2014	A-B	−118 dBu	10 kHz
2014	A	−112 dBu	1 kHz
VCA-1001	A	−112 dBu	10 Hz
MTA-1537	A	−108 dBu	500 Hz
TA-101	A	−108 dBu	300 Hz
MAT-04	A	−107 dBu	200 Hz

−50 dB gain command

Model	Class	Noise figure	Noise corner frequency
MasterMix	ASB	−134 dBu	1 kHz
202-XL	A-B	−132 dBu	800 Hz
2014	A-B	−131 dBu	300 Hz
2151	A-B	−129 dBu	200 Hz
TA-101	A	−125 dBu	500 Hz
VCA-1001	A	−122 dBu	300 Hz
MAT-04	A	−119 dBu	200 Hz
Hawksford	A	−118 dBu	500 Hz
MTA-1537	A	−117 dBu	1 kHz
2014	A	−117 dBu	1 kHz

TABLE 2 Modulation noise
+2.75 V DC applied to input
CV port shorted (except where stated)
Figures express noise in excess of the no signal residual (with input shorted)

Model	Class	Description
VCA-1001	A	<1 dB at most frequencies. Up to 1½ dB below 100 Hz
MTA-1537	A	<1 dB above 300 Hz. Up to 2 dB below 300 Hz
2014	A	<1 dB at most frequencies. Up to 3 dB below 100 Hz
Hawksford	A	<2 dB above 300 Hz. Up to 5 dB below 300 Hz
MAT-04	A	<2 dB above 800 Hz. 10 dB or more below 300 Hz
TA-101	A	10 to 13 dB above 30 Hz (CV shorted). Up to 20 dB at 15 Hz, with CV restored
2014	A-B	Up to 8 dB above 2 kHz. Below 2 dB, 200 Hz to 1 kHz <4 dB below 200 Hz
202-XL	A-B	Up to 15 dB <100 Hz and above 10 kHz. Typically 23 dB at mid frequencies
2151	A-B	Up to 10 dB in midband (CV shorted). Up to 30 dB in midband (CV restored)
MasterMix		Not tested due to AC coupling at input. Expected to be similar to other log-antilog VCAs

