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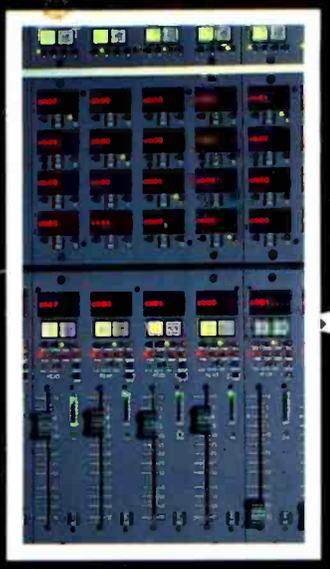
THE INTERNATIONAL TECHNICAL MAGAZINE FOR PRO AUDIO, POSTPRODUCTION & BROADCAST



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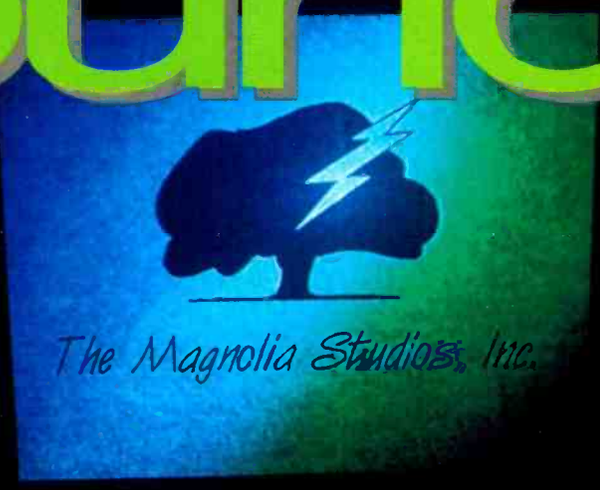

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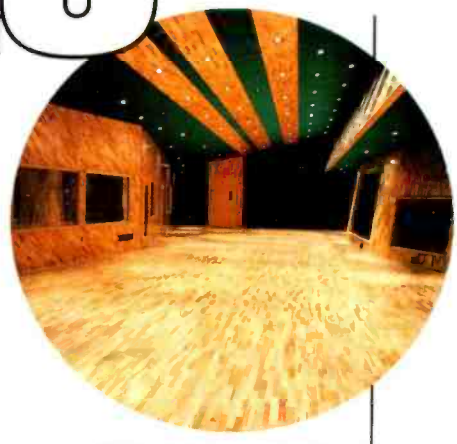

Studio design: The Tracking Room at Masterfonics in Nashville has a 3-D trapping system in relation to the main monitors which are open to the room. Page 52

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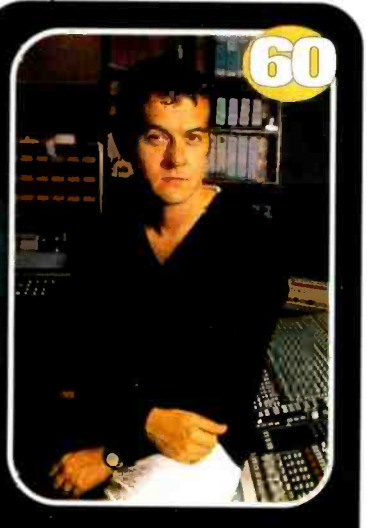

STREET INTERVIEW
His production curriculum vitae is so cool it's almost embarrassing: Stephen Street in an exclusive interview with **Studio Sound**

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THIS EDITION'S CONTRIBUTORS

BARRY FOX is as close as you can get to being a household name as an internationally renowned technology expert. He is a regular contributor to countless scientific, technology and business magazines as well as appearing frequently on national television and radio.

BEN DUNCAN is an author, consultant and equipment designer specialising in analogue audio and EMC. In his spare time he has been busy producing a new audio reference book; guiding the detailed sonic upgrade of an entire PA system and throwing wicked all-night raves.

ALLEN VARELA who is a recognised expert in the field of audio post, enjoys the impossible task of covering Hollywood from Long Island. Seeming to relish the impossible, he is currently writing a series of children's books, recording another music project and looking for an agent.

The reformation

I have long lost count of the number of times I've heard pro-audio technology described as being second in its complexity only to that of the space race, military aviation or some similar bastion of technical advance. Maybe it's true but who has measured it? And how?

Perhaps it doesn't need to be true—perhaps it's simply an expression of pride in the technology available to us as we make records, radio, television or films. That it's impressive technology is inarguable—it impresses the hell out of my dad—and I'd argue that it's impressive beyond what might be expected for an entertainment field. It's easy to identify the power of the driving forces behind weapons design; less so that behind audio.

There is, I'd wager, a powerful force in unacknowledged competition within pro-audio. I'm not referring to anything so trivial as inter-manufacturer rivalry here, but the interdisciplinary competition that exists in expanding the envelope of technical achievement. While I've never been directly involved in the design of any piece of audio equipment, I'd be surprised if those who are fail to regard their area(s) of activity to be leading or trailing adjacent areas.

For example, the advances made in commercial analogue-to-digital convertors over recent years has exposed the shortcomings in the dynamic range and noise floor of many other pieces of kit. Consequently there is a discernible pressure on mic manufacturers to match—or better—the performance of the latest generations of A-D convertors.

And if every advance in one area potentially brings pressure to bear upon some other—weaker—link in the audio chain, it follows that these advances are a source of satisfaction to their designers. And there you have the competition: one grounded in technical pride rather than commercial recognition, on diligent research and applied knowledge rather than magic and misinformation, on objectivity rather than bullshit. One thoroughly representative of the standing of professional audio.

BUT THERE IS MORE at stake in this race than simply pushing the boundaries of existing areas of technology. There are many more researchers active outside the field audio than there are within it. Pro-audio did not ask for digital technology or computers, for example. These developments arrived from elsewhere and were seized upon by those with vision as future tools of the trade. Now they are accepted facets of audio technology—and arguably only just coming into their own. Vague—or 'fuzzy'—logic is steadily becoming an accepted advance in the design of control circuitry while the advent of nanotechnology holds unexplored potential for changing the face of audio technology.

And the research goes on.

What, I wonder, will become of loudspeakers? Over recent months, a number of articles on this subject have cast speaker design in a 'mature' phase, with incremental developments being brought about by advances in materials technology and optimal design ethics. Yet loudspeakers and the attendant fields of acoustics and psychoacoustics are still widely misunderstood or not understood. To many engineers this is still magic. What would be the effect of some genuinely revolutionary technical advance in this area? Easy question—a revolution. Better question: how certain can we be that such an advance will not come along in the foreseeable future?

Obviously the general question applies across all the areas of technology we currently use. And some that we don't.

Just as computers brought with them concerns such as data storage and compression, other areas of computer-related technology are steadily becoming our concern—telecommunications, data archiving, data warehousing, data security...

So while it pays to be able to identify the weakest link in your working chain, it also pays to be aware of the weakest links in our applied technology. Or, if you prefer, to be aware of which areas of our equipment are most likely to become obsolete or obsolescent first. Along side this, we would be prudent to recognise arriving areas of technology sooner rather than later. It's a tall order.

Putting all this into some sort of perspective, it is tempting to speculate that the loss of the 'professional margin' enjoyed by pro-audio before the arrival of the CD is steadily being restored by the enduring quest for better technology and better audio. Plenty of us will welcome its return.

editor

The OXF-R3 Digital Mixing Console.

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Until you use it.

Sony Broadcast & Professional Europe, Jays Close, Viables, Basingstoke, Hampshire, RG22 4SB, United Kingdom. Sony is a registered trademark of the Sony Corporation, Japan.

SONY

Soundbites

Classics at Abbey Road

ABBEY HABITS recently acquired include the adoption of British-made Digital Genius ada 20.16 integrated A–D/D–A convertors. After rigorous in-house testing (both technical and on various classical sessions) four convertors have been purchased. Three of these have since seen service both in-house and on location sessions where they fed 20 bits to a Nagra machine; the fourth is installed in the studio's multimedia suite.

In the wake of the announcement that 3M are to disband their tape division, confidence in 996 analogue mastering tape is high—classical specialist Testament Records recently adopted 996 for fresh recordings of Polish violin soloist Ida Haendel made at at Abbey Road. Haendel is no stranger to Abbey Road having first used the studio back in 1939, and making some of the earliest ever classical tape recordings in 1947 with producer Walter Legge. The new recordings —of Bach's complete sonatas and partitas for unaccompanied violin —were made with a pair of Sanken mics and Massenburg preamps to 996 running at 15ips with Dolby SR. The resulting CDs and 180gm vinyl pressings were cut as Abbey Road and pressed at EMI's Hayes plant. *Tim Goodyer*

Genesis Pro Systems via Kinetic Systems, UK. Tel: +44 181 953 8118
3M UK. Tel: +44 1344 858614

THE QUEST for authenticity in refurbishing the crashed alien spacecraft that is now Soho's Space Studios has meant having even the acoustic doors specially designed.

Hidden in a Victorian warehouse in Soho since it crash-landed in 1859, the craft has posed serious restoration problems to owners Robbie Weston and Rick Dzendzera, whose pursuit of 100 per cent authenticity has bordered on obsession.

