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# STUDIO SOUND

AND BROADCAST ENGINEERING

INTERNATIONAL PRO AUDIO  
AND POSTPRODUCTION MAGAZINE



## DAWs

- ATM: The new network?
- Fostex Dancing Fader Module
- FED Video Mod 100
- dSP Poststation

## Monitoring

- Quested's material witness
- The waveguide conspiracy
- Design principles on trail

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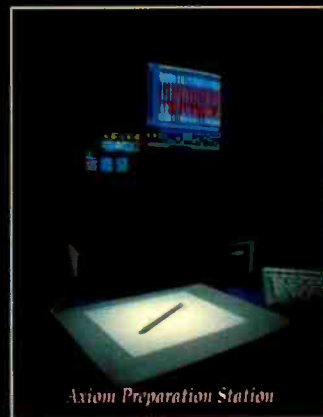




# Axiom

## F I L M M I X I N G S Y S T E M

Film  
mixing direct  
from hard disk



Axiom Preparation Station

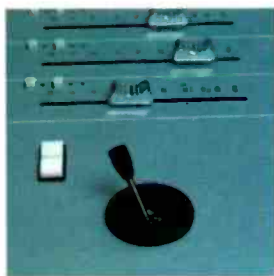


### SSL DIGITAL

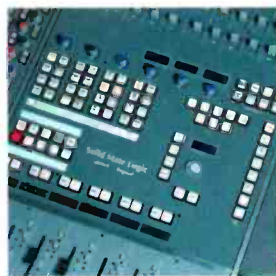
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# STUDIO SOUND

AND BROADCAST ENGINEERING



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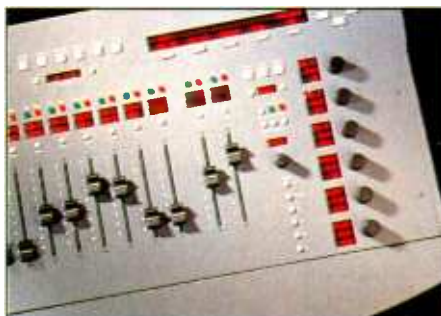
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# STUDIO SOUND

AND BROADCAST ENGINEERING

September 1995.  
Volume 37, Number 9.  
ISSN 0144 5944

## EDITORIAL

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London SE1 9UR, UK.  
Tel: 0171 620 3636. Fax: 0171 401 8036.

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The contents of *Studio Sound and Broadcast Engineering* are subject to reproduction in information storage and retrieval systems.

*Studio Sound and Broadcast Engineering* incorporates *Sound International and Beat Instrumental*.

*Studio Sound and Broadcast Engineering* is published monthly. The magazine is available on a rigidly controlled requested basis, only to qualified personnel.

The publisher may pass suitable reader addresses to other relevant suppliers. If you do not wish to receive sales information from other companies, please write to Circulation and subscription at the address below.

## SUBSCRIPTION RATES

UK annual subscription: £24.00  
Europe surface mail: £30.50/US\$52.00  
Overseas airmail: £52.50/US\$89.00  
US airspeeded delivery: \$70.00

Refunds on cancelled subscriptions will only be provided at the publisher's discretion, unless specifically guaranteed within the terms of the subscription offer.

## CIRCULATION AND SUBSCRIPTION

**Assistant Circulation Manager:** Joanna Southward

**UK:** Miller Freeman Entertainment Ltd,  
Royal Sovereign House, 40 Beresford Street,  
London SE18 6BQ. Tel: 0181 855 7777.  
Fax: 0181 317 3938.

**USA:** *Studio Sound and Broadcast Engineering*  
Magazine, 2 Park Avenue, 18th Floor,  
New York NY 10016.

## US Postmaster

Please send address corrections to: *Studio Sound and Broadcast Engineering Magazine*, c/o Mercury Airfreight International Ltd Inc, 2323 Randolph Avenue, Avenel, New Jersey NJ 07001.  
US second class postage paid at Rahway, NJ.

Origination by Craftsmen Colour Reproductions Ltd, Unit 1, James Street, Maidstone, Kent ME14 2UR, UK.

Printed in England by St Ives (Gillingham) Ltd, 2 Grant Close, Gillingham Business Park, Gillingham, Kent ME8 0QB, UK.

Newstrade Distribution (UK).  
UMD, 1 Benwell Road, London N7 7AX, UK.  
Tel: 0171 700 4600. Fax: 0171 607 3352.

**ABC**  
AUDIT BUREAU OF CIRCULATIONS  
BUSINESS PRESS

**PPA**

Total average net circulation of 18,566 copies July 1993-  
June 1994. (UK: 6,927. Overseas: 11,639. (ABC audited)

**Miller Freeman**  
A United News & Media publication

## Enigma variation

I recently spent a weekend with Adam and Betty—and Eve, of course. I didn't see her, but I knew she had to be there. Looking around I realised that I had gate-crashed a party and was keeping the company of more and greater people than I had realised; Georg Riemann, Francis Walsingham, Alan Turing, Frederick Marryat, David Hibbert, Hans Fischer and Karl Gauss to name a few. Last to join the party—and add a dash of contemporary glamour—was the author, Robert Harris.

It was a cryptographers' party, of course.

There have been other, similar, parties that I've crashed: very recently there was the Information Superhighway party; that neatly followed the Chaos Theory party of a few years back; the Genetic Engineering party a while before that; and the Microchip party before that. The enormous Digital Electronics party is still going on, everyone appears to be welcome...

All of these celebrations are simply the result of some technological innovation catching the imagination of the public. A popular trivialisation of some significant scientific innovation or revelation. But once these terms break out into the public domain, they become the justification for a wide variety of books and films, advertising campaigns, political imperatives and God knows what else. At the same time they become the scapegoats for a contrasting set of issues. The latest such phenomenon could easily be cryptography.

About to receive its highest peacetime profile through Robert Harris' novel, *Enigma*, encryption has become an integral part of the modern IT and communications business. Where *Enigma* concerns itself with the events surrounding the Allies' breaking of the German WWII Enigma code at Bletchley Park, what should concern pro-audio and video operators is the escalating vulnerability of new working methods. Our ongoing acceptance of systems such as ISDN, ATM, and OMS increasingly expose our programme material to the activities of high-tech pirates. As we send greater numbers of rough music mixes, film rushes, preliminary edits and even masters over commercial comms system, we risk bringing methods of piracy already in use in other areas into our own. For while most comms systems employ some form of encryption (cellular telephones, for example, use the French A5 format) these are invariably low-level and easily broken by anyone with sufficient incentive.

The consequences here are easy to see—with piracy of cassettes, CDs and videos already established and worth big money, being able to tap into the transmission of a new album, feature film or even multimedia programme in advance of its release could badly compromise its commercial viability. Ultimately, it could have a major impact on the business as a whole.

The security problem is exacerbated by the attitudes of Western governments to the area of encrypted communication—in short, it makes them extremely nervous. And while we can safely assume that they have no vested interest in piracy, we can be absolutely certain that the prospect of terrorist and pornographer communications being too cleverly protected for the appropriate government agencies to decipher is of considerable interest. Curiously, of the European governments, only Germany advocated high-level encryption for cellular telephones.

The experts are already talking about the issue of encrypted communications in terms of a 'battle for freedom which will shape our society into the next century' and of the need to 'strike a balance between personal, social and business freedom and governmental control'. It's serious stuff.

Some years ago I spent a while at Bletchley Park; I have heard the ghosts of broken codes and broken codebreakers. More recently I have been keeping a secret of my own: as of next month there is to be a new look to *Studio Sound*. I've got to go now—it's not safe here. But I'll tell you all about it next issue. ■

Tim Goodyer

Cover: Fairlight MFX3 Digital Audio Workstation

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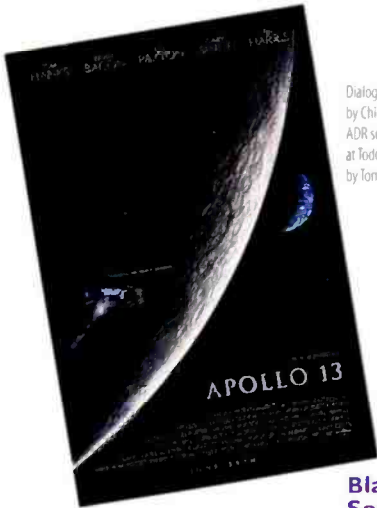
Tune in to ABC Radio, BBC, CBS, NPR, Premier Radio, Dutch Radio or anywhere up and down the dial and chances are you're listening to Sonic.

**Multimedia: The New Frontier**



*Star Trek: A Final Unity*. Editing by Mark Waldrep, Pacific Coast Sound Works.

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Dialog editing supervised by Chic Ciccolini at Hastings Sound, ADR supervised by Lisa J. Levine at Todd-AO/East, 20-bit music editing by Tom Drescher, Wonder Dog Music.

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# World Events

## September 1995

● September 6th-9th, **NAB Radio Show (including SBE Engineering Conference and World Media Expo)**, New Orleans Convention Centre, New Orleans, USA.  
Tel: +1 202 429 5350.

● September 7th-8th, **Screen Entertainment Conference**, Conrad Hotel, Hong Kong.  
Tel: +65 732 1970.

● September 10th-12th, **ECTS**, Olympia Grand Hall, London, UK. Tel: +44 181 742 2828.

● September 10th-13th, **PLASA**, Earls Court 2, London, UK. Tel: +44 171 370 8179.

● September 14th-18th, **IBC 95**, RAI Centre, Amsterdam, Holland. September 19th-24th, **Live 95**, Earls Court, London, UK. Tel: +44 181 742 2828.

● September 21st-24th, **Nordic Sound Symposium XVII**, Bolkesjø Mountain Hotel, Norway. Tel: +47 2 79 7730.

● September 22nd-24th, **ShowBiz Europe**, MOC Exhibition Centre, Munich, Germany. Tel: +49 89 47 02 399.

## October 1995

● October 2nd-5th, **SATIS**, Porte de Versailles, France. October 3rd-11th, **ITU Telecom 95—the 7th World Telecommunication Exhibition and Forum**, PALEXPO, Geneva, Switzerland. Tel: +41 22 730 5111.

● October 6th-9th, **99th AES Convention**, Jacob K Javits Centre, New York, USA. Tel: +1 212 586 5989.

● October 17th-19th, **Vision 95**, Olympia, London, UK. Tel: +44 181 948 5522.

● October 18th-19th, **SoftExpo**, RAI International Exhibition and Congress Centre, Amsterdam, The Netherlands. Tel: +1 303 745 5711.

● October 23rd-25th, **European Cable Communications 95**, Olympia, London, UK. Tel: +44 171 222 2900.

● October 24th-26th, **REPLITECH Asia**, Singapore International Exhibition Centre, Singapore. Tel: +1 212 643 0620.

● October 25th-28th, **Broadcast Cable and Satellite India 95**, Pragati Maidan, New Delhi, India. Tel: +91 11 462 2710.

## November 1995

● November 1st-5th, **Audiovideo-95, Lenexpo** Exhibition Complex, St Petersburg, Russia. Tel: +7 812 119 6245.

● November 2nd-4th, **Broadcast India 95**, World Trade Centre, Bombay, India. Tel: +91 22 215 1396.

● November 7th, **Sound Broadcasting Equipment Show (SBES)**, Metropole Hotel, Birmingham, UK. Tel: +44 1491 838575.

● November 7th-9th, **Wireless World Expo 95**, Moscone Centre, San Francisco, USA. Tel: +1 301 986 7800.

● November 9th, **20th Sound Broadcasting Equipment Show (SBES)**, Metropole Hotel, NEC, Birmingham, UK. Tel: +44 1491 838575.

● November 14th, **UK AES Conference: Tape—Is There a Future?**, Imperial College, London, UK. Tel: +44 1628 663725.

● November 16th-19th, **Reproduced Sound 11**, Hydro Hotel, Wyndermere, UK.

● November 21st-23rd, **Visual Communications 95**, London, UK. Tel: +44 181 995 3632.

● November 23rd-27th, **9th International Audio, Video, Broadcasting and Telecommunications Show (IBTS)**, Milan Trade Fair, Milano-Lacchiarella, Italy. Tel: +39 2 48 15541.

● November 28th-30th, **Computer Graphics Expo 95**, Wembley Conference and Exhibition Centre, London, UK. Tel: +44 181 995 3632.

## December 1995

● December 5th-9th, **Expo Comm China South 95**, Guangzhou Foreign Trade Exhibition Centre, Guangzhou, Peoples Republic of China. Tel: +86 1 841 5250; US Tel: +1 301 986 7800.

● December 6th-9th, **Communications India 95**, Pragati Maidan, New Delhi, India. Tel: +91 11 462 2710.

## January 1996

● January 5th-7th, **Showbiz Expo East**, New York Hilton & Towers, New York, USA. Tel: +1 513 8400.

● January 30th-February 1st, **SortExpo 96**, Santa Clara Convention Centre, Santa Clara,

USA. Fax: +1 303 745 5712.

## February 1996

● February 6th-8th, **The ISDN & Broadband User Show**, Olympia 2, London, UK. Tel: +44 1733 394304.

● February 11th-14th, **SIEL 96**, Paris, France. Tel: +33 1 45 22 35 40.

● February 13th-16th, **Expo Comm Mexico 96 including Wireless Technologies Mexico 96**, World Trade Centre, Mexico City, Mexico. Tel: +1 301 986 7800.

## March 1996

● March 11th-14th, **DSPx 96**, San Jose Convention Centre, San Jose, USA. Tel: +1 203 840 5652.

● March 13th-17th, **Musikmesse and Pro Light & Sound**, Messe, Frankfurt, Germany. Tel: +49 69 7575 6662.

## April 1996

● April 4th-7th, **Broadcast Thailand**, Queen Sirikit National Convention Centre, Bangkok, Thailand. Tel: +66 2 503 2199.

● April 21st-23rd, **Midcab & Midsat 96**, Abu Dhabi Exhibition Centre, UAE. Tel: +971 4 310551.

● April 23rd-25th, **Entech 1996**, Sydney Exhibition Centre, Sydney City, Australia. Tel: +61 2 876 3530.

● April 23rd-27th, **Information Super Highway China 96**, Beijing Exhibition Centre, China. Tel: +86 841 5250.

## May 1996

● May 11th-14th, **100th AES Convention**, Bella Centre, Copenhagen, Denmark. Tel: +45 9785 1122.

● May 14th-16th, **Midem Asia**, Hong Kong. Tel: +33 1 443445444.

● May 25th-28th, **Pro Audio, Light & Music China 96**, Beijing Exhibition Centre, Beijing, China. Tel: +852 2861 3331.

For your World Event to be included, or updated, contact the Editor during your nearest appropriate time window.  
Fax: +44 171 401 8036.  
E-mail: cz73@cityscape.co.uk.



# ...how times change ...



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# International News

## In brief

### ● Newrooms at Metropolis

In line with the current drive to attract project-studio business back into the commercial sector, Metropolis are completing two new production rooms to add to the five studios and four mastering and postproduction rooms in the complex. Built around a 56-channel Mackie in-line consoles, the rooms both have sizeable control rooms, separate overdub booths and movable keyboard stations. Recording is on *Pro Tools III* integrated with *Logic Audio*.

**Metropolis Studios, UK.**

**Tel: +44 181 742 1111.**

### ● Major deal prompts

#### *SADIE* purchase

The London Festival Orchestra have signed a 90-album deal with BMG's Arte Nova label, leading them to buy their own *SADIE* Digital Editor. The contract hinged in part on the LFO editing and mastering their own CDs, and Conductor Ross

Pople and colleague Michael Field realised that acquiring their own facilities made economic sense as editors can charge £1,000 an album. *SADIE* was recommended by Tony Faulkner, who himself bought a system a few years ago.

**Studio Audio and Video, UK.**

**Tel: +44 1353 648888.**

### ● Asian distribution for Soundscape

Following their successful showing at Pro Audio and Light Asia 95, Soundscape Digital Technology have announced several new distributorships for the area to promote their DAW equipment including the *SSHDR1*. Singapore, Malaysia and Indonesia are covered by Singapore's AUVI Pvt Ltd, Japan by Continental Far East Inc, and India by Audio-Lab Pvt Ltd.

**Soundscape Digital Technology, UK.**

**Tel: +44 1222 450120.**

**AUVI Pvt, Singapore.**

**Tel: +65 283 2544.**

**Continental Far East, Japan.**

**Tel: +81 3 3581 8451.**

**Audio-Lab Pvt, India.**

**Tel: +91 22 631 6981.**

### ● *Miss Saigon* down under

*Miss Saigon* is the latest musical to open in Australia with a Cadac *J-Type* mixing console, premiering at the Capitol Theatre in Sydney on 29th July 1995. Sound design is by Autograph's Andrew Bruce, who specified the three-frame 86-input *J-Type* supplied by System Sound Pty.

**Clive Green & Co, UK.**

**Tel: +44 1582 404202.**

**System Sales Pty, Australia.**

**Tel: +61 3 9529 7755.**

### ● Alfa option for BSS

David Karlin has joined BSS Audio as the company's new Managing Director. Karlin has a strong background in ►

## Digital TV Group

A number of the UK's major communications, TV and electronics organisations have announced the creation of an industry-wide forum to smooth the introduction of digital terrestrial television into the UK.

Called the Digital TV Group, the forum aims to co-ordinate efforts to develop the technical systems necessary for digital television services to become practical as quickly as possible—by the end of 1997 it is hoped—in line with the timescale envisaged in the recent Government White Paper. The founder members are the BBC, British Telecom, Channel 4, ITV, Motorola, NTL, PACE and Sony.

Membership of the Group is open to all participants in the European Digital-Video Broadcasting project who wish to play an active part in implementing digital terrestrial television in the UK. The founding members are keen to emphasise that this is an open forum, not a commercial partnership or a joint venture, with the aim of developing an open and competitive market in

service provision, receivers and conditional access to ensure the rapid implementation of DTT services. The group will be co-ordinated by Brian Green of British Telecom. **Digital TV Group, UK.**  
**Tel: +44 171 728 3241.**

## ...who help themselves

On Sunday 23rd July 1995 two AKG *C451* microphones with capsules were stolen from 'the BBC church', All Souls Langham Place. The microphones were slung from the roof as a coincident pair, and in the space of less than an hour and a half, while the building was occupied, the thief managed to climb up on to the roof, haul up the mics and remove them unnoticed. The loss was only discovered shortly before the evening service was due to begin. The church's PA system, manned by a team of about eight volunteers, is used during all four church services each week, and for the several memorial services held at All Souls,

including those for Dan Maskell and Roy Castle. The in-house system is used for all events even when the BBC is in recording. The *C451E* microphones are serial numbers 522959 and 530611, with CK1 capsules numbers 82511 and 98751. Anyone with information on the whereabouts of the stolen equipment is asked to contact:

**PA Team Leader Jonathan Stunt.**

**Tel: +44 171 244 6823.**

**Fax: +44 171 436 3019.**

## Dave Harrison

Dave Harrison, founder of console manufacturers Harrison Systems, died on 17th August 1995 of a stroke following surgery for colon cancer. Harrison is credited with revolutionising the console market by pioneering off-the-shelf, as opposed to custom-built, consoles, and with developing the in-line format and modular, PCB-based designs. He licensed his original design to MCI before setting up Harrison Systems, and his company has remained at the forefront of console design ever since.



**UK: AMS Neve have invested £0.5m in new machinery for their UK-based manufacturing operation. The company have installed intelligent fully-automated surface-mount placement machinery and four semi-automated PCB stations, with links by network to their Computer-Aided Design suite. Director of Manufacturing Trevor Nuttall explains: 'Our ISO 9002 qualification demands that all output is completed to a strict standard and this latest technology is facilitating our quality-control process as well as improving the general efficiency of PCB production. 'One of only two in the UK, the surface-mount machine can place up to 5000 various-sized components per hour which represents a significant increase on previous methods. The additional semi-automated machines have significantly reduced production times for placing through-hole components. Again, by using software linked directly into the Drawing Office, they have improved the right-first-time performance.' AMS Neve, UK. Tel: +44 1282 457011**





**UK:** the ancient Welsh traditions of Druids and demons can be encountered once more in a striking exhibition designed by John Sunderland and entitled *Celtica*. The problems presented by the 10 laser disc and 20 CD players required to accommodate a wealth of fx, ambience and multiple language soundtracks were solved through the use of a Sennheiser infrared transmission system. The 9-rack SI1029 transmitter system is the largest yet installed in the UK. Sennheiser, UK. Tel: +44 1628 850811

## Barry Porter consultancy

An audio-design consultancy has been set up by Barry Porter, who was responsible for the circuit design of the legendary Trident *A Range* consoles, with Malcolm Toft handling the systems design. More recently, he has been involved in console designs for companies such as Raindirk, Cadac and Philip Drake, and many other audio products. Besides mixing consoles, specialities include power amplifiers, active loudspeakers, equalisers, analogue-tape electronics and test equipment.

The services offered by the new

company include initial design, PCB layouts; CAD drawings of enclosures and cabinets; prototype building and testing through to short-run production; evaluation of existing products and preparation of handbooks and manuals.

**Barry Porter Designs, UK.**  
Tel: +44 1582 665231.

## Rembrandt at Livingston

Livingston Recording Studios are the first UK studio to order Amek's new *Rembrandt* console. Studio 2 is undergoing an extensive refurbishment including a private

lounge and acoustic improvements by KFA, and will house the new 80-channel console. Co-owner Jerry Boys believes the *Rembrandt* incorporates the sonic attractions of their existing Amek *Angela* combined with the computer power of an SSL-Neve console, and comments: 'After looking at many alternatives, when Amek first showed us the *Rembrandt* it was like an answer to a prayer. Here at last was a console that has full-scale automation, Recall and Dynamics in a desk that sounded good and was completely affordable.' Amek, UK. Tel: +44 161 834 6747. Livingston Recording Studios, UK. Tel: +44 181 889 6558.

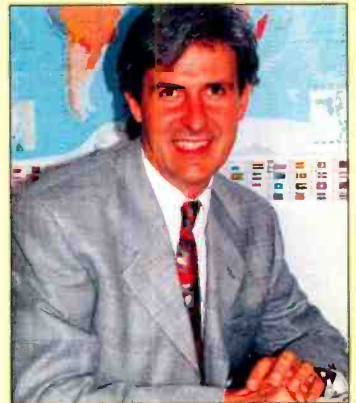
## SAE European expansion

The School of Audio Engineering have opened its first Swiss site within the Zurich Technopark, which also houses a congress hall, film-production companies and a number of multimedia organisations. SAE Zurich's Studio A will incorporate a 36-frame Neve VR console, 24-track Studer A800, telectronic M5000 Digital Audio Mainframe and 32 tracks of ADAT, used in conjunction with a 100m<sup>3</sup> live room. ►

### In brief

computer networking and digital technology, and will be spearheading BSS's thrust into the domains of DSP and computer-controlled audio processing. This follows the success in both the touring sound and installation markets of the *Omnidrive*, BSS's first all-DSP product launched late last year. Karlin was previously a consultant to the Harman Pro Group on DSP products and audio networking. His past career has included Fairchild Semiconductor, Sinclair Research, and the specialist data communications company Alfa Systems which he cofounded.

**BSS, UK.** Tel: +44 1707 660667.



### ▲ Soundtracs go West

Soundtracs have announced the appointment of Chris West as International Sales Manager to help broaden distribution and continue to increase sales of both new and existing product lines, with the new *Topaz* range of entry level consoles particularly in mind. West comes from similar senior positions with Harman Audio UK and Malcolm Toft Associates. At the same time, Soundtracs continue to invest in their operation, taking on more new staff and investing sizeable funds on new robotic equipment for their Glenrothes factory, increasing build capacity for the *Topaz* consoles.

**Soundtracs, UK.**

Tel: +44 181 388 5000.

### ● Stolen cable

During the early morning of 1st September, some cables were stolen from the outside broadcast compound at London's Wembley Stadium. Anyone who has been offered three 100m runs of 125 amp mains cable; four 100m and three 150m runs of camera triax; or three 100m, four 50m and four 25m runs of audio multicore is asked to contact Sunset & Vine Moblles on +44 181 569 8800 or Sound Moves on +44 181 471 4936. The audio multicore is blue and clearly marked 'Sound Moves'. Any information will be treated in confidence. ■



Amek's Nick Franks (left) and Livingston's Jerry Boyd consummate Livingston's intent to equip Studio 2 with a *Rembrandt* console



### Contracts

#### ● Radio Plassenburg into Orban

Radio Plassenburg of Kulmbach, Germany, have taken delivery of an Orban *DSE 7000* Digital Sound Editor to produce commercials, promos and news. The station produces eight hours of programming a day for 210,000 listeners they make all their own promos and commercials, and they cite speed and ease of use as deciding factors in the purchase.

Orban, USA. Tel: +1 510 351 3500.

Orban, Europe. Tel: +44 1344 412342.

Radio Plassenburg.

Tel: +49 9221 949350.

#### ● Avid enthusiasm in Denmark

Regional Danish broadcaster TV SYD are building a new production and broadcasting operation in Kolding based around Avid Technology's digital newsroom, editing and playback systems.

The new operation will include a 20-user Avid *NetStation* newsroom system (formerly *BASYS*), three *NewsCutters* for news editing, an *AirPlay* for digital playback, a *Media Composer 4000* for editing programmes, and a 16-channel *AudioVision*—Avid's top-of-the-range DAW. Danish systems integrators

Danmon Systems Group will be responsible for all design, installation and staff training in connection with the new operation. Nine other broadcasting centres in Denmark, also all part of TV2, already use Avid broadcast and newsroom systems.

Avid Technology, Europe.

Tel: +44 1753 655999.

TV SYD, Denmark.

Tel: +45 76303132.

#### ● TimeLines for Skywalker

Skywalker Sound, the audio-post division of Lucas Arts, have installed six fully-configured *TimeLine StudioFrame* DAWs. This is the first stage of the purchase of 16 *StudioFrame* systems which will make Skywalker one of the largest film audio-post users of the system in the world.

TimeLine Vista, US.

Tel: +1 619 727 3300.

#### ● Euphonix for CBS mobiles

Two of CBS' mobile units have been re-equipped with Euphonix *CS2000B* digitally-controlled, broadcast-mixing systems. The two 48-foot vans needed new consoles to fit the available space, and the *CS2000B*'s combination of compact size and features, including Euphonix' *SnapShot Recall*, prompted the purchase.

Euphonix, US. Tel: +1 818 766 1666. ■



The Netherlands: Wisseloord studios in Hilversum, The Netherlands, are now operating with their 72-channel SSL 9000j installed in early May. This is the first SSL 9000j equipped studio in Europe, and Wisseloord have already completed their first mixing project. A second recording project is under way. Other news from SSL includes the order from Radio France for probably the world's largest digital console, a 96-channel Axiom, for the refurbished Studio 103 in Paris. Solid State Logic, UK. Tel: +44 1865 842300.

Wisseloord Studios, The Netherlands. Tel: +31 35 6217256

The complex also includes an 8-track ADAT studio, MIDI suites, an edit area and *Pro Tools* workstations. The first intake of students are scheduled to begin work in September.

SAE are also constructing their fifth school in Germany, a three-studio complex within the German media community in Cologne. The main studio here will be 24 track, based round a 32 input Soundtracs *Jade* console with another to *M5000* and a *Lexicon 480*.

SAE Zurich. Tel: +41 1445 2040.

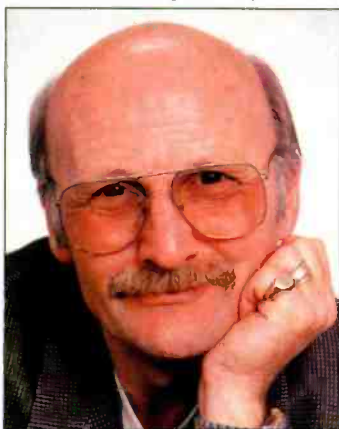
SAE Cologne. Tel: +49 221 954 1220.

SAE Amsterdam.

Tel: +31 20 689 4189.

## Chris Huston studio design

Best known for his work as producer and engineer with such artists as War, The Who, Led Zeppelin, James Brown, Van Morrison and Todd Rundgren, a career which has won him more than 80 gold and platinum



Chris Huston moves from production duties into studio design

records and a Grammy for Album of the Year 1973, Chris Huston is going commercial with his studio-design work. Since 1981 he has been designing recording studios, radio stations and video-production facilities for a select group of clients, and now he is marketing his services worldwide. Notable projects so far include George Benson's studio on Maui, Tom Petty's studio in North Hollywood, Sound Kitchen in Nashville, OMAC Video in Mexico City, The Enterprise, Polygram Records and Mike Post Productions in Burbank. This work means a return to his roots—Huston graduated in design in 1962 but was led astray to become lead guitarist with Merseyside group The Undertakers and then into production and engineering.

Christopher Huston Design, US.

Tel: +1 503 846 7642.

## Synchrosound studio opens

Malaysia's largest recording and postpro complex, Synchrosound Studio, will be up and running as of November. Through nine Walters/Storyk-designed suites, Synchrosound offers a comprehensive facilities for music recording, AV post, film and CD mastering. Pride of the music suites are SSL SL9000j and AMS Neve Capricorn consoles which keep the company of both digital and analogue multitrack machines, as well as an extensive selection of microphones and outboard. Heart of the postpro rooms are two Logic 2 consoles, each equipped with 24-output AudioFile Spectras configured for surround sound and HDTV




HBB's 1995 catalogue is now available, detailing more than 1,300 professional audio products in 128 colour pages. The large range covered includes HBB's exclusive distribution lines, such as CEDAR audio-restoration products; signal processors from Eventide and Summit Audio; as well as the entire range of DAT recorders available and recordable CD products.

HBB Communications, UK. Tel: +44 181 962 5000

operation. Further offline duties are handled by an AHB Sigma console. A Lightworks nonlinear system is also on hand and open media interchange formats will be supported wherever possible. For film work, Synchrosound has THX facilities employing Apogee MPTS-1 monitors. CD mastering is supported through a Sonic Solution system. The studio's VP of Operations, Bernadette Kelly, will be waving the Synchrosound flag at the forthcoming New York AES Show under the wing of the World Studio Group where it is hoped to develop the international profile of the facility.

Synchrosound Studio, Malaysia.  
Tel: +60 3 755 7777. ■





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In brief



▲ Hearos ear protectors

Newly launched in the UK after success in the States is the *Hearos* range of hearing protectors, designed to offer maximum protection for musicians, road crews and sound engineers. The four styles in the range include waterproof *AquaHearos* and disposable version offering 30dB of noise reduction. An unusual endorsement came from Motley Crue, who made *Hearos* available to their audiences during last year's world tour.

**US:** DAP Enterprises.  
Tel: +1 818 786 3295.

**UK:** The Music Shipping Company.  
Tel: +44 1562 886641.

● Crown CM-700

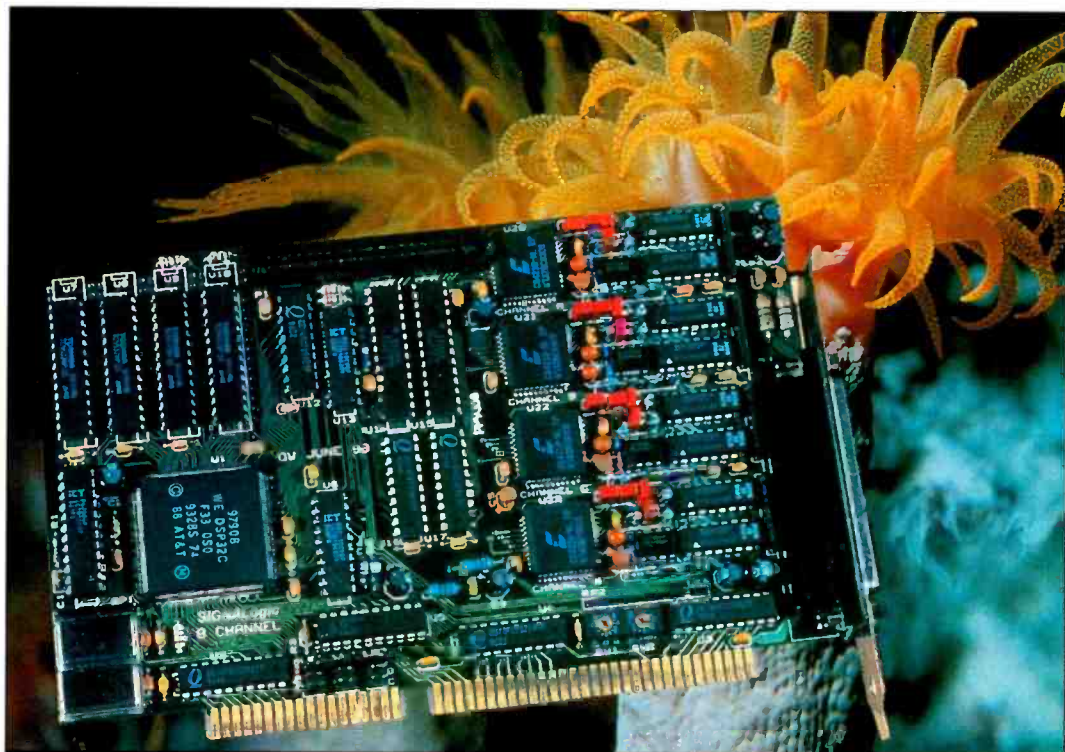
Crown are entering the studio condenser microphone field with the *CM-700* compact cardioid. Intended for both studio and live applications, it is designed to handle high SPLs without a pad and to provide a smooth frequency response both on and off axis. Features include an ultralight diaphragm, humbucking transformer, polycarbonate capacitors and a gold-plated XLR. Its facilities include a three-position bass tilt switch and a two-stage foam pop filter.