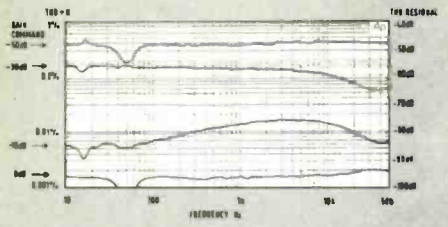

Fig 7: Audio Kinetics MasterMix THD+N vs frequency

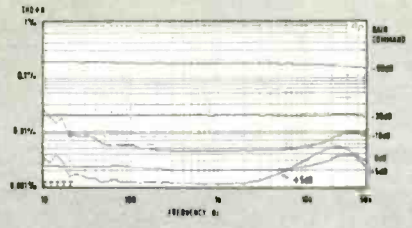

Fig 8: Aphex VCA-1001 THD+N vs frequency

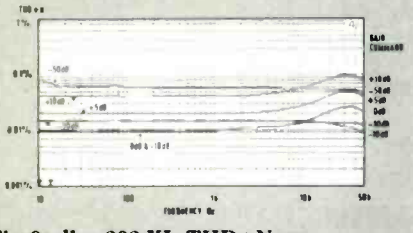

Fig 9: dbx 202-XL THD+N vs frequency

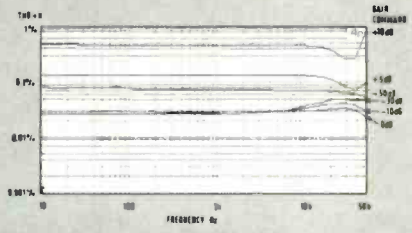

Fig 10: dbx 2151 THD+N vs frequency

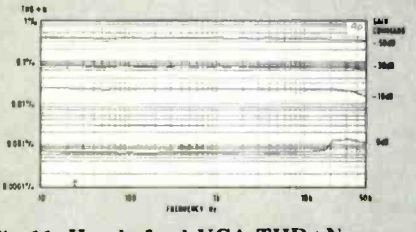

Fig 11: Hawksford VCA THD+N vs frequency

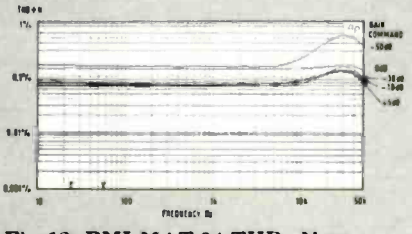

Fig 12: PMI MAT-04 THD+N vs frequency

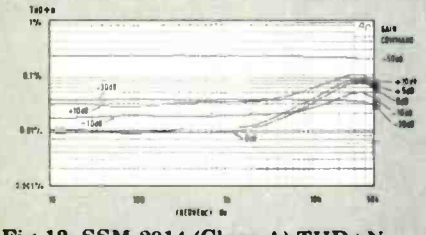

Fig 13: SSM 2014 (Class A) THD+N vs frequency

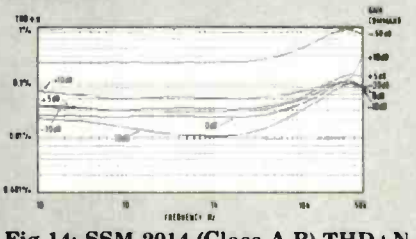

Fig 14: SSM 2014 (Class A-B) THD+N vs frequency

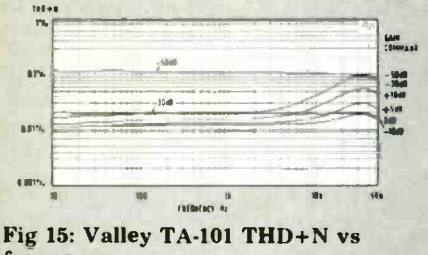

Fig 15: Valley TA-101 THD+N vs frequency

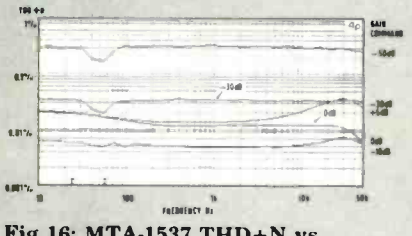

Fig 16: MTA-1537 THD+N vs frequency

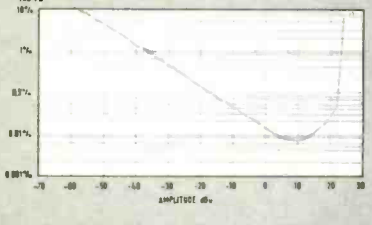

Fig 17: SSM 2014 (Class A) THD dynamic plot

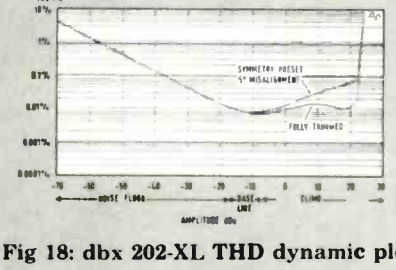

Fig 18: dbx 202-XL THD dynamic plot

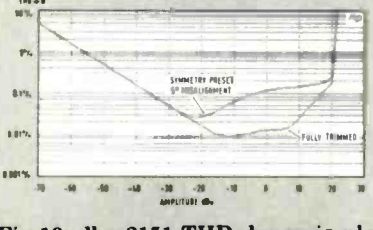

Fig 19: dbx 2151 THD dynamic plot

Aside from unity (0 db), measurements were made at attenuation settings −10, −30 and −50 dB, and at gains of +5 and +10 dB where applicable. After puzzling over an initial set of measurements made at 0 dBu, showing higher than anticipated figures on all the VCAs, an input drive level of +10 dBu (2.3 VRMS) was adopted to keep the broadband noise component (+N) at bay—particularly when measuring THD at gain command settings below unity. +10 dBu sounds high but in systems averaging +4 or 0 dBu, it comes close to simulating the distortion that's likely to be encountered with real music signals peaking around +8 to +12. The multilevel plots in **Fig 7 to 16** sweep from 10 Hz up to 50 kHz. The AP's lowpass filter was set to 80 kHz, enough to attenuate white noise at VHF without excluding the 2nd harmonic of 20 kHz.

Being intended as voltage controlled faders, Audio Kinetics' *MasterMix* and Malcolm Hawksford's prototype were configured for a maximum gain of 0 dB. Audio VCAs aren't often used at 'positive' gains (>0 dB) but I decided to investigate THD with moderate positive gain commands (>0 dB) to show what happens in expanders and the like. The +5 dB gain step is out of step with the others but was needed to produce a useful amount of data, bearing in mind that gain commands above +6 dB are confined to the log-antilog and related VCAs.

Looking into the results, some of the traces at the −50 dB attenuation commands look rather high but then 0.7% of −50 dBu is 17 μV or −93 dBu, or 0.0017% THD referred to the everyday ZOL (+4 dBu). In fact, for most of the data points at the −30 and −50 dB settings, noise (+N) is the dominant component.

A sign of good behaviour (compared with some line and power amplifier stages) is that few of the DUT's THD plots change by more than 10 dB across the frequency spectrum. The *VCA-1001* showed a slightly rising THD+N residual at LF at gain commands of −10 and +5 dB. As the residual is so low, it's possible that what's being seen isn't THD but a shift in the LF noise corner. The *2151* circuit is just beginning to slew limit above 40 kHz at the +10 dB command, seen as an abrupt change to a steep ascent. The *MasterMix* module shows a small rise in the midband, levelling out at high audio frequencies. The remainder of the VCAs exhibit substantially 'flat' THD in the audio band. At some point beyond 20 kHz, THD+N rises at some point (as dictated by universal laws) depending on the gain command. For the *2014* and *TA-101*, the THD curves show a distinct null value at unity gain, rising with both attenuation and gain, a non-monotonic effect. The same applies to the *2151*, only the increase of THD with gain (+5, +10) is more pronounced. In comparison, the *MAT-04*'s THD+N increases most at VHF with progressive attenuation, which suggests that noise and latent instability are both playing a part.