One of the main problems that faced them was the structural damage caused to the craft on impact. The extent of the damage meant that eleven of them need replacing with new acoustic doors.

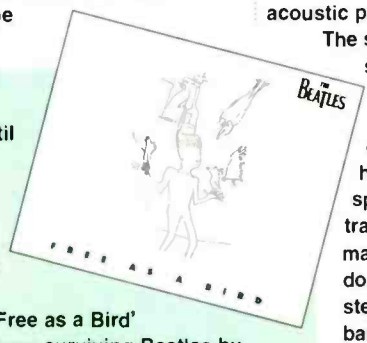
'We went to IAC and showed them some alien sketches and explained our unusual requirements,' said Dzendzera, Technical Director of Space. 'The prototype they showed us a few weeks later was spot on. Though IAC has managed to emulate the alien style perfectly, there has been no compromise in the acoustic performance.'

Space's doors of perception (above) conceal the 'classic' lines of the Neumann U87 (left), which seem oddly in keeping with the lines of the flight deck of Soho's marooned intergalactic cruiser. According to Dzendzera: 'Many mics were tested, but we came to the conclusion that when it comes to the recording of human voices, as opposed to aliens, the old favourites had to be the best.'

The single-leaf, fore-rated steel Noise-Lock doors are proof, reckons IAC, that acoustic doors can be made to harmonise with alien spacecraft as well as traditional studios. To make them fit in, the doors have a polished steel finish, matching the bare metallic surfaces used throughout the studio. Each door has also been decorated with radial steel ribs, a perfect match for the original doors, and a shaped toughened-glass viewing window.

All of the doors have a leaf thickness of 78mm and a laboratory-certified STC49 acoustic rating. Double magnetic seals at the head and jamb create an effective acoustic bond. *Nick Smith*

THE NEW BEATLES single 'Free as a Bird' saw extraordinary levels of security until its release on the 4th December. The first new song from the group in 25 years—the news of which was broken to the world by *Studio Sound* in the October 1995 issue —features the voice of the late John Lennon preserved on a tape kept by Yoko Ono.



Originally composed by Lennon in 1977, 'Free as a Bird' was given, in cassette demo format, to the three surviving Beatles by Ono. They completed the work on the track at Paul McCartney's Sussex studio in February-March 1994. A productions credit goes to Lennon as well as George Harrison's fellow Travelling Wilbury, Jeff Lynne.

Despite his extensive work with other parts of the global Anthology machine, George Martin is absent from the credits for the song. As it is almost inconceivable that he would not have been asked to produce the song, it is hard to draw any other conclusion than that he did not want to work on it.

According to sources close to Martin, when asked what Lennon's reaction to the 90s version of 'Free as a Bird', he is reputed to have said that Lennon was sometimes a difficult man to work with and that he was often idiosyncratic in his criticism of works in progress.

The song itself has many of the hallmarks of a Beatles Song, but lacks the jaunty dynamics of the originals. Its 'Dear Prudence' bass line, phased vocal involvement also show through: it is easy to trace the production back to middle period Electric Light Orchestra. *Nick Smith*

THE WEB continues to make inroads into the insular world of pro-audio with AMS Neve, Euphonix, Dolby Labs and MTV Finland announcing World Wide Web sites.

At **http://www.ams-neve.com** AMS Neve has some 50 pages of regularly maintained information on its mixing and editing equipment, distributor information, news and contact details.

At **http://www.euphonix.com** offers a similar 40-page service with a particular emphasis on software status and a 'full on-line version of the CS2000 System Overview'.

In contrast, Dolby's site at **http://www.dolby.com/** lists forthcoming cinema releases and the cinemas equipped with Dolby Digital surround systems. Dolby AC3 releases are also supported in terms of releases and technical descriptions of the AC3 format. Dolby anticipates expanding the site to include pro-audio, cable, satellite and ISDN matters along with the publishing of key technical papers.

At **http://www.mtv3.fi** MTV Finland has opened an interactive site providing news, education, programming details and an opportunity for audience response. In particular, the Jyrki programme

gs News in brief

—which specifically covers the use of data networks and is aimed at a young audience—will be directly augmented by the internet facilities.

At http://194.72.60.96/www/sadie/ Studio Audio & Video is offering product information and inviting user feedback. In addition, a number of documents are offered covering operational and informative issues related to the application and operation of nonlinear recorder-editor systems like SA&V's own SADiE.

Studio Sound's own presence at cz73@cityscape.co.uk continues to serve as a barometer for web usage as well as a valuable international communications channel.

Tim Goodyer

GOLDENEYE, the latest Bond movie, saw the reunion of the threesome that created the soundtrack for the cult movie *Leon* with the addition of a full 60-piece orchestra.

Written by Eric Serra and arranged by John Altman, the work was recorded at London-based Angel studios by Resident Engineer Steve Price.

'We recorded the music for *Goldeneye* onto a 32-track Mitsubishi digital machine,' said Price. 'It was a real pleasure to work with Eric. Obviously, I'm delighted he chose Angel for this project as well.'

As we go to press, Angel's reception and corridor areas are being refurbished but a spokesman for Angel said that this would not interfere with the operation of the recording studios and should be completed by December.

Nick Smith

Natthaya (left) and Nutjarin stars of the new Thai TV show *Care With All My Heart* being made at Bangkok's SPM facility

The man with the black gun: Bond (Pierce Brosnan) and Natalya (Izabella Scorupco) pause for a quick spot of heroine-saving in their inevitable escape from the Russian Military Archives.

◆ Polygram Thailand is to collaborate with the Far East Music Company in establishing a new mastering facility in Bangkok. The facility will be based around a British SA&V SADiE disk editor system and joins Media of Medias, Fatima Racio, You and I Corporation and Stylus Studios in the list of recent SADiE converts.

Further Thai activity involves a new TV show, *Care With All My Heart*, which has been produced by Five Star Productions for Channel 3. The programme is being made at Bangkok's SPM facility which boasts the first installation of a 24-bit AMS Neve AudioFile in Asia.

SA&V, UK. Tel: +44 353 648888.
KDM Trading, Thailand.
Tel: +66 2 318 2724.
AMS Neve, UK.
Tel: +44 1282 457011.
Audio Consultants, Kowloon.
Tel: +852 351 3628.

◆ BBC Radio Production Resources in London has recently purchased eight Pro Tools III systems along with Power Computing Power 100 computers. The computers are Nubus-based Macintosh clones which have only recently arrived in Britain.

Digidesign, US.
Tel: +1 415 688 0600.
Digidesign, UK.
Tel: +44 1753 653322.

◆ Quintessential Sound is to be the first US mastering facility to use the British 24-bit Genex Research GX2000 M-O recorder. The New York facility anticipates its first use being PGM Recordings' *La Voce Virtuosa: Lute and the Saxon Vocal Tradition.*

Quintessential Sound, US.
Tel: +1 212 586 5339.
Genex, UK.
Tel: +44 171 609 6151.

◆ Icelandic National Broadcasting has chosen the American Orban DSE 7000 nonlinear editing system for preparation of its public broadcast radio programming.

INB, Iceland. Tel: +354 515 3000.
Orban, US. Tel: +1 510 351 3500.

◆ Tokyo's White Base studio has installed a British Soundtracs Solitaire 40PB console with Moving Faders and VCA automation. The studio is owned by the Japanese Power Box production and recording company which is responsible for established Japanese pop artists such as Dip in the Pool.

White Base Studios, Japan.
Tel: +81 3 3486 6405.
Soundtracs, UK.
Tel: +44 181 388 5000.

◆ Hollywood multimedia concern, 7th Level, has added a fifth Spectral Prisma-Prismatica system to its arsenal. To date, the Spectral systems have seen battle in preparing the *Monty Python's Complete Waste of Time* and *Battle Beast* CD-ROMs while work on *The Lion King, The Universe According to Virgil* and *The Great Word Adventure* continues.

Spectral, US.
Tel: +1 206 487 2931.

◆ HBO Singapore has upgraded one of its edit suites with the installation of a Graham-Patten D-Esam 820 digital mixer to accompany its Grass Valley Model 251 edit controller and GVG Model 200 video switcher working to Sony D2 and Digital Betacam. HBO handle handles a variety of movies, trailers and promos.

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

◆ HBC Prague, has taken a D-MAS multichannel automation system from the British manufacturer, Drake. This is the second system to go to a broadcaster in the Czech Republic following an earlier sale to TV Max last year.

Drake Automation, UK.
Tel :-44 1707 333866.

◆ Cahaya, Malaysia's largest audio and lighting production company, has added 24 Australian AFX LF loudspeakers to its stadium concert system. The rig now features 48 ARX 212 mid-high units, 48 925 LF units and 48 full-range speakers for delays and fill-ins. Already proven with Indonesian Arist Rhoma Irama and Singaporean Ramli Sarip, the new system has a busy schedule ahead.

AFX Systems, Australia.
Tel : +61 3 9555 7859.

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The state we're in

After allowing the Far East to take the lead in high-tech equipment, the time is right to restore the tradition to the West

By and large the readers of *Studio Sound* are audio engineers, wannabe audio engineers, or at the least know somebody who is an audio engineer.