**Crown, US:** Tel: +1 219 294 8000.

● Creamware WaveWalkers

Creamware have released v1.1 of *tripleMAGICI* for the *tripleDAT* system, allowing the handling of two soundboards with improved synchronisation features, alongside a new software plug-in called *WaveWalkers*. This allows real-time audio effect processing on any Pentium-90 or faster PC, including a room simulator, a delay processor, dynamics, and 4-band parametric EQ. Also provided are a selection of measuring and testing tools including a spectrum analyser and a correlation meter with vectorscope.

**Creamware Datentechnik, Germany.**  
Tel: +49 2241 59580.



Signalogic's *Sig32C-8* PC DSP plug in—32-bit floating-point processing, 16-bit sigma-delta conversion and 8 channels of I-O

**CLIO UK debut**

*CLIO*, a PC-based audio-testing system developed by Italian equipment manufacturer Audiomatica, is now available in the UK through DBS Audio. The system, on a half-length card, provides a range of test and measurement functions via a mouse-driven Graphics User-Interface. Nine instruments include MLS time-domain analyser, which allows

room reflections to be removed and frequency-phase responses and waterfall plots to be generated, a programmable signal generator and RMS voltmeter, a swept frequency-phase response analyser, 16-bit FFT analyser with THD meter, storage scope, third-octave analyser and RT60 room acoustics analyser.

Measurements can be saved, recalled, manipulated and exported for CAD of crossovers and so on, and in addition *CLIO* measure impedance and derives Thiele/Small-speaker

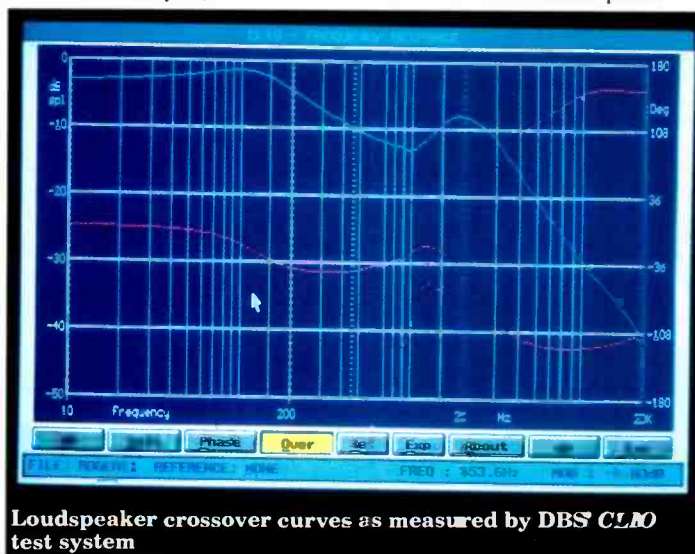
parameters. A calibrated *CLIO* electret microphone is available for use with the card.

**DBS Audio, UK.**  
Tel: +44 1284 828926.

**Signalogic  
Sig32C-8**

The *Sig32C-8* from Signalogic is a PC plug-in board incorporating an 80MHz AT&T DSP32C 32-bit floating point DSP, up to 640kx32 SRAM, and eight channels of analogue I-O. Each channel contains 16-bit sigma-delta A-D and D-A converters and programmable input gain, output attenuation and sample rate.

The card is fully supported by Signalogic's *Hypersignal-Macro* and *Hypersignal-Acoustic* software packages, and all these products can be used with the company's *DSPower-HWLib DLL*, which offers C/C++, Visual Basic and MATLAB programming interfaces, and also with their *DSPower-Block Diagram* package, which offers block-diagram user-interface, simulation and source-code generation. The combination provides sophisticated DSP-based instrumentation, visualisation and display of ▶



Loudspeaker crossover curves as measured by DBS *CLIO* test system



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**In brief**

● **AK ES.Lock software**

Audio Kinetics have released new software for their *ES.Lock* system, addressing a range of issues including varispeed synchronisation, enhanced serial control facilities and reverse play synchronisation. The main feature is the FIT mode which enables synchronisation to be performed at varispeed on all continuously controllable transports. Uses for the facility include correcting off-speed material and allowing fixed speed corrections to pull slave material up or down in speed. The software allows the difference in rate to be adjusted between 24 and 25fps, and by the 0.1% difference between NTSC and 30Hz frame rates.

Also included is a Serial Only synchronisation facility, removing the need for dedicated LTC or VITC connections for Sony 9-pin controlled devices. The upgrade is available for all *ES.Lock 1.12* and suitably equipped 1.11 units.

Audio Kinetics, UK.  
Tel: +44 181 953 8118.

● **Graham-Patten D-ESAM 200**

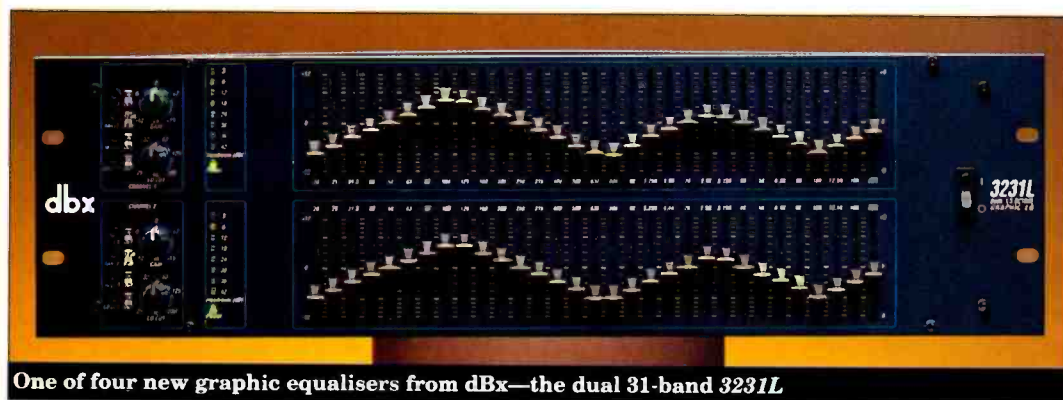
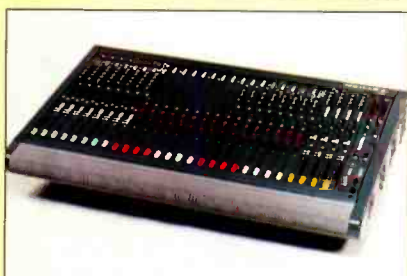
New from Graham-Patten Systems is the *D-ESAM 200* digital-edit suite audio mixer, the latest addition to the range featuring the familiar human interface, a compact design, 20-bit audio throughout, eight inputs and four digital and analogue outputs. The new mixer is aimed at the smaller digital edit suites who need a digital mixer for two- and three-machine sessions and for whom the *D-ESAM 400* and *820* configurations are larger than necessary.

Graham-Patten Systems, US.  
Tel: +1 916 273 8412.

▼ **Soundtracs Megas II Mix Broadcast**

Soundtracs' latest console for the recording and broadcast industries is the *Megas II Mix Broadcast*. The *Broadcast* has a number of module options, the most notable being a choice of master module, one an extended broadcast module offering automatic ducking control plus additional control of the clean feeds and remote start functions. All input modules are available with or without EQ and offer comprehensive clean feed and remote start facilities.

Soundtracs, UK.  
Tel: +44 181 388 5000.



One of four new graphic equalisers from dBx—the dual 31-band 3031L

waveforms, block-diagram-based automation of development and test sequences, and numerous tools for all levels of DSP product, system and algorithm development.

Instruments can show any two of the eight channels at once, and any number and combination of the eight can be recorded and generated continuously to or from hard disk. Instrumentation includes a digital oscilloscope, real-time spectrum analyser, continuous signal generator (up to eight channels), stimulus and response measurement, digital tape recorder and more.

Signalogic, UK.  
Tel: +1 214 343 0069.

## JRF Ultra Analogue kit

JRF Magnetic Sciences have introduced a conversion kit for the Studer A-800 analogue multitrack recorder to turn it into a 2-inch 8-track with time code. The record and play heads each have eight 200mil audio tracks, while a fourth head places an 18mil time-code track between audio tracks four and five. The complete conversion package includes all the electronics required for the time-code track. Along with the traditional analogue characteristics, the wide tracks are claimed to give near-digital dynamic range and signal-to-noise ratio, with a typical output per track quoted as being 9dB hotter than 24-track at 15ips.

The conversion can be fitted on any A-800 2-inch machine with no mechanical modifications being required, and packages for other Studer models (A-80, A-820 and A-827) may be made available on customer request.

JRF Magnetic Sciences, US.  
Tel: +1 201 579 5773.

## dbx 30 series and 290

dbx will be launching a new range of products aimed at recording, broadcast and sound-reinforcement applications at the Plasa show. The *30 series* comprises four new graphic equalisers, including the *3031C* 'cut only' 31-band EQ and the *3231L* dual 31-band model. All feature a passive power-off bypass as well as an active bypass for comparisons, and interfacing on XLRs, barrier strips and 1/4-inch RTS connectors.

Also new is the *290* reverb, a true stereo in-out dedicated reverb effects processor incorporating six programmable algorithms ranging from rooms and plates to cathedrals and halls.

Harman Audio, UK.  
Tel: +44 207 5050.

## SADiE hardware controllers

Studio Audio have launched two hardware control surfaces to supplement control of the *SADiE* and *Octavia* digital audio workstations and provide the user with a fully featured tactile interface. The main control panel provides time displays, jog wheel, transport and editing controls, assignable function keys and an assignable motorised fader. The weighted jog wheel controls the speed or position of playback and allows full scrub editing facilities, while the motorised fader can be used to automate any sort of custom fade and level characteristic or simply control the monitoring volume.

The fader panel contains eight motorised faders plus assignable shaft

encoders for EQ and other adjustments. All faders can be assigned to any playback stream and can be changed in banks or individually, with group control from one fader if desired. The controller allows full control of all the automated mix parameters, including aux sends and returns, and up to four banks of faders can be ganged together.

The two panels have been designed to control *SADiE* software v3 under RS422 protocol but can emulate a JL Cooper *CS10* controller, with the addition of moving faders, under MIDI control in *SADiE* v2.2.  
Studio Audio and Video, UK.  
Tel: +44 1353 648888.

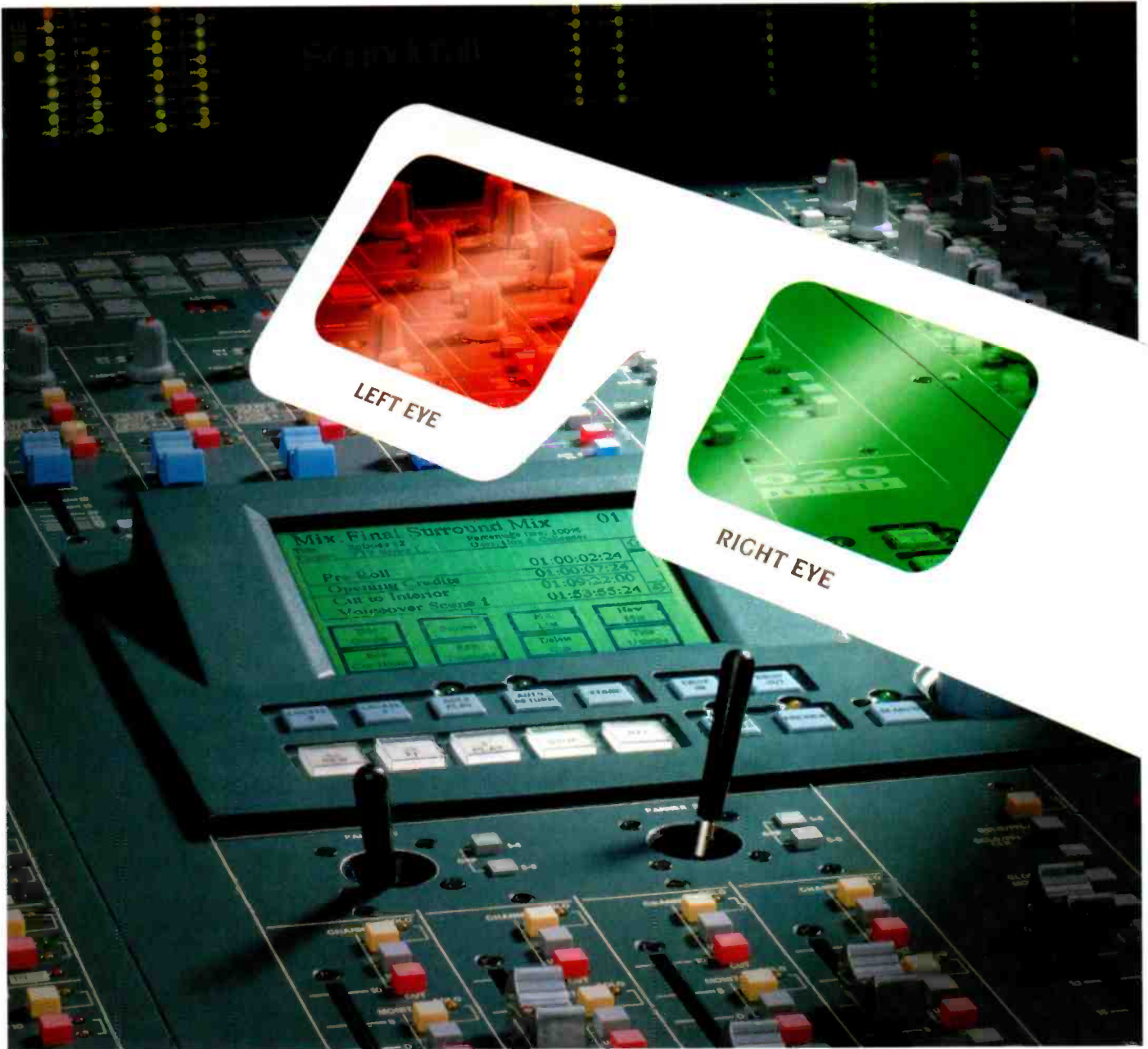
## Comrex Codec Buddy

The *Codec Buddy* from Comrex forms a companion to any digital audio codec, providing audio mixes for program feeds, communications, headphones and PA systems. The 4-channel mixer has two microphone channels and two mic-line switchable, and a versatile headphone mixer and monitor matrix allowing headphone listeners to make their own cue selections and adjust levels individually. Cue options include programme audio, telephone line, spotter-producer and return-codec channel.

An analogue telephone interface with dial pad, tone-pulse switch and a line ringing indicator is available for communications with the receiving station. This phone line may also be used for program transmission, and a one-line frequency extender encoder is built into the *Buddy* for audio enhancement.

Although the *Codec Buddy* was designed specifically with ISDN and Switched 56 in mind, it is also ►





# The Soundcraft DC2020 (Now available in 3D)

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**In brief**

● **Audix Broadcast digital mixing systems**

Scheduled for launch at IBC is a new generation of mixing systems from Audix Broadcast using digital signal processing in the main signal path to offer a high degree of dynamic signal control in conjunction with simplicity of use. The *MXT 1500* features the company's new D<sup>2</sup> EQ (digital dynamics and equalisation) subsystem.

**Audix Broadcast, UK.**  
Tel: +44 1799 542220.

● **Digigram workstations**

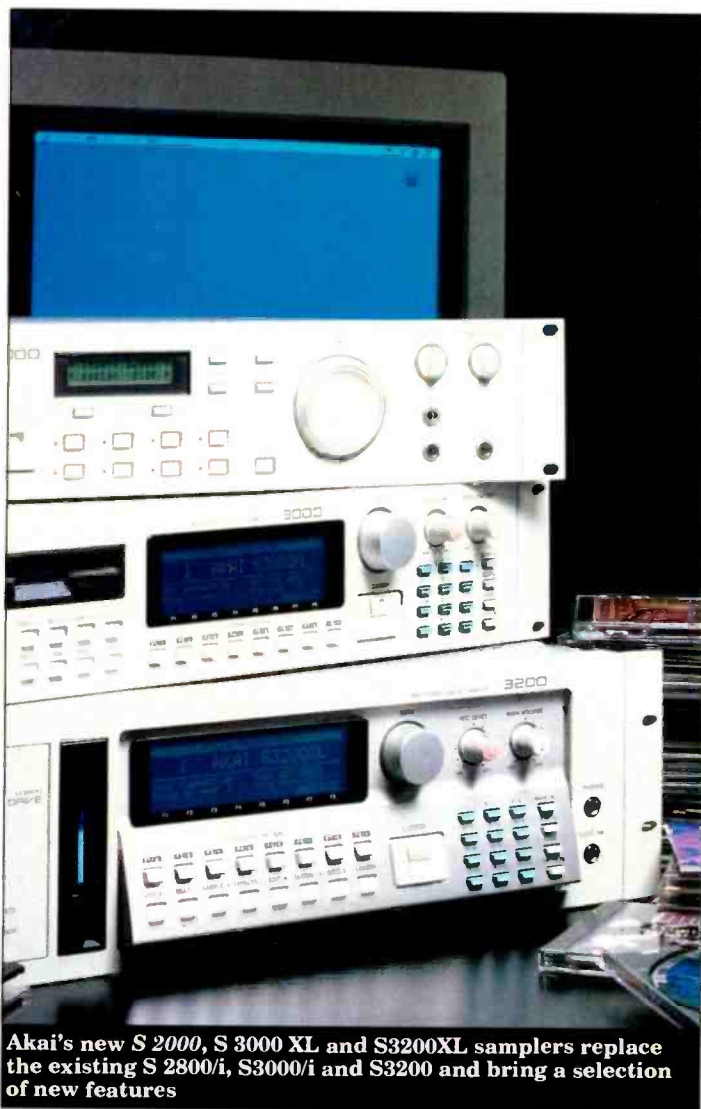
Digigram's IBC line-up includes a new range of three *Xtrack* workstations, based on their new PCX boards, offering twice the functionality of the previous boards. The new packages are the *Xtrack S11*, *S9* and *S80* systems, with the flagship *S80* offering eight analogue outputs. One of the main enhancements to the system is the management of new peripherals, particularly an external digital video system with its picture appearing on the *Xtrack* control screen.

**Digigram, France.**  
Tel: +33 76 52 47 47.

▼ **AKG—soul of discretion**

Discreet Acoustics is a new series of AKG microphones to be launched at the Plasa show. Designed for contractors installing reinforcement systems in places of worship, theatres, conferences and the like, the range comprises eight microphones including goosenecks, boundary-layer designs, and two models that can be hung from ceilings on non-twist cables.

**Harman Audio, UK.**  
Tel: +44 207 5050. ■



**Akai's new S 2000, S 3000 XL and S3200XL samplers replace the existing S 2800/i, S3000/i and S3200 and bring a selection of new features**

new line-up. As well as being competitively priced, the new models offer several new facilities, including a new Multi Mode feature allowing sounds to be auditioned and edited easily within the context of a multitimbral setup, an optional EB16 Multi-effects board allowing samples to be re-recorded with effects, memory upgradable to 32Mb using 72-pin SIMMs instead of Akai boards, and the option of up to 8Mb of Flash RAM which enables the user to store setups ready to play on power up without the need to load from disk. All are fitted with SCSI as standard, and hard-disk recording is standard on the *S3200XL* and *S3000XL* models.

**Akai, UK.** Tel: +44 181 897 6388.

**AES HIGHLIGHTS:**

**SSL Axiom Preparation Station**

Featured on SSL's AES display will be the new *Axiom Preparation Station*. This is a desktop unit which provides shared access to *Axiom's DiskTrack* for recording, editing and pre-lay, and additionally records video. *APS* can select up to 24 tracks from the *DiskTrack's* maximum of 128, and shares *Axiom's* I-O resources. The system is intended to free *Axiom* for large scale mixing projects while allowing program preparation to be conducted through the shared resources.

**Solid State Logic, UK.**  
Tel: +44 1865 842300.

**JoeMeek Voice Channel**

The *Voice Channel*, the follow-up to the much-acclaimed *JoeMeek* compressor launched earlier this year, will be on show at the forthcoming NY AES. The unit combines a full-blown *JoeMeek* compressor and image enhancer with a high-quality microphone preamplifier with the aim of bringing a combination of the distinctive *JoeMeek* sound and the vocal sound of a mastering studio within the reach of demo studio budgets.

**Interstudio, UK.**  
Tel: +44 1923 285266. ■

suitable for use with multiline frequency extenders or as a stand-alone remote console for use on a single analogue phone line.  
**Comrex Corporation, UK.**  
Tel: +44 508 263 1800.

**Xyratex data storage**

Information-storage systems manufacturer Xyratex will be launching a number of products aimed at the media industry at IBC 95. All feature Xyratex' own Serial Storage Architecture (SSA) enabling data access at over four times faster than SCSI-2 fast-wide.

The main product is the *S9000*, a single unit providing over 32 gigabytes of storage, enough for over five hours of 24-bit MPEG 2

video. With the SSA interface it provides data access at a rate of 80Mb/s. Also on show will be the *S1000*, a 2Gb or 4Gb subsystem designed for the desktop, which when daisy-chained offers a potential capacity of 384Gb.

The full range of SSA products can be attached via a PCI-SSA adaptor for PCs and workstations, and device drivers for a wide range of popular operating systems will also be available.

**Xyratex, UK.**  
Tel: +44 1705 486363.

**Akai samplers**

Akai are replacing certain of their current range of samplers with new models. The *S2800/i*, *S3000/i* and *S3200* are superseded by the *S2000*, *S3000XL* and *S3200XL*, although the *CD3000i* will continue alongside the





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*Fairlight*™



## NONLINEAR A-V EDITOR

## V-Mod 100

Sound-for-picture established itself some years ago as the area of our business most likely to demand attention when considering diversification, upgrading, and, in some cases, survival. Huge strides have been made, with most of such work now being carried out on some form of digital-audio workstation, but for the smaller operator in the field, a big question still remains: how best to integrate the pictures into the audio system?

So far there have been two video options: tape and nonlinear. VTRs capable of being integrated into such setups can be bought relatively cheaply, but with certain trade-offs taken as read, the biggest of which is still-frame performance. Streaks and noise bars on a still frame can mask crucial elements of the picture, including, perhaps, the burnt-in time code. Repeated use of the same few frames on a tricky section can also quickly lead to tape damage, exacerbating the situation. Expensive VTRs can overcome some of these problems by using RAM for still frames, but still take time to move tape around from section to section, defeating part of the object of using a random-access, hard-disk audio editor in the first place.

The other possibility is a nonlinear video editor, but these are still outside the price range of the small facility specialising in sound.

Enter the *Video MOD 100* from German company FED (Future Equipment Design), intended to overcome all these problems, and more, in the simplest way possible, giving random-access video transparently linked to the operation of a DAW.

The *V-Mod 100* is a simple, unprepossessing box, and it quickly becomes apparent that its visible lack of complexity is reflected in the ease with which it can be slotted into a system. The box is half-width, 3U-high, rackmount size, and one or two (or one and an extra drive) can be racked in an optional mounting kit. There are currently two basic versions, one employing a removable hard-disk drive and the other a magneto-optical disc drive, and it was the second of these that I saw in operation.

The internal drive is used to record the required video footage, and has variable M-JPEG data compression according to the desired picture



**FED's Video MOD 100: the latest in sound-for-picture technology for the audio editor**

quality, reflected in the resulting running time. FED call the system Application Specific Record Duration Optimising, or ASRDO. At SVHS quality it will give 16 minutes a side of a 1.3Gb disc, and this rises to 40 minutes a side for basic off-line quality—this equates as far as I can tell to straight VHS or a little worse than off-air, and is more than adequate for the job in hand. Higher quality still is available with the CCIR 601 option, which provides 4:2:2 serial digital video in conjunction with a removable hard-disk expansion option. This gives from 54 minutes Betacam/MII per 9Gb of disk space, and as with the other storage options multiple drives can be used via SCSI to give up to 385 minutes of component quality video. Used conventionally, video inputs and outputs are on both composite and Y/C or S-video connectors, and there are also two audio tracks, fed in and out of analogue on XLRs but stored as either 8-bit 16kHz or 16-bit 32kHz digital. This, like the most basic picture quality, is more than sufficient for the guide and cross-reference purposes for which it will be used.

Once the video is on the drive, the unit can be connected to any DAW or

editor having Sony 9-pin control facilities and slaved to it. There are time-code options for the machine, comprising an LTC-VITC-biphase reader interface and an LTC generator/time-code inserter. There is, apparently, not room in the case for both simultaneously, but this is not seen as a problem as in a given installation only one option is likely to be needed. Even without any specific time-code facility, however, the unit will follow the DAW with frame accuracy once the correct offset has been specified, simply by counting frames. At this point the full power of the *Video MOD 100* becomes apparent, as it follows every action on the DAW instantly and transparently. Jumping to any point in the audio produces the relevant picture immediately, and stopping the audio playback freezes the frame at the precise point. Still-frame performance is exactly the same as moving-picture performance, with no noise, no jumping, no unwanted disturbances of any kind. The same is true of scrubbing, where again the picture follows the scrubbed audio frame for frame, forwards and backwards, with no loss of quality compared with normal playback whatever. In fact, however many hoops the system was put through, I never saw anything on the screen

other than a clear, stable picture.

It is safe to say that the *Video MOD 100* will be the answer to many an operator's prayer. It gives the kind of instant random access and unwavering picture quality previously found only on serious (and seriously expensive) nonlinear video editing systems for half the price of a fully-featured VTR, which for these purposes it knocks spots off. Suddenly, producing sound for pictures becomes more affordable, faster and easier, to the extent that the unit could easily find its way into project studios, composers' private facilities as well as the major league film and TV companies who apparently, in the US, have taken to it so strongly that FED can barely meet demand. See it in action and you will see why. ■

**Dave Foister**

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---- [very slowly] ----



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# Microtech Gefell M 900

It has already become a cliché to go on about the number of microphones to have become available from Eastern Europe since the fall of the wall, so much so that a new microphone from Australia attracts attention as much for the fact that it isn't an old Soviet design as anything else. Certainly, I have seen more than a few such microphones, but as I recall the very first one was from Microtech Gefell, formerly the East German branch of Neumann. This was the *UM70*, reviewed in *Studio Sound* as long ago as April 1993, built around essentially the same capsule assembly as the Neumann *U47*. Their initial range of models as unleashed on an unsuspecting West comprised a fascinating selection of large and small diaphragms; solid state and valve electronics; end-fire and side-fire; in fact all the choice one would hope for from a major league microphone manufacturer, and set the scene for the revelations that were to follow. Now they have two new models, whose distinctive appearance surprises as much as their forerunners' classic quality did, and one of those is the microphone reviewed here.

The *M 900* is eye-catching indeed. Its conical capsule-grille assembly tapers to a slender wasp-like waist where it joins the body. The body itself consists of two back-to-back conical sections defying the use of anything other than a dedicated stand mount, although the old bulldog-clip-type makes a valiant, if precarious, attempt—just as well as no mount was supplied with the review microphone. I did eventually find an old RCA clip which matched the main taper almost exactly.

This, despite its outlandish appearance, is a no-nonsense end-fire cardioid microphone, with the size of diaphragm more usually found in a side-fire configuration, as suggested by the diameter of its front grille. The grille incorporates a pop filter which seems as effective as can be expected. It appears from peeking through the back grilles that shock resistance arrangements extend to the use of a coil spring forming the electrical connection between the backplate and the electronics. The microphone is

phantom powered, and the only controls consist of a pair of recessed switches for bass cut (10dB down at 60Hz—quite subtle) and a 10dB pad. These are small basic PCB-mount switches and require the use of a pointed instrument to alter their positions, which makes them fairly tamper-proof but can also be frustrating when you're in a hurry. No accessories whatsoever were supplied with the review microphone, although the usual selection of extras is available from a close-speech screen to an elastic suspension and table stands. The microphone comes packaged in the now familiar Microtech Gefell (hereinafter known as MTG) wooden box.

Several of the design features reflect current trends, from the gold-plated polyester membrane to MTG's newly developed transformerless preamplifier, which is intended to give a high output capability and low intrinsic noise. The specification reads well, with very respectable noise figures allied with a claimed SPL handling capability of 143dB for 0.5% THD. The published curves show a clear lift between 5kHz and 15kHz, with a plateau 4dB above reference, in an otherwise flat response, and a polar pattern which remains commendably

consistent with frequency apart from a distinct rear lobe around 5kHz. The other of the two new models is a hypercardioid version, the *M 910*, with an even more consistent performance claimed in the literature. MTG suggest that the *M 910* has a frequency response specially optimised for vocal work, although on paper it appears flatter, with a less pronounced presence boost, than the cardioid *M 900*.

Despite the advice, the *M 900*'s large diaphragm and upper-mid boost makes it an obvious choice for vocals. The resulting sound is very fresh and crisp, with a smooth sheen to the upper range that avoids being so pronounced as to reek of coloration. Its sensible roll-off back to flat towards 20kHz means that the edge that many 'vocal' microphones give, whether you want it or not, is absent. So rewarding is the vocal sound from the *M 900* that I would be intrigued to hear how the other version improves on it.

This subtle balance between quasi-neutrality and forwardness makes the *M 900* an excellent all-rounder, which is presumably what MTG had in mind for it in the first place. The lower end sounds as flat and even as MTG's curves suggest and as extended as one would hope from the size of the diaphragm. I used it on the

usual broad range of instruments that come my way and it never disappointed, standing up well to high SPLs and having a sufficiently extended and flat frequency response to do justice to virtually anything. Off-axis pickup, too, is surprisingly neutral and uncoloured.

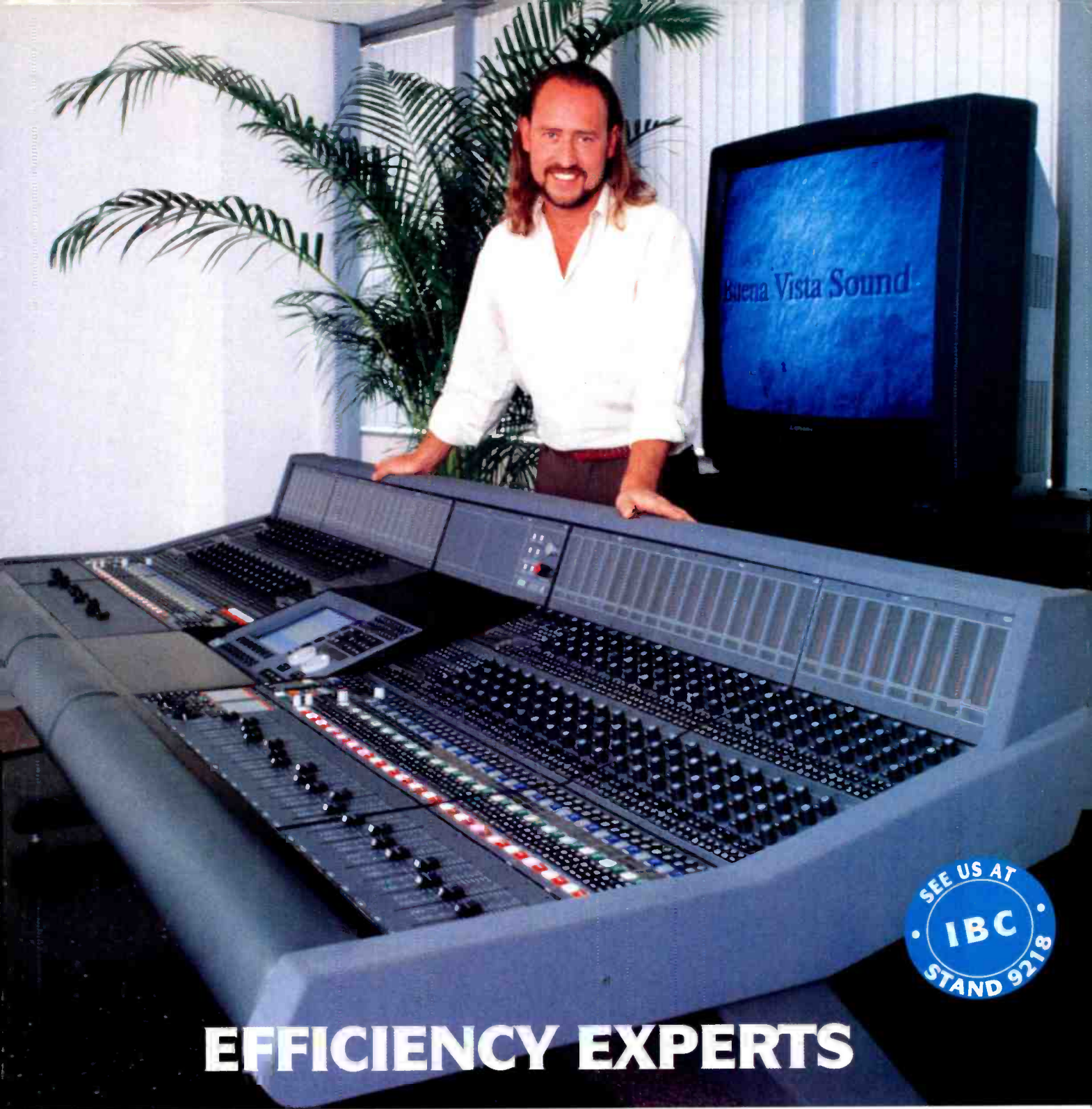
The *M 900* is certainly a conversation piece in the studio. Its looks provoke immediate comment, with one singer expecting me to perform some sort of medical examination with it. Fortunately its smooth performance is also a talking point, inviting favourable comparisons with more familiar and considerably more expensive microphones. It is good to know that Microtech Gefell are following up the success achieved by the introduction of their original models not by cashing in or hiking their prices but by continuing to develop the microphones the studio wants at prices that remain remarkably low. ■ Dave Foister

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London NW6 7SF.  
Tel: +44 171 624 6000.  
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The unorthodox appearance of the *M900* belies its excellence as a vocal microphone





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## Nevaton CMC 47 and CMC 51

You thought you'd seen them all. The introduction of previously undiscovered Russian and Eastern European microphones has been such a bandwagon that surely anyone with any excuse for jumping on it would have done so by now. Not so—there are still more to come, and still plenty of surprises and bargains, if these two are anything to go by. There must have been a time in Russia when it was easier to buy a microphone than a loaf of bread.