Test 5: THD dynamics

Using the Audio Precision's AM test facility, the THD data was replotted in a fresh set of dimensions, by sweeping a 1 kHz sinewave over a 100 dB operating range from −70 to +30 dBu. With a typical amplifier stage (including a VCA run at fixed gain), the characteristic pattern of this dynamic test has four regions. Taking SSM's *2014* Class A plot for example (**Fig 17**), on the left, the noise floor slopes down at exactly 6 dB/octave (ie a tenfold change in % THD per

◁ tenfold change in level). Distortion components first break through where the slope begins to flatten. The second region is the baseline, where the residual is predominantly THD and visible as a (reasonably) straight, horizontal line. In the third region, the horizontal line starts to climb. If the amplifier stage employs a high level (>50 dB) of NFB at 1 kHz, the upwards slope is almost simultaneous with clip. This is the fourth and smallest region where the THD trajectory changes course for the stars.

Table 3 shows that the Class A VCAs had a THD baseline lying comfortably below 0.01%. The *MasterMix* and Hawksford VCA gave the lowest residuals, followed by the *VCA-1001*, itself nearly an order better than the *2014* and *TA-101*. Of the Class A-B VCAs, the *202-XL* has the lowest residual. The action of the log conformance correction circuit can be seen clearly in **Fig 18**, pulling the THD back down above +10 dBu. For the *MTA-1537, 2151, 2014* and *TA-101*, region 3 (the slow relapse) comes into play for drive levels above 0 dBu as the core devices' log conformance begins to deviate. If it exists, the mirror image climb in THD at low levels must be academic as it is hidden deep in the noise 'mountain'.

TABLE 3 THD residuals
1 kHz swept from −70 to +26 dBu
Unity gain command

Model	Class	THD baseline
MasterMix	ASB	0.0003%
Hawksford	A	0.0006%
VCA-1001	A	0.001%
MTA-1537	A	0.004%
2014	A	0.007%
TA-101	A	0.008%
202-XL	A-B	0.008%
2151	A-B	0.01%
2014	A-B	0.02%
MAT-04	A	0.07% (interpolated)

For the remaining VCAs (including *2014* in Class A mode) the THD baseline persists up to a dB or so below clip. The *MasterMix* module has no region 4 because its clip threshold is just beyond the AP's unbalanced drive capability. On the maker's recommendation, it was the only unit to be operated on ±20 V rails. (Hawksford's VCA specified ±30 V input. The remainder were operated at ±15 V; enough for the clip threshold to lie above +20 dBu permitting 10 dB of gain with a +10 dBu input).

Finally, to demonstrate the effects of a small misalignment in a typical VCA's symmetry trimpot, the presets on the two dbx VCAs were moved about 5° from the THD null position (**Fig 18** and **Fig 19**). In this condition, the baseline disappears; distortion is climbing just as soon as it emerges from the noise-floor. When was the last time you checked your own VCA's THD alignment?

Test 6: Plotting sonics with SMPTE

Intermodulation was tested using the AP's SMPT-FRQ test, a development of the classic SMPTE intermodulation measurement, where 60 Hz and 7 kHz are applied to the input in a ratio of 4:1. Intermodulation products are then plotted by sweeping upwards from 2500 Hz, once again with an input level of +10 dBu. While seeming esoteric, this test is included for good reason: more than any THD test, it should corroborate with 'subjective' sonic quality.

Table 4 demonstrates how at unity gain, the Class A VCAs and Class ASB exhibit SMPTE residuals that are typically an order lower than Class A-B VCAs. The *MasterMix* module, and

TABLE 4 SMPTE intermodulation
+10 dBu drive level
Swept from 2.5 kHz to 100 kHz

		Unity gain command SMPTE residual			−50 dB gain command SMPTE residual
Model	**Class**	**at 10 kHz**	**Model**	**Class**	**at 10 kHz**
MasterMix	ASB	0.001%	202-XL	A-B	0.05%
Hawksford	A	0.001%	TA-101	A	0.08%
VCA-1001	A	0.004%	VCA-1001	A	0.1%
2014	A	0.02%	2151	A-B	0.15%
TA-101	A	0.03%	MasterMix	ASB	0.15%
202-XL	A-B	0.03%	2014	A	0.2%
MTA-1537	A	0.04%	2014	A-B	0.2%
2014	A-B	0.1%	Hawksford	A	0.25%
2151	A-B	0.18%	MTA-1537	A	0.4%
MAT-04	A	0.3%	MAT-04	A-B	0.45%

Hawksford's VCA are equal first with a bare 0.001% IMD, with the *VCA-1001* a close second. At the −50 dB command there's a possibility that some of the data is being 'dithered' by noise. The tables are certainly turned: the *TA-101* and *VCA-1001* returned the lowest figures among the Class A devices, yet the *202X* (in Class A-B remember) yielded an even lower residual. As for trends, the *VCA-1001*, *202X*, *MAT-04* and *2014* all show a climbing SMPTE residual above 100 kHz at unity gain. It might be a characteristic in the *NE5534* and *5532* op-amps, common to all of these circuits. The *Mastermix* module was the only one to display a significant climb in IMD: above 10 kHz, IMD increases some 10 dB (threefold) before levelling off.