Out of all the subjects I have been involved in, I make no secret of the fact that audio is my first love–although helicopters come a close second. Mind you, the two subjects are remarkably close: Fourier transforms are used to analyse rotor dynamics, and some of the lift is the reaction due to acoustic radiation (bumble bee technology). But I digress.

We work in an industry which is necessarily on the subjective end of the scale, but nevertheless an industry it is. And because it is an industry, it has to be profitable. It doesn't matter how good that last mix was, you have to eat. The only difference between an individual, an industry and a country is one of scale. We all have to be profitable because we all have to eat. In practice we have to do more than that. We have to house ourselves, care for our health, educate our children and maintain the infrastructure which ensures that we will be able to do those things tomorrow. The degree to which we are able to do that is generally known as the standard of living.

When that standard falls, the result is poverty and rising crime. I believe that in UK we are already seeing that.

An individual can only do so much. However highly skilled, the individual's efforts can only succeed if there is a suitable environment. That means, for most of us, is having a decent job. Unfortunately, the efforts of an individual can be brought to nought because he or she works for a company that fails to consider the future. And, on a different scale, the efforts of a company or even an industry can be brought to nought by a government that fails to create a suitable environment.

One job of a government is to create a climate in which the nation's industries can operate effectively. I would suggest that in Great Britain today that role has been neglected for several decades. We are a very creative country, yet we consistently fail to capitalise on our ideas. We fail to make products based on our ideas, or if we do they are not profitable. We blame the Japanese and more recently the Koreans for taking away our markets, yet we should not. They are only doing what we could do if we had the vision. The truth of the matter is that it should be easier for us than for Japan.

IN THE EIGHTIES the Japanese Ministry of International Trade and Industry (MITI) published a report on the origins of innovative ideas. It revealed that only 6% of Japanese exports were the result of Japanese ideas. The remainder come from the West.

If you don't believe that, take the example of the DAT machine, that quintessentially oriental digital recorder. Look at the inventions that were necessary to create it and where they came from. PCM, the concept of carrying an analogue signal as a pulse train, is a Western invention, due to Reeves. The rotary-head tape recorder was developed by Ampex and RCA in the 1950s. The channel-coding concepts required to record data on tape, including group codes as used in DAT, were developed in the US computer industry, notably by IBM and Sperry. The history of error correction is dominated by Western mathematicians such as Philip Fire, Irving Reed and Gustave Solomon. The transistor and the integrated circuit are American inventions. The digital computer grew out of work by the Briton Alan Turing and the Americans John von Neumann, Presper Eckert and John Mauchly who would found Univac.

Armed with that lot, no inventive step is necessary to make a digital-audio tape recorder. The laws of physics are the same the world over and so the development challenge was the same. Yet it was the Japanese who built DAT, just as they built VHS earlier while the West watched.

Our problem is not in the creation of ideas, but in our failure to convert them into products. If it can be done elsewhere it can be done in Europe and US as indeed it once was. Likewise in the emerging former Soviet countries.

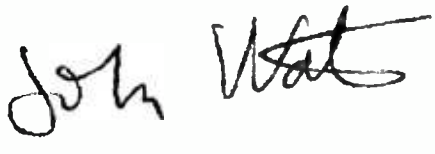
There are two major problems in UK, which may well exist elsewhere.

Firstly, the government consists almost entirely of classically educated people who simply don't understand technology. The opposition is equally unqualified to make technological decisions and just cloaks its ignorance with a different veneer of dogma. Secondly the banks have become profit centres, indistinguishable from any other business. They are no longer supportive of innovative small businesses and indeed help many to go to the wall by recalling loans when the sun goes in. High technology companies tend to be high geared and are vulnerable to changes in interest rates and cash flow problems.

The time is right to put high technology manufacturing back on the map in the West. We in the audio industry are well positioned to help with that. Britain particularly is well served with audio expertise.

In our Universities and in places such as BBC R&D as well as in the existing audio manufacturers we have a knowledge base which is unparalleled. We can and should produce the highest quality, best engineered products available by aiming beyond what is possible today. Only in this way can we capture the high ground of the technology. Once the high ground is secure the skills and techniques developed there can migrate to a wide range of applications creating a substantial manufacturing and export opportunity. We can do it, but right now it will have to be without the help of high street banks or politicians.

With their lack of vision and leadership, our politicians and bankers have relegated themselves to the role of administrators. Leave them there.



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Footing the bill

The rising cost of studio technology and falling studio rates necessitate an initiative in client education writes **DAN DALEY**

It's impossible to talk to a studio owner in the US and not have the issue of rates raised at some point in the conversation. The subject has crowded out sex, food, sex, sports, sex, intoxicants, sex and all the other staples of the general-purpose chatter that makes up what had once been a highly social industry.

The grist in the mill these days is how to maintain an increasing upward slope of more expensive technological acquisitions when clients are paying you rates on a par with a decade or more ago?

You can't, really.

You might borrow more money but then you get into the same situation that most governments do–deficit spending. And studios have yet to learn a way to levy and then increase taxes on clients.

You might try to raise studio rates but run the risk of losing business to the proliferating low-tech studios out there, or to competitors at your own level, all of whom are in the same boat and happy to see the business come their way at the old rates.

You might diversify–start a record label (several American studios, such as Platinum Island in New York, Ardent in Memphis and River North in Chicago, have done just this), add postpro or tape duplication–but in addition to the startup costs being a cash drain, such moves also tend to make studio owners lose focus on their core business, sometimes with disastrous results.

You might specialise–reposition the studio to cater to a niche market, like vintage freaks or gangsta rap (yes, there are studios that cater to gangsta rap and I've seen the graffiti on the walls to prove it)–but then you're banking your future on a narrow market base that can disappear overnight as whims change in a fickle industry.

At great expense, you might expand your studio significantly and predicate a rise in rates on a substantial increase in technology and design. Masterfonics' new The Tracking Room, with an SSL 9000j, a fashion-forward Tom-Hidley design and a daily rate of $2,500–nearly 40% higher than the average rate for top-end Nashville studios–is an example. It's too soon to tell whether Masterfonics will get that rate consistently when it goes into effect January the first, but uncredited comments going around the town suggest that producers and labels are not willing to pay more, based on both a contraction in their own sales (country music lost 2.4 market-share points in 1994 and RIAA statistics are expected to reflect another drop for 1995) and the perceptual problem they experience that manifests itself in the mantra, 'A console is a console. A studio is a studio. Why should I pay more for this one?'

THE PLIGHT in which studio owners see themselves is thrown into yet starker bas relief in two ways: On one hand, they watch as the technology of personal studios drops in price even as it increases in capability, at the same time that upper-end technology increases in cost and complexity. Secondly, as regular American guys and gals, they buy bread and gas, go to the doctor, pay rent and kick the tires of the occasional 4-wheel-drive recreational vehicle. The prices for all of the above products and services have steadily increased, along with other staples like tape and valves, while the price of their own services have declined in comparison. It's cold comfort that recent analyses of US incomes shows that individuals have lost ground over the last 15 years as well, as compared to incomes in the 1960s and 1970s. The perception that studios have stagnated as much as they have makes the problem acutely emotional. It reminds one of Shylock's soliloquy in The Merchant of Venice: 'If you prick us, do we not bleed? If you poison us, do we not die?'

The situation has not yet reached the timbre of the last phrase of that quote: '. . .and if you wrong us, shall we not revenge?' And I don't expect to see studio owners 'going postal' on the front page of the *New York Post* anytime soon. But the situation is reaching towards some sort of denouement. And the best hope, the one that there's some kind of consensus about with a broad range of studio owners, lies in educating their clients. National professional studio organisation SPARS has had this on its agenda for some time, and the still-embryonic Nashville-based Nashville Association of Professional Recording Studios has had it as a subtext as it works out its own regional syllabus. But what's more important is that education crops up often and consistently in individual conversations with studio owners, an intrinsic and spontaneous response that seems to have established a common ground among studio owners. This kind of universality in a solution is heartening.

AND HEART is needed. It's a broad range of clients that require education, from record labels to producers to artists, all of whom have participated and benefited from downscaled recording technology but all of whom also demand the apex in technology when they use commercial studios. What form does education take? I'm tempted to suggest an open house for clients with little price tags attached to every piece of gear. A $250,000 tag on a Euphonix desk or a $500,000 one on an SSL might not only reinforce the overhead of the studio but also discourage the placing of beer and coffee on the console. Another more realistic approach might be to itemise equipment costs in some way on purchase orders and invoices, or to note new major acquisitions on them along with their costs. Newsletters have proliferated with the advent of DTP; studios can inform their clients in very friendly way about new equipment while at the same time indicating to them that progress comes at a price.

There are numerous ways in which to skin a cat. But this particular cat is getting pretty scrawny, and has traded in more than one of its nine lives. The obsession with rates needs to be replaced with action about them, and raising awareness levels on topics ranging from fur to snow owls has been an American pastime since the Carter administration. Studios can't wait for an Endangered Species Act to bring about this awareness. Take a client to lunch, explain that the cost of technology is rising as steadily as the demand for quality, and that the availability of full-service, cutting-edge recording studios is predicated on the notion that supporting that technology has to be based on a partnership between service provider and client. Speak in glowing terms of the bright future of professional audio and how together, client and studio can bring music and sound to new heights of quality and innovation. Then let the client pick up the check.