A S MacKay are an international distributor with a strong interest in equipment from Russia—as subtly suggested by the stuffed bear on their Audio Technology Show stand. They handle the Oktava microphones (*Studio Sound*, April 1995) and the Neva power amplifiers (*Studio Sound*, December 1994) and have now added to their list the Nevaton microphones manufactured in St Petersburg and under

consideration here, both of which have their own unconventional features and can startle with what they have to offer.

These two models are very closely related, the one being essentially a stereo version of the other. The straightforward mono microphone is the *CMC 51*, and even this does things in its own idiosyncratic way. It is a large-diaphragm design, with a 3/4-inch capsule, side-firing from a bulbous head on a thick cylindrical body. No stand-mount was supplied with the review sample, although I understand a shock-mount is available. In the absence of this I was concerned about how to attach such a wide heavy microphone to a stand, and felicitously discovered that an AKG *D202* mount was the perfect size.

The microphone offers four polar patterns, but not perhaps the conventional four. Omni, cardioid and fig-of-8 are expected, but in place of the usual hypercardioid is a wide or sub-cardioid setting. The quirk here is that the pattern switch is not the usual 4-position slide switch but a thumbwheel which rotates continuously through its four detents. Similarly, the pad switch is a continuous wheel, and offers a straight 10dB of attenuation. There is no bass-cut facility. There is, however, a red LED which serves the dual purpose of showing the microphone is

receiving phantom power and indicating the front of the capsule.

The sound produced by the *CMC 51* is something of a revelation. It is obvious that the design aim has been to produce a top-end flat all-purpose microphone, with no tailoring for specific purposes but with full exploitation of the characteristics of the large diaphragm. The result is a microphone which has something (dare one say it) of the Neumann warmth and body. This is a big, real sound, which can hold its head up in the best of company and make one wonder why one would want to spend any more on a microphone of this type. It gives a remarkably natural rendition of the voice, with both frequency extremes impressively smooth, and produces distinctly desirable results on anything with the kind of natural depth that can so easily be lost—cello and trombones were particularly noteworthy in the fullness of their sound. This is an amazing microphone for the money, giving access to the kind of results one would normally expect to pay three times the price for.

The stereo microphone, the *CMC 47*, trades off some of the facilities of the mono version in exchange for its stereo capabilities, which it implements in the most bizarre fashion I have ever seen. It incorporates two of the same

capsules, mounted one above the other, and has no polar pattern selection—both are fixed at cardioid. The extraordinary thing is the mechanical arrangements for adjusting the stereo pickup, that is to say the angle between the two capsules. A single thumbwheel on the side physically swivels the two capsules in opposite directions, so that at one extreme they both face forward and at the other they are at 90° to each other. Between the two extremes the angle is fully variable, with no detents or even any calibration (although the capsule orientation is just visible through the grille), and the resulting flexibility is very useful even if the method of achieving it is unconventional. The physical result of all this is a body identical to the mono microphone apart from its longer head assembly, and it too fits snugly in a *202* mount. The only other control on it is a pad switch, usefully if unusually calibrated in 5-pin XLR, and a good quality reasonable-length cable split into two 3-pin plugs was provided with the review microphone.

Although it would not be my first choice for every situation, the coincident cardioid technique has both its uses and its diehard adherents, and the *CMC 47* provides all one could want from the configuration. The exact vertical alignment of the capsules gives the same kind of time coherence as, say, an *AKG426* or Neumann *SM69*. Just as important, of course, is the sound produced by those capsules, and again the results stand comparison with both of those microphones, which is quite staggering in view of its price. Its low-frequency extension is everything one could hope for from the large diaphragms, and yet its top end sparkles sufficiently for it to make an excellent drum overhead microphone.

These two models from a previously unknown company sum up the surprises we have been seeing from Eastern Europe for the past couple of years. These are both microphones that the most familiar top-end stables could be proud of, on offer for silly money. Buy some now. ■

**Dave Foister**

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Russian latest: studio standard condenser mics appear in the West





[The DSE 7000 Version 5.0]

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▲ "The ear is faster than the eye. And the DSE is still the best editing system for radio."

*Grandolf Welter, Technical Director  
Producer MDK 100, Leipzig, Germany*



▲ "Anyone can learn to do anything on the DSE in an hour. And UNDO it in a second."

*Dolby DeLaurie,  
Commercial Production Director  
HOT 97, WQUT FM, New York*



▲ "Three stations, 36 commercials a day, who has time to fool with a waveform editor?"

*Peter Belt, Chief Engineer  
Radio 10, Amsterdam*



▲ "I've stopped looking for a better digital workstation for radio. With upgrades, the DSE is future proof."

*Russell Koor, Planning & Development Manager  
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# Sound Enhancer 5022

I read in *Studio Sound* recently the comment that the original promise of digital audio was not just improved sonic quality but eventually cheaper equipment as well. Until recently this has been far from the case, but the advent of the modular digital multitrack and the ludicrously cheap digital mixer has changed all that. The same is true of more mundane equipment—the various kinds of interfaces, processors and general bodge boxes that so much digital work requires. Not so long ago a simple digital fader would have set you back over a thousand pounds, (close to the price of the Philips Sound Enhancer reviewed here) on which the fader is only one of several processing blocks combining to create quite a pretty versatile problem-solver.

The label *Sound Enhancer* is less than informative and, perhaps, ill-chosen. It belies the functional aspects of the 5022, which are a combination of Philips various OEM signal-processing cards.

All the 5022's processing takes place in the digital domain, and it has inputs for AES-EBU, SPDIF and analogue signals (both balanced and unbalanced) and the same selection of outputs. Clearly, then, it incorporates

both A-D and D-A convertors. These are not Mickey Mouse affairs but intended to be useable as quality convertors in their own right. The A-D is of 20-bit resolution and the D-A is a DAC 7 Bit stream convertor. The next useful job is sample-rate conversion, which not only carries out the usual 48kHz-44.1kHz conversion (or vice versa) but is claimed to deal with any source sample rate from 15kHz-50kHz and deliver either 44.1kHz or 48kHz as required. This allows jitter removal and the use of varispeed on a digital source while maintaining the correct output rate. The unit's clock can also be locked to an incoming digital signal or a rear-panel word clock BNC.

The available treatments fall into two broad categories, one for corrective processing and one for special effects, and it is, perhaps, the first category that is of most interest in the studio. The aforementioned fader is a manually-triggerged automatic fade either up or down, with control over timing from half a second to 11 seconds. The fade curve is neither adjustable nor specified, but seems smooth and well tailored for general use. Besides this there are front-panel level controls for the two channels, which despite what the manual says do not work only on the analogue inputs but on the digital signal passing through the unit, before the processing. The digital nature of these controls is revealed by zippering when moved quickly, although this is not a problem in normal use. The controls appear to give a useful few dB of gain as well as almost complete attenuation.

The Scratch removal process is no competition for the *CEDAR* system

but nevertheless impressively effective on certain types of problem, notably (as one might expect) a straightforward scratch on an LP. Too much of the process can disturb the wanted audio quite unpleasantly, particularly the bass end where it introduces a strange burbling effect, but far less processing than this is required to remove a simple scratch almost completely with negligible side effects.

The noise filter is less sophisticated, consisting of nothing more than a variable cut-off digital filter, with cut-offs from 6kHz-16kHz. Its effect when used in moderation is subtle and worth trying on slightly noisy sources.

Bass and treble EQ are provided, and although once again no figures are given the results are smooth and musical; similarly vague in specification is the compression-expansion effect, which on first hearing seems to do little more than make the signal louder or quieter. Closer listening reveals the compression in particular to be working remarkably well, and although no adjustments are provided other than the amount of compression, the built in delay (which is not a problem for a single stereo signal) seems to virtually eliminate any trace of pumping or other undesirable effects, leaving quite simply a punchier 'louder' track which retains a similar peak level.

The remaining effects are the ones least likely to find very much use, although they have their place and work better than many such cheats. Stereo Enhancement is intended for use with a mono source, and adds simulations of room-wall reflections to

create a passable stereo effect without too many disadvantages, while Spatial allows an existing stereo recording to be made wider or narrower; this again is quite effective on certain material and could conceivably be used to rescue or enhance a less than ideal stereo image.

Operation of the unit is unusual but reasonably intuitive: a pair of select buttons flash the effect LEDs one after another, and the currently chosen effect is then adjusted with two nudge buttons—there is only ever one adjustment available on any effect, and its current value is shown on the rows of LEDs normally used as peak-holding level meters. Various combinations of the effects are allowed, but not all; the fader, EQ and Spatial effects are, however, always available.

This is an odd box in many ways, but an undeniably useful one for all that. One or two of the effects may strike many as superfluous, but there are enough worthwhile processes to make the 5022 good value for money for them alone. This is the kind of box one might buy on spec and then see pressed into service more and more often, as its various elements solve a host of little problems which once would have been much more expensive to address. ■

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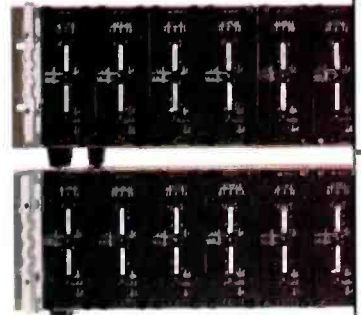
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ADV 473

# Prisma Music

From Spectral Synthesis, the makers of the *Audio Engine*, comes *Prisma Music*—a free software package for all *Prisma* buyers that reconfigures the hardware specifically for music-production purposes with hard-disk recording, editing and automated mixing. In many ways it is the antithesis of the *Prismatica* postproduction variant of the *Prisma*, which has been shipping for around a year, and now has the added distinction of being among the cheapest DAWs fitted with autoconforming.

Written by Stephen St Croix, *Prisma Music* has had a meteoric development path. Conceived last September, launched at NAMM in January and now shipping, *Prisma Music* owes much of its speedy development to *Prisma* as this contained a software development kit. In a sense, *Prisma Music* demonstrates the possibilities of the *Prisma* program.

'*Prismatica* is the Swiss-Army-knife application which has a bias towards postproduction in that it is almost an exact replica of *Studio Tracks* on the *Audio Engine*,' explains Spectral UK's Managing Director Dave Shapton. '*Prisma Music* is a dedicated music package and is unique in not being written by Steinberg or E-magic.'

'What people will notice most is the quality of the graphics,' he says. 'The philosophy behind all Spectral products is host independence—you can reset the PC and it will carry on doing what ever it was doing without glitching and, up to now, that has meant that the *Windows* application is very little of the processor's power. They've changed that emphasis with *Prisma Music* and squeezed about as much graphic power as you could get onto conventional equipment. You have to run it with a 17-inch monitor minimum, you have to run it with 16Mb of RAM because it's very graphics intensive.'

Graphic points of note include instant waveform drawing across all levels of zoom and excellent metering displays. Shapton states that this attempt at taking a PC-hosted hard



disk into music recording, while most other manufacturers have shied away from it, is significant and bold. 'It looks wonderful and it's very efficient—people will either love it and use it or they won't. I would see it as a showcase for what is possible on the *Prisma* hardware in terms of presentation and functionality. Having fitted everything imaginable onto the same screen, I think the trend will then be towards simplification—there might be a *Prisma* broadcast version, for example, which is as simple as *Prisma Music* is complex.

'However, if you get good at it, then it is very, very powerful,' he adds.

Some of the operational aspects of *Prisma Music* take in analogies to popular microprocessor designs that use long instruction words to carry out multiple tasks simultaneously. The mouse cursor can be pre-armed to perform a cut or copy on a press and a completely different operation on release. It adds up to a type of mouse macrokeying that permits predetermined functions to be performed very quickly.

Minimum PC requirements are a 66MHz 486 with 1,024 by 768 by 256 colours, 16Mb of RAM, and 30Mb of

disk space on a local drive. It also requires *Windows* 3.1, MS-DOS 4, a mouse and a free 16-bit ISA slot. The package includes a SCSI controller and can record to four high-speed drives. Backup is DataDAT, 8mm Exabyte and magneto-optical.

Operation revolves around Mix window and Edit window displays and up to 16 tracks can be shown simultaneously—each being four layers deep for multiple takes. The system maxes out at 99 4-layer tracks with simultaneous play from, or record to any eight, while mixing to any two other tracks with complete freedom to manipulate from any layers.

Each mixer channel has 2-band fully parametric EQ, pan, solo, mute, two sends with pre-post switching and metering. Channel faders are armed for the automation from the base of the strip and the system employs Spectral's AutoTrace display for visualising actual fader position against its automated position.

Digital routing, internally for bouncing or externally to digitally connected effect units, is integral to the system. Two-channel AES-EBU and an 8-channel Spectral digital-audio interface to popular

digital multitracks are complemented by 2-channel and 8-channel converters. Synchronisation takes in LTC and VITC, MTC, genlock, AES and word clock. Project management routines are also included.

The editing options are especially impressive as the user can choose between object-orientated editing, which employs 'handles' that can be gripped to slip, position, nudge, stretch or trim a section on screen, or free-form. The latter permits editing operations to be applied to marked segments. Additionally, each track can be viewed and treated individually in either of these editing modes. ■

Zenon Schoepe

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# TABALET ESTUDIOS

Tucked away in a sleepy hollow near the Spanish city of Valencia is a busy studio facility. Caroline Moss charts Spanish recording trends through its work and choice of equipment

**T**ravelling east, the buildings that are Valencia, Spain's third largest city, come to an abrupt end as tower blocks give way to green rice fields thinly sprinkled with farmhouses. Driving out of the city at speed, one feels a rush of surprise like emerging from a tunnel, instead of the gradual, almost imperceptible shift from city, through suburb and on to countryside which characterises the outskirts of many urban areas.

Tabalet Studios is situated in the middle of one such green field, a whitewashed building with views across tranquil farmland through which the occasional horse and cart makes leisurely progress. All this is within a 20-minute drive through midday traffic from the city centre. Outside the July

sun is blistering, but inside the white walls, ceramic tiles and dark oak beams create a cool and shadowy place; a haven of tranquillity.

In reality, the old farmhouse has been a hive of activity since the first Tabalet studio was built there 20 years ago by partners Ignacio Carreras, his wife Africa Pons and Luis Miquel Caspos, a local musician. The main studio, Studio A, has remained in the same first floor location since the beginning, though it has seen several renovations. Studio A's control room was originally designed by Peru-based freelance Acoustician Mike Llewellyn Jones. Two years ago it was upgraded by the Acoustic sciences Corporation of Oregon using its valve Trap products.

The studio is one of two or three large facilities in Valencia that cater for a mainly local market. As such it is a basic but well-equipped and hard-working environment for local clients, some of whom have used it for years, its reputation having spread through the region by word of mouth. The mixing console is a Soundcraft *TS-12 36:12:2* with *Fame* automation. Analogue and digital recording options are available, with a 2-inch, 24-track Saturn multitrack tape machine and a Tascam *DA-88*, 8-track, digital recorder. A standard array of noise reduction (Dolby A and SR, dbx) and outboard equipment (BSS compressors and gates, Klark Teknik, Aphex and dbx equalisers, Eventide *H3000-S*, Klark Teknik *DN-780*,



An old Spanish farmhouse is the ideal setting for a musical haven—Tabalet Estudios





**Tabalet's large live room accommodates up to 90 musicians for jazz and classical music recordings**

AKG M-250, Yamaha Rev-7 and SPX-90, Lexicon LXP-1 and LXP-5) is available, together with Neumann, AKG, Sennheiser and Electro-Voice microphones. Main monitoring is driven with QSC. Amcron and Quad amplifiers and wired with Mogami cable. There are also SADiE and Pro Tools systems for digital mastering and editing.

Tabalet specialise in jazz and classical music recording, and, accordingly, the large live room can, and often does, accommodate up to 90 musicians. Alongside traditional music recording work, Tabalet have recently begun to attract increasing amounts of advertising and soundtrack work—the source of much of this is a large toy factory located just outside Valencia which requires the dubbing of its radio and TV commercials into many different European languages. More complex soundtrack projects take place in Studio A, while the smaller Studio B handles smaller projects and voice-overs—for which it is equipped with an 18-channel Midas console and 8-track 1/2-inch analogue machine. In addition, there are two dubbing suites on the ground floor

working constantly under the supervision of five technicians.

Like business-conscious recording studios the world over, Tabalet also have their own production company, Estudios Grabacion Tabalet SA. This company handles the production and release of their own range of CDs—specialising in jazz and classical recordings—and also works with large labels such as Harmonica Mundi. Fernando Brunet, Chief Engineer at the studio, estimates that the company has released around 160 CDs over the past five years, roughly three-quarters of which are on the EGT label. Grant-funded classical recording for the state also constitutes a proportion of the studio's work.

Although Tabalet appears to be working to full capacity and is instrumental in creating its own projects, co-owner Ignacio Carreras has a vision for the future which includes the addition of a further business dimension.

'The way forward is not to run a traditional studio, because more and more music is being recorded at home,' he says, echoing the sentiments of studio-owners the world over. 'I think the most important thing is the final stages—music postproduction and mastering of music which has been recorded cheaply.'

To this end he has set up a research project to investigate new mastering and postproduction techniques. The results, for the moment confidential, sound encouraging.

'We have found a way of increasing the dynamic without modifying the sound at all,' says Carreras. 'In a few months we hope to be able to announce a new system for mastering and postproduction. If our findings are correct, we think this product will be something of a bombshell.'

In the meantime, the studio continues to service the Valencia market for musical and soundtrack work. Although most clients are local and therefore do not require residential facilities, there is an apartment belonging to the studio about five minutes drive away. There is also an extensive selection of restaurants in the immediate vicinity. And for those in need of the bright lights, Valencia is just a few kilometres away, back across those rolling, green, rice fields. ■

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**'In a few months we hope to be able to announce a new system for mastering and postproduction. If our findings are correct, we think this product will be something of a bombshell'**

Ignacio Carreras





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# DSP POSTATION

## Entering the competitive DAW arena comes a powerful system from Australia. Keith Spencer-Allen checks the post

The *dSP Postation* arrived as something of a surprise a year earlier this year. Although the company Digital Studio Processing has been in existence for over five years and has 30 systems of varying sizes installed in their native Australia (and New Zealand), it was only this year that they had any presence internationally. Recent months have seen sales of *Postations* in Frankfurt and Osaka but the first installation outside of Australia has been at Fountain Television in south west London. It was here amidst the latter stages of installation and refitting of the studio that there was the opportunity to look more closely at this integrated workstation that has been creating a lot of interest in postproduction circles.

While a full *Postation* is 'wraparound' furniture, it can be viewed as three separate units which behave as a single large system. Processors for each section are held in separate racks, separate down to their own floppy drives. The system allows full editing and processing of audio with synced video tracks and automated mixing.

The design also allows the user to grow a custom system starting with an 8-track editor which can be upgraded to 16-tracks. The screen (and later screens) can be upgraded to be touch sensitive, and the NLV video and VCS mixer sections then provide a full *Postation*.

## Philosophy

Joe Narai, dSP MD, claims to have developed *Postation* from close liaison with dSP's clients. Many companies make this claim but I saw it working when Fountain Head of Sound Ken Williams explained that he wanted to appear on his screen and what preferences he had in operation. Narai moved to the voice booth where he had his computers and programmed the changes, loaded them on the system where they were accepted or modified further.

The heart of *Postation* is the central controller—the Speedette, a name derived from an ergonomics acronym. The wheel is the easiest way to fine control any parameter on the system from EQ to machine shuttle to scrolling through lists. Surrounding it are buttons that perform a range of functions. The buttons are arranged to enable one-handed operation—the leather rest pad is indicative of how long your hand will remain in this position.

## Editing

The editor is the heart of the system and virtually all editing functions are performed via the same screen. The

upper section displays 16 tracks but the number shown is adjustable—audio 'clips' are shown as coloured blocks with their length indicating the length of the clip. Up to 64 clips may be layered on a track and are displayed as blocks sitting on top each other. These could be viewed as 'assigned virtual tracks' as it is only the clip on top of the stack that will play out of one of the 16 outputs.

This concept is puzzling at first but in operation it has much to commend it. In normal editing use it allows you to keep a number of alternatives very easily accessible—by cycling through the clip pile. Clips carry names and triangular graphics indicate crossfades. Mixing functions such as level changes and EQ are also shown.

The length of the material in the track section displayed can vary from six frames to 24 hours but there is the ability to zoom in as needed. The now line or 'head' travels over the display from left to right.

The graphic Track display is the 'workshop' area of the screen, where any editing of the waveform takes place. ▶



dSP's *Postation* has generated interest in postproduction circles

Regions can be identified, split, moved and slid against each other to sync points recognisable in the waveform. The waveforms image is rock solid and even when running quickly across the screen there is no sense of hesitancy in the display. Full time-code displays of current head position and any incoming code from a VTR or other external device are included.

The lower half of the screen is divided in to three small windows: a small prompt window gives permanent on screen help a centre window lists the status of certain aspects of the systems and modes chosen and the remaining window is a multifunctional area displaying vu meters for 16 tracks, lists of clips on that track, time-code calculator and so on. At the bottom of the screen is a strip of 12 function keys that now has two layers of functions.

The two other screen displays are the System Configuration page—that sets up all the user definable operations and modes within the system which can be set into individual user preferences—and the Project Menu—which allows management of the all Projects recorded on any of the seven drives. This also controls backup.

## Video

Known within the system as the NLV (nonlinear video), this is the right-hand touch screen. It displays video stored on hard disk in a choice of ways with a display quality that equates to low-band U-matic. The most used screen layout would be that of a large central picture with 13 small stills around it. When the NLV is locked to the dSP audio, the large image follows the audio, playing out instantly. The 13 small stills are reminders of the other clips available and these can be selected by touching the clip. Should you wish, the video play picture can take up the full screen with the option of overlaying clip stills or ADR cueing as required.

Also part of the NLV screen are time-code windows, buttons to create locate points, and a small graphic running the width of the screen showing image density with red markers indicating a video cut and the ability to locate changes of scene.

An alternative NLV display forms part of the Project management system where up to 16 Projects can be listed (the maximum on a single drive) together with thumbnail stills identifying the Projects.

## Mixing

While *Postation* provides comprehensive mixing facilities through the VCS (Virtual Control Screen), dSP have yet to design a mixer of their own. Close association with Yamaha Music Australia has led to most installations using a Yamaha *DMC1000* or other models. The Fountain system will use a modified *02R*. Mixers can sit hidden in the left-hand leg of the furniture so all control is through the VCS screen or can be left accessible with all mixer controls remaining active. dSP see this approach providing the benefits of a mixer integrated with the system but with mixer choice left open. All that is necessary is that the chosen mixer has MIDI or 422 control and the manufacturer make the control tables for parameter control available. There are

three such systems working with Euphonix consoles and it is possible a VCS screen might be prepared specifically for it.

The VCS itself is a representation of the mixer control surface; touching one of the knobs on the screen activates that control. All of the available controls for that channel then appear top right of the screen rather larger than in the channel 'strip'. The selected control is adjusted through the wheel on the Speedette, the control screen 'knobs' move and a window in the top left hand displays a graphic representation of what ever control is being adjusted.

Particularly clever is the way that some of the mixer controls are displayed as dual concentric pots and selection is by just 'touching' the screen knob for the outer control and 'pressing' for the inner. Level control is via 12 motorised faders mounted below the screen.

The top left-hand window shows an area with the LCRS locations indicated and channels can be positioned by touching within the window and a small cross appears. The cross also follows a finger moving on the screen surface and the movement can be automated. Shortly this will support full 8-way surround.

The software can support up to seven SCSI drives that are in the form of removable Track-Packs. The new 'Big Software' release allows support of up to TerraByte drives should they ever become available.

To move a Project to another *Postation*, the Project menu can housekeep the hard disks to ensure that every aspect of that Project is on the disk to be removed. General backup is to Sony SDDS DAT format which runs at 5x speed. Following minor changes, both partial back-up and partial restore functions are available to save time.

## In use

It can only be through using it that the benefits of a system can be judged. I selected a few key operations so see how it worked.

Loading picture and guide audio from VT: the audio tracks to be recorded on are 'armed' as is the NLV. External time code will cause the system to drop into record. If the audio is checker boarded, there is an option called 'threshold recording' where in and out levels are set and the audio is only recorded when the signal is above this threshold. This saves disk space and can clean up low level noises.

EDL: there is a full EDL control menu and the system supports CMX format. The source material can also include an existing dSP Project.

Selecting and pasting sound effects: sound effects in the system are listed in two ways. Those that are used frequently are held in a Quick Import List that appears on the lower left corner of the Edit window. The sound effect is selected and then Play hit. Stop returns readies the system to select another effect. Paste places this effect into the track. Should the sound effect you want not be in the QIL, the full SFX database that allows more comprehensive search facilities. This will soon include RS422 control of a CD carousel together with auto import of selected FX.

ADR: when recording to picture you can select ▶

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in and out points in the dialogue, create a loop and then enter auto record. If you do not nominate different tracks, the takes are sequentially numbered and stacked on the same track—up to 64 takes—for later audition. When editing, waveforms can be cut into sections, copied and then slide against each other to replace another section. Sync can be seen from the waveform and then played out.

Editing: With a single button push, clips can be selected by touching them and where they are to go. Two 'snap' modes allow one clip to paste immediately onto the end of another while the other allows it to remain at the original position but on a separate track. There are 10 levels of undo and 10 of redo which 'follow' the Project. It is also always possible to return to sync that returns the clip to its original position against picture. Movement within the waveform is achieved by touching the desired position.

There is a menu of digital functions, including time compression and expansion which maintains stereo phase over two tracks, varispeed, sample-rate conversion between 44.1kHz and 48kHz, and signal reverse. Useful for ADR is gain matching, which adjusts gain between two clips to within 0.25dB based on peak level. A similar function allows alignment using equal energy matching.

## Pending

*Postation* has an intensive programme of upgrades and options due over the next six months. Early 1996 will see the launch of the 24-track I-O card with 24-bit, 96kHz sampling capabilities. This will allow up to 72 tracks in the editor or up to 36 tracks running at 24-96. Optional cards will be available to upgrade the video to broadcast quality but with increased disk usage. A dedicated control panel will be added to the left of the Speedette for dedicated track selects and a locator pad for entering time code. Future software will support basic video editing to allow video to be reconfirmed against a revised EDL eliminating the problem of having to reload the picture and start again. Reconfirming of already conformed audio is also scheduled which will take the revised EDL and automatically recut the audio. This means that cutting of audio can start earlier in the Project, maybe without waiting for the completed video track.

*Postation* supports modem help in the event of software problems; a screen in Sydney Australia can monitor internal functions of *Postation* while the fault is replicated in London.

What did surprise me was how little acoustic effect the shape of *Postation* had on the sound in the room—I have not been the first to remark on this. There is a minimum of reflected sound from the system surface and it allows you to concentrate on the direct sound.

## Conclusion

I was impressed with the way that dSP have implemented their declared aims in *Postation*. The approach to editing and the ease of auditioning audio against picture is particularly impressive when combined with speed of operation. The recently implemented Project Management

## FOUNTAIN TELEVISION

Located about ten miles from central London, Fountain Television is a full TV production and postproduction facility with broadcast studio, edit suites, digital graphics and audio post. Their location means that most of their work is long-form TV production—complete series that are both shot and posted in the facility.

Fountain have a single sound suite equipped with DDA AMR desk and Otari 24-track machine to handle sound from the studio floor and audio-post. Further suites including an *AudioFile* system were added in 1988, initially for CDV work.

The current changes are part of a major rebuild of the audio facilities part of which is the removal of the remaining analogue postpro facilities and a move towards totally digital audio post which has been completed with the installation of a full dSP *Postation*.

Head of Sound, Ken Williams, first saw *Postation* at the Paris AES Show. Aside from the certainty that whatever equipment was installed it had to be digital he had an open mind. He followed it to Berlin for two days evaluation and then again in London.

'I saw *Postation* and fell in love. What convinced me was that it's a complete integrated package. It is also very intuitive and you can access anything you want at any time without typing numbers unlike some other systems we considered. It's also very fast—faster than anything else I saw.'

'I like the way I can go instantly from beginning to the end to the middle of the programme and not having to spend time shuttling tape with the client paying the hourly rate. The time saving is considerable. Previously you may have had to spot 50 effects in a show and just for previewing the VTR lockup may have taken up to eight seconds. That is a saving of over six minutes which could be used to improve the mix.'

'We've had the system here being installed for five days and we've gained three new series on the strength of it. I'm more convinced now than before that this is the way to go. It is a very elegant way of putting sound effects to picture' ■

software gives ready access to stored material in a logical manner, while locating to sections of a Project via time code, and the tracks display by waveform or picture clip.

*Postation* is not the only workstation that runs with integrated video and mixing, but in its present form it looks set to become a major player in the postpro field. ■

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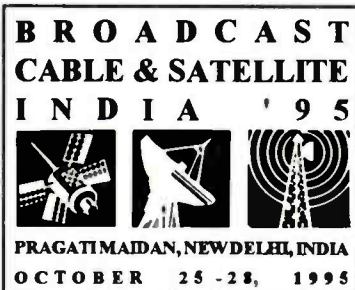
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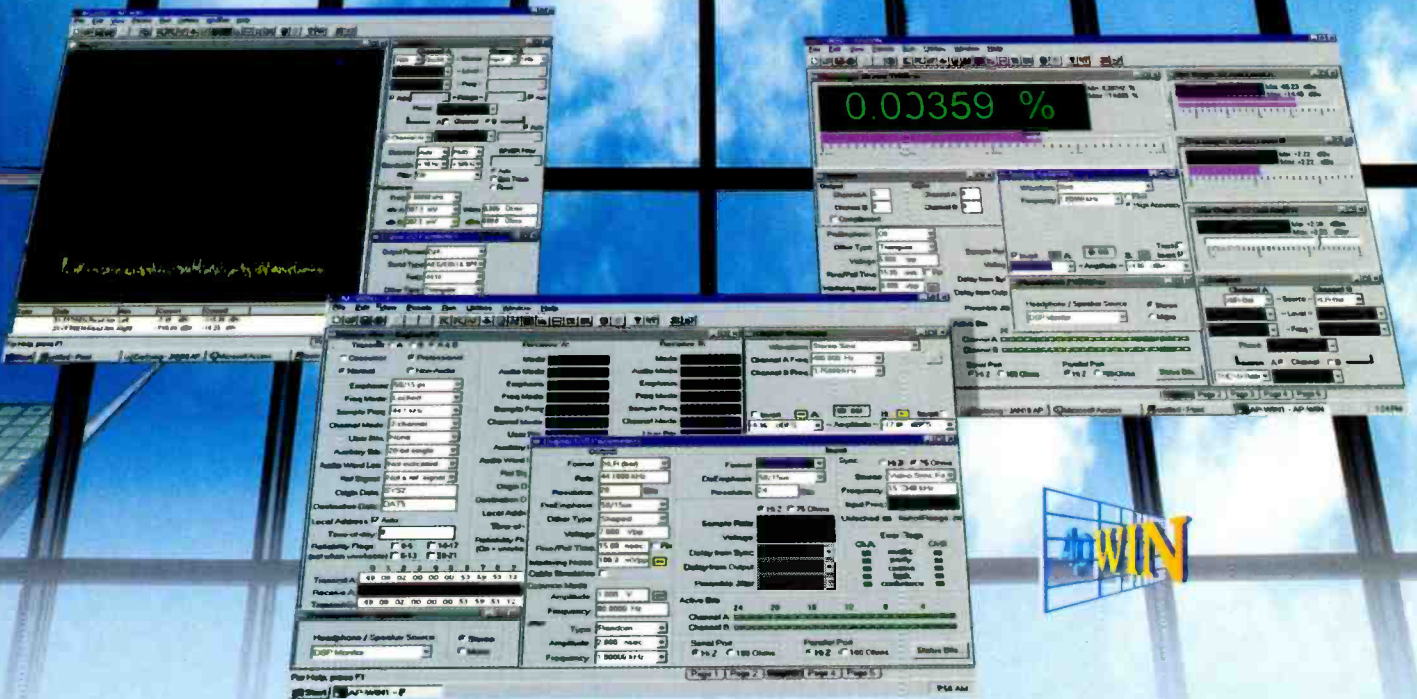
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# FOSTEX DFM CONSOLE

Patrick Stapley  
test drives the  
*Dancing Fader  
Module* interface  
for the *Foundation  
2000* dedicated  
workstation

Since launching the *Foundation 2000* workstation into the postproduction market nearly two years ago, Fostex have promised a dedicated hardware control surface to allow easy access to the system's mixing and DSP functions. Until now, this has been achieved in a pretty basic manner using MIDI controllers such as the Fostex *DCM 100* console or *Cubase*. However, Fostex have now fulfilled their promise and released the poetically named *Dancing Fader Mixing (DFM)* system.