Summary

Concentrating on the five commercially available VCA building blocks, the *VCA-1001* is 10 dB noisier than the quietest unit but has the lowest noise corner, the lowest modulation noise and THD, and the lowest SMPTE residual. Verdict: excellent, except for noise. Even this could be overcome by operating at hot drive levels (+8 dBu) within an architecture having +26 dBu drive capability (for >18 dB headroom).

The *2151*'s modulation noise, THD baseline and the SMPTE residual are all among the highest, except at −50 dB, where the SMPTE residual was lower than average. Verdict: the effects of modulation noise on programme detail are worrying in some conditions. For best sonic performance, gain commands above 0 dB and drive levels above 0 dBu are best avoided.

The *202-XL* is fractionally quieter than the *2151* at −50 dB, confirming it as the quietest OEM VC under no signal conditions. Compared to the *2151*, it exhibits 6 dB less modulation noise and a similar reduction THD for a given drive level. However, SMPTE IMD was disappointing as they were an order higher than some other VCAs. Verdict: it can be driven 10 dB harder than the *2151* for the same THD but modulation noise is proportionately higher considering the advertised improvement in SNR is rated under no signal conditions while being achieved by driving the core 6 dB harder.

The *2014*'s no-signal noise was better than average in Class A and A-B. In Class A, modulation noise and the THD baseline were among the top three. At 10 kHz, the unity gain command noise corner was unusually high. Switched over, the *2014* returned the lowest modulation noise of the Class A-B units but the THD and SMPTE residuals were below par. These are exactly the conditions under which the RF problem intensified. I challenged SSM to produce their own AP plots of THD versus frequency and these were found to be in close agreement. On this basis it seems the RF oscillation has little bearing on the results published here, except perhaps the SMPTE residuals. Verdict: when laid out so it doesn't oscillate, the *2014* has many good qualities and no truly bad points.

The *TA-101*'s noise at unity gain was below par but at −50, it was only 7 dB noisier than the quietest (Class A-B) unit. Noise modulation was (unexpectedly) the highest of the Class A VCAs but still ahead of Class A-Bs. Ditto the THD baseline. The behaviour of the SMPTE residual echoes the *202-XL*: both remain fairly constant at the two gain commands, the *TA-101*'s SMPTE IMD being equal first at −50 dB, becoming average at unity gain. Verdict: despite being the oldest VCA design to be tested, it returned results ahead of newer designs in some categories and average results in others. At the same time, Audio Kinetics' scheme shows just how much potential there is for improvement using the closely related *ECG-101*.

MTA-1537 is quiet and has the second lowest THD baseline and modulation noise—where it's virtually equal first but the SMPTE residual is below average. Verdict: the handicap of being configured in a mixing console (however well executed) can't be discounted; some results could have been a little better in isolation.

Finally, poetic justice prevails: the Hawksford and *MasterMix* results demonstrate how much further established transistor arrays (in this case Nat Semiconductor's *M394* and Valley International's *ECG JI*) can be pushed with some extra circuitry nd a little canny thinking. PMI's *MAT-04* should also give excellent results in Hawksford's circuit.

Afterthoughts

Even at component level, nobody is giving any unequivocal answers to the question 'which is the best VCA?' It all depends on what you want to do with it.

As is often the case, it's partly a choice between noise and distortion. In many ways, noise is preferable. But just how many dB below the noise-floor do different kinds of distortion products need to be before they're positively dithered out of existence? The final, telling stage of data crunch-down hinges on which set(s) of figures you personally hold to be most important. One fact is now clear: the performance of the VCAs tested doesn't correspond very closely with their cost—at which point, I'll leave you to judge for yourselves.

Because nature makes it difficult to optimise all parameters at once on any future expansion of the VCA's clean operating range, achieving the optimum balance of trade-offs will continue to depend on a measure of inspired trial and error. At least until the psychoacoustics of audio are better understood by all. VCA pioneer Paul Buff reminds us[6] how much circumspection is needed before we decide that one VCA is better than another: "...a change in distortion parameters is a lot less immediately detectable than is a muting 'thump'. Thus it is more likely to go undetected...(at first)...only to show up later as 'something' indefinably wrong." Meanwhile, the rapid data acquisition that's possible with PC driven test systems like the AP's *System One* will help to add to pro-audio's communal data base. It should also make line-up of VCA trimpots something to be less frightened of and improve the chances of engineers finding time to check that the VCAs inside newly installed equipment are actually correctly set-up, instead of leaving it to chance.□

Acknowledgements
The author wishes to thank David Heaton for stoically carrying out hundreds of preliminary Audio Precision *System One* measurements.
Thanks also to the following for their extensive co-operation and assistance in compiling this survey: Marvin Caesar and Donn Werrback, Aphex; Tim Harrison, Audio Kinetics; Chas Brooke, BSS Audio; Les Tyler, dbx (now That Corporation); Robin Bransbury, Dolby Labs; Dr Malcolm Hawksford, Department of Electronic Systems, Essex University; Nick Martin and John Wase, SSE Marketing; Dan Parks, Ron Dow and Eddie Cooper SSM/PMI; Tony Williams, Sound Technology; Mike Morgan, Valley International; Hill Audio Ltd.