Pioneering the past

Broadcasting's digital future lies in its analogue past but digital *recording*'s future with Decca is in jeopardy writes **BARRY FOX**

Sound studios went digital ten years ago. CD turned the home into a digital domain. Radio and TV production is well on the way to becoming fully digital. Consumer video is moving into the digital age. We have MPEG-1 Video CD, the first digital video-cassette recorders are now on sale in Japan and MPEG-2 DVD is promised for late 1996. Only radio and TV transmission remains analogue. The increase in channel capacity should mean more jobs. But how long will it take?

Kevin Hilton, in his column, will already have described the gloriously inept way in which the BBC's publicity crew launched digital radio and announced plans for digital TV. So the time is now right for some sub-text.

As Hugh Peltor, Director of BREMA, the British Radio and Electronic Equipment Manufacturers Association, said after the DAB event, 'We should be cheering them for what they are doing'. Instead we were boggling at the contradictions.

If the BBC had just let its engineers say 'we are spending £10m to encourage the manufacturers, by promising not to turn the transmitters off', everyone would have cheered. Instead we had Project Director David Witherow with the classic comment, 'Eureka is a world standard, it will not necessarily be the world standard'. We had Liz Forgan, Managing Director of BBC Network Radio, heralding 'the dawn of the third age of radio' but admitting that if listeners phone the BBC about receivers 'we shall tell them that consumer models will not be in the shops for two years'. And we had the BBC's house magazine *Ariel* devote almost an entire issue to articles headlined 'The Third Age of Radio and Radio Steps into the Digital Age'.

Small wonder that BBC staff, crippled by cash cuts and threatened with redundancy, were so reluctant to do as they were told and plug the launch on air.

The ignorance shown by John Birt (Director General) and Patricia Hodgson (Director of Policy and Planning) at their briefing on digital TV was both alarming and revealing.

I am not just talking about their blissful distance from the debate over consumer attitudes to widescreen TV which has been going on for at least ten years; or the fact that Channel 4 in the UK has already had to cut back its widescreen transmissions through lack of viewer interest. I am talking about the BBC's own documented history.

In calling for the government to push viewers into buying new digital receivers by naming a date when all analogue transmissions will end, Birt and Hodgson drew a parallel with the changeover from VHF 405-line monochrome TV to UHF 625-line colour. This they say was 'achieved within 15 years'.

Wrong. After several years of planning, BBC 2 started 625-line monochrome transmissions in 1964 and created two incentives to buy new sets, extra programming and clearer pictures. BBC 2 switched to colour in 1967, providing a third incentive. In 1969 BBC 1 and ITV strengthened this third incentive, by starting to simulcast in 625-line colour. The last 405-line transmitter was switched off in early 1985. Whichever way you cut the numbers, the 405/625-line transition was not 'within 15 years'.

Indeed, Phil Laven, Director of Engineering Policy, admits 'There was no deadline for 405-line transmissions when the 625-line service began. There were clear expectations that the 405-line service would end, but no date. The market decided. There were no more 405-line receivers to buy'.

Twenty years ago, most homes had only one television set and no VCR. The TV set was unreliable and the tube aged badly. The incentives of extra programming, clearer pictures and colour were very powerful. Modern television sets and VCRs often last ten years. Digital TV offers no comparable incentives. Satellite and cable provide extra choice. Widescreen is a slow pull.

John Birt admits that although he has seen a demonstration of widescreen TV, he does not have a widescreen set himself.

The real giveaway was Birt's reminder of the '. . .very great value to the nation and the Treasury of the analogue spectrum which transition to digital broadcasting will unlock'.

The UK has pioneered the idea of making big money out of the electromagnetic spectrum by selling it off to the highest bidder. Using DAB technology makes room for more commercial radio stations so makes more money for the government. Transmitting TV as digits instead of waves makes room for more commercial TV stations, all paying the government to broadcast.

The commercial broadcasters cannot afford to prime the digital pump. The BBC can, however, use the licence fees which the public are obliged by law to pay. The same situation exists in many other European countries. So the public ends up funding the transition to digital which then earns money for the government. But this only happens if the public broadcasters are prepared to play the game. Under John Birt, at least, the BBC is willing.

Birt's contract with the BBC runs out in a couple of years. This coincides neatly with the planned startup date for his digital experience. If it all goes wrong he'll be in another job.

MUCH OF THE pioneering work on digital recording in the UK, and Europe, was done at Decca's Recording Centre in North London. The September issue of *Studio Sound* told of reorganisation that looked likely to put a stop to all that. Decca reassured with news of a new corporate structure. The technical heads of Deutsche Grammophon and Philips would report to Tim Harrold, Executive Vice President for PolyGram International. Despite his clearly unhappy departure, Decca's ex-Technical Head Tony Griffiths would report too, as 'consultant'. This, we were told, would strengthen PolyGram's commitment to technology.

Almost at once, news filtered out of PolyGram that Tim Harrold is leaving. Funny. Despite all my interest in the Recording Centre shuffle, no-one at PolyGram thought to tell me until I found out. Harrold is 'taking early retirement' in January and—familiar phrase—will remain as a 'consultant'. Chris Roberts, previously President for PolyGram Classics and Jazz in the US, takes over.

'It is a great honour to be offered the chance to lead Deutsche Grammophon, Philips Classics and Verve into the future', says Roberts who has a degree in Musicology and German literature and spent five years in Germany composing and producing music for films, TV and commercials. PolyGram believes that Roberts 'will bring a fresh approach to what is an important and profitable area for PolyGram'.

Only time will tell where the 'fresh approach' leaves research and development at Decca's Recording Centre in London.

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The only way is soap

A masterstroke of media marketing, or a cynical clone of a style pioneered in the West? **DAVID LI** on the rise of the star factories

It had to happen: in the fifties there was Nashville, and in the sixties there was Motown. In the seventies there were London's New Wave sausage factories (the most famous being Stiff). And in the eighties, elsewhere in London, there was Stock, Aitken and Waterman. And now there's Thailand. Its food and an inheritance of ever more elaborate martial arts have already pervaded western culture. The entertainment is not far behind.

The rise of the multimedia/multi-art-form studio complex, complete with in-house 'creatives', has been inexorable. And although the system has made a lot of people rich, it is quite often a mixed bag for the artists and paying public alike. Buddy Holly found it hard to cope with the style of the resident Nashville session players; Martha Reeves was an archivist until Berry Gordy made her Martha of the Vandellas; Declan MacManus was propelled to the acceptable limits of superstardom as Elvis Costello; Kylie was just one of the modest talents to be hoicked out of Aussie soap *Neighbours*, only to be seen weeks later cavorting beautifully on *Top of the Pops* with her all-time SAW classic *I Should be So Lucky*.

Now in Hong Kong we have gelled-haired Andy Lau the the monster film star who can sing a bit—it's all a bit like Cliff in *The Young Ones* or Elvis in *GI Blues*, isn't it?

BUT IN THAILAND there's—let's call them—Big Promotions, who have a 49% slice of their domestic market, while their only local competitor—Bigger Productions—claims a massive annual turnover in excess of US$300m.

There's also the very real threat of product withdrawal if quality procedures are not adhered to and the factory turns out substandard product. The component sourcing and product delivery method, JIT, is very much an oriental industrial philosophy

So here's what you get when you go to Big Promotions. Let's look at it like a department store. In the basement you've got the graphics guys. What have these got to do with pro-audio? You might well ask, but it's really a staggering feat of concurrent engineering, or, come to that, pre-emptive engineering, because what they're doing is working on the promotional material—album sleeves, point-of-sale, tour posters, display advertising, gig flyers, etc—for the artists who maybe don't even exist yet.

Meanwhile up on the figurative ground floor you've got the music, or if you like, the 'creative' department, where the in-house salaried producers and salaried composers work with the salaried and distinctly royalty-free artists on songs which have been written into a bank of Apple Macs by the salaried songwriters.

It's a cross between a finishing school and a production line, where what rolls off the end is the perfectly groomed teen idol with a polished product indistinguishable from the last.

This is also where the studios are, and here Big Promotions, with their license to print money, spare absolutely no expense: quite apart from the US$30,000 koi carp in the foyer, they've probably got fully equipped SSL facilities with two identical 4048s sitting there just waiting for something to happen.

If the writing and composing is comparable to DFM (design for manufacture) then the studios are run pretty much like a production line in a manufacturing environment, where the studios are given jobs with job numbers, budgets, time windows, inspection schedules and so on. There's also the very real threat of product withdrawal if quality procedures are not adhered to and the factory turns out substandard product. The product delivery and component sourcing method—JIT (just in time)—is very much an oriental industrial philosophy.

ANOTHER FLOOR UP lies the A&R department packed with talent scouts who go out scouring the Thai club scene looking for young, beautiful wannabe boys and girls who, inevitably, can't sing and—we'll come to this later—can't act either. These clubs are where most of these desperate wannabes are destined to stay, and these are the clubs to which the starlets who lose their ascendancy will tragically fall.