Designed specifically for *Foundation 2000* (not compatible with the entry level *2000RE*), the standalone *DFM* console currently offers full digital control over levels, mutes, solos, pans, EQ, aux sends, source selection and phase reversal. Both dynamic and snapshot automation are also catered for, and according to Fostex other DSP functions, such as dynamics and reverb which are to be made available shortly, will also be controllable from the console.

At present, the *DFM* is running beta software, but despite this the demand has been so strong that Fostex have already sold 15 systems to existing *Foundation 2000s* worldwide in excess of 100 with the greatest take-up being in Californian postproduction houses.

The *DFM* interfaces to the *Foundation 2000* mainframe via a single, high-speed data cable, and apart from a mains lead there are no other connectors. The desk itself is extremely compact (482mm x 590mm x 290mm), being simply laid out with a mixture of assignable and dedicated controls including 10 long-throw motorised faders (eight assignable and two dedicated masters), seven large assignable rotary encoders, and 20 alphanumeric LED displays.

From a user's point of view, the *DFM* is very easy to operate, and once familiar with the overall layout, the system is quick and intuitive to use. The uncluttered control surface and use of plenty of display windows both being contributory factors here.

Being totally software based, the console has been built with expansion in mind. The standard configuration with one Fostex DSP ACE cards provides a stereo mixer (10:2:2), 3-band EQ, two aux sends and four aux returns. With additional ACE

cards it will soon be possible to expand the system into an 8-bus mixer (10:8:2:2) with selectable EQ types, and extra aux sends and returns.

## Patchbay

Fundamental to the operation of the mixer is the Patch Bay which is accessed from the main display on the *Foundation* Edit Controller. From here all input and output connections to the *DFM* are organised by marrying together sources and destinations.

Again the system is intuitive, using a series of 'From' and 'To' boxes into which choices are entered from a list of the I-Os fitted to the system. So, for example, to connect an analogue multichannel module to the desk and route direct to the *Foundation* tracks, the procedure is as follows:

Add Analogue In 1-8 to the 'From' box, enter Channel In 1-8 to the corresponding 'To' box; repeat the procedure this time connecting Channel Out 1-8 to Track In 1-8.

This setup is adopted as the default, along with other regular connections making the system 'ready to go'. However, any changes you make to a patch configuration will be saved and reset along with the rest of the Reel data. There is presently no facility for storing/recalling user patch presets, but this is something Fostex are working on and has scheduled for the next software release in the autumn.

When patching digital I-Os, the system automatically switches sync reference. For instance, if system sync happens to be SPDIF and an AES-EBU input is selected, the reference will be changed to AES-EBU, disconnecting any SPDIF patches.

## Console

The assignable nature of the *DFM* means that the faders and knobs can perform a variety of functions. Central to this functionality are the Mode buttons and Menu display which run across the top of the unit. From here the desk is globally switched to different control modes causing different functions to be assigned to the faders and knobs.

There are currently three main control modes which switch the desk to Channel, Monitor or Auxiliary operation. If Channel mode is selected the eight assignable faders will control the systems 10 channels (A,B and 1-8)—to make this possible an additional switch toggles fader assignment between 1-8 and A,B 1-6. In Monitor mode the faders control the eight monitor outputs from the recorded tracks, and in Auxiliary mode the faders are subswitched from the Menu display to control Aux Sends, Masters or Returns. Being motorised, faders automatically reset between functions to show the current levels—of course, this acts purely as a visual indicator as no audio actually passes through the fader.

Directly above each fader is a SELECT button which allows access to mixer parameters such as EQ, Pan, Input Trim and so on. Depending on the

current mode, only certain parameters will be available—for instance EQ is only available to the channels and cannot presently be added to the monitors or auxiliaries. More than one SELECT button may be accessed at the same time (providing the MULTIPLE button is active) allowing identical adjustments to be made on a number of channels simultaneously.

There are seven knobs that are assigned to the Selected channel-channels; six of these run in a column down the right-hand side of the desk and deal with EQ or Input Trim, while the seventh is positioned next to the LR and Monitor Master faders and adjusts left-right pan. Each of these controls has an associated display window showing the current setting.

Additional channel functions are accessed from the Menu via soft keys including phase reverse, individual pre-post switching for the aux sends, channel input source (either Track or assigned Input), and EQ in-out. The same keys are used to select between the high and low bands of the 3-band, parametric equaliser (HF 625Hz–19.9kHz, MF 125Hz–3.98kHz, LF 25Hz–797Hz. All  $\pm 15$ dB with constantly variable Q from 0.1–3 octaves)

Also associated with each fader but not dependent on the SELECT keys are Mute and Solo buttons. The latching solo operates post fade and pan, and can be applied additively between channels. Solo selection also activates the SELECT key ready for parameter adjustment. A useful facility is the three CLEAR keys for Mute, Solo and Select which allow selections to be cleared down by a single button press.

One slight niggle connected with the Mute function is that it appears to use a relatively slow ramp down time—presumably to avoid clicks—and rather than producing a finite cut, it can often leave a tail depending on the signal. Fostex are currently investigating this.

As mentioned earlier, routing is controlled from the patch bay display in the Edit Controller. However certain connections can be made from the console from a group of master routing keys. At present routing is restricted to the LR bus and Monitor bus, however 8-bus routing is provided and will become available with the introduction of the 8-bus mixer option later this year.

Grouping is another function that is only available in Channel mode. A group can include any of the 10 channels, but only one channel may belong to one group at a time.

Groups are created by first selecting the Master GROUP button, which will cause the SELECT buttons on all available channels to flash. A group master is then created by pressing one of these SELECT buttons, and an asterisk appears in the Channel Display window to confirm master status. Subsequent selections will add slaves and once these have been included, the GROUP button is pressed again to establish the group.

Any changes to any parameter on the group



master will then apply to the grouped channels, although slaves may be independently adjusted in relation to the master. If slave faders are adjusted they will retain their relative position to the master, but with other controls this offset relationship is not preserved, and as soon as a master parameter is adjusted the slaves will assume its absolute value.

Group information remains intact after the group is disbanded, and any dynamic fader moves will be saved if using automation. Groups, however, can only be created or disbanded while the automation is switched off and this can be a little irritating.

## Automation

The system has two levels of automation—Snapshot and Dynamic. Snapshot affects all console parameters apart from solos and the Monitor Master Fader, while Dynamic automation affects faders, mutes and pans for the 10 channels and LR Master Fader—EQ is not a dynamic function.

There are 99 user snapshots available per Reel and two presets—FLAT and ZERO. FLAT as its name suggests sets all EQs flat, centres pans, sets trims and levels to unity gain, and switches phase to positive. ZERO does exactly the same except levels are set to off rather than unity.

User defined snapshots are created from dedicated keys by selecting a snapshot number from the Snapshot Window and storing the desk setup to it—an asterisk will appear next to the snapshot number confirming it has been saved. Once stored snapshots may be used in two ways, they can simply be recalled manually to reset the console, or they can be placed against time code within a reel to create changes at strategic points.

A possible way of working with the system would be first to add a series of snapshots to create the basic mix skeleton, and then flesh this out using dynamic automation. There are four dynamic automation modes which are set globally to the channels from the Menu display: Master, Playback, Touch and Hold.

Master mode is a universal write status that continuously records fader, mute and pan movements and this is the mode that will be used for the first mix pass. Once this pass is completed, the system will automatically switch to the update status Hold. This switches all the controls to read until they are touched at which point they remain in write until the mix is stopped. The other update mode Touch also switches from read to write but remains in write only as long as finger contact is maintained with the control. There is currently no offset or relative status employed by the system.

Dynamic mixing operates on a continuous update process—the last mix being overwritten by the new mix. There are no facilities to save mixes and no means of undoing moves, so the user has to be very careful to avoid making mistakes like I made by trying to change status half way through a mix. Unfortunately this meant that I inadvertently entered Master mode which, of course, wiped a large whole in the middle of my mix before I was aware of what was going on. The system would certainly benefit from an 'Abort Pass'



Seen here with the *Foundation 2000*, the *DFM* (right) is a dedicated hardware controller

button, and Fostex are looking into this.

Another area that Fostex are considering is segment or event-based processing where DSP functions relate to audio events rather than time code positions. There is also the possibility of creating a DSP library where for instance useful EQ settings could be stored for future use.

## Conclusion

It should be stressed that the *DFM* system being looked at here was running beta software and that Fostex are implementing changes very rapidly.

Taking into account that many of the points raised are being addressed and that the system has been designed to grow, the *DFM* offers a lot of potential. As a fully integrated part of *Foundation 2000*, the *DFM* brings a superior level of control and increased functionality, which will

undoubtedly give the overall system far greater appeal—certainly people will be reluctant to use *Foundation* without *DFM* once they have tried it.

A very noticeable factor, and one into which Fostex have put a lot of effort, is the system's overall simplicity and ease of use. As stated a number of times, operation is both fast and intuitive and users should find they get to grips with the system very quickly. ■

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# THE NEW NET

## ATM is being hailed as the brave new world of networking. Joe Bull of Studio Audio discusses some of the issues and explains why this technology is being integrated into *SADiE* and the new *Octavia* disk editors

Anyone who has used the World Wide Web (or 'Cruised the Internet' as some would say) can hardly doubt that networking is here to stay. The ability to link up to computers anywhere in the world and download text, pictures, sound bytes and information is most alluring. But they will also know that it is slow.

Most disk editors and workstations now have methods for transferring audio between individual workstations or workstations and file servers along some sort of network as well. Bill Foster's article on ('Understanding ISDN', *Studio Sound*, July 1995) gave a good insight into the current state of networking disparate bits of audio from various sources or locations using the codecs described therein. However, as was explained, there are cost considerations and the bandwidth is limited. These are all networks in their own right but they are scarcely integrated and to set up any

interconnection requires a lot of planning.

Many may also have heard of the 'information superhighway' and the audio-on-demand and video-on-demand systems that are predicted to be upon the domestic market in the next decade. These systems would enable users to choose the precise entertainment they want from a selection of audio and video material on central file servers—and at a time of their choosing. The same systems will be used for general telephone calls but probably with a video link and data-file link. The physical connection to these systems will be a network. But this would require a phenomenal bandwidth if every household were able to listen to and watch whatever they wished to. This is where ATM comes in.

Asynchronous Transfer Mode (ATM) is the next generation of extremely fast networking technology that will be infiltrating homes within the coming

decade bringing information, entertainment, communications, and all manner of other facilities that have yet to be dreamt up. From our perspective in the pro-audio industry, it will be here much sooner than that. Avid, Sonic Solutions, Studio Audio and many other manufacturers of disk editors are already adding ATM networking to their various systems and it seems set to take over from earlier networking solutions. Why should this be so?

### The mechanics

ATM describes the protocol (the order and sequence of data and control information on the network) only not the physical medium that the network uses (UTP-STP, Cat.5, fibre-optic and so on). The protocol is at the heart of the ATM technology. It not only dictates the way that data is put onto, routed through and then received from the network, it controls the whole way that the network is operated and policed.

All data that needs to be put onto the network is broken up into 48-byte packets. These packets have a 5-byte header, of address, status and control information, added to form a 53-byte cell. All ATM messages use this homogeneous 53-byte cell size. The physical network is comprised of a series of interconnected switches which use the address information in the header to route each cell through the network from switch to switch until it reaches its destination.

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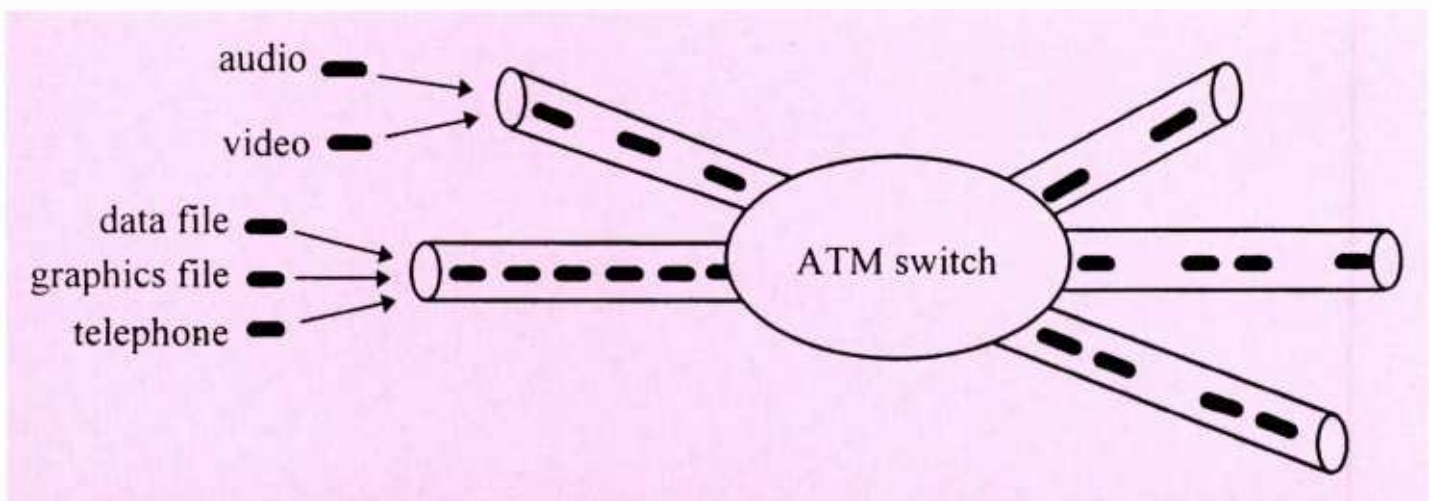


Fig. 1: Small ATM cells ease the task of multiplexing by eliminating operator intervention and maximising bandwidth

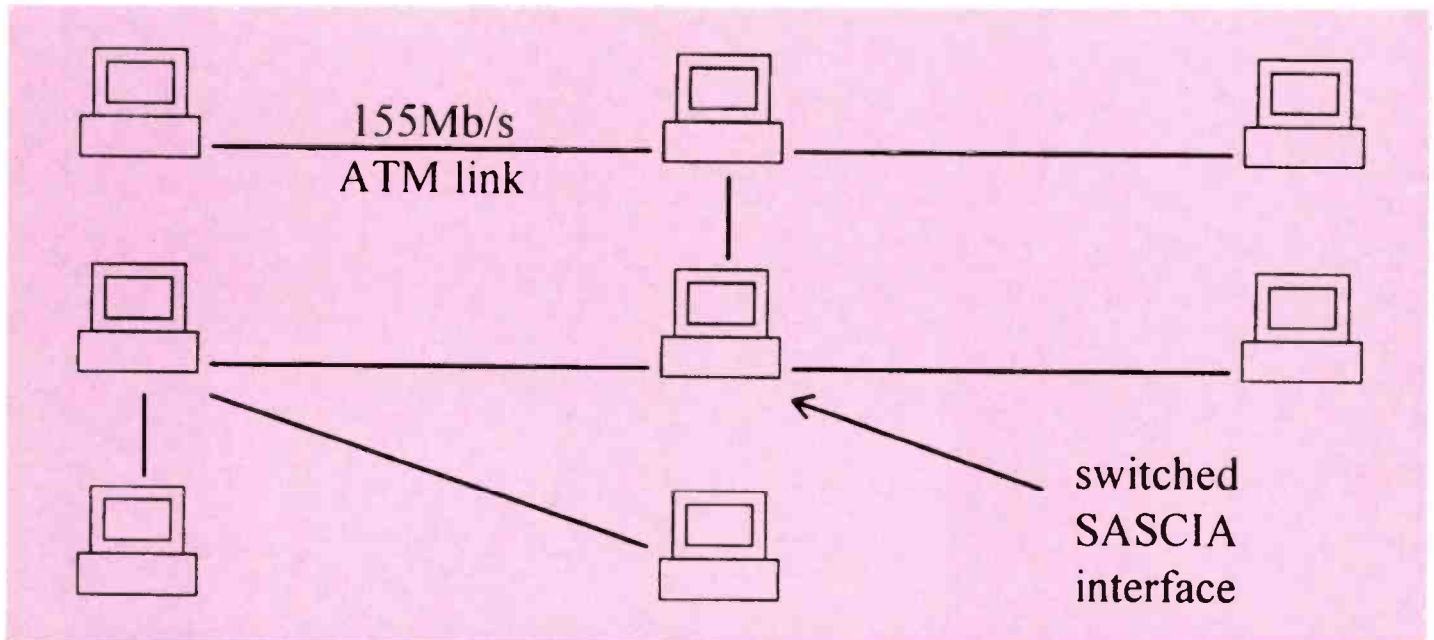


Fig. 2: Diagram of a small network utilising SASCIA's optional distributed switching for a SADiE-Octavia ATM network

ATM node negotiates and is then allocated a bandwidth from the network management system that can be used for data transmission and reception. This bandwidth can be guaranteed (as would be required for real-time, high-quality, audio transfers) or variable (such as for a telephone conversation, where silence need not be transmitted, or an off-line file transfer). A guaranteed bandwidth gives the user exclusive rights to transmit a certain volume of data per second, a variable allocation will share the available bandwidth with other users who can soak up any unused capacity. The negotiation process also configures the switches between the source and the destination to make the connection. Each switch removes, analyses and updates the address header before sending the cell on way to the next switch or ATM node.

As a switched network, ATM offers the same

A small network of a few workstations could later have file servers and many more workstations... without having to throw any of the existing hardware or cabling away

possibilities as ISDN for multipath propagation delays but this is handled by the receiving ATM node without user intervention. The multiple paths are actually an advantage as there are more potential ways of routing the required data-transfers around the network, maximising the available bandwidth.

ATM is not constricted to a certain speed of operation. There are already various defined data transmission rates for ATM interconnections. The slowest one I know of is 25.6Mbits/s—400 times faster than the 64kbit/s of ISDN streams! Slower data streams from various sources can be concentrated at a switch and then sent down a faster combined data stream to the next switch and so on. 155Mbit/s and 622Mbit/s silicon parts are already available and 2.4Gbit/s parts are on the drawing board.

There are many types of network topologies that have been developed over the years: ethernet, switched packet, token ring to name but a few. ATM by its very nature of adopting distributed switching has a scalable architecture. This means that whatever networking requirements you might have now can be added to in the future. A small network of a few workstations could later have file servers and many more workstations or even connections to other networks appended without having to throw any of the existing hardware or cabling away.

The use of distributed switching and the small consistent cell size allows the ATM network to be easily optimised to the throughput in real time by the network-management software. This allows the maximum number of users to share data across the network.

ATM is not a bed of roses though. It is 'state-of-the-art' and subsequently undergoing constant protocol revisions (changes to the operating software) to ensure that all interested parties and, there are very many, are catered for. This process is

starting to stabilise now and the protocol is fairly stable for local area networks. Another example of an ATM 'problem' is known as congestion. If multiple users have chosen a variable data rate and then all require to use it at once a switch may become swamped with data faster than it can be routed to its outputs. The switch is said to be congested and some data will have to be thrown away. The ATM forum have defined a message that the switch can send to the destination alerting that some data was lost but they have yet to devise a method of getting the switch to tell the source directly to resend the lost data which would save a lot of valuable bandwidth.

Due to ATM still being a very new technology, the price of a small installation can be prohibitive at present. A typical ATM switch chassis with connections to half a dozen workstations can leave little change from £80,000 but this is set to drop rapidly once the corporate business users start to implement ATM networks in the near future. ►

GLOSSARY

ATM	Asynchronous Transfer Mode
Cat.5	high grade UTP/STP cable
FDDI	Fibre Distributed Data Interface
ISDN	Integrated Services Digital Network
LAN	local area network
Octavia	new modular editing system running SADiE software
PSN	public service networks
STP	Shielded Twisted Pair cable
SADiE	Studio Audio Disk Editor
SASCIA	Studio Audio SCSI Connected Interface to ATM
TCP/IP	Transfer Control Protocol/Internet Protocol
UTP	Unshielded Twisted Pair cable
WAN	wide area network



# The Ultimate Analogue Console

# 9098

by Rupert Neve the designer



Photocourtesy Lisa Stansfield's Gracieland Studio, Rochdale, UK.  
Configuration shown has 48 9098A Mono inputs, 24 9098K Dual Monitor inputs and 4 9098L Stereo inputs. Console has full complement of AMEK SUPERMOVE automation controlling 106 servo faders, 116 channels of VIRTUAL DYNAMICS and comprehensive SYSTEM RECALL.

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## SASCIA interface

So, why was the choice made to design an ATM network for Studio Audio's *SADiE* and *Octavia*? There seems little point in reinventing a solution using existing old technology when a clear advancement is in evidence. Also, due to the widespread acceptance that ATM will become the preferred network used throughout the business world and the public service networks, the price will inevitably fall over the next few years.

In *SADiE*, as with all other professional disk editors and workstations, the audio data is stored on a SCSI disk drive attached directly to the card. All audio data transfers are processed on the card itself and never come into contact with the PC's memory directly. This lends advantages (in that the audio acts as a separate subsystem leaving the PC available to handle the user-interface and the *SADiE* program. But, it leaves the design without an obvious place to connect to a network of other audio data. The data could be fed from the network through the PC (but this could restrict the operations of the PC while network transfers were taking place). The hardware could be modified to provide a network access port (but there is a huge overhead in processor time administering the network which would be unacceptable and it is then difficult to upgrade existing systems). The SASCIA network interface was therefore designed as a bridge between the ATM fabric and a SCSI interface. *SADiE* will make a request for audio data that can be addressed to a pseudo disk (SASCIA) using standard SCSI calls, these requests are translated and sent over the ATM network to another unit where they are sent as SCSI commands to the disk itself. The actual audio data will return to the calling *SADiE* unit via a similar method. The SASCIA interface implements a 155Mbit/s ATM capability which neatly maps onto the 20Mb/s maximum capacity of SCSI2 (fast and wide). This gives theoretical maximum of 200 channels of 16-bit 48kHz data simultaneously available across the network. All the data transfers and housekeeping functions on SASCIA are performed by a Power PC RISC processor and the unit boots and self-initialises from flash RAM.

The expandability that ATM offers through its switched architecture is also an important factor. A real solution should cater for smaller facilities as well as larger installations but the price of the commercially available ATM switches often makes an installation of less than a dozen workstations financially impractical. For this reason SASCIA can optionally be supplied with an embedded switch that allows three connections into the ATM fabric from each SASCIA Node. This makes a small network more affordable as a useful architecture can be designed using a few small distributed switches but still allow for future expansion. Another reason for choosing ATM as a network solution is that it provides the potential for interconnection between many different workstations but unlike OMF it can work in real time. This represents a major benefit to the postproduction industry who often have to perform lengthy file transfers and conversions to move material from one workstation to another. We at

Corporations are starting to realise the potential of multimedia in communicating ideas and information

Studio Audio are already talking to other editor manufacturers about exchanging each others file formats and are interested in talking about licensing the SASCIA technology to help other companies add ATM functionality to their systems.

Fig. 2: shows a simple 8-workstation network that uses just 3-way ATM switches (four workstations can be connected using just one 3-way switch.) This provides a considerable cost saving over installations requiring a large central switch but still leaves all options open for future expansion.

## The future

What trends can be seen of the future of ATM? Most of the large corporations are starting to realise the potential of multimedia in communicating ideas and information between departments and individuals at their PC workstations. This large scale uptake of ATM networking by the corporate market is predicted to bring the cost of the component parts down sharply over the next few years. This is substantiated by the fact that all of the silicon manufacturers who have any interest in networking technologies are designing their own ATM parts and this too will force prices down. The birth of the 'Infobahn' is imminent in the US and will hopefully soon be upon us in Europe (if the various governments permit it to get started). This will put the development of ATM technology into a different echelon altogether and will potentially allow affordable access to data from all over the world.

ATM meets the emerging needs of networking by accommodating mixed media traffic, being equally at home with audio, video and file data. By being scaleable and flexible so that you do not have to predict your future requirements at the outset. By providing a relatively simple method of interconnecting existing network technologies and ATM is the first system that provides for eventual worldwide connectivity—ATM facilitates this by being connection orientated, supplying only the bandwidth that is required and being able to charge the user for only the bandwidth used.

ATM is the first networking solution that has been designed to cope with the varying demands of local area networks (LANs), wide area networks (WANs) and the public service networks (PSNs) and allow interconnections between them. It's also extremely fast. ATM is the future of networking. ■



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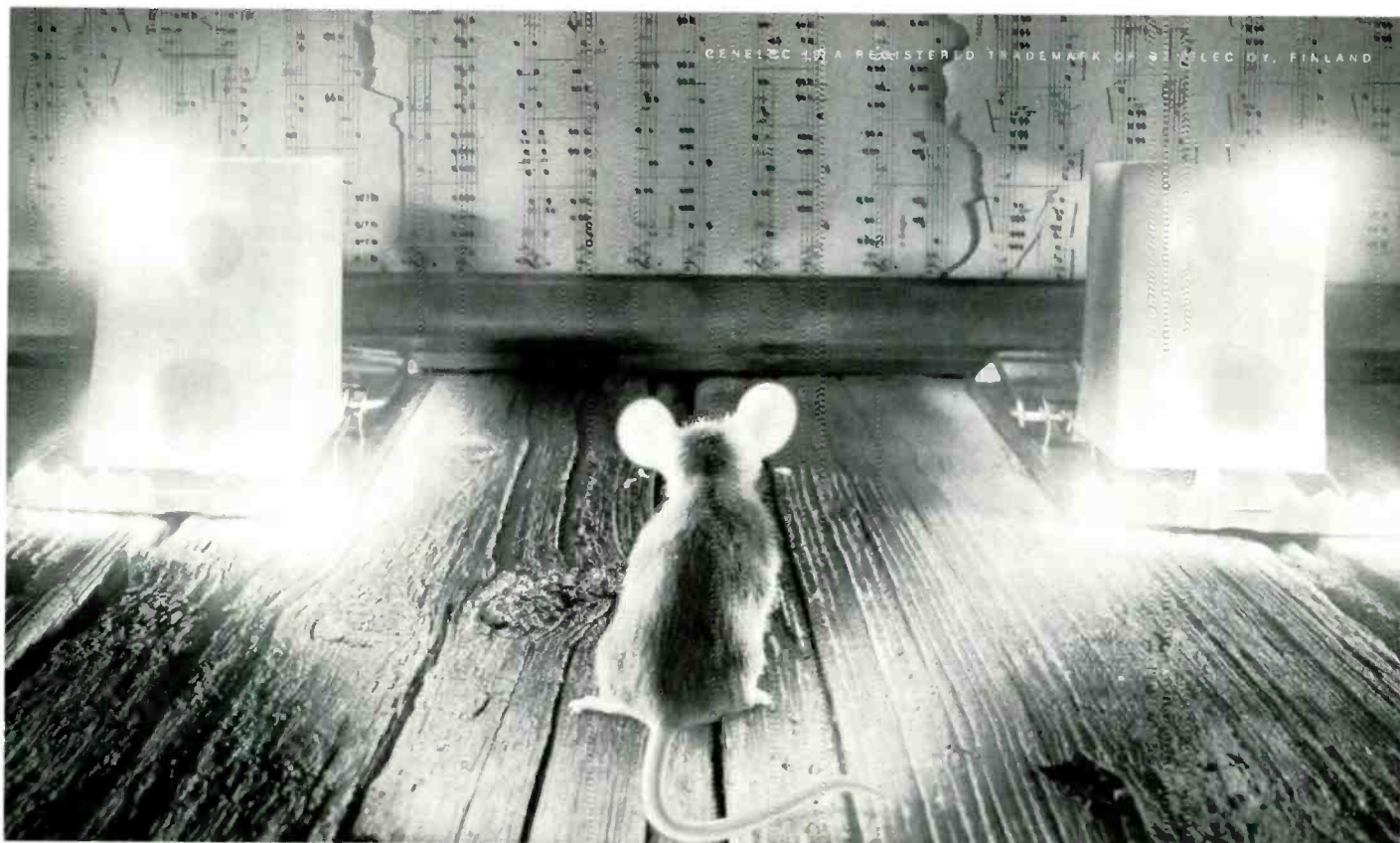
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# MAKING WAVES

The high output levels required of professional monitor speakers has forced their designers to adopt some controversial solutions. Philip Newell investigates the increasingly popular 'waveguide'

Last year saw the launch of new loudspeaker designs by a number of different manufacturers making much of their use of axisymmetric horns. But whether driven at the throat by a dome, a cone, or a compression driver, or even under another name, a horn is still a horn.

Horn loading provides three significant differences over direct radiating—higher electroacoustic-conversion efficiency, more control over directivity and something more akin to spherical expanding wave propagation than the lobed directivity frequently encountered with piston-type radiators.

The degree of horn loading depends on the degree to which the radiating diaphragm is given a greater amount of air against which to push. The compression technique increases the loading by forcing the vibrations to travel through restrictions such that the cross-sectional area in the restricted ducts is less than the area of the radiating

diaphragm. The ratio of these two areas is known as the compression ratio.

In conventional compression drivers a phasing plug is added in order to help to produce an equal path length from all parts of the radiating diaphragm to the throat of the restriction. Were this not done, any path length differences would produce uneven responses, dependent upon the waves arriving in phase or out of phase in the throat.

The compression technique can, however, only be used up to a certain point before problems begin to emerge. At high output SPLs, the SPL in the phasing-plug ducts is higher by a function of the compression ratio and the air itself becomes nonlinear in its response. We can only compress one litre of air by one litre before the compression becomes infinite. On the other hand, we can rarefy it infinitely, so the resistance to compression for any given applied force tends to be greater than the resistance to rarefaction by the same force applied in the other

direction. Hence to compress by 1cc represents a greater percentage of the available volumetric change than to rarefy by 1cc. When SPLs reach the 150dB region, this effect begins to become significant. At these levels, the positive-going half cycles tend to get 'squashed' as compared to the negative-going half-cycles, giving rise to second-harmonic distortion.

In sound-reinforcement applications in large auditoria, there are few if any alternatives to using such devices, as small diaphragm, low-efficiency drive units. But in studio monitoring applications, we often find ourselves in a situation where domestic components are inadequate and the capabilities of sound-reinforcement applications are not necessary.

All horns are acoustic waveguides, but the term waveguide is being applied more and more to horns of the non-compression type. Here a small diaphragm—be it a cone, dome, or ribbon—is placed at the throat of a (usually) exponential waveguide. By using a combination of a waveguide and a relatively high-efficiency drive unit, in-band sensitivities of 100dB to 105dB/W at 1m can be achieved without the need for precompression. This technique greatly improves the sensitivity, and hence maximum given output SPL from the drivers, without introducing some of the pitfalls of high-compression techniques.

I have mentioned in print many times that the Tannoy dual-concentric loudspeakers were rarely, if ever, accused of sounding typically horn-like. Given the state of the art when these devices were first produced, such as the lack of high-temperature coils, a compression driver was used, but it was of a low compression ratio. The Tannoys were thus axisymmetric horns of a low compression. In the article 'Round The Horn' (*Studio Sound*, March 1994), the sonic benefits of smoothly terminating axial symmetry were discussed at great length.