References
1 Ben Duncan, 'AMP-01 state of the art preamplifier—Part Five', *Hi-Fi News & Record Review*, Sep 1984
2 Wilfried Adam, 'Designing low noise amplifiers', *Electronics & Wireless World*, June 1989
3 Paul Buff, 'Specsmanship and the new generation of VCA', *RE/P*, pp138 to 49, Oct 1982

Author's note
Control feedthrough hasn't been measured, because it's critically dependent on the control signal and the design of the sidechain circuitry—enough to mean that the VCAs with inherently poor control rejection can nonetheless be made workable in practice. In order to keep the space occupied by this series within reasonable bounds, 22 of the Audio Precision printouts have been omitted. Photocopies of the originals are available from *Studio Sound*'s editorial offices.

VCA manufacturers' addresses

Aphex Systems Ltd., 13340 Saticoy Street, North Hollywood, CA 91605, USA. Tel: (818) 765-2212
UK: Sound Technology plc, 6 Letchworth Business Centre, Avenue One, Letchworth, Herts SG6 2HR. Tel: 0462 480000

dbx, THAT Corp, 15 Strathmore Road, Natick, MA 01760, USA. Tel: (508) 653-6334.
UK: SSE Marketing, Unit 2, 10 William Road, London NW1 3EN. Tel: 01-387 1262

SSM Audio Products, Precision Monolithics Inc, 1500 Space Park Drive, PO Box 58020, Santa Clara, CA 95052, USA. Tel: (408) 727-0917
UK: PMI/SSM, 90 Park Street, Camberley, Surrey GU15 3NY. Tel: 0276 692392

Valley International, PO Box 40306, 2817 Erica Place, Nashville, TN 37204, USA. Tel: (615) 383-4737
UK: None (Sterling Audio only distribute Valley's processors, not their OEM Parts)

VCA Associates, 7131 Owensmouth B87, Conoga Park, CA 91303, USA. Tel: (818) 704-9202
UK: Sound Technology plc, 6 Letchworth Business Centre, Avenue One, Letchworth, Herts, SG6 2HR. Tel: 0462 480000

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Barry Fox

Developments in Solocopy discussions and Sony 20 bit recordings

There have been some interesting developments on the *Solocopy* front. That's the system that was proposed by Philips two years ago as a way of limiting the number of digital copies that a DAT recorder can make.

At the time CBS and the IFPI were still trying to flog the *Copycode* dead horse, so Philips clammed up immediately after unveiling the *Solocopy* proposal at a London seminar organised by the European Commission's Copyright Unit. Since then Philips have refused even to mention the name *Solocopy* in any on-the-record discussion. The reason given was that Philips did not want to go public on any of the topics under private discussion at the endless series of roundtable meetings between the electronics companies and IFPI. Philips, owners of Polygram, have been playing middle man at these meetings.

Now cracks are showing in Philips' patience. When a group of American journalists visited Eindhoven in the spring, they asked about *Solocopy*—and got answers. Needless to say they then went back to America and wrote about them. There wasn't anything new but whereas everything previously written about *Solocopy* has been the result of back door sleuthing, deduction and surmise, we can now be positive about the proposal that has been on the table for the last two years.

We now know that at the roundtable meetings the IFPI always say they object to any domestic recorder that can make digital copies of compact discs unless a 'meaningful' tax is levied on the blank recording medium. By 'meaningful' the IFPI mean so large that no one will buy blank media.

The Japanese electronics companies then object to any technical systems that prevent copying. They also argue that it is unfair to levy a large tax when many people will only be copying discs they have already bought. The British Government have already rejected the idea of a tax altogether.

So far the only DAT decks offered to the public have been available just in Japan. They cannot make a digital copy of a CD, because the makers bowed to the IFPI and created deliberate mismatch between the recording frequencies, 44.1 kHz for CD and 48 kHz for domestic DAT. Not surprisingly, these DAT recorders do not sell, even to gadget-hungry Japanese shoppers.

The Japanese know they have to do something. Matsushita, makers of Panasonic and Technics audio and video equipment, are the largest consumer electronics company in the world. The company's future in this field depends on the sale of new digital technology they cannot sell. Akio Tanii, president of Matsushita, admits there is stalemate.

"The trend is from analogue to digital," Tanii told me in Tokyo. "The consumer has the right to have this technology. On the other hand, copyright holders, musicians and artists, do not want consumers to copy what they produce. Unfortunately there is no convenient solution."

Philips have now come off the fence and said bluntly that there is no point in selling a recorder that cannot make one full quality digital copy of each CD. *Solocopy* lets people make one copy of a CD but not to then copy or 'clone' the copy.

Solocopy relies on the ability of any digital recorder, whether using tape or disc, to insert an extra bit of code or 'flag' into the digital data stream when it makes a recording. Unlike *Copycode*, which put an analogue notch in the music signal, the *Solocopy* code is completely inaudible. But, rather like the *Copycode* notch, it is recognised by any other digital recorder equipped with sensor circuits. The recorder then refuses to record. So a recorder can make a digital copy of a CD, when connected to a CD player with digital output. But the digital copy cannot be cloned.