Which brings us cheerfully onto the next floor, where —hey!—they've got their own video production department where they make their own Karaoke discs and videos. It's also where the rehearsal studios are for the salaried and distinctly royalty-free dance instructors to teach their young protegees how to move in a commercially viable way. You'll also find on the next floor up Big Promotions' own radio station, which is used to promote their own records, pumping out 24-hour cyclical playlists of their royalty-free artists. If I seem to be droning on garrulously about how devoid these functionary artisans are of royalties, it's simply because it's so hard to conceptualise how critical you can be to the money-making machine without having any sort of performance-related (in both senses) pay. Only the very top-selling artists are allowed to negotiate percentage-style deals, and this, not surprisingly, is only as they approach the twilight of their careers when their earning potential has considerably waned.

One floor up there's the in-house duplication and distribution department where there's the latest in CD, tape and video technology. The whole thing from conception to distribution is handled in the one complex.

THE TOP FLOOR: there's only one thing you can do really, and, no that isn't to put yourself out of your misery by jumping out of the window: rather it's to look *out* of the window to your left across the car parking lot to the low-rises where Big Promotions produce the soap operas designed to plug the new superstars, increase their record and video sales, and, generally speaking, make thumpingly huge wedges of cash by then selling the TV rights on to anyone of a mind to buy them.

And if you look to your right there's a small plot of undeveloped land which will, we are assured, be the home of the movie production department. This seems to make sense too: because, after all, when you've done records and soaps and you've wiggled and mimed your way through promo video, what else—apart from the American presidency—is there left for you to do?

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REVIEW

Harrison SERIES TWELVE

Putting the high-end music-tracking studio squarely in its sights, Harrison has endowed its Series Twelve with the best in analogue, digital and interface technologies. DAVE FOISTER reports

SOME DESK manufacturers are revered for their sound, others for their features, control and functionality; few, it seems, are able to achieve a world-class reputation for both. One of this elite is undeniably Harrison, always at the forefront with new ideas but never at the expense of its much-admired sound. The release several years ago of the Series Ten introduced the automation of more features than had ever been seen on a console before, while continuing the Harrison tradition of sonic excellence, and now Harrison has two new systems with yet more levels of automation and control.

Sadly appearing in the UK in the year in which company founder Dave Harrison died, the two systems share precisely the same audio electronics but with two entirely different control consoles, which gives away the nature of the systems' structure. These join the growing band of digitally-controlled analogue consoles, with audio paths residing in remote racks or towers and the console proper being nothing more than a control surface for those racks.

Series Twelve master-programme faders and soft keys

The first system is the MPC, designed specifically for film work and available in multi-operator configurations the length of a truck. Several of these have already found their way into major film facilities, but the one we are looking at here is, so far, less well established. The Series Twelve is unashamedly a music recording console, with options and layouts available for broadcast as well. It takes the ideas inherent in the basic concept, such as customised configurations and the combination of real channel controls and complete automation, to new lengths, and manages in the process to remain familiar and intuitive.

It seems established that, for the time being at least, the world does not want to operate equipment by software alone. Every time someone produces a virtual environment for mixing, editing or whatever, someone else will come along and design a hardware interface for controlling it—people still like real controls, real buttons, and, ideally, a full set of one for each function. This has been a problem for designers of automated consoles: how much real manual control can you put on to each channel of a big desk and still automate it all before the cost of the mechanical controls becomes prohibitive? Only recently has it become feasible to make a system of this type look like a mixer rather than an anonymous piece of control hardware, and the various approaches to the issue make for interesting comparisons. There cannot be many more than two other manufacturers designing analogue consoles like this, both working hard to make the result immediately familiar as a mixing console within the constraints of the final price bracket.

Both these others still look sparsely populated with controls compared with conventional desks, which is a comment unlikely to apply to the Harrison. There is almost a knob for every function, and since they all need some indication of their current status the result is more controls and LEDs than you can shake a stick at, and a console depth which defies easy reach from the engineer's chair. There are some who will find the result rather overwhelming, but others who will see it as the Series Twelve's biggest selling point, scoring over heavy reliance on assignable control panels in its directness and fluency of operation.

Since the Series Twelve comes as standard with 16 Aux Sends, 4-band fully parametric EQ and full dynamics processing on both signal paths in every channel, it is obvious that that there cannot truly be a knob for each function, but the system is about as close to that ideal as seems practical, and control of any function can be carried out locally in the place you expect to find it. All the variable controls apart from the faders are rotary encoders rather than pots, whose effective position is indicated in a variety of ways. Each channel strip's controls can be selected to either signal path, and the multifunction controls are logically implemented. Thus there are four aux-send encoders, which can be assigned as pairs to any pair of the 16 buses, either as two mono sends or a stereo pair with level and balance controls. There is a single encoder for each band of the EQ, with buttons immediately under the fingers for giving that encoder control over gain, frequency or Q. Small rows of LEDs, of the type found all over the console for this purpose, show the current settings for all the parameters, and more detail can be seen in an alphanumeric display at the top of the channel. Similarly, the dynamics block has only one rotary control with local function selector buttons and a bar graph on the module shows gain reduction.

THE CENTRAL SECTION of the console is the part one expects to find most prominent on a system of this type, as it can take instant control of any channel and provide an even more comprehensive set of controls and displays. The combination presented by the Series Twelve gives the best of both worlds: real, fast, local control under the fingers in the expected places and centralised assignable control right in the monitoring sweet spot. The system offers a third complete control interface, in the form of a touchscreen sitting in a pod beside the engineer, and this too comes as standard as there are certain functions, mostly to do with entering text, which can only be done from here. The point is that there are three simultaneously available systems for controlling the console, all of which have

Harrison Series Twelve installed in London's Intimate Studios

their advantages, anc the Series Twelve can consequently be operated in just about any way you like. Besides this, the various panels and module styles can be mixed and matched and placed more or less anywhere in the frame, and the result is possibly the most flexible, user-configurable and accommodating console yet developed.

Essentially the channel strip is laid out like a familiar in-line console, except for the fact that there is a single set of controls which can be used for either the channel or the monitor path. The only duplicated items are the faders and their associated mutes and automation facilities; on a standard channel two faders are provided, both motorised. The rest of the strip is switched *en masse* to the path to be adjusted, and can also be used to control the two paths together as a stereo channel. There is also a full stereo channel available, where both paths are stereo. Note again that there is never any question of assigning bits of the channel to one path or the other—splitting the EQ between them for instance—as all facilities are included on both paths throughout the desk.

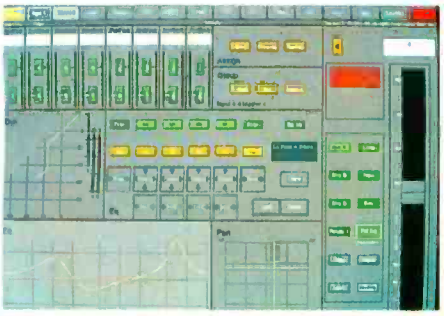
The bandwidth controls have no calibration as such, neither are they continuously variable; each offers seven narrow and seven wide settings, and the HF and LF bands also have a shelving setting

Input arrangements are slightly unconventional and very much in keeping with current trends. All console inputs are line-level inputs, although each channel path has one marked for microphone; this assumes outboard microphone preamps, and Harrison offers two types, one with basic manual adjustment and one with full remote control from the console. Using the latter allows all the relevant preamp settings to be part of the snapshot automation of the desk. Either, of course, allows the preamps to be sited locally to the microphones themselves and line-level signals to be run to the audio racks, with all the advantages that this arrangement is now acknowledged to have.

The Dynamics section provides a compressor and a gate simultaneously, with full control over attack and release times and thresholds. The gate can operate as a ducker and also as a 2:1 expander, and a separate key input/side-chain insert is provided.

EQ covers the range 40Hz to 16kHz in four broadly overlapping bands, with over 15dB of boost and cut available on each. The bandwidth controls have no calibration as such, neither are they continuously variable; each offers seven narrow and seven wide settings, and the HF and LF bands also have a shelving setting. The EQ is flexible and sounds good, with no reservations about sacrificing sound quality for controllability; this is EQ you'd buy as an outboard. It is augmented by variable high-pass and low-pass filters, both with an unusually wide range. Conventional channel facilities are rounded off with the pan section, but routeing is handled rather differently; each group of four channels shares a panel at the top of the console with a single set of routeing buttons feeding up to 48 busses. Each channel can be independently routed as a mono or stereo signal or configured for 4, 6 or 8-channel cinema-surround systems, and individual LED arrays above the control buttons show the current status for each. This panel also carries the aforementioned display for the various channel functions; as soon as a control is moved, its function and value appear in this window together with the name or number of the channel concerned. For instance, moving the low-mid level encoder on channel 14 would immediately produce a very legible alphanumeric read-out of the level, frequency and bandwidth of channel 14's LM EQ at the top of the channel.

Most of the channel's sections allow their settings to be copied to other ☞



The touchscreen allows complete control of the console

channels across the desk, and a development of this in the latest software is a Link function, where, for instance, groups of equalisers on various channels can be controlled together from any one of them.

Every channel will inevitably have a main fader, adjacent to which are all the controls and indications for automation status together with solo and mute. Each fader also has an eight-character display attached, to be used as a scribble strip whose contents will be saved and recalled with the mix. Two small 4-LED meters indicate signal levels in the two audio paths, and eight more LEDs show links to Remote Grouping Faders, which provide very flexible level subgrouping to the extent that the channel can be controlled by multiple groups.