## Radiation

Typical radiation patterns from a direct-radiating cone are shown in Fig.1. The diaphragm radiates by a piston-like action producing sound from the whole of the surface area almost simultaneously. If the sound is radiating from a relatively large surface area compared ▶

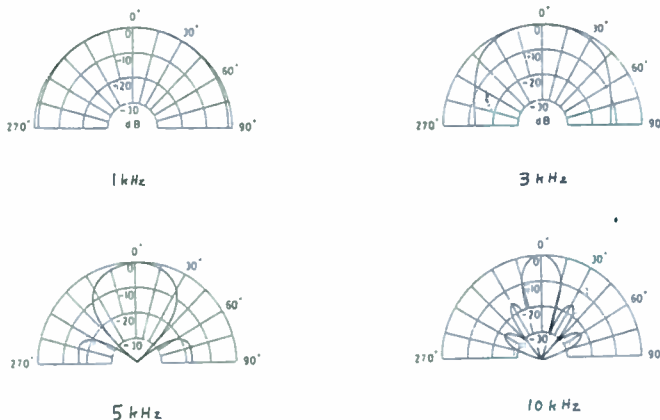


Fig.1: Typical lobed radiation pattern of a 4½-inch piston radiator (after Beranek)

to the associated wavelengths, then, depending upon the relative position of the listener and the diaphragm, the same path-length differences at higher frequencies will occur as would require a phasing plug to 'straighten them out' in a high-compression driver. In the case of the direct radiator, instead of the peaks and dips caused by the path-length distance interference creating an overall irregular response, the effect manifests itself as lobing of the polar pattern of the radiation into the listening room. The peaks and dips thus occurs not only at different frequencies, but also at different positions in the room, producing different responses at different listening angles.

In highly absorbent control rooms with few reflections, the response irregularities can be noticed in the direct sound when moving around the room. In more reverberant or reflective rooms, the effect can be an imbalance in the spectral content of the reflective or reverberant energy, dependent upon the nature of the lobing (peaks or dips in the directional response) where the sound strikes the reflective surfaces before returning into the room. The general 'fix' for this is to keep the radiating areas small, consistent with the wavelengths of the highest frequency to which any given driver will be used, but as frequencies rise and units become smaller, we can run into our power handling-headroom problems. Furthermore, because of the need for smaller drivers as the frequency rises, more drive units fed from more crossover points need to be used in higher output systems. Here we encounter an even bigger problem: because all of these drivers cannot occupy the same point in space at any one time, they must all radiate from different positions.

For any multi-driver system, there can only be one point in the room which can be equidistant from all the drive units, hence the lobing of responses is inherent. No amount of time aligning, phase correction, or even active signal processing can change this fact.

A purely co-axial, 2-way system can become an almost perfect point source, but once the SPLs rise, the large excursions of the bass cone will inevitably

begin to modulate the loading on the high-frequency horn termination, producing level dependent response irregularities. Whichever way we turn, we seem to be forced into one compromise or another. In this respect, designers of domestic hi-fi loudspeakers have an easier task than the designers of studio monitor systems.

Fig.2 shows the typical propagation pattern from an axisymmetric horn in any plane. Depending upon the precise rate of the flare, a section of a spherical or spheroid expanding wave leaves the mouth of the horn. Axisymmetric horns produce sound by a means similar to the action of a section of an expanding or contracting balloon, and quite unlike that of the flat(ish) surface of a 'direct' piston radiator. Whenever one moves within the coverage angle of the horn, only one source is apparent, and no path-length differences exist between the source and the listener.

By the use of axisymmetric horns for the MF and HF, conversion efficiencies can be achieved which allow smaller loudspeakers to produce higher SPLs over a wider frequency range than can be achieved by direct radiating, without any of the drawbacks of conventional rectangular horns. This can greatly facilitate the design of the loudspeaker system, and indeed also its interface with the control room. Dr Keith Holland and I considered the possibility of greater directivity control while carrying out the research described in the 'Round the Horn' article. By taking an axisymmetric horn made from a rubbery material, one could distort the form of the horn, without producing angular surface junctions or any abrupt cross-sectional changes, but the calculations necessary to contour the mouth of such a flare are fiendishly complicated. Without a near-perfect termination, the mouth will tend to produce reflections, which soon begin to cause the overall performance to revert to some of the response irregularities of rectangular horns. It is not possible to over-emphasise the importance of a smooth termination of the flare merging seamlessly into the front baffle.

In hindsight, it seems remarkable that the development of systems which place ►

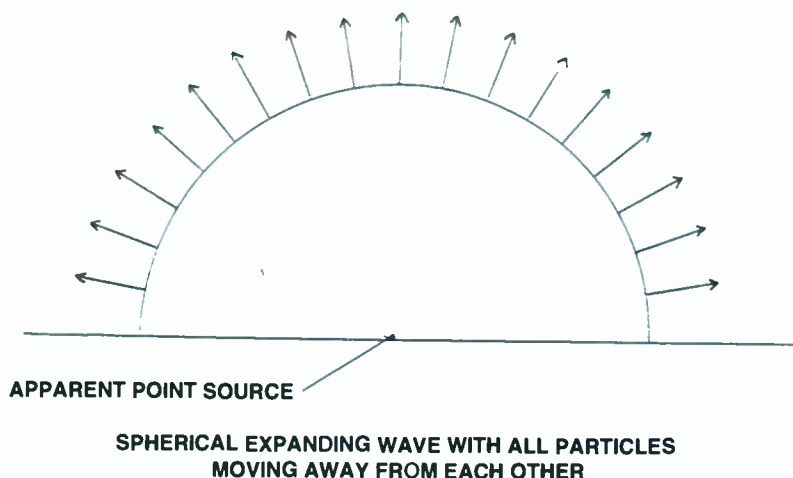


Fig.2: Typical style of radiation from a horn with below the radiation pattern from a rectangular horn. Note the absence of any lobing



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The Reflexion Arts 239 system in Regiestudios, Amadora, Portugal, circa 1992

non-compression drivers at the throat of axisymmetric horns has taken so long; especially in medium-sized monitor systems of relatively high SPL capability. Tannoy and Genelec have approached from opposing directions; the former by using low-compression axisymmetric horns (where the bass formed the horn of the mid-high frequency driver) and the latter by the use of sculpted front baffles on their direct radiator systems, which mildly load the drivers by constraining the radiating directions and help to control the wave propagation.

## Loading

During research at the Institute of Sound and Vibration Research (ISVR), Keith Holland's work on acoustic distortion in horns used a Community *M4* driver as the sound source, compressing only very slightly into the throats of the horns to be measured. Such was the only way (by using an inherently low distortion driver of enormous output) to separate the driver, phasing plug, and diaphragm-cavity distortions from the acoustic distortions in the horns themselves. The *M4* has seen commercial use both as a direct radiator and with a horn termination, but the loading difference is a point which is worthy of further consideration here.

Richard Small's 1970 paper, 'Constant-Voltage Crossover Network Design', stated that while direct radiators are mass controlled, horn-driver diaphragms are resistance controlled. The result is a constant phase difference of  $90^\circ$  between the transfer characteristics of the two types of drivers. It is the reactive (spongy) and resistive (more solid) loadings which give rise to the different radiating efficiencies of direct radiators and horns respectively, and it is this difference which manifests itself in the  $90^\circ$  phase difference. Consequently, when horn loading, one needs to look very carefully at crossover time-phase responses, or one can get misleading results.

Taken to the extremes, a horn of zero flare would be a plan-wave tube of constant cross-

section. On the other hand, a direct radiator in an infinite flat baffle is effectively a conical horn of  $180^\circ$  flare. Where one type of loading changes into the other appears to be an area which has received little general attention, and the horn loading effect is not entirely constant with frequency. In fact at the zero flare extreme of the plane-wave tube, it is constant, so long as the tube diameter remains small relative to the highest frequency to be propagated. At the other extreme of  $180^\circ$  conical flare, the horn-loading effect is constant by its absence, but at points in between, the rate of flare defines the lower frequency limit, and beaming defines the upper limit.

## Control

Horn directivity can be divided into three general regions. At low frequencies, where wavelengths are large compared to the size of the mouth, the coverage angle widens as the frequency lowers, and is similar to that of a direct-radiating piston with dimensions similar to the horn mouth. As frequencies increase, to the region where one wavelength becomes similar to the mouth dimension of the horn, the coverage angle begins to be dictated by the geometry of the horn walls. It then remains more or less constant up until frequencies where the throat of the horn begins to 'beam', with a narrower angle than that described by the walls of the larger part of the horn.

Beaming occurs in direct radiators when the wavelengths of the radiated sound begin to become small in comparison to the diameter of the radiating diaphragm. In such instances, sound can only effectively radiate more or less directly ahead through a narrow angle, or beam, where the interference remains positive. Beaming is often used in compression drive-horn combinations, to support the naturally falling high-frequency responses of the drivers by 'concentrating' the available power on-axis. In fact, as the interference mechanisms responsible for the beaming are exactly the same as those responsible for the

flattening of the radiation-resistance curve of a direct-radiating piston at high frequencies, and, as the resistive loading and directivity properties of a piston are inextricably linked, once the horn becomes unable to control the directivity, it will cease to function as a horn. In smoothly flaring horns, beyond a certain frequency dependent angle, the higher frequencies lose contact with the horn walls, so the directivity is dictated by the termination of the angles of the horn walls at the point where the high frequencies lose contact with them. Frequently, in an exponential horn, it is only the narrow and more parallel throat section which provides any effective horn loading at high frequencies, with the remainder of the flare being unable to influence the directivity.

Constant-directivity horns deliberately put angular cross-sectional changes in the sections of the horns immediately before such contact is lost, to use the properties of diffraction to bend the high-frequency propagation, and spread it over a wider angle. Firstly, and as previously mentioned, the discontinuity produces reflections, which superimpose themselves on the overall response by means of systematically loading and unloading the diaphragm as they return in a non-minimum-phase nature to the diaphragm. Secondly, the same power, when distributed through a wider angle, will be relatively lower at any point in its coverage area than when distributed over a smaller area. Hence, electrical equalisation is needed to boost the higher frequencies, in order to maintain the same on-axis response. The overall result of this trend is towards more circuitry and less HF headroom, and away from sonic neutrality. The benefits of constant-directivity horns and smoothly flaring axisymmetric horns would currently not seem to be mergeable.

The low frequency cut-off is solely a function of the rate of flare; the more rapid the flare, the higher the cut-off frequency and vice versa. A plane-wave tube therefore has an infinitely low cut-off frequency, and a direct radiator (or  $180^\circ$  conical horn), at least at its apex, an infinitely high one. A rapidly flaring waveguide will therefore have a relatively high cut-off frequency, below which the propagation of sound will be similar in efficiency to that of the same drive mounted in a flat baffle. Above the cut-off frequency, more efficient horn loading will begin to take effect. In the case of the Genelec-style sculpted baffles, the very rapid flare takes the cut-off beyond the highest frequencies propagated by the corresponding drivers, so they do not in practice horn-load. Here the term 'waveguide' can be used in a more technically correct sense.

Why horns exhibit the property of cut-off seems to be difficult to establish. Dr Keith Holland and I concocted this plain language description (well, as plain as we could make it) to try to make the principle more understandable.

## Horn cut-off

Horns are waveguides which have a cross-sectional area which increases, steadily or otherwise, from a small throat at one end to a large mouth at the other. An acoustic wave within a horn therefore has to expand as it propagates from the throat to the ►



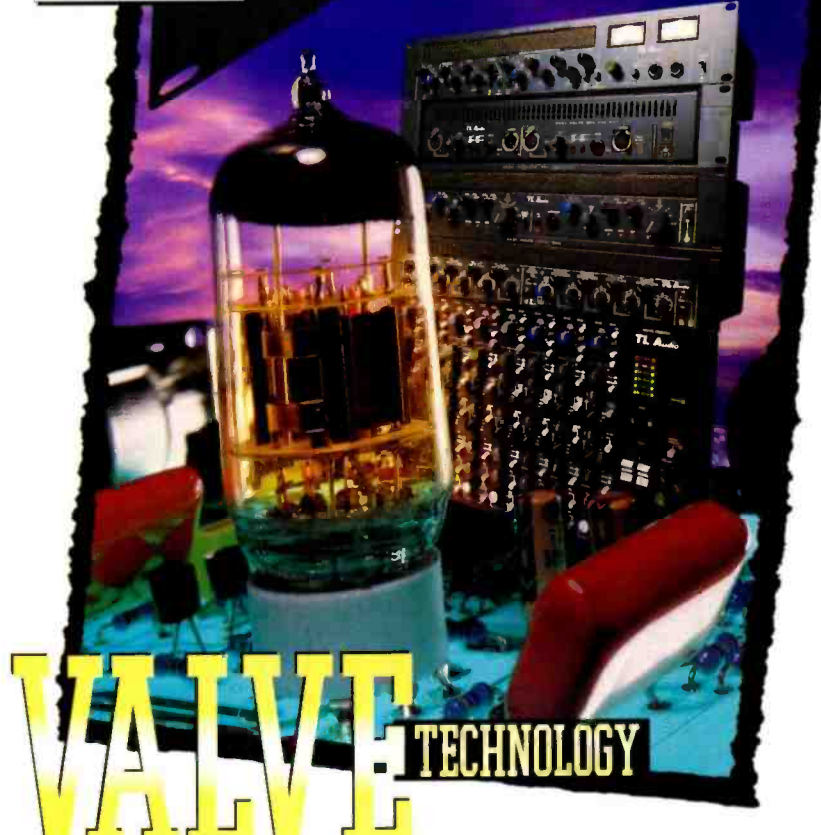
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mouth, at a rate dependent upon the local flare rate of the horn. A comparison between the propagation of waves in two simple acoustic systems may help to explain the physics of horn behaviour; one in which the wave does not expand as it propagates, and one in which it does. In the first instance, consider the propagation of a one-dimensional free progressive plane wave, such as a low frequency sound in an infinite pipe. A wavefront, defined here as an iso-phase surface, undergoes no change in cross-sectional area as it propagates, and the normalised acoustic impedance at any point along or across the pipe, ignoring losses, is purely resistive and equal to one. A plane velocity source placed anywhere along the pipe thus has no reactive acoustic loading on it at any frequency, either as added mass or as stiffness. In the second instance, consider the propagation of a 3-D free progressive spherical wave, radiating from a monopole point source. In this case, a wavefront continually expands as it propagates, and the normalised acoustic impedance at any point is dependent upon both the distance from the source and the frequency.

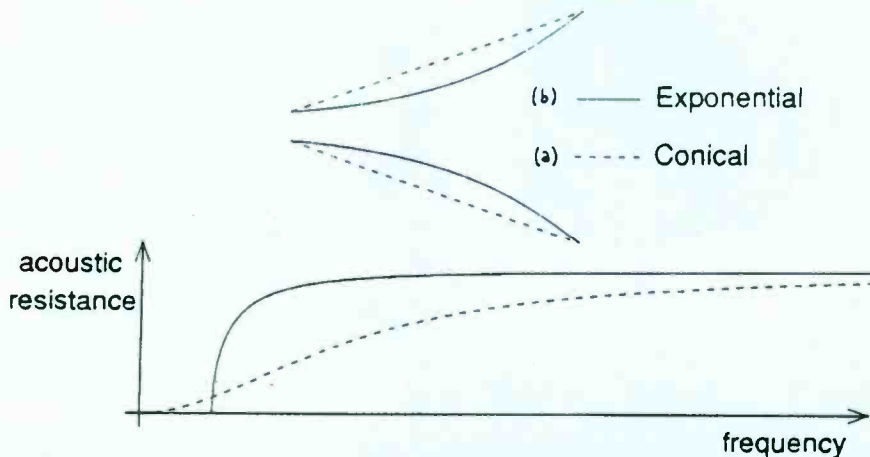
The impedance approaches unity, and hence is largely resistive, at large radii and at high frequencies, but is reactively dominated at small radii and low frequencies.

When the product of the radius and frequency is equal to the speed of sound divided by  $2\pi$ , the reactive and resistive parts of the impedance will be equal in magnitude. A spherical velocity source of finite size will therefore be subjected to either resistively or reactively dominated-acoustic loading, depending on the size of the source and the frequency of vibration. The only physical difference between the propagation of waves in these two systems is the expansion or stretching of the spherical wave as it propagates; similar to the stretching of a balloon skin as the balloon is inflated. In the case of the plane wave, a forward or positive-particle velocity is accompanied by a positive increase in pressure at the same point, due to the parallel motion of all of the adjacent

particles, and sound is thus radiated. In the case of the spherical wave however, because an outward positive velocity causes adjacent particles to move apart, like pieces of shrapnel from a bomb blast, the positive, plane wave-like radiating pressure is accompanied by a negative 'stretching' pressure due to expansion. It can be shown that the plane-wave-like propagating pressure is proportional to, and in phase with, the velocity, and independent of frequency and radius. The non-propagating stretching pressure is proportional to displacement, inversely proportional to the frequency and radius, and in phase quadrature with the acoustic particle velocity.

The expansion of the wave, and hence the stretching pressure, thus has the effect of reducing the resistive part of the impedance at low values of the distance-frequency product, and increasing the reactive part. Such positive reactance is usually associated with added mass, but in spherical waves there is no extra inertia involved when compared to plane-waves. The usual description is therefore inadequate to explain this property. In this case, the positive reactance is clearly due to a 'negative stiffness' and to added mass. The region near to a small source where this reactance dominates is known as the hydrodynamic near-field of the source; its extent is frequency dependent. The region outside this where resistance dominates is known as the far-field.

The concept of stretching pressure can be applied to horns by considering their flare rates. The flare rate can be defined as the ratio of the rate of change of wavefront area with distance, to the area of the wavefront. A conical horn has a flare rate that is inversely proportional to the distance from the apex of the cone. Indeed, a spherically radiating source can be considered to be a special case of a conical horn, and thus shares the same expression for flare rate. At any given frequency, the radius at which the resistive and reactive parts of the impedance are equal in magnitude occur where the above mentioned distance-frequency product is equal to unity. ▶



**Fig.3: Comparison between the Normalised Throat resistance of an exponential and a conical horn of comparable size (ignoring reflection from mouth). The acoustic resistance curves are typical of the 'frequency response' to be expected from such horns**



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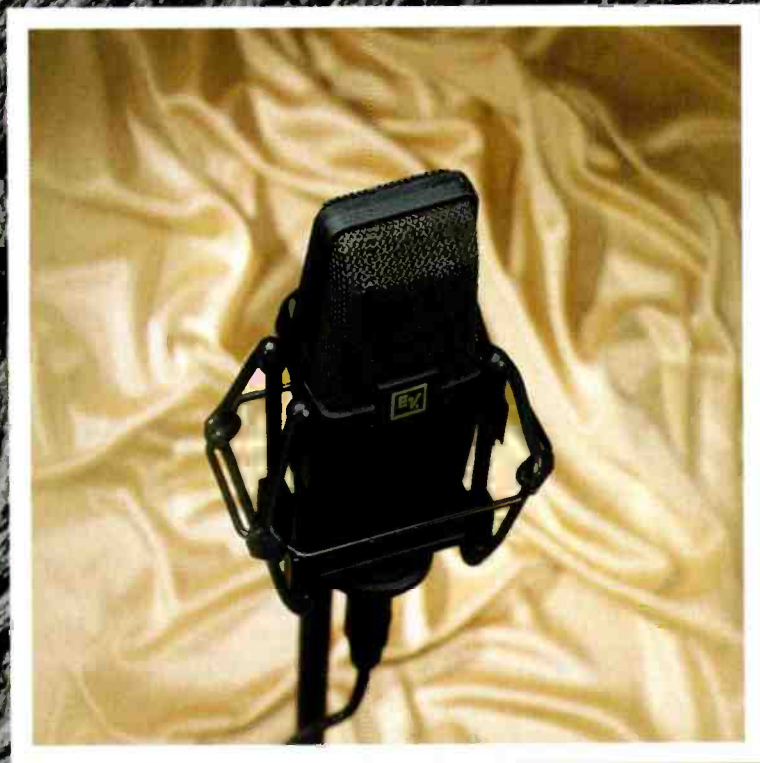


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The flare rate at this radius is equal to twice the free-field acoustic wave number,  $(2\pi/\lambda)$  and is identical to the flare rate in an exponential horn having this cut-off frequency. With flare rates below this value, resistive, far-field-type propagation occurs. Using this physical concept, the difference in behaviour between different types of horn can be explained.

The radial dependence of the flare rate in a conical horn, which shares the propagation properties of a spherical wave, gives rise to a gradual transition from the reactive, near-field

dominated propagation associated with the stretching pressure, to the resistive radiating, far-field dominated propagation as any wave propagates from throat to mouth. This transition in a conical horn from near to far-field, reactive to resistive dominance, is gradual with increasing frequency and-or distance from the apex; distinct zones of propagation are thus not clearly evident. As it is the property of resistive loading which gives to horns their greater efficiency when compared to direct radiators, as the resistive loading rises, the radiating efficiency rises. From

the above, the characteristic gradual throat impedance cut-off slope of a conical horn should be readily appreciated (Fig.3).

On the other hand, an exponential horn has a flare rate which is constant with distance along the horn. Therefore at frequencies below cut-off, the reactive or near-field type of propagation dominates throughout the entire length of the horn. Below cut-off, if the horn is sufficiently long, an almost totally reactive impedance exists everywhere within the horn. Conversely, above cut-off, the resistive, far-field type of propagation dominates, again almost everywhere throughout the entire length of the horn. Above cut-off, propagation within an exponential horn is physically similar to a spherical wave of large radius, with minimal stretching pressure. Below cut-off propagation is dominated by the stretching pressure, and is thus similar to a spherical wave of small radius. Clearly, the abrupt cut-off phenomenon of an exponential horn occurs because the transition from resistive to reactive propagation takes place simultaneously throughout the entire length of the horn as the frequency is reduced below cut-off, producing the typical throat impedance characteristics of the exponential horn in Fig.3.

The use of conical horns in audio is thus limited, because for practical sizes of horn, the resistive loading, and hence high-radiating efficiency, rises only gradually, and thus the useful high-efficiency radiation only begins to develop into a uniform response at much higher frequencies than in an exponential horn of comparable size. At the frequencies below cut-off, the reactive propagation of any horn is somewhat similar in nature to the reactive loading of direct radiators, and thus falls to the comparably low radiating efficiency of a direct radiator of the same throat size.

This description may be a little obscure at first sight, but hopefully it will give an idea of the physical concept of what goes on inside horns. ■

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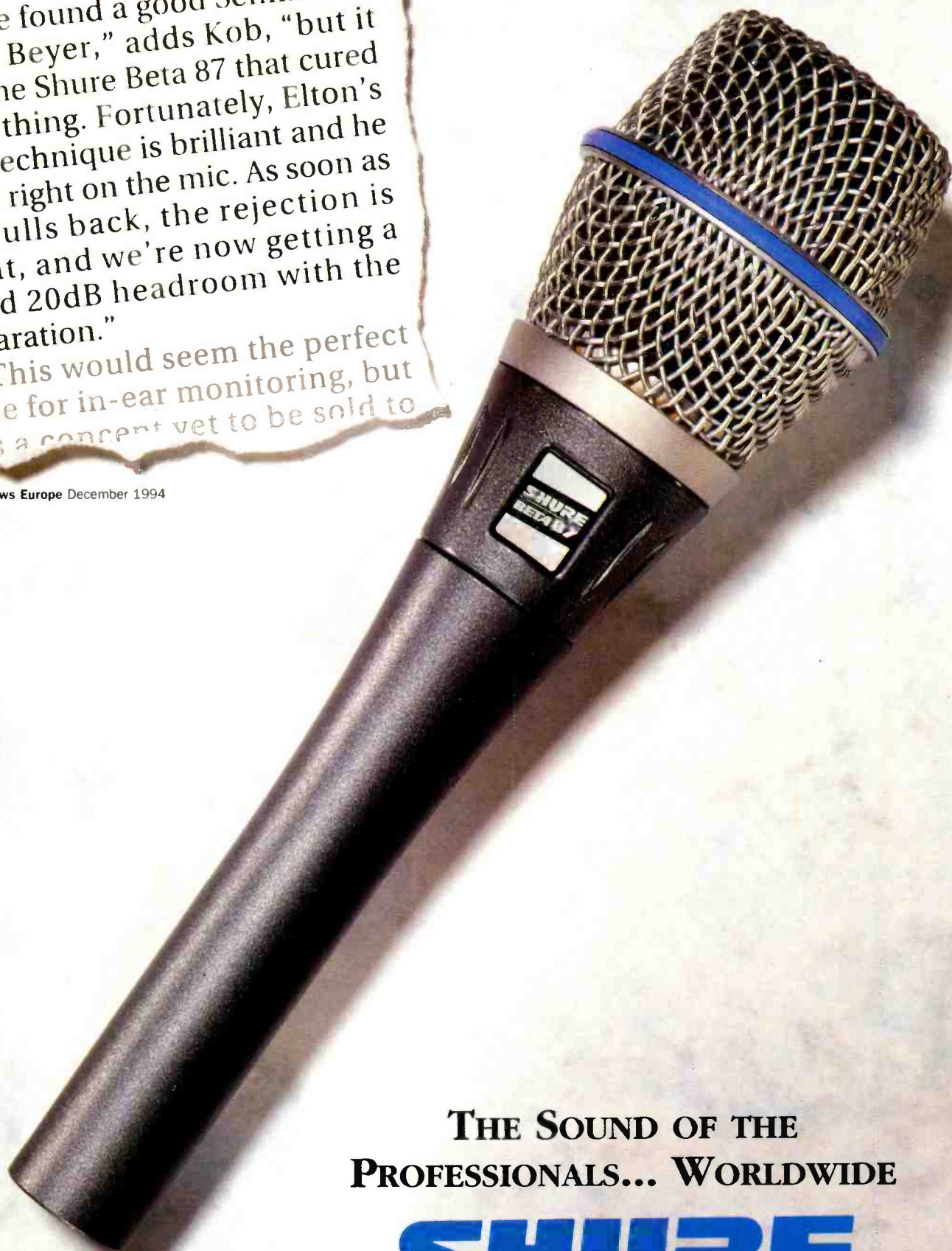


FOH desk. I was almost riding the fader between each word."

"We found a good Sennheiser and a Beyer," adds Kob, "but it was the Shure Beta 87 that cured everything. Fortunately, Elton's mic technique is brilliant and he stays right on the mic. As soon as he pulls back, the rejection is great, and we're now getting a good 20dB headroom with the separation."

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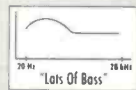
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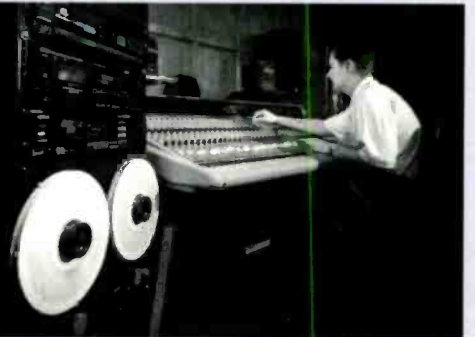


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# MATERIAL GAINS

Stretching the fabric of monitor design to new lengths.

Roger Quested talks materials technology with Tim Goodyer

**W**hen we started designing loudspeakers around 13 years ago, the 2-way systems which were common then used two 15-inch drivers running into a compression driver. At the point of crossover you had a huge lump of cardboard trying to behave exactly the same a 2-inch diameter piece of titanium.'

In just 23 words, Roger Quested has summed up one of the key problems that continue to plague designers of all current multiway loudspeaker systems. While many of the peripheral details have changed—2-way systems have yielded to those employing 3-way and 4-way crossovers, typical SPLs have climbed exponentially and amplifier technology has explored numerous avenues—this basic facet of material technology has remained a constant.

Quested's range of monitors cover the audio industry from the considerable demands of the high-end music recording studio down to those of the project room. All are subject to constant reappraisal and modification on all fronts—acoustic design, electronic circuitry and, of course, materials. Presently, many of the models either have been, or are being, upgraded, and Quested is happy to discuss his concerns. His high-end *HM412* and *HM415* monitors have recently made the transition from 3-way to 4-way designs highlighting two of these issues: materials technology and fidelity.

'The most important part of the audio spectrum should be your midrange,' the designer explains, 'that's where most information is. But this seems to have been forgotten by a lot of people who, in their attempts to make louder speakers, either put multiple drivers in to get the power handling or put drivers in the quality of which leave something to be desired. Or they mask the mid range so that the top and bottom sound stunning—but that isn't really what a monitor should do.'

'We decided to build the best possible

midrange. We used to cross over at 450Hz–400Hz from the bass to the lower mid, at 2kHz into the 2-inch upper mid and 6.5kHz into the tweeter. Most of the work on the drivers was integrating them to get seamless joints between the drivers. With a 4-way system, when you set it up right it sounds stunningly good but you do have to set it up right.'

But before you can begin to correctly set up a 4-way, state-of-the-art monitoring system, you have to design and build it. Having identified construction materials as a fundamental consideration, much of Quested's initial effort is invested in developing the most suitable drive units. Sometimes this means using commercially available drivers but usually it demands custom-designed units.

'Alternative materials may work in one situation and not another,' elaborates Quested. 'We used a Yamaha beryllium unit running into a 5-inch driver on the little *Q205* and it sounded stunning. We tried the same unit on a larger system and it sounded awful because of the difference between it and the other drivers. You can't suddenly make a magic tweeter that will work in every situation.'

The result is that Quested's 4-way *HM412* and *HM415* monitors currently use woofers custom-built by Volt, lower-mid drivers custom-built by Community Light and Sound, upper-mid drivers custom-built by Precision devices and tweeters custom-built by Morel. All were designed by Quested himself to meet the requirements of his designs and, in the case of the lower-mid unit, employ alternative materials to those in common use.

Having fashioned a *papier mâché* dome on a football to establish the viability of the new design, an alternative to a paper cone was sought and found in the form of a specialist foam.

'I don't know if anyone else uses this,' comes the explanation. 'We started off with paper like everyone else but it was just too heavy; we had to reduce the mass.

We needed something to interface between the soft dome and the paper of the woofer and upper-mid drivers and the properties of the foam was the solution. Community's Bruce Howze came up with.'

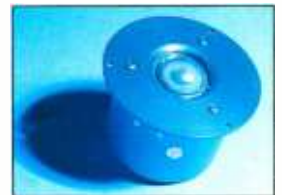
Quested's current programme of redesigns embraces the whole range of monitors and is prompted by a variety of issues. At the smaller end of the range, the electronics are being redesigned to bring costs down and increase reliability. 'From a sonic performance point of view, the small self-powered systems have been well received but are considerably more expensive than our immediate competitors,' comments Quested. 'At the top end of the range we have no problems with price at all but the lower-end systems can be sold through retail outlets and so we have to build that into the price.'

To this end, the *Q108* is being given a 'c' suffix and fitted with new electronics. The *H208* has a new midrange driver to counter problems with the original production drivers and the *HQ410* is now supplied to be used passively, bi-amped with passive crossover, or tri-amped. And the *Q212* and *Q412* now employ custom bass drivers which give an additional octave over the original version.

'You have to design things for different reasons,' Quested concludes. 'You either redesign something to make it better or cheaper. Sometimes you have design something because people want it—the thing that springs to mind is digital, people are asking for a digital monitor. We had two customers last year who wanted to buy systems without crossovers so I asked them what they were going to do with them. In both cases they were ideas I had already tried and I told them it would degrade the sound of the system as a whole. One we never heard from again and the other bought an analogue system. That said, digital systems are getting better so we will be forced to go in that direction. But not until we're happy about what we can do.'

With all the major players agreeing that with the technology currently in use, monitor loudspeaker design is a mature science. It appears that they will concentrate their efforts on refining existing systems and meeting the specific demands of the industry. ■

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**Quested gets down to the bear essentials and reveals his upgraded monitors**

# What do you like best about your DA-88?

"Built-in headroom. It makes a big difference when you're trying to track quickly."

"The TASCAM unit is clearly more dependable."

"I like having the A/D and D/A converters on an interface card because you can drop in a new card without having to disassemble the whole machine."

"MIDI syncing is so easy and clean. It's hard to know where the virtual recording ends and the taped recording begins."

"I've had a lot of experience with TASCAM... the dependability and the value. It was a no-risk investment for us."

"With the sync card it's so easy to synchronize our audio both to video and other audio source, including our DAT."

"Bouncing. I can bounce forever, it seems. The DA-88 just doesn't distort like other digital decks."

"It sounds great. Especially in the upper frequencies."

"The seventy minutes of recording time means we can do something we never could before — get an entire performance on a single piece of tape."

"The sync card has built-in SMPTE, video sync and Sony 9-pin. Perfect for our video house."

"The sheer number of professionals using the DA-88 system put paid to any reservations I might have had about moving into digital recording."

"We really like the convenience of the Hi8 format. You don't get tape stretch, you get much more time per tape, and it's really cost-effective."

"I can't help but notice the difference in the sound. Unbelievable."

"It's trouble-free. All I have to do is clean the heads. I'd call it the stress-free modular digital multitrack!"

"It locks up a helluva lot faster than our other digital multitrack recorder."