We now also know that a modification called *Solocopy 2* allows digital dubbing and then allows one digital copy of the dub, eg for editing. After that, the copy won't copy. Think of it as a 2-flag system, with one flag stripped out at the edit copy stage to leave one other flag that prevents any further copying.

The Japanese would say 'yes' to *Solocopy* because it lets them sell a DAT recorder with the currently missing facility to dub at 44.1 kHz. The IFPI now does not want *Solocopy*; they say they prefer some other unspecified solution.

One theory is that this is a lock and key in the recorder's circuitry. Owners of DAT decks only get to borrow the key if they can prove to the IFPI that they are copying non-copyright material.

And the IFPI have now widened their objections to all digital recording systems, such as recordable CD.

You can see why the IFPI see *Solocopy* as a bad deal. It does nothing to prevent analogue copies being made. It also does nothing to stop someone making many identical digital copies of the same CD by playing the disc over and over again, and making a fresh copy each time.

But I wonder if the IFPI has sussed that *Solocopy* has a hidden technical benefit for the record companies that will only become apparent after the system is widely adopted.

The CD system already provides for the insertion of copy-prohibit flags in all discs sold to the public. The idea was to let record companies decide whether to allow digital copying from disc to tape. But most record companies have never implemented this option. Often they do not even know of its existence. Some regarded it as redundant once Japan agreed to the frequency mismatch that has so far prevented all digital DAT copying.

If digital recorders with *Solocopy* now go on sale with the facility to make one digital copy, the public will at first be able to use them as intended. But if the record companies then start to add flags to CDs, the public may well find that their *Solocopy* recorders suddenly refuse to make even one digital copy of a CD, even on to a tape or disc that has been taxed to compensate the record industry for home copying. Some CD players, such as Philips' own, automatically add a copy-prohibit flag to the digital output—regardless of whether the CD is flagged or not.

I asked Philips about all this. I was told that "there were so many issues involved that it is impossible to answer".

> If the record companies start to add flags to CDs, the public may well find that their Solocopy recorders suddenly refuse to make even one digital copy of a CD, even on to a tape or disc that has been taxed to compensate the record industry for home copying

While the industry argues about whether DAT should be regarded as a professional tool or not, Sony have been pushing ahead with tests on a new 20 bit DASH format. By the end of April, EMI's mobile had made two location recordings using a modified *3402*. The first was in Germany, with the Berlin Philharmonic under Dietrich Fischer-Dieskau singing Mahler songs. The second was at Walthamstow Town Hall with the London Philharmonic performing Mozart's *Requiem*. More will follow.

The *3402* uses standard ¼ inch tape running at 15 in/s but has a modified track pattern to allow 20 bit recording. So far the DACs are in external boxes but when the system is finalised they will, of course, be built into the chassis. Sony says the DACs are working as near 20 bit as current chip technology allows.

Why do this, when the CD system offers only 16 bit resolution? Think of it as headroom, rather as digital mixing desks work at 18 bits or over. What you get out of the tape system and on to master disc is true 16 bit. Those who have heard the modified *3402* describe the difference between 20 and 16 bit working as 'chalk and cheese'.

Decca's pioneering work on digital tape, which spun off from the mastering system for the abortive Teldec video disc, left room for 18 bit code. There were no 18 DACs available at the time. The very wise men at Decca were thinking ahead.

Although the first two 20 bit Sony sessions were only experimental, with multitrack backing, CBS Masterworks plan to release the results, along with other sessions in the pipeline, on a new 'Classical Sony' label due to appear towards the end of this year. These discs will have a label identifying them as 20 bit recordings.□