The small fader, which also carries full automation facilities, solo, mute and electronic scribble strip, is one of the items which can be dispensed with to customise the console; on desks which are to handle very large numbers of inputs or several separate configurations, the relevant space may be taken up by a panel for selecting what Harrison calls layers. Each channel strip can control up to four stereo or eight mono audio channels in the rack, and even on the standard channel selection buttons are provided, labelled simply A to D. For more complex work, the layer control option allows the layers to be named and displayed for more immediate recall to the control surface, and shows small LED meters for the resulting eight signal paths lying under the module.

Two big illuminated push buttons on each channel allow either of its paths to be called to the central control area, where not only are there more individual controls for the various sections but some additional features and more informative displays. The best example is the EQ, which has the full twelve encoders for level, frequency and bandwidth of all four bands, together with twelve displays for the current values. Each band can also be individually switched in and out of circuit, a feature not found on the channel itself. Aux sends, too, have a full set of level displays, although there are still only four controls which must be assigned to the sends in pairs. The pan section adds two controls, for front-back pan position and LCR divergence. The result of all this is that the entire console can be controlled from this centre position by calling channels one at a time on to its surface. So comprehensive is the control that it is perfectly feasible to configure a Series Twelve without controls on the channels at all, which obviously gives a substantial cost saving at the expense of losing the instant familiarity presented by the full desk's layout.

It is also possible to control the console entirely from the touch screen pod—Harrison likes to tell a story of a demo of the system at which someone accidentally turned off the power to the console itself, leaving the onlookers bemused as the sound continued to emerge from the monitors complete with all the programmed changes. The demonstrator was unaware of the problem because at the time he was operating the touch screen.

The screen allows yet another set of views of the console, with all controls duplicated in various panel displays which open up from a general overview when touched. Moving the finger around the screen adjusts the various parameters, sometimes two at once, and graphic displays show EQ curves and changes in real time as well as the operation of the dynamics processors. Here, too, are the housekeeping and file handling facilities, and text entry for these and the scribble strips is handled by an on-screen QWERTY keyboard. This is reasonably quick to use, but anyone who can actually type will find it maddeningly slow compared with a real keyboard.

THE FACILITIES, then, are certainly comprehensive, as befits a console aimed at the Series Twelve's market. What adds the real power is the automation, which quite simply controls every function on the desk. Complete console settings can be saved and recalled virtually instantly, and every single button and control on the system is dynamically automated, with a multitude of modes for various methods of working and stages of mixing. The touch screen deals with the sequence of mix passes and comparisons between them, and helps with features like swapping between two mixes at a predetermined point. Off-line editing is promised in a future software upgrade. Meanwhile even Harrison in the manual can find little to say about the automation, as it does everything you are likely to want in a straightforward intuitive way.

Space considerations preclude giving details about the soft key-macro facilities, the highly flexible stereo routeing, preset global console status configurations, the forthcoming machine control facilities and a host of other niceties; they all add to the point, however, that this is as powerful and comprehensive a console as you are likely to see, with as much automation and control as you can possibly imagine. Its highly flexible configuration means that it can be specified as large, small, simple, complex, very expensive or not so expensive; in fact Harrison tells me its most complicated piece of software is the one for costing the consoles. Many people share the opinion that this format—sophisticated digital control of a high-quality analogue audio path—is the future, and Harrison has set about showing us how it should be done.

Thanks to Paul Madden at Intimate Studios, London, for allowing me access to his Series Twelve.

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Stedman N90

A new American dynamic microphone has challenged the position of the studio condenser. **DAVE FOISTER** evaluates its claim

WITH THE MARKET being increasingly flooded with inexpensive, high-quality condenser microphones, it is a brave move for a little-known company to launch an up-market dynamic model claiming quality comparable to condensers. Yet this is what US manufacturer Stedman has done with the N90, whose design and marketing, indeed whose very shape, clearly invite such comparisons.

This is sticking one's neck out in a big way, as for general studio work, the condenser rules. There are many fine dynamic microphones gracing most studios, but they have favoured applications; think of the AKG D12 and D112, the ElectroVoice RE20, the Sennheiser MD421 or the Shure SM57 and in every case you will immediately think of the one main use associated with each. All of the uses exploit either the microphone's bomb-proof handling of high SPLs or some specific sonic characteristic, and none of these models would be regarded as a general studio workhorse in the way that a 414 would. Stedman's vision of a dynamic which could fit that description therefore warrants careful inspection.

The N90 is unashamedly styled to look like a studio condenser, with a satin aluminium finish like an old Neumann and a chunky cylindrical body supporting a side-firing capsule within a silver mesh grille. It is utterly bereft of switches, and is supported in its clamp by a sideways-mounted XLR connector.

The stand mount is particularly well-designed; a single knob tightens the clamp around the microphone's base and locks the swivel, and a spring arrangement inside allows it to be slackened enough to alter the angle without the microphone falling out of its clamp. This combination of security and speed of adjustment is sadly all too rare.

The N90 claims to have a cardioid polar pattern, and I have read elsewhere the comment that its rear pickup is much higher than it should be. This was accompanied by the bizarre suggestion that this was due to the N90's lack of the second diaphragm which in a familiar condenser microphone, we are told, cancels out the back pickup. This, of course, is incorrect, as both diaphragms are by nature cardioid because of the acoustic construction of the capsule. The rear diaphragm plays no part in cardioid operation but is either added to or subtracted from the front diaphragm to produce an omni or figure-of-eight pattern respectively. Having said that, the back pickup of the N90 is disappointingly high, being only 4dB down on the front response at 1kHz as against 16dB for a 414. Intrigued, I carried out further measurements which established that at many frequencies the pattern is much closer to figure-of-eight—the pickup 90° off axis is always lower than the rear pickup and at 100Hz and 10kHz is an almost perfect null. While this is at odds with Stedman's information it does not detract from the microphone's usefulness—as long as you know what it is doing. The frequency response at the rear is not flat enough for the N90 to be considered a true figure-of-eight, but the side nulls offer the same rejection possibilities.

On axis, the sound of the N90 is quite a surprise for a dynamic. It has a more natural, smooth upper end than expected which suggests a wider range of uses than more familiar dynamics. The top is still not in the same league as a condenser, and it would not be my microphone of choice for vocals; it did, however, produce a surprisingly effective sound on saxes and other horns, adding thickness rather than gloss and flattering some otherwise breathy sounds. It has an earthy quality ideal for vintage sax sounds, giving a slightly period feel without having to reach for the EQ.

Its ability to deal with very loud sources, even without any kind of pad, is without question, even if it results in a rather low sensitivity as one expects from a dynamic. The ads claim a maximum SPL of over 155dB, and this makes it ideal for close miking of drums and guitar amps but, perhaps, without the trade-offs normally associated with this use of a dynamic. Certainly close on a loud amp it gave the feeling of a condenser-like openness along with its level tolerance, and the same applied to drums.

THE STEDMAN N90 sets out with a heavy burden to bear: that of living up to claims that it can hold its own against top-flight condenser microphones. It can hardly be blamed if it doesn't measure up to those standards, and should instead be judged for what it is—an ambitious high-quality dynamic microphone. On those terms, to my mind, it succeeds very well, shedding or minimising many of the sonic limitations of the stereotype dynamic and with them many of the restrictions as to the uses one might consider for it. In the areas traditionally associated with the dynamic it positively shines, and at the same time opens up new possibilities where its headroom advantages and distinctive character may be just what the situation demands.

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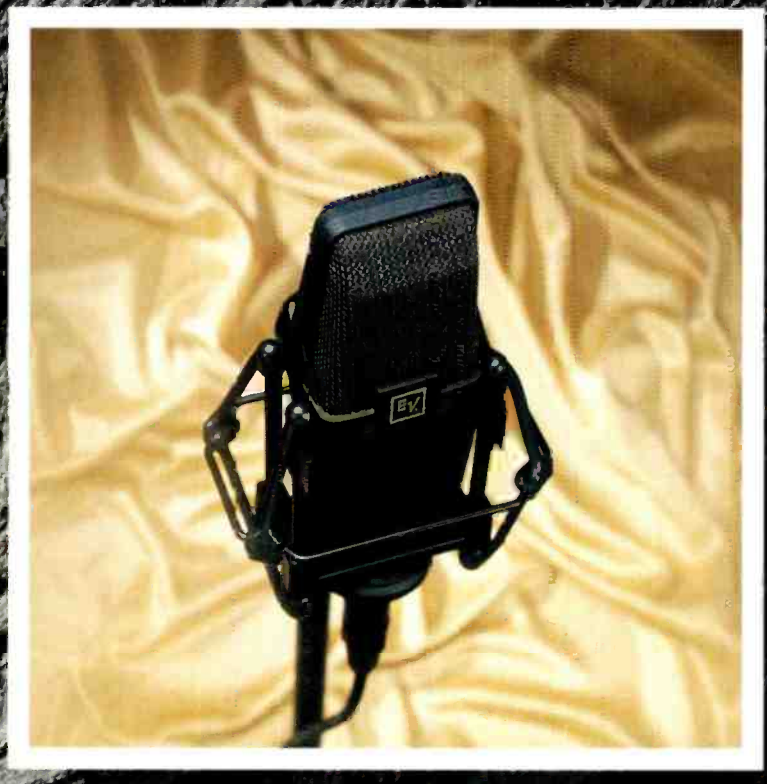

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Enough of the theory. This mic's been tested in practice by some extraordinary engineers, and they've got plenty to say. Like "the perfect mic for recording any acoustic string instrument" (John Beland of the Flying Burrito Brothers), and "the warmth of a tube mic — extremely quiet and sensitive, allowing me to pick up low-level material without adding noise" from Scott Weber of Buena Vista Sound, Walt Disney Studios. Tom Cusic of TM Century, Dallas "used less EQ to achieve what I look for. What goes in...comes out! It's also extremely versatile...from vocals to acoustic guitars to trumpets and violins", while Roy Thomas Baker (Producer of Queen et al) thinks "it's one of the most versatile I've ever used."