"I needed over an hour of recording time. The DA-88 is the only digital recorder to offer that."

"The frame accuracy is so fantastic, I can edit voice-overs and guitar parts as small as two frames using the Absolute Time capability."

"Punching in and out is so simple. That fact alone made it worth buying a DA-88."

"The punches are very clean and accurate. A dream."

"I've been on the DA-88 nonstop for three weeks now. The transport is phenomenal."

"I like the size, the editing capabilities, and the price. I even like the way it looks."

"I just finished scoring two movies on it. Unbelievable machine."

"Two things. First, the DA-88 gives me a full one-hour and thirteen minutes of record time. Second, the wind times are so wonderfully tight and quick... it takes my other digital recorder a day and a half to rewind."

"I can now offer my customers digital recording at analogue prices."

"I like the auto-locator and rehearsal modes, and of course we're doing our next album on it."

"It's just faster. Speed counts. Time is money."

"It just feels better than any other recorder in its price range."

"We love the jog/shuttle wheel. It's working out great."

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It features the latest generation in digital multitrack recording technology. According to users, it's the best-sounding, best-built, most functional and affordable digital multitrack on the market.

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"I'm focused on the TASCAM. It will become the standard. And I don't want to be left out."

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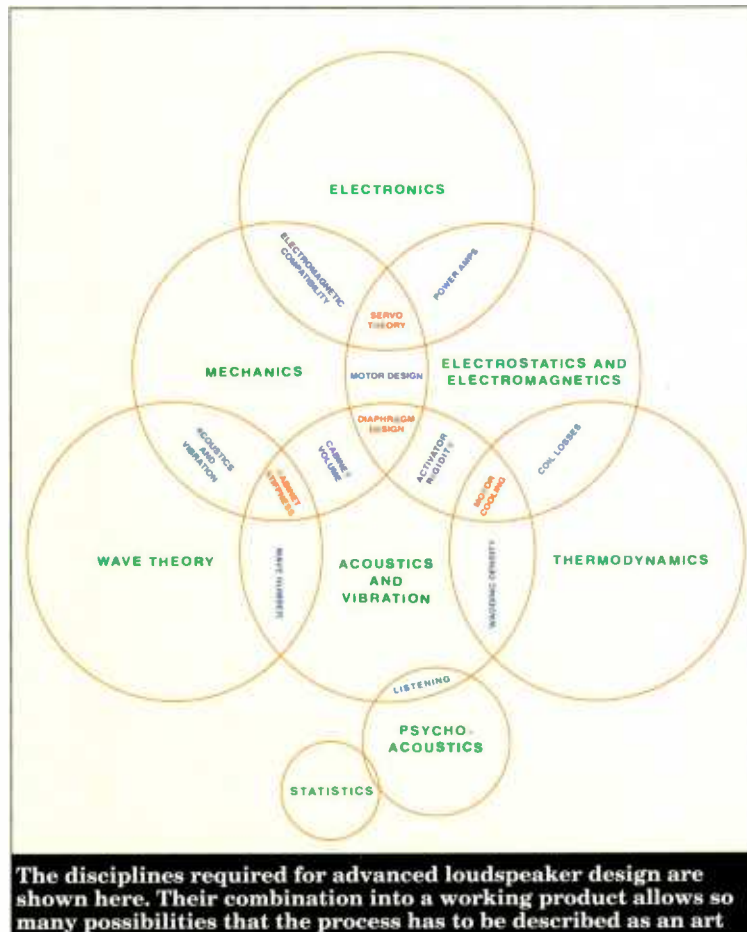
# THE ART OF MONITORS

**S**o you want to design a loudspeaker? It's easy really: you take six rectangular pieces of wood and make a cuboid. Next you randomly insert a collection of woofers and tweeters and a crossover from Acme Transducers along with an arbitrary amount of wadding. Naturally you spend more time polishing the veneer than studying acoustics and the result is total crap.

From experience I have been forced into the viewpoint that, with rare exceptions, most of today's loudspeakers fall far short of what is desirable. In fact they are primitive. There is no technological reason for this state of affairs; in fact we have never been better served with advanced materials and means to form them. The good news is that it is possible to have much better loudspeakers than are generally available if the vision exists to create them.

Let us press the reset button and change our initial question slightly: So you want to design a *good* loudspeaker? This is not so easy because it requires an understanding of a broad range of disciplines and an ability to make trade-offs between them. The figure shows the important ones of which I am aware. As an aside you might want to consider the question 'good for what?'

Most importantly, it has to be appreciated that the only fundamental criteria we have for loudspeaker performance are purely subjective. Loudspeakers exist only for human indulgence and need only reproduce what can be perceived. It follows that a loudspeaker designer must understand psychoacoustics, defined as the study of how the human ear-brain system perceives sound. The understanding must be quantitative as well as qualitative. As human beings vary, we

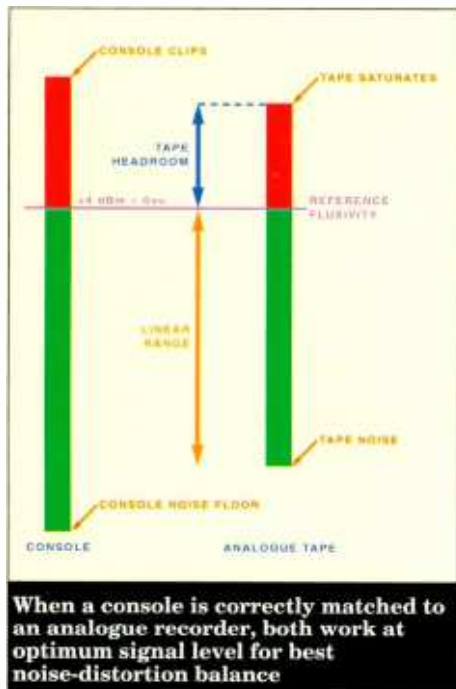


have also to understand statistics in order to appreciate that psychoacoustic data are not absolute like classical physics but are subject to variation. Psychoacoustic variation between nationalities is normal. One of the most striking examples is that Japanese and English hearing are significantly different; the English dislike of

Japanese loudspeakers and compression algorithms is not mere prejudice. It is also true that it is possible to train the hearing to be more sensitive than average. The blind do this automatically, but anyone with sufficient motivation can do the same. If we seek to produce a loudspeaker which a certain group of listeners will find flawless, it makes sense to have it assessed by someone with more critical hearing in order to ensure a performance margin. However, we should take care not to hone hearing to a sensitivity which becomes a disability because there is nothing left which reaches our standards and no pleasure to be had.

If psychoacoustics helps us to define what performance our loudspeaker must have, it does not tell us how to achieve it. We can stir the air in a variety of ways, but seldom directly. Generally we need to cause some ►

**John Watkinson is best known for things digital but he has a degree in sound and vibration and a long-standing interest in loudspeakers. Here he takes a fresh and possibly controversial look at loudspeaker technology**



object to vibrate, and subsequently transmit those vibrations to the air. The study of what happens next is known as acoustics.

Causing precisely controlled vibration requires a knowledge of how masses move. Classical mechanics and physics tell us enough about electromagnetic and electrostatic actuation of diaphragms. To follow what goes on inside the speaker we need to know thermodynamics because we are compressing a gas, and it matters whether we do that isothermally or adiabatically. As listeners we are primarily interested in what happens outside the speaker; in the far field to be precise. It is the job of the cabinet to separate these two results. The job of a loudspeaker cabinet is to do absolutely nothing. It must be utterly inert and resist the reactions from transducers and the internal pressures without any movement or flexing. Most of today's loudspeaker cabinets are very poor in that respect yet a basic knowledge of structural engineering and materials science will help to design a suitably rigid structure.

At low frequencies it is primarily the volume of the speaker cabinet which concerns us, whereas as frequency rises the shape becomes more important. In order to anticipate and control the high-frequency sound output of a loudspeaker it is important to have more than a passing acquaintance with the wave or diffraction theory of acoustics. The concepts of coherence, phase and interference become crucial to the creation of a useful polar diagram, yet are widely neglected. In fact, light behaves in exactly the same way as sound, although on a different scale, because it is a wave motion. A knowledge of wave optics is extremely useful in loudspeaker design because it allows the diffraction behaviour of cabinets to be predicted.

Unfortunately, we can never separate a loudspeaker from its surroundings, and the designer has to make some assumptions about

where his creation is to be located. It is a shame that in practice few loudspeakers seem to be positioned according to the same assumptions. This is not helped by the fact that most loudspeakers are not supplied with suitable stands.

Although I consider the above list of skills to be a minimum for the development of advanced loudspeakers, such combinations are rare. Little wonder that the average speaker today is so primitive. Many loudspeakers are developed using pure empiricism. The mechanism is not understood but the parameters are changed until it sounds best. Unfortunately, it may only sound good on a certain type of music. The design may then appear in a cookbook to be copied parrot fashion with even less understanding of the principles.

Often the designer is forced by economics to use sub optimal techniques. Here the home constructor may be at an advantage because he can fabricate complex enclosures which could never be produced economically.

## How to specify a loudspeaker

Let's take our theory and apply it to the practical problem. In an attempt to limit the variables, I assume here the loudspeaker to be one which will be used for high quality music listening or monitoring. There is no point in attempting to design a loudspeaker without a clear idea of the technical specification it should meet. A technical specification is a good anchor because it is possible to perform objective tests to see if it has been met. Naturally the technical spec must be derived from psychoacoustic considerations. A good general spec for a loudspeaker is that over the audible frequency range it should reproduce as closely as possible the original electrical waveform as an acoustic waveform both on-axis and within reasonable angles of the axis and achieve a realistic sound pressure level.

A spec phrased in this way is elegant but quite demanding. Reproducing the original waveform is the goal of microphones, recorders and amplifiers and so I cannot see why it should not be the goal of a loudspeaker. This goal implies a flat frequency response which is phase linear and a transfer function which is also linear.

The audible frequency range requires some defining. At the top end, we usually pay lip service to a 20kHz bandwidth in recorders and circuitry even though many of us cannot hear such a frequency. In air such a frequency is incredibly directional and suffers high losses, as some simple tests will reveal. Assuming a musical instrument can produce much energy at that frequency, the chances of it being radiated in your direction are small, and the chances of it reaching you intact are smaller. I have no argument with specifying a response to 20kHz in the hope that a good transient response will result, but I am not convinced that a ruler-flat response to that frequency is necessary. A mild but monotonic roll-off is quite acceptable provided it is truly monotonic. Non monotonic frequency responses are out of order because they imply a ►



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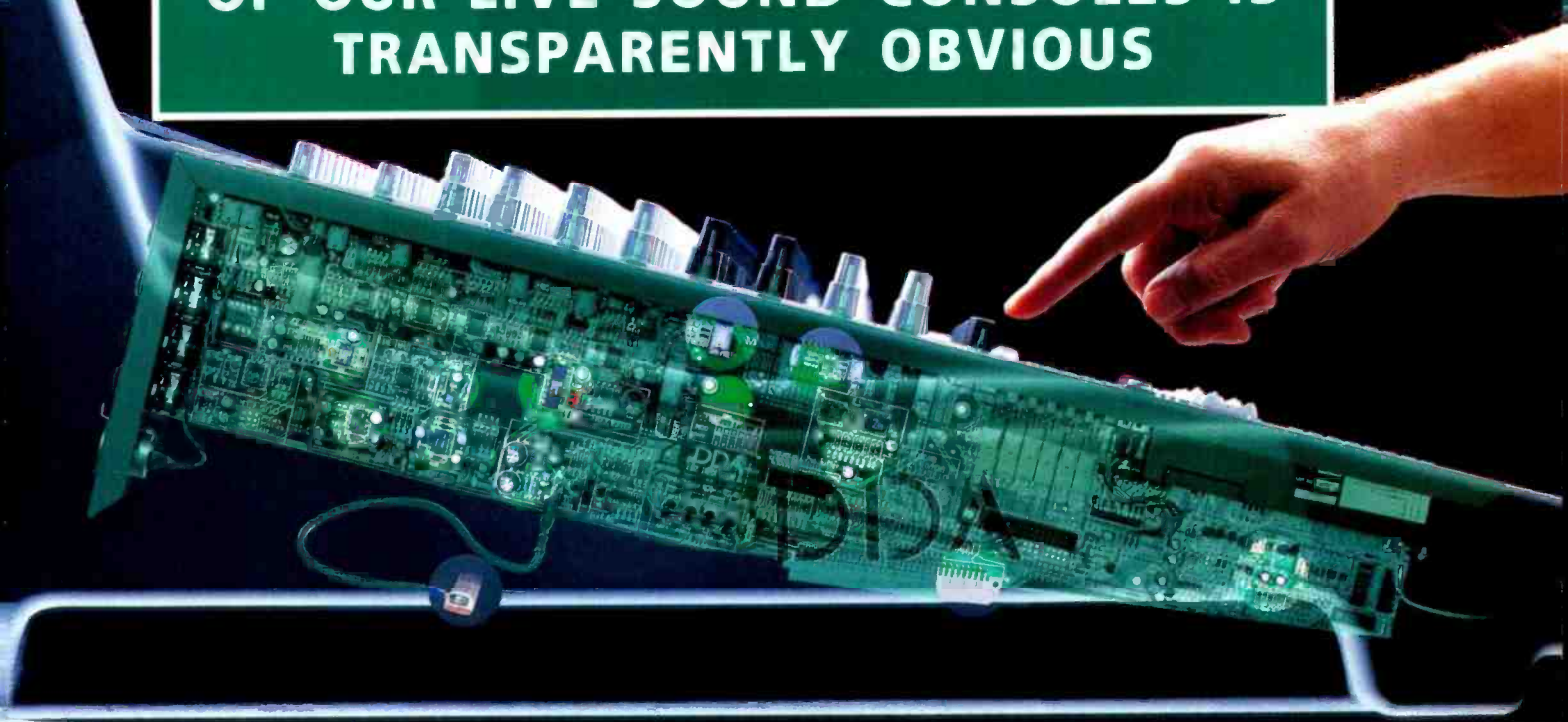
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DDA's approach to console design is simple.

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And as for their sonic quality, we know that as soon as you work with a DDA you'll agree with us: It's transparently obvious.



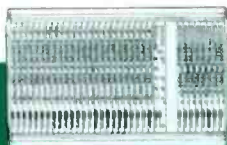
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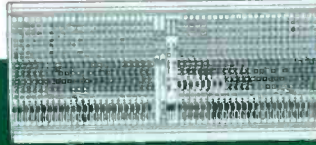
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resonance, audible as a honk on complex spectra. Energy storage is also implied, resulting in blurred transients. If the only way you can deliver 20kHz is by boosting output with a resonance, you might as well forget it.

Interestingly enough, the same argument applies at low frequencies. The lowest frequency to be reproduced is debatable and depends upon the material to be reproduced. If we want to be able to reproduce all musical instruments, we have to include the organ. In my view, organ pedal notes do not become realistic unless a response is maintained to around 20Hz. At this frequency you do some of your listening with your chest even at moderate SPLs. Low frequency roll-off is unavoidable but must be monotonic and preferably have a slope of no more than 12dB/octave.

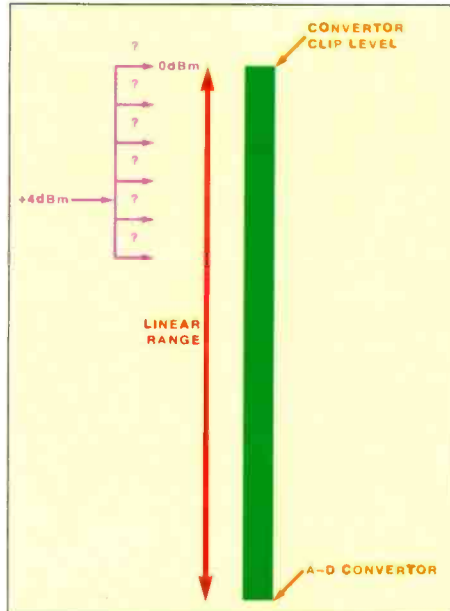
Most loudspeakers are deficient in the low frequency department. Here I part company with convention by insisting on faithful reproduction of the waveform even at LF. Unless this is done, a loudspeaker simply does not deliver high fidelity. An obvious example is the transients when an organ pipe begins to speak or stops speaking. The sound is distinctive and a good loudspeaker should reproduce it. Further examples include marimbas and other bass percussion instruments like hollow logs.

Most loudspeakers employ resonances to obtain an extended frequency response in the mistaken belief that only steady-state frequency response is important. Resonance, by definition, works by storing energy. This energy is taken from the leading edge of a bass transient and added to the trailing edge. Again by definition a tuned loudspeaker cannot be phase linear. Consequently, transient edges are blurred and unrealistic. The correct term is linear distortion. Therefore reflex loading is unacceptable on fidelity grounds. It achieves a lower frequency steady-state response by destroying the waveform of bass transients and has a steeper roll-off below resonance which is unnatural. Untuned loudspeakers which do not store energy are essential for high fidelity because they can be made phase linear. However, an unported woofer still has a fundamental resonance and this must be sufficiently damped to prevent the frequency response being non-monotonic.

The above may not be a conventional view but I formed it after having heard the uncanny realism of linear-phase monotonic woofers; an uncommon experience at the moment. Before I heard such reproduction I was dissatisfied with the ported woofer sound but could not say why. Now it is obvious: if the waveform is not preserved, it is not going to sound right. With a theory as basic as that, I'd be surprised if it was terribly wrong.

Preserving the waveform is such a simple concept as it teaches us to minimise linear distortions and nonlinear distortions. Phase linearity and transient preservation are one and the same thing and if both are achieved, linear waveform distortion is under control.

Transient preservation also requires a greater degree of discipline in crossover design. The



**Digital audio has a completely linear range from noise to clipping. There is no standard for relating analogue level to digital code value, and consequently many different calibrations are used**

necessary performance is probably impossible with a passive crossover.

That leaves nonlinear distortion; the generation of harmonics due to the transfer function not being straight. This is easy inside circuitry compared to the problems of achieving linear mechanical motion. Linearity gets harder as the diaphragm excursion increases and this means that woofers are more likely to be nonlinear than higher frequency units. Usually what happens is the force produced by a given coil current is not independent of coil position because of non-uniform flux distribution. Furthermore, suspensions usually stiffen towards the end of their travel.

The polar diagram of a speaker in the horizontal plane tells us a lot about its performance. Naturally at LF most speakers are omnidirectional, but this characteristic will give way to directional behaviour once the wavelength approaches the cabinet width. The polar diagram must be smooth at all frequencies. Most moving-coil speakers sound dry at HF because they are too directional to excite the room enough. Bipolar loudspeakers are advantageous here because the rear radiation gives an effect of spaciousness without detracting from the detail. At high frequencies cabinet diffraction must be carefully controlled otherwise it causes multiple reradiation which puts ripples in the on-axis response and makes the polar diagram extremely uneven. This is undesirable as it causes coloration in the reverberant field.

While these are very strict, perhaps impossible requirements, they should not discourage us. In my view it is only worthwhile tackling the seemingly impossible because the easy is over-subscribed. ■

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## Mic balancing

Dear sir, we enjoyed the review of the Brüel & Kjær 4040 microphone in your April issue, and, although we appreciate that Dave Foister put together his article under great time pressure, we must draw attention to a couple of inaccuracies.

He points out that the B&K 4040 has no polar pattern selector and that it is cardioid only. No B&K microphone has a polar pattern selector, because Brüel & Kjær/Danish Pro Audio have chosen the path of acoustics over electronics, knowingly sacrificing versatility for audio quality.

Sorry Dave, but the 4040 is an omni! Omnidirectional microphones are pressure microphones and do not have vents behind the diaphragm. Cardioids always have vents, and that is a useful rule of thumb for when manufacturers neglect to send documentation with their mics!

In all other respects, thank you to *Studio Sound* for a most complimentary review.

**Morten Stove, Danish Pro Audio.**

## DAT distress

Dear sir, I seek assistance with a DAT problem that, it seems, cannot be solved here in Australia. Maybe with more people and more machines in use in Europe and the US, there may be some answers out there.

I am experiencing big troubles—broken tape, stretched tape, tape disappearing into machines...

The machine is a Panasonic 3700; the tapes are made by BASF, HHB and Ampex. Both machine and tape currently live in the same room—temperature maintained at about 68°F. Is the problem due to dirt, humidity, tape tension, use of the shuttle wheel, a poorly designed machine, an unsatisfactory medium (DAT) or what?

I have had no problems of this sort on location—or in the studio—with a Sony portable machine.

The last 92-minute tape—that is still spread around the inside of the machine—has 45 archival cues on it. All edited. All ready for a new CD and radio programme. Location tapes gone, no backup—the material was recorded all around the country over a two-year period and is irreplaceable. Help!

**Peter Mumme, Victoria, Australia.**

## HHB reply

To identify the exact cause of these problems is difficult without seeing the fault first hand. However, the likely cause is a fault with the Panasonic SV3700, especially as all the tapes being used are reliable and of good quality.

The Panasonic SV3700 does have an excellent transport but, like all DAT recorders, requires regular servicing—especially when used in a mastering situation. The operating temperature of 68°F with average humidity should cause no problem, and with a well-maintained machine any transport mode, including shuttle, should not cause any damage to the tape.

We would strongly advise that the machine is checked by an experienced engineer and given a full mechanical service and line-up as soon as

possible. Jeff Knight at Technical Workshops in Ashwood, Victoria (Tel: +03 9888 2333) should be able to help.

To sum up, Peter Mumme has been unlucky, on the whole DAT is a reliable and robust format in wide use the world over. However, I cannot stress enough how important it is to make a safety copy of important material (something Peter did not do), use a good quality tape and maintain your equipment regularly. After all whenever we made a recording on our old analogue reel-to-reel we would not dream of starting without cleaning the heads and carrying out a full audio level line-up.

I hope the above is some use, if I can help any further please do not hesitate to call.

**Steve Angel, Sales Director,  
HHB Communications, London.**

## More Vu-More

Dear sir, thanks for your review of the *Vu-More* (*Studio Sound*, May 1995) but you may have misunderstood its purpose, so here are a few things that may clarify the validity of the unit.

I may not have made the functionality and operational details clear when I sent you the unit and maybe our literature needs to be more explicit. This we will take care of.

The system is not only intended as a diagnostic tool, but we think should be across the programme line all the time to monitor the status of the recording or repro and to catch 'nasties' before they get to tape or on air. For example, considering a rock session, the noisy guitar amp, in overdrive, may be the only contributor in the mix to wreck an otherwise -75dB S-N, deteriorating the programme to an S-N of say: -46dB. A *Vu-More* connected across the solo bus on the console enables individual channels to be QC'd for both signal and noise. When sessions get long and loud, ears shut down and it's not so easy to assess noise in a mix. That's what started it all off.

Mike Stock Studios took delivery of a *Vu-More* in March and on connecting across their main console left-right bus (can't mention the brand, you know who) we soon found a mic amp on one channel that was oscillating at full gain. Reducing the gain to unity on that channel, -50dB fell to -80dB. By leaving the unit across the programme line all the time, these kind of problems will be shown as and when they happen. We call this 'Real Time Maintenance.'

The unit is available in 19-inch rack format as you tested, and also in a console version clad in wood without the oscillator for sitting on the meter overbridge and, finally, in a replacement meter version that will fit directly into the console overbridge.

The meters are Sifam AL29s modified with our scales (we credit them on the rear of the literature) and I chose these as they are something of an industry standard.

The internal-jumper problem you encountered is understood, but please understand that we intend to supply the units factory set to suit the customer. Lowest noise range for the serious studio and the higher range for the live sound-MMS (Mickey Mouse Studio) operation. You also commented on the

amount of space within the case and that's the name of the game when you use surface-mount technology.

Anyway, thanks for what you've noted, especially the general response to the system. All points have been given serious attention and we will see that *Vu-More* gets the benefit of your comments.

Pioneering is always tough going at first, but maybe engineers will take on the fact that knowing how low noise-signals are is just as important as knowing how high programme levels are.

**John W Oram, Managing Director,  
Oram Consulting Limited, UK.**

## The Editor replies

This is, perhaps, the ideal opportunity clear up a further point relating to Oram Consulting. *Studio Sound* has referred to John Oram as 'the self-proclaimed father of British EQ' in line with his own publicity material—a claim which has caused comment within the industry. The origin of this accolade, however, lies not with John himself, but with a consensus of the American pro-audio market. 'Some achieve greatness, others have greatness thrust upon them', or so we are told.

**Tim Goodyer**

## BBC codecs

Dear sir, in response to Barry Fox's criticism of the BBC's choice of mono audio coding used with ISDN (Business, *Studio Sound*, May 1995), I would like to take this opportunity to put what he calls a 'maverick approach' into a wider and more international context.

Having been involved in the BBC's decision to stay with G.722 when UK commercial radio adopted apt-X audio coding for mono ISDN, I can perhaps explain some of the reasons for their respective adoption.

G.722 is an ITU international standard for audio transmission that is used globally by broadcasters and telecommunications companies, and which BBC World Service first started using in 1986 on international digital circuits. When the first pre-ISDN dial-up digital services were installed in 1989 to link BBC overseas news offices to London, G.722 was the obvious, and only, choice. Since then its use has grown to the point where the BBC has over 1500 ISDN lines for sport, news and other speech links.

G.722 and apt-X are fairly similar ADPCM systems, but apt-X is proprietary whereas G-722 is an open standard. There is little difference in their mono performance at 64kb/second with frequency response (7.5kHz) and delay (less than 10ms) being virtually the same, but apt-X has slightly lower distortion and wider dynamic range (80dB vs 65dB) though with speech material this difference is not very significant.

In 1991, ILR decided to adopt ISDN for mono news and commentary links and the then AIRC Technical Committee carries out listening tests to decide which system they should adopt. Indication at the time were that they saw no great reason for compatibility with the BBC and, therefore, they had no particular reason to go for G.722. Instead they opted for apt-X because of its slightly ►

enhanced performance and also because better commercial terms had been negotiated for an apt-X codec than could then be achieved from a manufacturer of G.722 codecs.

Apart from UK commercial radio, there is little use of apt-X for mono ISDN (single B channel) working, since G.722 is in such widespread international use. The problem of interworking principally affects outside contributors (such as Barry Fox) who wish to connect to both BBC and ILR. However, this problem is now greatly eased by equipment (such as the GlenSound GSGC4) which works to both standards in a way which is completely transparent to the user.

Use of ISDN in the broadcasting and music industries is greatly complicated by incompatibilities in the various audio coding standards and manufacturers' implementations. In general, the problems relating to stereo and music quality transmission are far more intractable than mono speech, and coping with these difficulties requires great skill from our engineers and operators.

The BBC Engineering Operations Centre at Broadcasting House has been equipped to offer a central facility for the handling of all audio coding systems currently used in broadcasting in the UK and around the world. If required, the EOC can carry out decoding and recording for other areas of the BBC.

Over the last six years, the BBC's use of the

G.722 open standard has increased significantly and is the preferred way of providing our mono ISDN links. It is also the official EBU and North American broadcast standard with numerous daily exchanges, thus in using a different standard it is UK commercial radio which is the exception.

**Jeffrey Cohen, BBC Technical Support Section, UK.**

## EMI's Manor

Dear sir, Philip Newell's article *The Manor 1971-1975* (*Studio Sound*, June 1995) provided an interesting insight into the history of this famous studio. Philip's conclusion that the reasons for the studio's closure were EMI bureaucracy and a lack of will to keep it going is both misguided and ill-informed. Furthermore, he has wrongly suggested that EMI has a 'graduates only' staffing policy. Nothing could be further from the truth as anyone in the company can confirm.

I think that our side of the story is worth airing so that *Studio Sound* readers can make their own judgments.

Following Richard Branson's sale of Virgin Music to Thorn EMI in 1992, keeping Virgin's identity and culture intact within EMI Music was, and still is, something we all strive for. Accordingly, it was unanimously agreed that, after

the sale, The Manor should continue to be run by the existing staff headed up by the remarkable Nyx Darke, and indeed this was the situation until the day it closed. It is to Nyx and her team's credit that the studio had one of its busiest years ever in 1994.

As far as the decision on closure was concerned, this was certainly not reached through any lack of will on EMI's part to keep it going.

Unlike the situation during the early 1970s when The Manor was Virgin's vital production base and later on into the 1980s, when major acts signed to other labels would also indulge themselves in the delights of a few weeks at The Manor and spend accordingly, today's market forces and the way artists use their recording budgets has made it more difficult for a stand-alone residential studio like The Manor to cover its costs, let alone make a profit. It is worth mentioning here, though, that despite the studio's difficulties, The Manor Mobile has continued to prosper and will be keeping The Manor's name alive in the industry as an important part of our studio group.

The sad milestone was not, as Philip has implied, a result of some corporate boardroom decision taken by accountants, nor was it an autocratic one forced on us by a remote head office. It was made reluctantly after much soul searching by both the Virgin and EMI people directly involved, all of whom share a passion for studios

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**Martin Bengé, Vice President, EMI Music Studios, UK.**

## Accurate archive

Dear sir, I read Martin Polon's column entitled 'Audio archiving: today's problem or tomorrow's loss?' with a great deal of interest. I agreed with your assessment of the reliability of various storage media and difficulty of determining which is best. The compatibility problem of DAT due to the narrow tracks and the narrow tape is one which is seldom considered by archivists and less seldom ever mentioned in the press. Your analogy of digital and analogue methodology as new science capable of fixing ailing patients is very appropriate. The sound quality of material stored on analogue tape has the general property of slow and predictable deterioration over time whereas the sound quality of material stored on digital media either does not deteriorate at all or comes to cataclysmic ruin. Predictable deterioration can be digitally repaired, and analogue and digital technology can combine to restore material close

to the original through the use of digital fixes on a medium offering a great amount of insurance.

Martin emphasised in your column that the 'major shortcoming' of analogue-digital multitrack tape was the mechanical degradation of the tape—the threat of an 'archival bomb'. Most people assume this is a common problem of analogue mastering tape when, in fact, it is mostly limited to the production of two tape manufacturers, who produced a great deal of tape susceptible to binder breakdown before the flaw was recognised and fixed in subsequent production batches. The chemistry of the analogue mastering tape is not so significantly different from VHS or 8mm video tape. DAT, or compact cassette tape that it alone is susceptible to 'binder breakdown', yet users of the other tape format commonly attribute this flaw only to analogue mastering tape. The fact that VHS cassette tapes and compact audio cassette tapes have not needed oven baking after many years in the market is some encouragement that the problem was related to the formulations used and not to all mastering tapes as a format. (Report of U-matic cassettes having the same problem is not surprising—the formulation used for them at the time were very similar to those used by the manufacturers whose audio products suffered from binder breakdown). One should also note that at least two other manufacturers of analogue

mastering tapes in this time period did not have tapes which failed. The problem was due to two manufacturers' formulation and was not inherent in the format itself.

BASF have tape manufactured in 1935 which actually sounds better today than it did 60 years ago thanks to better head technology. (The sound itself is not very good—no bias was used so distortion was high and the unweighed S-N ratio was just under 30dB). These very first commercial magnetic tapes, however, certainly sound better as a storage medium than any other medium from that time period. Digital enhancements could clean up the sound of the tapes, but one has to admit that anyone archiving material in 1935 would be fully satisfied today in recovering the recording from the tape used back then. The 60 years of reliable storage would have satisfied the USAF's 25-year criterion if there were an Air Force in 1935. The tape manufacturer who claimed that their tape might have been able to survive a nuclear war may well have been correct if: (1) the manufacturer was one whose binders did not suffer from hydrolysis; (2) the tape did not suffer from severely high temperatures or magnetic pulses generated by gases; and (3) the cockroaches did not eat the tape.