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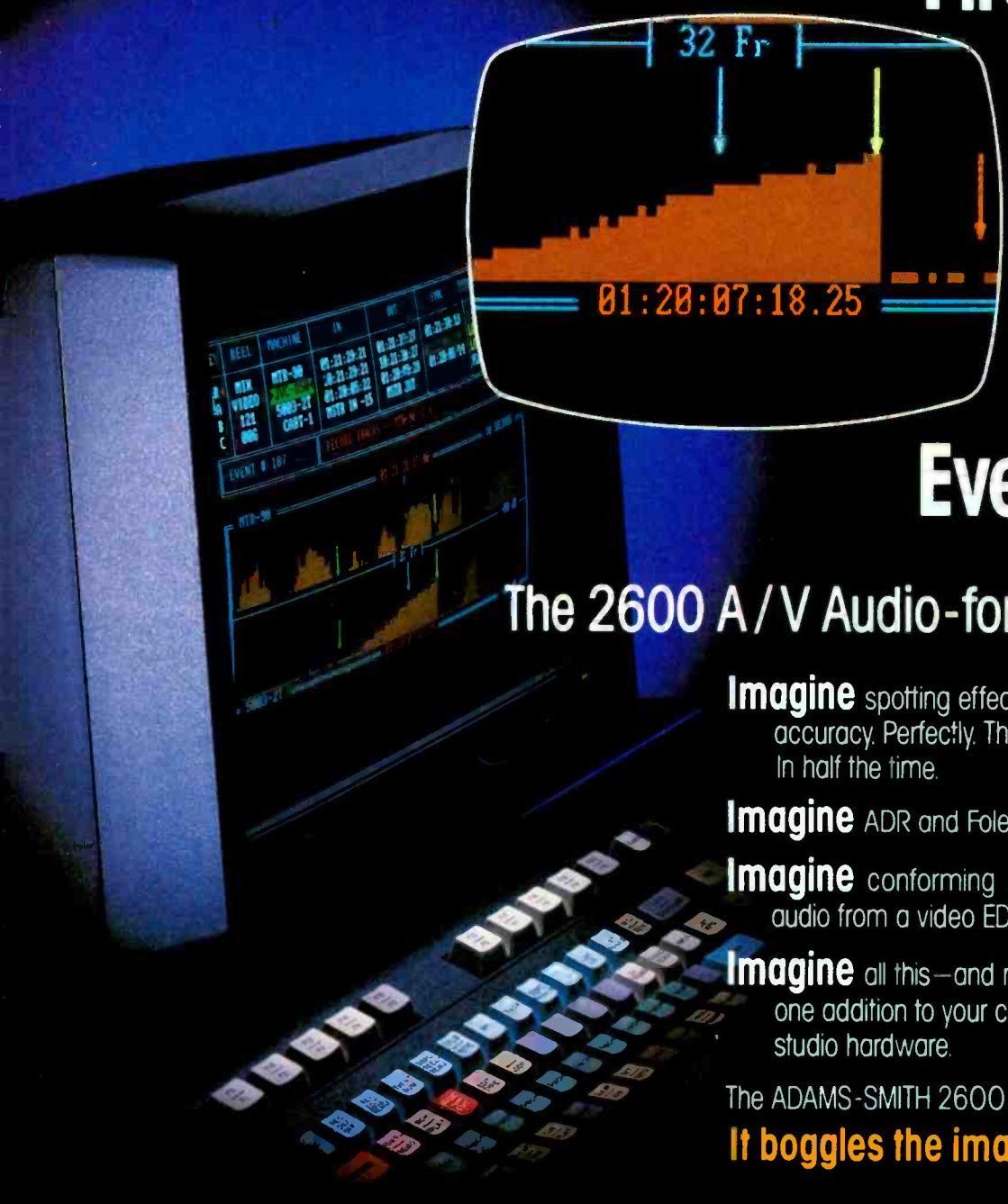

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Otari MTR-100A

Patrick Stapley looks at Otari's new analogue multitrack recorder

The *MTR-100A* was first unveiled at the Paris AES and became commercially available towards the end of '88. The machine succeeds the *MTR-90 Mk 2* as Otari's top analogue multitrack, and offers improved audio as well as a number of new features, including auto alignment. The machine inherits the characteristic Otari styling with its off-white, dark grey colour scheme and familiar built-in metering. However, it is noticeably taller than its predecessor and weighs an extra 70 kg at 270 kg. Like the *MTR-90* it has pinchrollerless transport, which, along with other functions, is microprocessor-controlled.

Controls

Most of the transport controls appear on both deck and remote, although some, like the cue wheel and varispeed controls, are only found on one. The brightness of illuminated buttons is controlled from a sensor, situated on the machine, which dims them in relation to local lighting by up to 30%. Loading the machine is now more straightforward, and a single press of the stop button is all that's required to take up slack and apply the correct tension: there is also an unload button on the deck that disables the reel servo system and relaxes the tension. The tension arms are of a different design to the *MTR-90* and are more rigid, also the rubber compound on the tach and capstan rollers has been changed to provide better 'stiction'. The machine will run at 7½, 15 and 30 in/s with a maximum user settable fast wind speed of 472 in/s, which is a good deal faster than the *MTR-90*'s 250 in/s. Alternatively a second settable wind mode is available by hitting the second function button together with the appropriate wind/rewind key. Tape speed is one of the displays that can be selected at the tape time window and, depending on dip switching, is represented either in terms of in/s or cm/s; the other displays are tape position, which reads either tach (1/10 s accurate) or timecode (from tracks 8, 16 and 24) and the percentage change in tape speed.

The cue button has three functions: if it's pressed while the machine is winding, the tape lifters will retract allowing an attenuated signal to be monitored from tape; with the machine in stop or play, a single press will engage shuttle mode and a double press will enter jog mode. Both these modes are controlled via the cue wheel, which is reminiscent of the 'search dial' on digital editors in function and appearance. The cue wheel is also used for setting up values for wind speeds and to adjust parameter values during manual tape alignment.

The machine will drop into record either by a single button press or by a combined two-button press depending on dip switch selection. Similarly drop-outs with tape in motion can be a one- or two-button operation. The *MTR-100A* provides *GSPIPO* (Gapless Seamless Punch In Punch Out) but it's possible to disable it in favour of a much quicker non-ramping response.

The second function button, mentioned earlier, if used in conjunction with the record button, puts the machine into spot erase mode. Reverse play mode is entered by pressing the second function button together with play, and it's possible to disconnect erase, enabling backwards recording without having to turn over spools and recalculate tracks.

The head shield can be lifted or dropped by a button on the deck but the famous mechanism that gave birth to the voice of R2D2 in *Star Wars*, has been replaced by a quieter more robust assembly.