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Electro-Voice

Tascam DA-P1

Breaking the price barrier on professional portable DAT recorders, the DA-P1 offers an attractive profile.

DAVE FOISTER measures 'one giant leap for portable digital recording'

AFTER A SLOW START, DAT seems to have gained wide acceptance in location recording. It is easy to see why there were initial reservations; location equipment is traditionally chunky, the kind of stuff you can not only throw into the back of a truck but drive the truck over, and a cassette that could get lost in the loops of the carry-case Velcro is going to have a hard time inspiring confidence. The early portable recorders were a bit dainty as well, and often lacked some of the facilities a location recordist relies on when using other formats.

DAT has grown up in most respects since then, and location work is no exception. Heavy-duty transports, rugged cases and more and more relevant extras have established DAT as a feasible medium for the application, and manufacturers vie with each other to produce the machine with the highest truck resistance and the largest number of switches per square centimetre.

Latest into the fray is the DA-P1, which Tascam reckons to be the most affordable truly professional portable DAT recorder. Tascam has clearly thought carefully about how to achieve this in terms of which facilities can be provided at the price. The most obvious thing not included is any handling of time code; for time code on a portable you still have to go up to the HHB Portadat and beyond. Apart from that, everything else important seems to be there, with even a few frills thrown in for good measure.

The biggest bonus for the price is proper balanced XLR microphone inputs complete with switchable phantom power. The mic amps incorporate a switchable limiter, and appear to be of a very high quality, with low noise and a clean, flat, extended frequency response—so much so that a high-pass filter would be useful but, unfortunately, is not fitted. The XLRs can also be switched to accept balanced line-level signals, and appear alongside phonos for unbalanced line sources, although it should be noted that these simply feed into the main signal path after the mic amps, and are not switch-selectable. Line outs are on phonos at -10dB, although as is usual with portable machines the outputs are not likely to receive much serious use. Digital signals in and out are IEC on phonos, and that completes the connectors (apart from headphones); there is no synchronisation of any kind.

A big gripe about most affordable portable DAT machines has always been their inability to record incoming analogue at 44.1kHz. For those of us recording with a simple setup on location with possible CDs in mind this has been a problem, with many such recordings having to go through the unknowns of sample-rate conversion. The DA-P1 puts this right with a sampling-rate switch offering 44.1kHz as well as 48kHz, and, of course, the digital input will cope with all three standard rates.

Tascam's bid for the title of 'affordable professional portable' DAT recorder: the DA-P1

Most of these functions—mic-line, pad, phantom, input selection and sample rate—are dealt with by recessed switches on the top panel. These are small, yet not fiddly, and positive in operation. Some of the transport controls are found here too, but in the best location tradition the RECORD and PAUSE buttons, bigger than the rest, are on the front panel where they fall under the hand when the machine is slung over a shoulder. Next to them are the dual-concentric input level controls, whose edge protrudes through the top panel to provide thumbwheel-style operation. The two controls have enough friction between them that they always move as a pair.

ID ARRANGEMENTS are reasonably comprehensive, apart from one detail; putting the machine into record from pause does not even add a Start ID, never mind increment the program number. Incremental program numbers can be added manually during recording by presetting the ID mode to Start Write and pressing the RECORD button, but I have always thought it useful to have a new Program number written every time the machine starts recording. The Auto ID function, on the other hand, is very comprehensive, with no less than four user-selectable threshold levels for writing a new ID.

Another aspect often apparently seen as an afterthought on such a machine is the headphone amplifier; too many are weedy affairs giving barely enough to be heard above the surrounding live sound, which always strikes me as short-sighted considering the kind of work the machine is likely to be doing. The DA-P1 suffers from no such shortcomings, delivering enough level to its headphone socket to blow your head off.

Powering is by an external mains adaptor or an internal NiCad, which can be charged on board or with an optional separate charger. There is no facility for dry cells, so a spare NiCad is advisable, although Tascam claims 100 minutes of continuous recording time from one battery even using 4mA of phantom power, and two hours without.

The location market is notoriously difficult to penetrate, but if time code is not essential the DA-P1 seems to provide everything else that is likely to be required, and deserves to do well.

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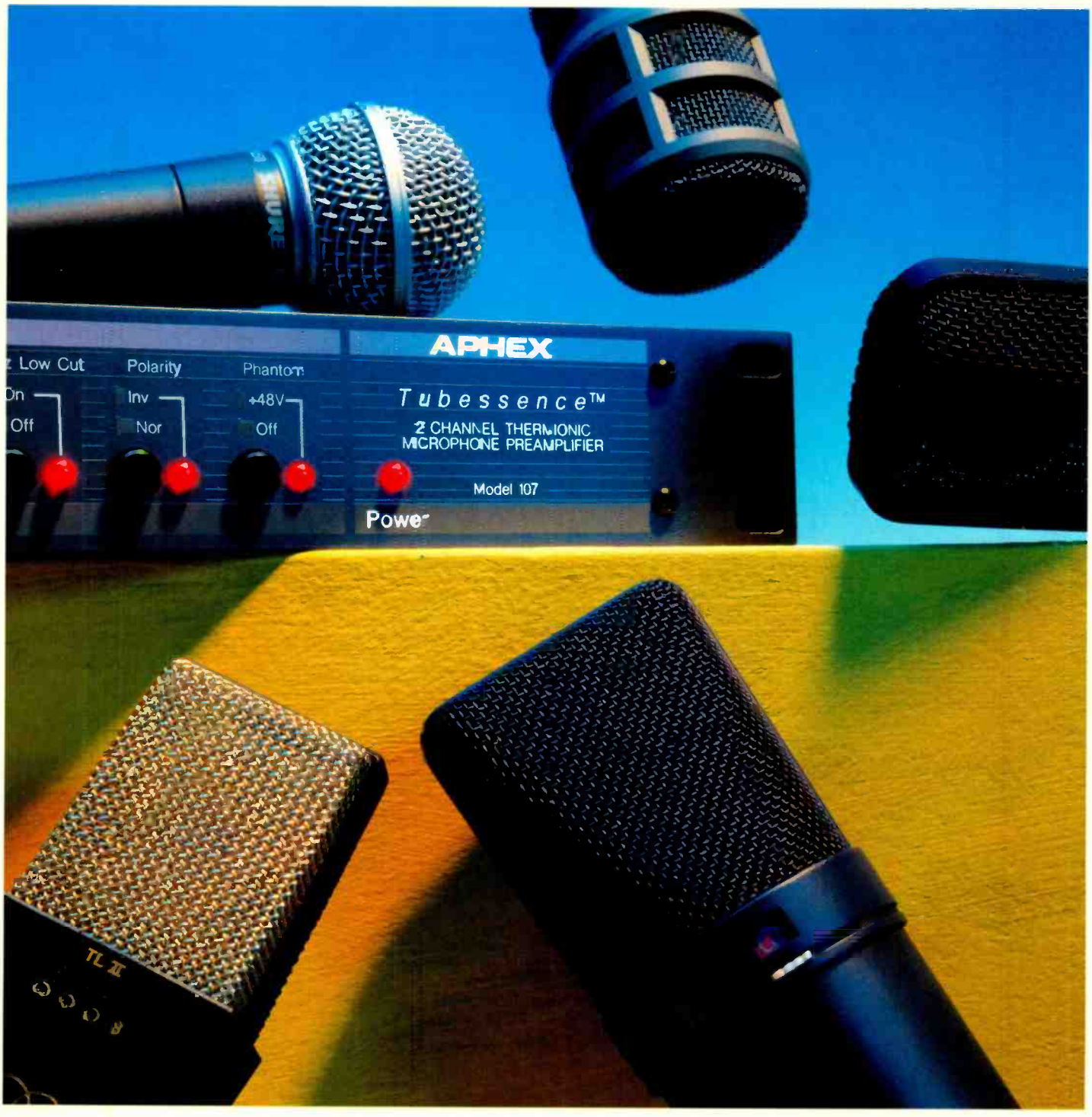

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REVIEW

TL Audio MIC PREAMP–DI BOX

The fashion for valve microphone preamps continues with a unit, which also offers DI options, from the TL Audio stable. DAVE FOISTER gets heated

THE OLD VALVE bandwagon keeps on rolling and gathering momentum. But a few manufacturers can stand and watch it thunder along safe in the knowledge that, while they may have given it an early shove, no-one can accuse them of jumping on to it. One such is Tony Larking's TL Audio, who has been doing it with valves too long and too well for any such accusations, and whose love for the valve and expertise with it give the lie to any suggestions of opportunism. Nevertheless, new valve-based models issue from TL almost weekly, leaving one wondering whether there is room for another valve microphone preamp. Evidently TL believes there is, for here is the latest dual-channel combination mic preamp and DI box, known winningly as the Mic Pre-amp-DI Box.