**Terence D O'Kelly, Director of Sales & Marketing, Professional Products, Audio-Video, BASF, USA. ■**

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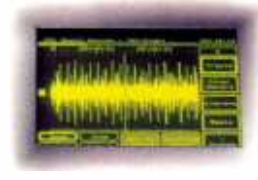
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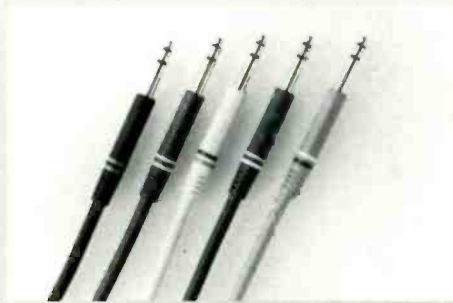
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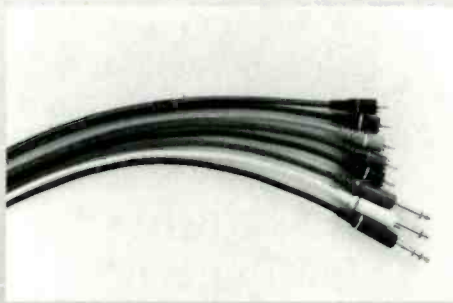
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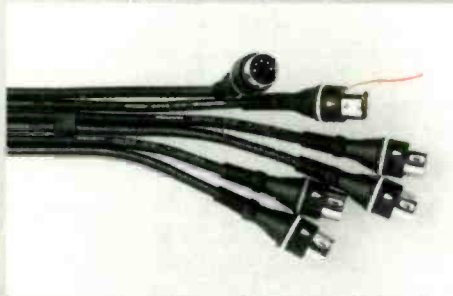
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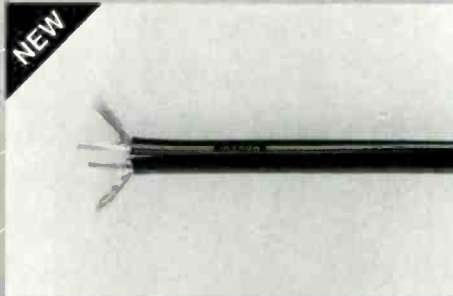
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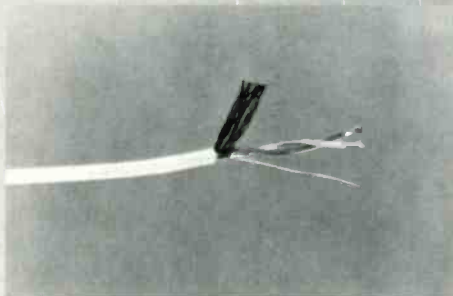
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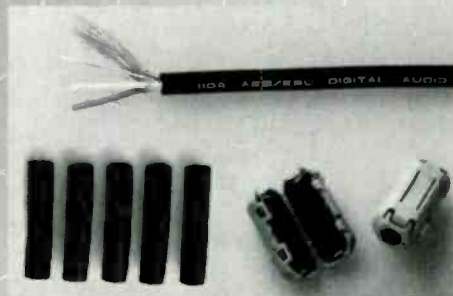
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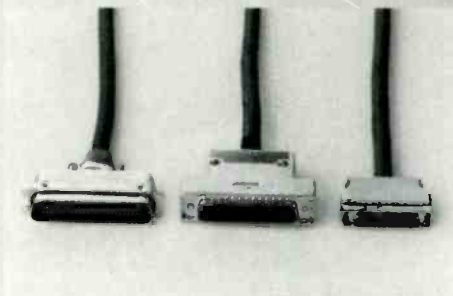
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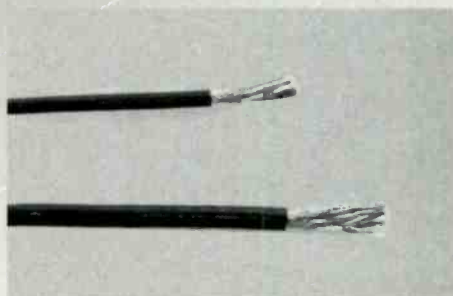
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**M**any articles have been written on avoiding stolen audio equipment. Yet very little is written about how to prevent equipment from changing hands via 'five-finger discount' inside the studio itself.

The problem frequently arises during recording sessions when the studio and its facilities are flooded with band members, techs, friends, agents, A&R types and groupies. There are too many people around with too much time on their hands. While most people are essentially honest, somehow the little gadgets and paraphernalia of recording frequently prove fatally attractive.

One studio owner who finally put a stop to what he called internal haemorrhaging commented while pleading for anonymity at a recent seminar.

'No-one wants to admit that they have been taken for a fool or that they have been vulnerable before or could be again. There is a certain impressionable nature about many of us in the recording business. We love our work, we love our music, we love our friends and nearly everybody is our friend. But, now we treat all of our customers as potential pilferers. We do it with finesse, grace and even respect—but we do it!'

The whole pilfering problem can be divided into three phases: before, during and after the fact of running a session. Starting at the top, equipment should be audited before each session. Items that can be removed from your studio should be secured. And since security problems are not exclusive to itinerant bands or even bands that are well known, visitors, suppliers and even hangers-on can potentially remove items that are not secured. Expendable things like blank recording media, gaffer tape, masking tape, pens, pencils and stop watches should be kept locked up as they are all likely to be subject to 'shrinkage'. Many studio owners and operators resist engraving their identity on their equipment because they think it reduces its resale value. Yet engraved equipment is frequently avoided by purloiners and can even lower studio insurance rates. Doors to unused studio space in the complex should be kept locked when there are no studio staff members present. More studios have lost equipment to bands who are actually working in Studio A but who wander into Studios B, C or D than from the 'on line' studio.

A US studio owner describes the *Modus Operandi* of one particular band: 'We began to notice that things would disappear from one or more of our less used studios. Microphones, in-line transformers, mic splitters... All small stuff that one could pocket. We studied our scheduling charts and divined that we had losses in the adjoining studios only with one particular band. We began to tell them we were booked solid when they called for a session date. Since we have begun to blacklist the band from hell, we have cut our losses to zero.'

You should monitor all sessions, no matter how unprofitable that process may seem. Frequently, bands will 'four wall' a given studio and perform all

Martin Polon

## When a recording studio's clients decide they are buying the equipment rather than hiring it, the studio operator has a problem

necessary operations with their own staff. The kinds of problem that have arisen, in this way, include the removal of ROMS or DSP chips, damage to multitrack machines and introduction of *Dr Pepper* to the interior of the mixing console. Incidentally, diet soft drinks frequently do less damage than those with sugar or fruit juices. In addition, most insurance policies require monitoring of facility users. In the case of particularly suspect groups, you might hire in security. Some studios have to do business with undesirable groups—for example, a large label 'feeds' 15 major sessions per year to one studio in question—but there are ways to control 'bad seeds' with careful usage of law enforcement. In most American jurisdictions, you can pay for a police officer on a 'detail' for about \$25.00 an hour. The officer can work 'plain clothes' and become part of

## The kinds of problem that have arisen, in this way, include the removal of ROMS or DSP chips, damage to multitrack machines and introduction of *Dr Pepper* to the interior of the mixing console

your crew with complete anonymity until needed! Additionally, you might have a 'roaming' staff member on duty to control access to the rest of the studio complex. This is especially important if multiple sessions are in progress simultaneously. One advantage of this kind of control is that it enables the studio management to have some appreciation of what goes on during sessions—for example, one major band has been known to have had a staff 'drug dealer' set up shop for the 18 weeks of a major album project. The United States Drug Enforcement Administration (DEA), have seized dozens of studios for drug activity—whether the studio was knowingly involved or not.

You should not, however, allow your staff to become engaged in conduct approaching violence with band or other ancillary personnel to the session. If something is being removed, note it and ask for a signature. It is amazing how often this works, especially when the 'fuckin'' record label is paying for everything anyway'.

After the fact, you should have a written report on the session in question, particularly when anything that could be construed as irregular has taken place. You should also photograph any damage or definable loss and make it part of the session file. ('Point and shoot' cameras with zoom lenses and microprocessor automation allow virtually anyone to take good pictures.) Telephone records, event reports and other written evidence of 'shrinkage' should also become part of the file.

The record label (or whoever is footing the bill) should be promptly advised about any problems. This covers everything from driving a pickup truck through the studio's front windows to a major league food fight in the control room. If a record label is paying the bills, the information that the studio provides will be used to put a leash on the offending group. The label has to pay all the bills—the faster they know about problems, the sooner they will fix the problems. And make no mistake about it, the label has far more power over the 'group' than the studio staff. Of course, there are a few groups 'big' enough or 'hot' enough that the label will let them take what they want and put it on the bill.

All of the above measures can be made invisible to your clients, or can be made to appear part of normal studio operations. In other words, if the studio operates as though all of the security and cost control measures are normal practices, the studio clients will accept them as such. If, on the other hand, the studio acts in a defensive way and makes a major issue out of all or any of these issues—the client reaction will be similarly negative.

No one wants to run a studio like a police station but the cost of theft can run as high as 20% of the total operating budget, according to studio owners queried in a recent survey. It is just plain good business to stop supplying those who try to shop in your studio with a 'five-finger discount.' ■

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**M**aybe I have a suspicious mind, but I have to wonder at the UK Government's swiftness in preparing the White Paper on digital terrestrial broadcasting. Earlier in the year, transmission specialists NTL announced that they were preparing to build the country's first digital terrestrial television (DTT) network, declaring that what they saw as 'the window of opportunity' would be fully open by 1997, but would start to close come 1998.

At a press conference in February, the company's grandees urged the Government to make provision for the new technology by making changes in current broadcasting legislation. NTL chief executive Andy Sukawaty said, 'As one of the world leaders in digital broadcasting, we're already participating in the conversion of satellite TV to digital. The speedy introduction of a digital terrestrial network would establish a UK technology which would generate significant export opportunities for ourselves and for UK programmers. This is why the timing for the UK legislation is so crucial and why it must move forward in the next few months.'

Sukawaty's suggestion that things should start to happen 'in the next few months' looks like it was heeded, although NTL probably already knew what the Department of National Heritage—which handles the broadcasting portfolio—was planning, given the comment from another NTL executive that there would be mention of DTT in the Queen's Speech when Parliament re-convenes after the summer recess. The White Paper, published on 10th August by Heritage Secretary Virginia Bottomley, sets out the new legislative framework that is required to implement digital broadcasting.

This is Mrs Bottomley's first major act as Heritage Secretary, having been re-shuffled into the post from her stint at the Health Department, where she won an unenviable reputation for arrogance and insensitivity. Her Thatcherite credentials seem better suited to the media, which successive Conservative administrations have successively deregulated and heavily commercialised, often marginalising any public service aspect, despite always managing to mention it somewhere.

With this in mind, the main intentions of the White Paper are to: ensure that viewers and listeners are able to choose from a wide variety of terrestrial television channels and national and local radio stations; give existing national broadcasters the opportunity to develop digital services and so safeguard public service broadcasting (there it is) into the digital age; give terrestrial broadcasters the opportunity to compete with those on satellite and cable; help a fair and effective market to develop; help UK manufacturers and producers compete at home and overseas; and make the best use of the available spectrum.

Broadcasting has long been the Conservative's favourite plaything. Five years after the present Broadcasting Act passed into law has come a triptych of documents which, said Mrs Bottomley, 'set out the Government's policies for broadcasting into the 21st century.'

The previous changes in legislation, at the start of

**Kevin Hilton**

## Question: when is a White Paper not a White Paper? Answer: when the Paper carries too many fingerprints

the 1990s, ushered in widely available satellite TV, with Thatcher supporter and favourite Rupert Murdoch embracing old technology (PAL) in order to steal a march on rival BSB, which effectively stifled MAC and D-MAC. However, there is the argument that sticking with the existing colour transmission system, along with the merging of the two services (which contravened the 1990 Act, although this didn't seem to bother many people), probably saved a lot of messing around because digital came along much quicker than anyone expected.

Digital satellite broadcasting is starting to happen at the moment, with services in the Pacific Basin largely relying on NTL's MPEG-2 compression technology. MPEG-2 also forms the basis of European and US direct broadcasting by satellite (DBS), and the latest Astra satellite and Intelsat's Hot Bird have digital capability, creating what is being called the 'DBS gateway'. One of the first digital channels to go into service in Europe is the French Canal+, which is DBS compatible.

The move to digital is giving satellite broadcasters the opportunity to fully implement all the services that have been spoken of for the past few years: Pay TV, Pay-Per-View, Near Instant Movies on Demand, widescreen, and multichannel sound. There has been the fear that conventional terrestrial television would have to become even more competitive to survive against such services from the skies, and that standards, which were already in question, would drop even lower. But then figures began to appear that put the actual take-up of satellite and cable TV into doubt.

The main points of the White Paper are: the initial availability of six frequency channels (multiplexes) for DTT, each able to carry at least three channels, with the potential for more at certain times, with the intention of covering 60–70% of the UK's population; the BBC, ITV, Channel 4 and, if established, Channel 5 will be offered guaranteed access to digital frequencies (C4 and Welsh-language service S4C will have a guaranteed joint place as long as C4 is made available throughout Wales, while still maintaining S4C); at least 80% of programmes on existing analogue channels should also be broadcast on the equivalent digital services; seven radio multiplexes, each offering at least six digital stereo services, are planned, with one already allocated to the BBC for its DAB service (starting on 27th September), one slated for independent

national radio, four for local radio, and one to be decided; licenses will be competitive and administered by the ITC or the Radio Authority, but these will be to operate multiplexes rather than individual services; applications will be judged on the basis of the speed and geographical spread by which digital services are made available over the UK, plus the support given to encourage consumers to adopt digital services, along with the variety of services offered; multiplex operators will be required to make payments to the Exchequer when services become profitable, although, given the start-up costs involved, payments may be waived for the first licence period (12 years); no single company should control more than two multiplexes (although the Government are seeking opinions on this), and individual broadcasters on these services will need ITC or RA licences; ten per cent of capacity will be set aside for additional telecommunications or interactive services.

Not surprisingly, the boys at NTL were fulsome in their welcome. 'NTL is very excited by [the] announcement,' said Jeremy Thorp, director of business strategy and development. 'This will bring significant benefits to viewers and will enable British industry to exploit its world lead in digital broadcasting technology. The proposal will provide fair and effective competition, enabling existing terrestrial broadcaster to access new, fast-growth markets such as subscription services.'

This last statement is slightly at odds with the stance taken by NTL's March 1995 publication *The Future of Television Transmission*, which states: 'The case for simulcasting the existing services on the new digital networks is weak. NTL favours granting first-refusal options to existing broadcasters. One new service slot each would be offered to Channel 3 (ITV), C4-S4C and the prospective C5 operator, along with one new service slot for the BBC.' The sub-text here is that NTL are in favour of the BBC's transmission network being privatised, and, if there is no shout of monopoly, they would put in a bid for this resource.

The BBC have welcomed the White Paper on digital broadcasting but will not make a full statement until October. However, a spokesperson did say that the Corporation were concerned about the role of the multiplex operator and wanted this clarified before the matter went any further.

Things do not just hang on the October deadline, as can be seen by the formation of the Digital TV Group, a forum for broadcasters and equipment manufacturers that aims to co-ordinate efforts to develop the necessary systems for DTT. The founding members are the BBC, British Telecom, Channel 4, ITV, Motorola, NTL, Pace and Sony, with membership open to all working on the European DVB project who wish to become involved in the implementation of digital TV in the UK.

In the meantime, Pace inaugurated their DVB MPEG-2 receiver production line on 24th August, and Finnish manufacturers Nokia are due to unveil their digital satellite set-top box at the LIVE 95 consumer electronics show in London at the end of this month.

All of which underlines that digital is the future. Everybody knew this anyway; the real key to success is when and how they get involved. ■

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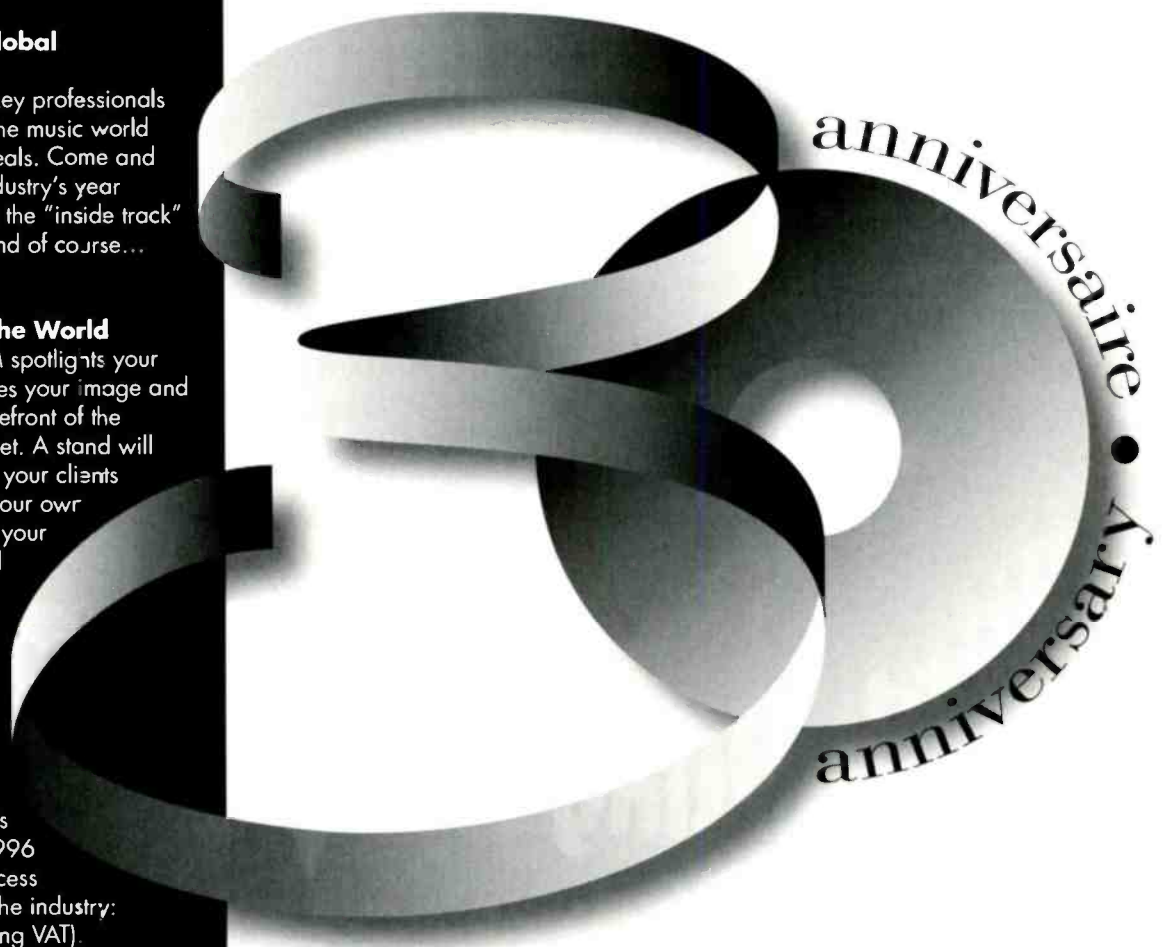
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# EVALUATING CHIP POWER

The use of computer sound cards in multimedia productions is placing increasingly high demands on IC power amplifiers. Ben Duncan tests 18 popular ICs

**M**ost IC power amplifiers go into consumer goods. They are behind the scenes inside nearly every portable *Walk-something* and 6V, 12V, 24V vehicle-powered devices, with '2 times lotsa-wots'. In pro-audio, low-power monolithic power amp ICs have long been used to drive headphone outputs on consoles, and in utilitarian talkback and other comms. They have also been used as driver stages in far higher power amplifiers, and occasionally as powerful line drivers.

Today, IC power amps are found in active mini-monitors, personal wireless monitoring, and on computer sound cards. Alas, the latter may be created by those who are unable to recognise the expectations of audio professionals. Yet musical judgments will have to be made while listening through these devices.

Nearly all line-level circuits in analogue mixers and processors have long used ICs in the form of op-amps and VCAs. Both have been reviewed previously in these pages.<sup>1,2</sup> But the insides of pro and serious domestic power amplifiers have remained stalwarts of mainly discrete circuitry. (See 'History' sidebar)

Fig.1 lists the 18 ICs under test. Eleven were selected as the top sellers, as reported by a major power IC distributor 18 months ago. Some, like LM380, are now two decades old, but so too is the TL071 found inside consoles made last Monday. Six of the remaining seven were added as cumulative new and more advanced parts that had become available up to Easter 1995. A seventh (LM12) was added as a landmark part between the two categories. The latter seven were subjected to a slightly different and more comprehensive test procedure.

The table shows that some power ratings are stretched by makers quoting at high-percentage THDs, well into clip.

If all were referred to 0.1% (as is *de facto* with reputable professional amplifiers), the power ranking would be slightly changed. With power capability being a virility symbol all the more when small, power output is also commonly made to look bigger by being cited into 4Ω rather than 8Ω. But where are all the 4Ω drive units? Here, all ratings have been normalised for 8Ω—the more representative norm.

The ICs' slew limits are listed—except that (along, more excusably with the older National Semiconductor ICs) SGS-Thomson do not cite this

parameter for any of their parts. And Philips only cite the slew limit of one out of four parts. Of the nine ICs where the makers claim to know their part's slew limit, asterisks show the few which meet or come close to Walt Jung's 19-year-old slewing criterion,<sup>3,4,5</sup> which defines the minimum safe slew limit for quality audio—and that means analogue with 80kHz full level (or 'power') bandwidth, and hence 20 bits or more of digital resolution—sample rates that pass music's ultrasonic content. The unasterisked and unspecified (-) parts may be approaching or well into slewing if the incoming signal is contaminated with surprisingly small amounts of RF (from use of a portable phone, say); or comprises ultrasonically rich music;<sup>6</sup> or just dares to peak at zero level above 2kHz. 'M\*' shows parts that marginally undershoot Jung's slew criterion and may therefore be considered passable by some users and for some uses. LM3886 might require selection for slew rate as Jung's criterion cuts across the tolerance ▶

Model, Series	Maker	Nom/Typ Po into 8Ω	%THD at nom Po	Slew limit	Max' supply
<b>Below 5 Watts/8Ω:</b>					
LM 4860, Boomer	Nat Semi	0.5W	1%	1.8*	+6volts
LM 386-N4	Nat Semi	0.7W	10%	-	+22volts
LM 4861, Boomer	Nat Semi	1.0W	1%	1.8*M	+6volts
TDA 2822-M	SGS-Thom	1.6W	10%	-	+12volts
TBA 820-M	SGS-Thom	2.0W	10%	-	+12volts
LM 380	SGS-Thom	3.0W	3%	-	+22volts
TDA 1015	Philips	3.5W	10%	-	+18volts
LM 383-T	Nat Semi	4.5W	10%	-	+20volts
<b>Over 5 Watts, up to 50 Watts into 8Ω:</b>					
TDA 2030	SGS-Thom	9.0W	0.5%	-	±18volts
TDA 2611	Philips	12.0W	10%	-	+35volts
TDA 2040	SGS-Thom	12.0W	0.5%	-	±20volts
TDA 1514	Philips	25.0W	0.1%	-	±30volts
LM 1875	Nat Semi	33.0W	1%	8	±30volts
LM 12	Nat Semi	40.0W	0.01%	9	±30volts
LM 3875, Overture	Nat Semi	40.0W	0.1%	5-11	±42volts
LM 3886, Overture	Nat Semi	50.0W	0.03%	8-19*M	±42volts
<b>Over 50 Watts into 8Ω:</b>					
PA 45	Apex	(to 200W)	-	36*	±75volts
PA 42	Apex	(to 1kW)	-	40*	±150volts

\* = not stated by maker. (Blah) = selectable range. ° = pass. M = marginal. Note: Philips parts were previously called Mullard

Fig.1: Parts under test, complete with manufacturer's specifications



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spread. At least the Nat Semi ICs' data admits that slewing has a tolerance and shows minimum and maximum figures. The slew capability of PA42 and PA45 meets Jung's criterion for voltage swings equivalent to up to 400W and 325W respectively, into 8Ω.

## Application: Test and use

The ICs come in a number of distinct physical formats. Partly, this hinges on power delivery. The package affects how much heat-sinking will aid them, how easy they are to connect to a solid enough heat sink, how firmly they can be clamped down, and how easy they are to replace.

Beginning with the lowest powered ICs, LM386, TBA820 and TDA2822 are plain, plastic 8-pin chips requiring no heat sink—though one could be advantageously glued on and no doubt found handy to disguise the part number. LM380 is similar to the above but with 14 pins. PCB tracks and copper lands are expected to aid heat dispersal. These parts were plugged into turned pin sockets for ease of testing. None are quite like conventional IC op-amps, in the sense that they operate on a single supply rail and require a large electrolytic capacitor in line with their output. The LM4860 and 61 'Boomer' ICs are only available in tiny, surface mount packages. They are notable for developing their rated power with just a +5V logic-computer supply, and for their minimum parts count. Inside are two true op-amps, wired in bridge mode. National Semiconductor supplied these ICs mounted on prebuilt, high-quality, demo boards with surface-mounted ancillary parts, mass produced for evaluation by prospective OEMs.

TDA2030, TDA2040, LM383 and LM1875 are

true power op-amps all in the Pentawatt package, a 5-legged version of TO-220. Thus they share a common application circuit. TDA 1015 is a true op-amp, but in a 9-pin plastic SIL package with a 'bedhead' heat flange. TDA2611 is likewise packaged, but is not a true op-amp. The LM3875 and 3886 are true power op-amps and have similar 'bedhead' tabs, but with far more fragile pins cranked into two close rows. With LM3875, most are unused. The LM3886, which would otherwise serve as an alternative part with only minor rating changes, has completely different pin outputs to frustrate audio manufacturers and repairmen, while employing one of the unused pins for signal muting. LM 12, one of the last designs of the late Robert Widlar, who designed the first ICs for National Semiconductor in 1967, lives in a 4-legged TO3 can. The circuitry within is the forbear of the LM3875 and 86, so many performance characteristics are shared. The PA45 is cased likewise but is eight legged. Both have the metal can's 'belt and braces' advantage of 2-bolt fixing. However, specially made insulating washers (and a socket if desired) will be needed for LM12, while for PA45, insulation is not needed (as the case is ground) nor recommended. Also the maker can point to a source of high current, professional-quality 'TO3-Octal' socket—used for this evaluation. This (not before time) makes blown amp fixing as easy and DIY-friendly as putting new valves into your instrument amp. TDA1514 and PA42 are flangeless SIL packs. The TDA1514 has the most solid leads and the case reassuringly bolts down with two screws. PA42, which is really just a beefy high-voltage op-amp, is encased in a conductive plastic which may be clamped to a heat sink if the rails voltages are above ±75V. Test circuits for these parts are shown elsewhere.<sup>8,9</sup> ▶

## IC vs DISCRETE POWER

There are several reasons why 'non consumer' audio power amplifiers used by professionals and dedicated hi-fi listeners have remained a stronghold of discrete circuitry. First, the true monolithic (cf. hybrid) ICs, that are far cheaper than the individual parts, are still limited to producing under 100W into 8Ω. Until five years ago, they were mostly limited to less than 20W. Second, monolithic power ICs are often rather stressed if used as rated. That's because silicon area determines IC cost on a disproportionate basis, and to keep the price low, the power transistors' area (and consequent power handling) can be no bigger than absolutely necessary. Reference 7 although over 15 years old, gives a particularly readable description of the difficulties of making practical power amp ICs.

Third, measured (let alone sonic) performance is generally the poor relative of a competently designed discrete amplifier. This may be in part because few if any IC designers have concurrent engineering attunedness for quality audio. Equally there are apparently insoluble problems of thermal distortion and stresses caused by the power transistors in asymmetric proximity to the

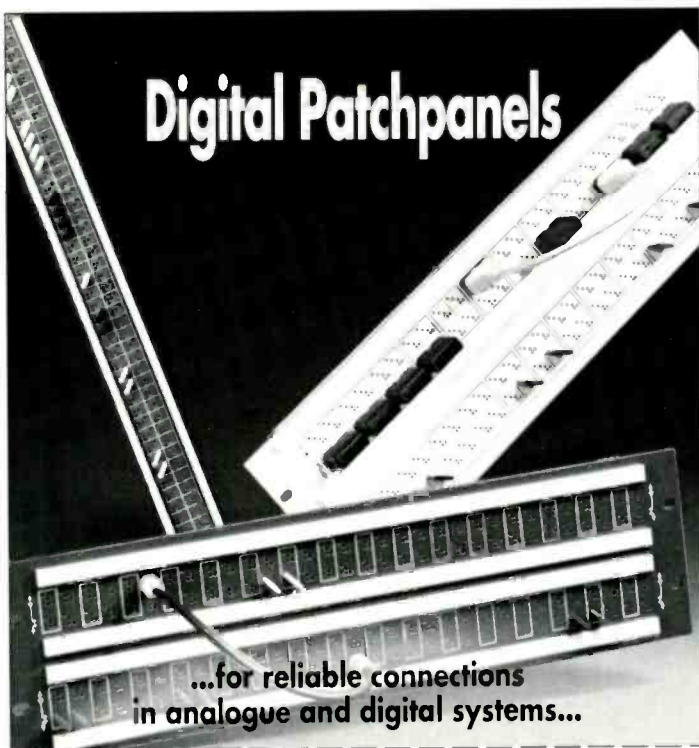
surrounding, sensitive drive circuitry. Thus it remains true that far better performance can be had with little compromise in the benefits of using ICs, by separating the driver and output sections, a 'two black boxes' solution—as implemented with the test circuit for the PA42.

Fourth, partly as a result of the latter two factors, IC survivability has historically been questionable. If the IC dies after a while from 'old age' it may no longer be made, whereas most conventional amplifiers of any vintage are repeatedly repairable. Even if the IC is available and costs less than the equipment is worth, replacement may be no less fiddly than fixing a discrete circuit, as so few ICs are made pluggable—a blown opportunity for transistor amp servicing to regain the plug-in simplicity of vacuum tubes. Fifth, design flexibility has been unimaginative. Important features are sporadic and are often flawed in real world use.

Components and facilities needed for input and output protection are often omitted, increasing the very same discrete parts count increase that the designer was using an IC to minimise in the first place. ■



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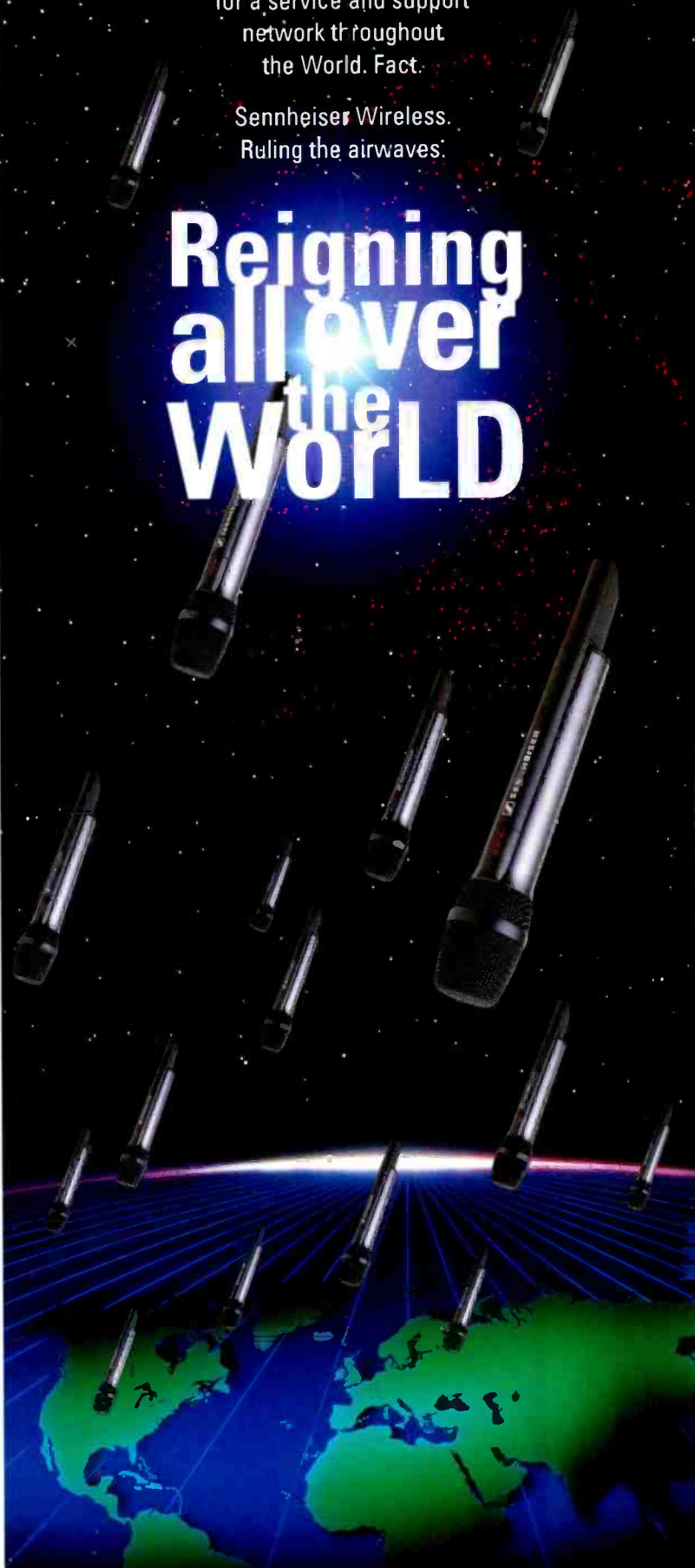
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HISTORY

The first monolithic and expressly audio power IC was a British development, made by Plessey in 1968. It offered about 1W. But it took Clive Sinclair to make a success of it second time around in 1972 as 'Sinclair IC.12'. But by the mid 1970s Sir Clive Sinclair had turned his efforts away from audio into calculators and watches, and the new names in innovative power ICs were Nat Semi of silicon valley, CA, and SGS-ATES of Italy. The same names remain the big players today in terms of models and production, except that SGS is now absorbed into and renamed SGS-Thomson, the Franco-Italian semiconductor conglomerate. ■

Test conditions

The logical ideal of testing all the ICs at the same gain was impossible. The makers' 'consumer oriented' application circuits are based on rather high gains, to give high enough sensitivities for direct connection of electret mics and guitars. In professional applications, more moderate gains of just +10dB to +20dB will suffice to use the amplifiers (with their diverse swings and applications) from typical line-level signals of 0dBu or less, up to +8dBu. Lower gains increase the frequency at which the nfb runs out, lessening the onset of very high harmonic distortion at high frequencies. Alas, the more minimal ICs, LM380, LM386, TDA2611 and TDA2822 have compulsory high gains. Overall, the ICs had to be operated at different gains between +9dB and +39dB, generally aiming to give clip into 8Ω with 0dBu while keeping some reasonable loop gain at 20kHz. Gains of the seven newer ICs were able to be set closer, within 10dB of each other. Gains were as low as 10dB as the gain-bandwidth product (figure of

merit for any op-amp) ranges so low. For example, the LM12 has 700kHz, about a quarter of that of the TL071 (with the lowest gain bandwidth product, at 3MHz, of any modern-day acceptable op-amp). At a gain of just ten times, error-correcting negative feedback will be falling close to nil at just 70kHz, only two octaves above where most people's conscious hearing stops.