A 'mini' autolocator is incorporated in both deck and remote; each provides three locate points as well as zero, and has cycle and 'locate to last play' facilities. There is the option of a more comprehensive, standalone autolocator—the *CB-120*.

Varispeed operates over a range of ±50% (30% more than the *MTR-90*) and is controlled by a velocity sensitive rotary control that changes the pitch in 0.01% steps if turned slowly but in much coarser intervals when moved quickly. A three-position knob selects between FIX, EXT, and VARI. The varispeed value can be displayed as a percentage or as in/s.

The remote houses the usual ready/safe, input, sync, repro matrix with individual or master switching for each status. Any combination of these switches can be stored in four channel set-up memories allowing, for example, a selection of tracks to be switched from sync to input as a group. Another way this can be achieved is by

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using the rehearse button, which inhibits record, and switches readied tracks into input, allowing a drop-in to be checked before it's too late!

Auto alignment

At the front of the machine, between deck and meters, is a retracting panel that contains the controls connected with auto and manual alignment. On the left of the panel is a pad of 24 channel keys, which double as alphanumeric keys, in the centre is a LCD with five associated soft keys, and to the right are a group of six command keys and a small monitor speaker. Auto alignment works for record, replay and sync, and will align all 24 channels or just selected ones. The system provides four *RAM* stores for each tape speed, which contain complete alignment data, including reference flux level and EQ curve information. Each 'tape type' store also contains a 13-character read out used to identify a particular line up. Factory default values for overbias, parameter offsets, oscillator frequencies and levels, etc, can all be changed but they act as good starting references and are retrievable from *ROM* whenever required.

Replay and sync alignment is performed using a test tape or reference tones recorded on a master. The procedure is completely menu based—the operator simply follows a logical sequence of instructions and plays the portion of tones relevant to the current adjustment. A full alignment for both replay and sync, adjusting gain, HF and LF, takes approximately 1½ mins. Manual alignment is carried out in the same way but using the cue wheel on the tape deck to adjust trimmer values.

The record side is aligned with an internal sine/squarewave oscillator, which has a range of 10 Hz to 25.5 kHz. The adjustable parameters are gain, bias, phase compensation, HF EQ, Mid HF EQ and Repro LF compensation. As with replay/sync auto alignment, each parameter on each channel is checked three times to ensure best possible results, if at the end of the alignment process a problem has been encountered, the machine will indicate the channel and parameter in question. Once the machine has aligned successfully—about four minutes—it will back erase to the head of the tape and automatically record a run of reference tones. In addition a line up check can be performed by putting the oscillator into auto sweep mode, whereby it sweeps between 10 Hz and 25.5 kHz, giving clear meter indication of machine response.

An option on the *MTR-100A* is an internal card frame for noise reduction, which will accept Dolby *SR Cat 350* cards, or the combined *SR/A Cat 300* cards. Noise reduction is then switched in/out from the remote, where a button labelled NR select mode, causes the monitor selectors to switch the corresponding channels in the following manner: Input=Dolby A; Sync=Dolby SR; Repro=NR Off. The internal Dolbys can also be auto-aligned and reference Dolby tone or Dolby noise will be added to the tone run.

Other features

The *HX Pro* (Headroom Expansion) system, which was developed by Bang & Olufsen and is now being manufactured under licence by Dolby, is a standard feature of the machine. The system first appeared on domestic cassette machines and it automatically adjusts bias to produce the optimum distortion, frequency and noise response for a given signal. It tends to be more effective at slower speeds and an indicator on the meter panel shows whether or not the system has been switched on.

The record and replay heads have changed from the hyperbolic type of the *MTR-90*, to a hemispherical type, resulting in a much flatter bass response. Audio improvement has also been achieved by mounting the head preamplifiers directly under the headblock, so reducing the length of cable. The headblock is now a 1 in thick stainless steel casting and is easily interchanged with a 16-track assembly, which automatically reconfigures the electronics for 16-track operation.

To make maintenance easier, components like the reel and capstan motors can be removed from the top of the 2 in thick deck plate, without having to get underneath it. General internal access has been improved, with the deck now lifting on air dampers, and the meter panel lifts and latches in two positions—angled up for alignment purposes and horizontal for access to NR cards. As before, audio cards, control cards and the power supply are all readily accessible behind the front 'cupboard' doors.

When the machine is switched on it runs a self-diagnostic test sequence and any errors will appear on the alignment *LCD*. There are also two other user selectable tests that check the machine in more thorough detail. Extensive use of dip switches and menus enables the machine to be set up and function in numerous user-determined ways, a few of which have been mentioned.

Connectors and options

All the connectors are on the rear panel of the machine; audio I/O are via *XLR* although there is the option of DL multiconnectors, a 50-pin connector pin is provided for external NR remote control, serial *RS-422A/RS-232C* connectors are provided for transport control, there is a BCD output for external tape time display and the option of a console interface. The remote control unit is connected via a serial interface, which is an improvement on the three multicores needed to connect the *MTR-90* remote. The optional *CB-120* autolocator has a parallel interface, and the optional *EC-103* plug-in synchroniser and remote have a special connector panel.□

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