All the ICs (other than LM4860,61) were assembled into their application circuits on Veroboard, with due care taken over the high current conductors and critical 0v/feedback nodding. The smaller ICs (the first eleven up to 20W) were tested with a uniform single (or dual) regulated and clean lab supply of +15V or ±15V, as applicable. Excepting the DIL types, they were fitted with individual small heat sinks of between 12 and 19°c/watt. Several of these parts required circuit fixes (such as increased zobel values) to get them to work without RF oscillation or other snags.

The LM4860,61 needed no heat-sinking and were tested as supplied. They, too, had RF stability problems. PA42,45 and LM3875,3886 and LM12, were tested at their various optimal voltages and were bolted to a 0.5°c/watt fan cooled heat sink. They were stable throughout. Both regulated and unregulated supplies were used to see how this would affect measurements.

Tests were performed with Audio Precision System One, in both analogue and DSP domains. Except where stated, the test load comprised a plausibly realistic 5m length of plaited wire (that is, like an exotic speaker cable) feeding 8 and 16Ω, 1kW resistive test loads. Hung off the back of the load was the capacitance of a 5m length of ordinary 2.5mm<sup>2</sup> PVC speaker-mains cable. The capacitance of the Audio Precision analyser's own reactive loading including bench cabling totalled another 1nF.

Noise and spectra

Noise is measured in two ways: conventionally by

third-octave spectra; and as a by-product of harmonic analysis. Test results for the latter covering all parts are tabulated in Fig.2. These noise figures are not comparable with conventional averaged figures, because the DSP process is more highly smoothed, and has subtracted all recurrent noise, for example 50-60Hz hum harmonics.

For the 'top five' third-octave noise spectra were plotted for the 'top seven'. Unlike noise tabulated in Fig.2, such plots do not fully distinguish between stochastic (true random) and periodic noise (50-60Hz) line frequency and harmonics. But they do reveal frequency-bound anomalies. In all cases, 0dB is the IC's full output swing.

LM4861 was initially RF unstable, then proved unexpectedly hum sensitive. Looking at Fig.3 the highest plot (A) on the rhs is with a regulated ►

Protection Resources

- LM 4860: Thermal
- LM 386: n/s
- LM 4861: Thermal
- TDA 2822: n/s
- TBA 820M: n/s
- LM 380: n/s
- TDA 1015: Thermal
- LM 383T: Short, OVP
- TDA 2030: Thermal, short, SOA
- TDA 2040: Thermal, short, SOA
- TDA 2611: Thermal
- TDA 1514: Thermal, SOA
- LM 1875: Thermal, short, ind
- LM 12: Thermal, short, SOA, OVP
- LM 3875: Thermal, short, SOA, ind
- LM 3886: Thermal, short, SOA, ind
- PA 42 (+mos): Thermal, short, SOA, ind
- PA 45: SOA

n/s = none stated.  
 OVP = Overvoltage.  
 Ind = inductive load protection.  
 n/a = not applicable  
 SOA = Safe Operating Area

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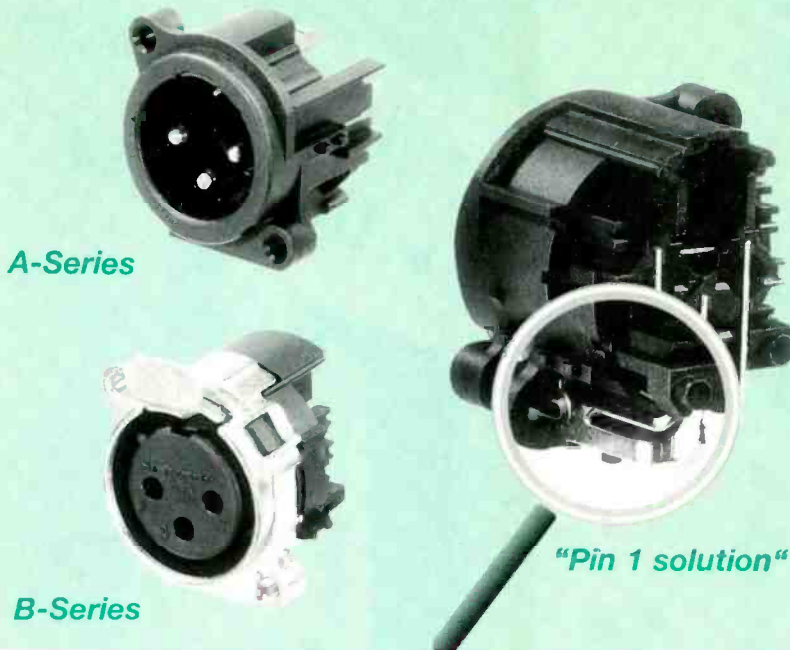


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# TECHNICAL REVIEW

## POWER AMPLIFIERS

**Part:** Averaged Noise, dB  
Unweighted in 400-22kHz BW:

Noisiest:	
TBA 820M	-104
LM 386	-115
TDA 2822	-119
LM 380	-120
TDA 2611A	-125
TDA 2030	-130
LM 383	-132
TDA 2040	-134
LM 4861	-135
LM 4860	n/a
PA 45	-136
LM 1875	-138
LM 12	-138
PA 42^	-139
LM 3875	-140
TDA 1514	-140

**Quietest:**  
AP Residue (typ) -148

**Note:** 0dB = - clip. All figures subject to ±5dB uncertainty due to gain setting variation.

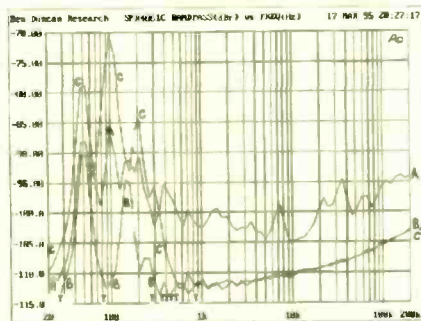
**Fig.2: Noise ranking**

but excepting PA45, are similar in magnitude and range. Overall, the PA42 is least affected and exemplary. The PA45 is most affected but ironically (noting the scales carefully) it still manages the lowest relative noise of all. This is aided by its high voltage swing.

## Harmonics

Percentage THD+n into an 8Ω load resistor was measured dynamically at 5kHz, from about 20dB below clip to beyond, for all the ICs. Space forbids displaying the 18 graphs but Fig.8 tabulates %THD+n for most of the ICs at two points. All are ranked at 'MBC', the 'minima before clip' corner after which %THD rises inexorably into clip. For the seven later ICs (marked \*), the test frequency was 1kHz. %THD of LM4860 and 61 was only improved at and below -20dB when the regulated supply was used. The LM12's %THD+n increases threefold in the top 18dB before clip at 1kHz, yet only 1½ times when retested at 10kHz. LM3886 and 3875 behaved similarly. With PA42 complete with outboard MOS-FETs, %THD+n was low and hardly varied in the 18dB below clip.

Measurements of harmonic distortion against frequency (%THD+n vs freq) were limited to five of the later seven. Fig.9 tabulates the results. These cannot be ranked but are ordered with regard to the power being delivered. LM4860's residue is dominantly 2nd harmonic (by eye) so is less bad than it appears. The LM3886 and LM12 have the lowest %THD+n at HF, while the PA42 and 45 are the clear winners at low bass. All except the LM4860 display a spike at 28Hz that is stronger with lighter loading. This is unexplained. Tests ▶



**Fig.3: LM4861 noise spectra. LM4860 is similar. Lower plots (B,C) on rhs are after adding a Zobel with reg (B) and unreg power (C). Lowermost on LHS and at 50/100Hz is with regulated supply (B)**

supply, before adding an output zobel network that NSC's data sheet categorically state is not required. With this, the noise drops, being the lower of the three curves at all points. To demonstrate PSR and simulate the effects sharing a rail with circuitry, an unregulated supply with just 7mV of ripple was then used. A +5V PC supply would be far noisier at HF. Here, HF noise remains as when regulated, but the 50Hz, 100Hz and 200Hz spikes are all markedly increased, to -78dB, -71dB and -84dB, suggesting poor PSR. Despite the shorted input, low field, semishielded environment, and supposed enhanced PSR of the bridged output stage, it turned out that LM4861's output impedance is very poor (about 0.5Ω) at low frequencies, and some of the hum is being picked up in the load cabling. Of course, with most power amplifiers, the same load connection cabling and its positioning has nil measurable effect on noise.

The other four noise pictures (Fig.4-Fig.7) are simpler to grasp. In each case, the dual plots show the difference between different ripple conditions. The ripple voltages varied,



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were also run with a 16Ω load. The PA45 was tested solely into this load, as the current limit setting used would not support 8Ω at the supply voltage used. Having such a high-swing capability, this is not so much of a problem. With the other ICs, only the LM4860 showed significantly reduced %THD with the lighter load. But as its output voltage swing is so small, this is not very useful.

A far more apposite test of %THD+n is into a dummy loudspeaker. Fig.10–Fig.15 show the results when six of the top seven drive an 8Ω Simulated Loud Speaker (SLS), with resonances typical of a sealed 10-inch to 15-inch driver. This is what the ICs would see, if employed in an active

speaker system to run the bass-drive unit. In each case, the 8Ω resistive load plot is included to demonstrate the difference. They suggest that the LM4861 and (surprisingly) the PA42 plus MOS-FETs are less good into a real load, whereas the others are generally better, particularly PA45.

Intermodulation

For six of the top seven ICs, SMPTE-DIN type intermod distortion was plotted against level (SIY) into the 8Ω resistive load with a 125Hz and 7kHz tones at 4:1. Compared to %THD+n, this test can better reject noise. Fig.16 shows the results. The ▶

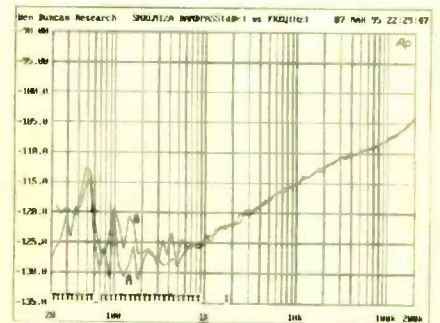


Fig.4: LM12 noise spectra with an unregulated supply, with ripple increased 10dB from 6mV (lower, A) to 20mV peak (B), showing at least 5dB degradation

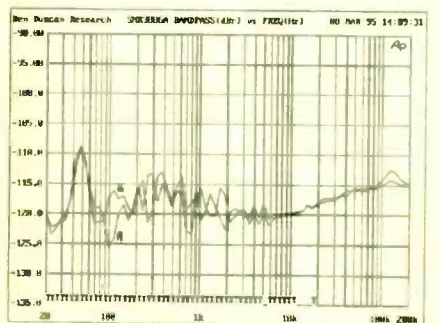


Fig.5: LM3886 noise spectra. LM3875 is similar. Again, an unregulated supply was used, with 5mV ripple (lowermost, A at 100Hz) again increased by 10dB, to 15mV (B).

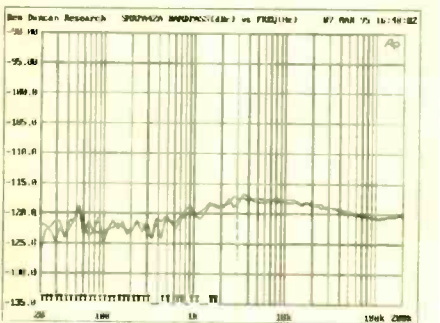


Fig.6: PA42 c/w discrete MOS-FETs. Noise is hardly changed with a similar change in ripple conditions.

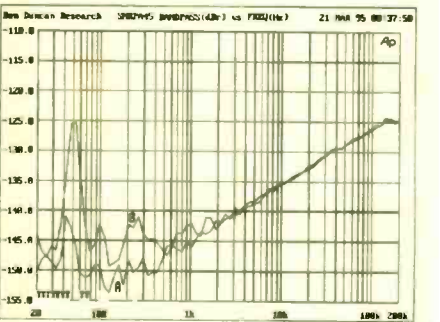


Fig.7: PA45 noise is very low with a regulated supply and while degraded (B) 7dB at 250Hz and 16dB at 50Hz, by an unregulated supply with 30mV ripple, performance is still very good

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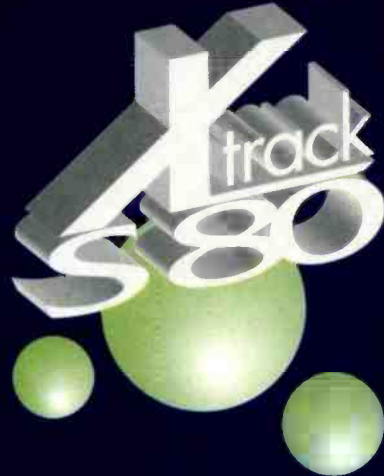
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LM3875 has the lowest intermod distortion on this occasion and holds it until clip. The closely related LM12 and LM3886 are next best. The PA42 and PA45 have higher intermod but are also delivering far more power, as symbolised by the higher drive levels before clip. The LM4861's poor results echo the %THD tests though at least softer clipping demonstrated by the shallower knee. Another six completely different intermod tests are possible, yielding another 108 graphs—and more surprises.

Harmonic spectra

The AP System One's DSP facilities were used to

show the individual harmonics. The sonic effects of harmonics can vary from inaudible, to euphonic (slight warmth, fattening) to highly dissonant (tinny, metallic, hard), according to their order (odd or even, low or high), structure, size, and frequency. Auditory masking phenomena must be considered alongside the ear's apparent and uncanny ability to perceive toxic high, odd harmonics that may be nearly a millionth of the signal magnitude (> -100dB), and well below the broadband noise floor. On this basis it is hardly surprising that after lumping harmonics together, conventional %THD+n figures would seem to have scant corroboration with sound quality below 0.1% or even 0.5%. ▶

Part	-20dB	MBC
LM 3886 (*)	0.003%	0.002%
LM 12 (*)	0.005%	0.002%
PA 42 solo (*)	0.005%	0.01%
PA 42 +MOS (*)	0.01%	0.01%
TDA 1514	0.01%	0.01%
LM 383T	0.01%	0.01%
TDA 2030	0.01%	0.01%
LM 1875	0.03%	0.03%
TDA 2040	0.005%	0.15%
TDA 2611	0.1%	0.1%
TBA 820M	0.3%	0.1%
LM 380	0.08%	0.3%
LM 386	0.5%	0.4%
LM4860, 61 (*)	0.2%	0.7%
TDA 2822	0.4%	0.7%

Fig.8: Dynamic Ranking %THD+n at 1kHz(\*) and 5kHz, vs Level

Part	30Hz	1kHz	20kHz
LM 4860	0.700%	0.8%	0.4%
LM 12	0.005%	0.0025%	0.06%
LM 3886	0.010%	0.002%	0.025%
PA 42,solo	0.003%	0.01%	0.07%
PA 42,+MOS	0.003%	0.01%	0.15%
PA 45, 16Q	0.003%	0.03%	0.2%

Fig.9 Distortion vs Frequency %THD+n at -1dB below clip, 22Hz-80kHz Ranking by power



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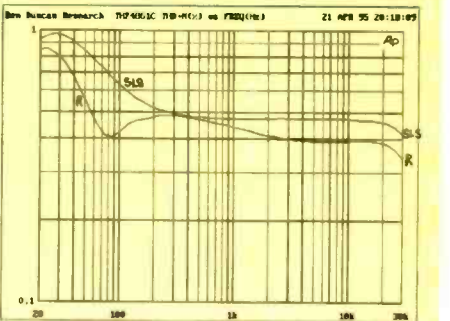


Fig.10: LM4861. Shows how bass end distortion would be increased with a real speaker. (SLS). 'R'= Resistive load

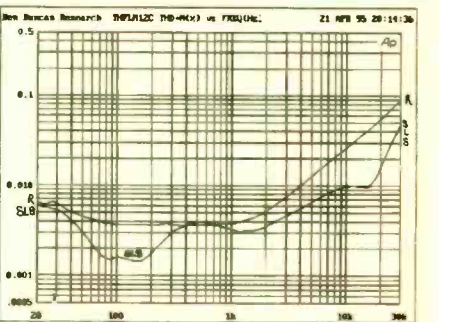


Fig.11: LM12. Shows how a real speaker is would yield lower distortion



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Fig.17 to Fig.21 reveal harmonic truths. All ICs were tested with a 1kHz impulse into the 8Ω resistive load at between -1dB and -2dB below onset of clip, or at the MBC, if soft. Junction heat-up and thermal settling time was allowed—but had surprisingly little effect. For each IC, 16 DSP samples were averaged. Sample rate was 48kHz, and bandwidth a very tight 3Hz (per spectral line).

Protection

Abuse protection schemes claimed by the makers are detailed in Fig.22. Short-circuit protection is a basic must unless the amplifier IC is permanently

connected to, and sealed in the same box as the speaker(s). Thermal protection similarly most important when illegal loads can be connected. But even with a permanently wired IC, temperatures that cause or accelerate IC failure could occur through high-level RF oscillation, or reception caused by bad input wiring, poor input-stage design and sheer bad luck; or else by overheating in adjacent electronics. All the ICs except PA42 and PA45 employ bipolar output and driver transistors. With these, an unfortunate combination of highish temperature, high voltage and enough current will trigger a catastrophic event known as secondary breakdown. After this, with the blown devices on one or both sides ▶



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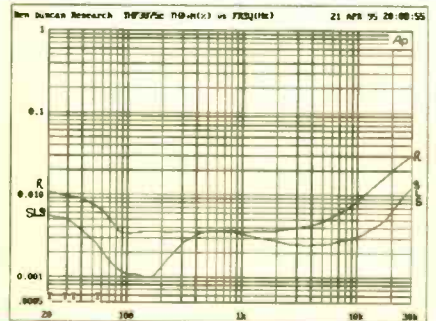


Fig.12: LM3875. As Fig.11

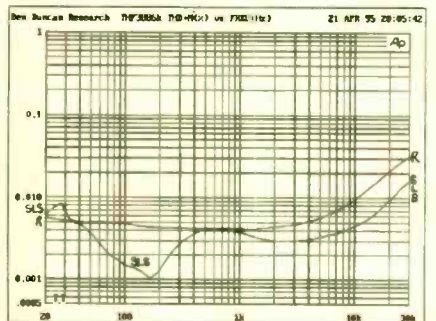


Fig.13: LM3886. Like fig.11, but notice how the 20–40Hz region appears more stressful with the SLS

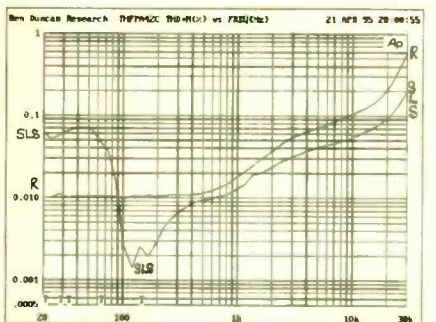


Fig.14: PA42. The bass end distortion hike with the SLS could be avoided by budgeting in more parallel MOS-FETs. The single pair used would normally be limited to driving into 16Ω

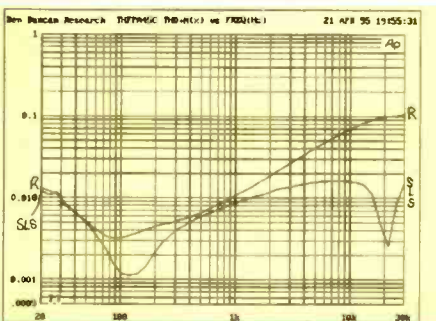


Fig.15: PA45. 'Loudspeakers = no problem'

Figs 10-15: 'Comparing distortion with resistive load versus. Simulated Loud Speaker (SLS)'



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turned dead short, the amplifier's power supply is either shorted and burns out, or else the wounded amplifier injects 20 odd volts of DC into your favourite cans or mini monitors—the classic, 30-year old DC fault condition that none of the IC makers address.

To prevent second breakdown without brute force clamping, so that the most is squeezed out of a given size of costly output transistors, an analogue computer is required, to monitor instantaneous volts, amps and °C. It can determine whether the parts are inside their safe operating area and limit drive if not; that is, tailor the limiting to just fit the moment-by-moment

situation. This procedure was pioneered in heavyweight amplifiers by Crown, as 'ODEP' in their PSA-2 (1979). Today, NSC's LM3875 and 3886 (and similar, related parts) are apparently the first power ICs of any kind to provide a similar analogue computation, where protection is linked to the near instantaneous monitoring of the real safe operating area.

The MOS output transistors in PA42 and PA45 have none of these problems with secondary breakdown. But with the tiny V (vertical groove) MOS-FETs inside PA45, safe dissipation is not self-limiting. Apex stress that the devices cannot be adequately protected by direct-to-chip sensing. In

the application circuit, a resistor connected between Pin 1 and Pin 8 sets a resistive-load limit line. This will provide inadequate protection with some speaker load conditions, but if adequately set, it will be overly protective for others. Added external protection against adverse loading and abuse is really needed. With the PA42, protection depends on the output parts used. For these tests, they were a single pair of Exicon UK-made plastic cased MOS-FETs of the type long proven in UK power amplifiers. These were comprehensively (thermal, short and SOA) protected with just five extra components, and tested in this form.

## Conclusion

The absence of documentation on slew behaviour is to be deplored, as is the provision of a typical figure, but no minimum. Makers might one day realise that to fully satisfy audio users, they need merely meet whether or not their part meets Jung's criterion, and by what factor. An IC rated with '2.0 Jung's' would have twice the slewing capability that it needed to meet the criterion, at its maximum swing capability.

Nearly all the designs manifest increasing low-frequency %THD at high levels. In the absence of a convincing alternative explanation, this demonstrates that thermal disturbance remains a problem. On the basis of these measurements, most audio power ICs remain an audio compromise, compared to the discrete or hybrid alternative. ▶

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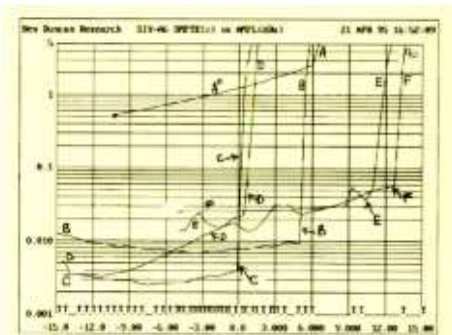


Fig.16: Dynamic SMPTE-DIN type intermodulation distortion. A = LM4861. B = LM12; C = LM3875; D = LM3886; E = PA42; F = PA45

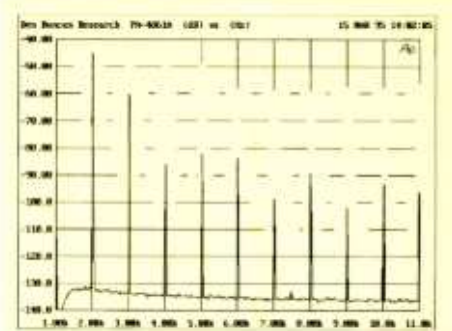


Fig.17: Spectra of LM 4861 -1dB below the knee of soft clip. At -18dB below clip, the spectra are worse



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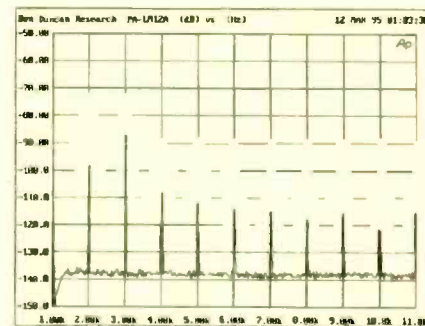


Fig.18. LM 12. At -25dB below clip, the harmonics increase and change

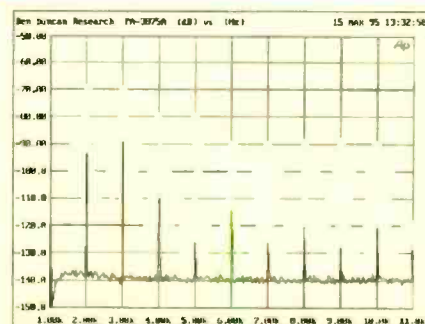


Fig.19: LM 3875. Similar in magnitude and pattern to LM12. Slightly more even order emphasis

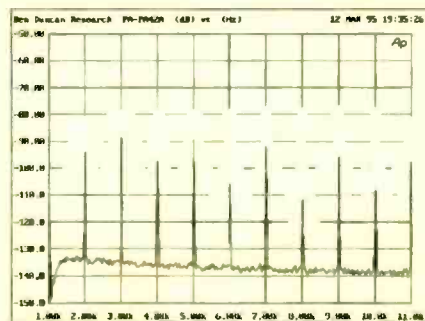


Fig.20: PA42. Apparently average... except this IC gets much better at lower levels. At -26dB below clip, spectra are the most subtle in the group, just a tiny amount of the second harmonic

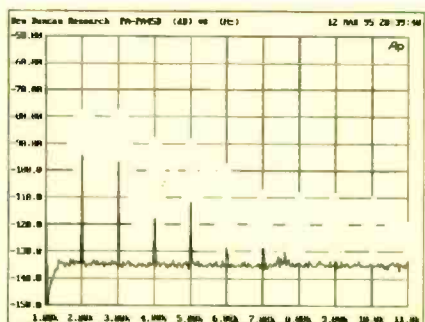


Fig.21: PA45. Quite clean. Results are less good if the supply rails are inadequate. But again, at low levels, spectra are far cleaner than any of the all-bipolar ICs tested

Figs 17-21: 'Spectra -1dB below onset of clip spikes in residue'



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I came as quite a shock recently to phone the Decca Recording Centre in North London and be told that Tony Griffiths had left after 25 years 'to become a consultant'. The word from the herd was very clear: Griffiths had not left because he wanted to leave. And his e-mail number quickly changed to no longer reflect the company name.

Griffiths trained with the BBC and joined the Decca Record Company in 1972. His first work was on TeD, the Teldec video-disc system. I remember visiting the Finley Lab to see the ten-man team working on TeD. It was by then doomed, knocked out of the game by Philips' optical Laserservice (now Laser Disc). But the digital processing which Decca had developed for TeD was used as the basis for the first digital-audio tape recorders in Europe. The Decca system used modified IVC video recorders and they are still working today. Right from the start the recorders had 18-bit capability, even though it took a decade for the electronics industry to catch up with 18-bit convertors. That is a pretty good definition of foresight, and it gave Decca a lot of kudos and saved the company scads of cash.

Decca's first digital recordings, made in the late 1970s were issued on vinyl LP. Decca were by then in serious decline and PolyGram bought the company in 1980. Griffiths was made Technical Manager, and then General Manager, of the new Recording Centre. Decca never adopted the U-matic mastering system for CD. They are now moving direct from IVC tape to optical disc. Instead of buying off-the-shelf kit from Sony, the West Hampstead team members developed their own system. The key difference is that the Decca system uses blank discs which follow existing computer-industry standards, not Sony's proprietary format. Eighty machines are now ready for use by Decca and Philips Classic in Holland.

Along the way, Griffiths had pushed the use of teletext as a simple way of storing subtitles for opera on Laser Disc. He has also worked for Philips on DCC, spreading the message that with the right processing, four bits of nonlinear PASC can outstrip 16-bit linear PCM. And while Deutsche Grammophon spent a fortune on the publicity campaign for better-than-16-bit 4D, Decca spent a lot less on quietly developing and using their own better-than-16-bit mastering system.

It took Decca a week to come up with an official comment on Griffiths' departure.



Barry Fox

## Solutions to the shortcomings of 16-bit, 44kHz digital audio and the end of an era for Decca's Recording Centre

He will report to Tim Harrold, Executive Vice President for PolyGram International. The heads of Decca, Philips and Deutsche Grammophon all also report to Harrold. Says Decca's President, Roland Kommerell, 'Decca's development projects will continue. Griffiths' influence could now be stronger. Although the three companies, DG, Philips and Decca are competitors, they will not now be pulling in three different directions'.

If I were an optimist, I would be happy to believe this means there will never again be a rerun of the 4D pantomime, when DG's publicity machine tried to discredit those who asked what the publicity meant. An optimist would also see the three companies happily cooperating on technology, while competing in the market place.

If I were a pessimist I would see the Decca reshuffle as signalling the end of DCC; the end of technical development at the Recording Centre, a technological slowdown within PolyGram, just as other record companies are exploring the potential of the Internet; and Decca's relegation of music recording to the role of a prettily packaged commodity. In other words the end of an era.

Time, a year or two at most, will tell.

The sound-coding system for DVD, the new Digital Video Disc, was assumed to be AC-3 for the USA and Japan, and Musicam for Europe. But

DTS, the Californian company that used apt-X to put sound on CD-ROM for *Jurassic Park*, belatedly pitched for the prize and won it.

apt-X is a professional system but is, realistically, too expensive (\$72 just for the chips) to be used as a consumer product. Some of its features are not needed in a consumer CD player. So DTS are developing a consumer variant with the help of a firm called ART. DTS Coconsumer Coherent Acoustics works over a wider range of bit rates, and uses a Motorola DSP chip.

It seems unlikely that DTS Consumer will shake AC-3 off its perch. The real-time coding equipment was not ready for comparative tests planned for July. It has probably only got this far because Steven Spielberg backed the movie system: over 4,000 theatres had to buy the DTS Professional hardware if they wanted to run *Jurassic Park* in its intended format. But the cinema industry does not want a disc-plus-film standard. It threw the idea out in 1927 with the *Jazz Singer*, which was originally disc-based. DTS Pro looks likely to become a dinosaur. DTS Consumer Coherent Acoustics looks to be a dead duck for DVD.

Whatever happens the Acoustic Renaissance for Audio will not be satisfied. The ARA's stance is clear: compressed sound may be acceptable for movie soundtracks but it is not for the high-quality audio applications of new high-density CD formats.

Instead we should be using lossless compression systems. In these, no data is thrown away. It is reorganised and packed tightly into the available storage space. Lossless compression is a tried-and-tested technology in the computer world. It is used, for instance, to double the capacity of a hard disk.

The ARA Technical Committee includes Tony Griffiths; Professor Malcolm Hawksford of the University of Essex; David Meares of the BBC and Bob Stuart of Meridian Audio, advised by consultants Peter Craven and Michael Gerzon, Chris Travis, Francis Rumsey of the University of Guildford and Hiro Negishi of Canon.

'There is a general consensus that 16-bit, 44.1kHz linear PCM is inadequate', say these members of the ARA. As 1% of the population can hear 25kHz tones, the new system should have a 25kHz bandwidth. Dynamic range should be inaudible to a sound pressure level of 120dB. Sampling rate should be a multiple of the studio rate, 48kHz, with coding-word length up to 24 bits.

The higher the sampling rate, and the longer the word length, the shorter the playing time. So instead of locking the HQAD system into one fixed coding standard, the new disc would provide at least five options, ranging from 74mins-371mins per side, in steps up to 24-bit and 96kHz coding.

At the same time, the number of channels can be varied to cope with full spherical recording, probably Ambisonics. There will be different levels of decoder, but even the most basic HQAD player will always be able to access 2-channel stereo from any HQAD disc.

Because the new high-density disc systems now offer the option of a 2-layer disc, the ARA wants to make HQAD backwards compatible with existing *Red Book*-compatible audio CD players by recording *Red Book*-standard audio in the deeper track. So an ordinary CD player will read an HQAD disc as an ordinary CD. The HQAD track will be nearer the surface, and thus readable only by a new player.

The main objections so far to ARA's proposals are that if the sampling rates must be pegged to any base reference, it should be 44.1kHz, with 88.2kHz being the next step. This would build a direct compatibility bridge to existing recordings. Ideally though, the new players should simply lock onto whatever sampling rate the HQAD disc uses. ■



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