This combination has been tried by TL before, but I for one felt that while the preamp was very impressive, the valve character in the DI was perhaps not strong enough to warrant its inclusion. The new model takes a different tack, with the now-familiar hybrid microphone amplifier—a solid-state initial gain stage followed by a valve buffer—alongside an additional valve stage for the DI input.

Something else TL Audio could never be accused of is unwarranted flash—the products don't even make a feature of functionality the way some do. Instead they look as though TL feels the expense of a designer is unjustified and still put them together the way they used to when they worked out of a shed. That is not to say they are poorly made—indeed the standard of construction is commendably solid—but one has the feeling the knobs and switches appear where they do because that was the easiest place to fit them on the PCB rather than because of any thoughts of ergonomics. At the same time it is refreshing to see a manufacturer who is not afraid to put ugly connectors on the front panel so you can actually get at them in a hurry. Thus the microphone XLR, the instrument jack and the output XLR are all prominent on the front, interspersed with the very simple selection of controls.

Each channel's complement is a continuously variable, uncalibrated gain control, a mic-DI switch, a phantom power switch and a guitar-keyboard switch for the DI input. Channel 2 also has a phase reverse switch for stereo use. A variable intensity LED on each channel not only shows peaks but glows gently in proportion to the amount of valve compression taking place. Above all this is the familiar TL grille for ventilation and showing-off of the valves themselves.

I have enjoyed TL Audio mic preamps before, and this new one did not disappoint. Its excellent technical specs—frequency response reaching 40kHz, EIN of -127dBu—are evident from its performance, and support an open, musical sound which appears to deliver everything the microphone has to offer intact. Unless more facilities are required, such as high-pass filters or EQ, this is an ideal interface between microphone and tape machine, either for purist 2-mic stereo or for multitrack overdubs.

The DI element of the unit would be better called an instrument preamplifier, as it differs from the requirements of a conventional DI box in two or even three ways. First, it has no loop-through output for connection to a local amplifier, making local monitoring—in the studio or on stage—difficult as well as the idea of taking a DI feed alongside miking up an amp. Second, its output is at line level where a standard DI is specifically designed to connect to a console microphone input. Third, it has no ground lift switch, which I would have thought would be all the more important on a unit which needs to be plugged into the mains locally. On all these counts it does not qualify as a DI box in the normal sense, but as a preamplifier to be used within a processing rack or for musicians working in the control room it has a lot to offer.

DESPITE ITS VALVES, this is not a box to be used to get cranked-up overdriven effects. Its two valve stages do, however, make sure the required sound is delivered, manifesting itself as a rounded depth and musicality which is never compromised by noise or unwanted distortion. Its performance is in fact remarkably clean and full; I found it particularly easy, for example, to get the best out of an acoustic bass pickup to give a convincing double-bass sound.

The pairing offered by this preamp crosses the boundaries. It scores well as a dedicated high-end microphone preamp, with a simple yet very desirable signal path and resulting quality. It also works well as an instrument preamp, for which the obvious market is the busy session musician wanting a good front end for an effects rack. Whether the two applications overlap is another question, but for the studio wanting to offer that little bit of extra flexibility the unit is well worth having.

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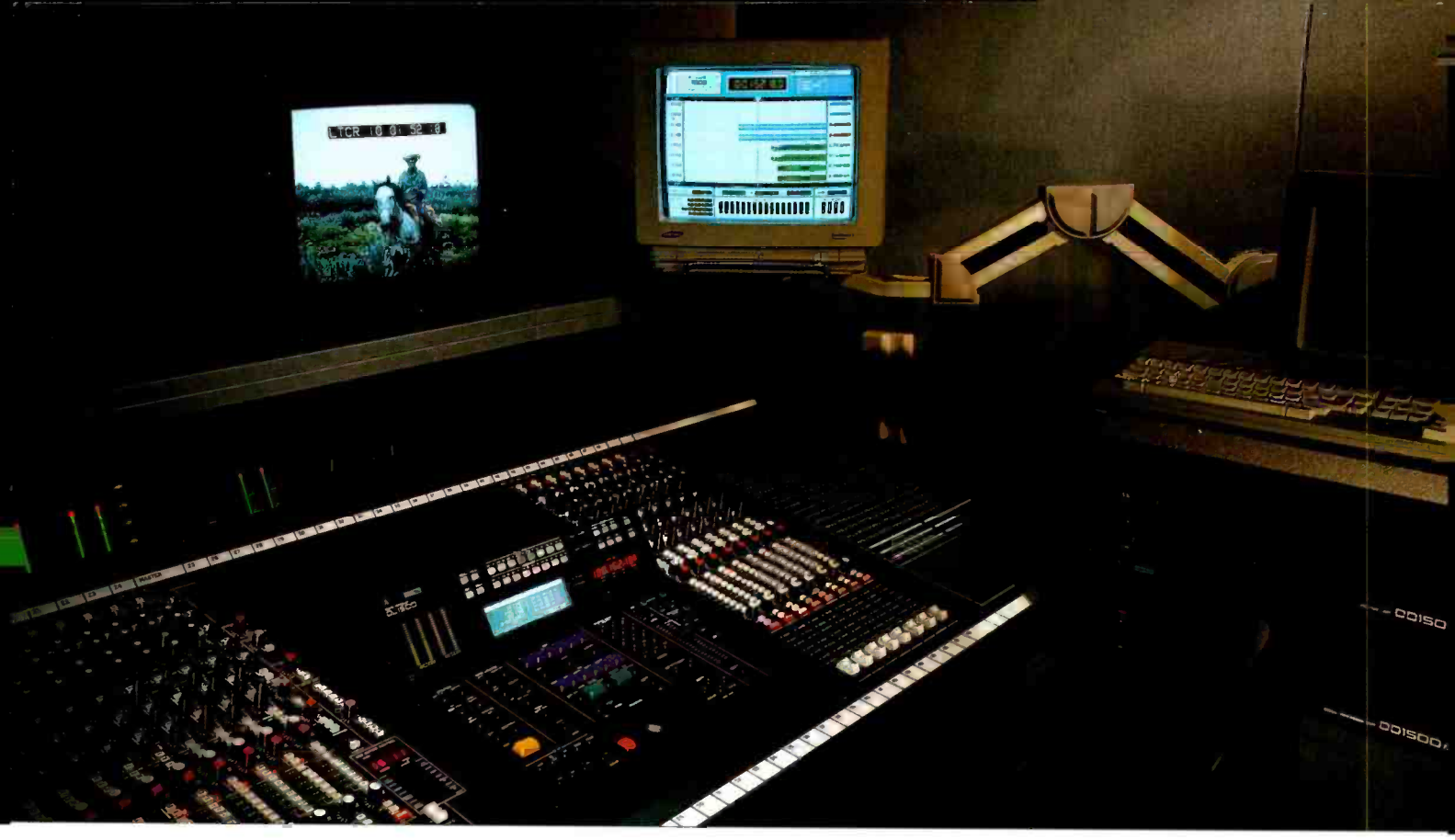

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The DD1500 comprises four integrated units; the DD1500m main audio processor, the DD1500a inputs/outputs, the DD1500x disk drive unit and the DD1500 remote controller which can be sited up to 400 metres away with Ethernet connection. Every command or action is accessed from a single screen without changing pages, and without the hassle of multiple windows or lengthy screen re-drawing, saving time and reducing key strokes considerably. The DL1500 is fitted with large, well targeted buttons making its operation very direct and straightforward with a rapidity and smoothness unique to the field, thanks to Akai designed LSI chips.

The DD1500 is as easy to use in record as a conventional tape machine, giving 8 tracks on a single magneto optical disk. The powerful editing facilities are precisely and rapidly accessed from the interface with all 16 tracks visible on screen. The highly accurate jog/shuttle wheel is used to find edit points giving the ability to change and amend. 20 levels of Undo are provided.

The system has highly sophisticated synchronization abilities with the full lineup of timecode interfaces fitted as standard, and can follow external sync forwards and backwards from 0-5 times nominal speed. Audio connections are equally flexible handling 12 inputs and 20 outputs, carefully isolated to ensure optimum sound quality, plus digital in/outs.

Akai has an ongoing programme of software upgrades, simple and convenient to fit via the DL1500's floppy disk drive and FLASH ROM. Upgrades include Auto-conforming, DSP functions (EQ, timestretch etc) and full automation for the internal 16 channel digital mixer. Future plans include full Networking capability. New, high capacity magneto optical drives are on the horizon and there is compatibility with the DD1000 and Akai's new DR8 hard disk recorder.

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Pioneer D-9601

High sampling rate DAT recorders offer one means of restoring the 'professional margin'. DAVE FOISTER reports on the first professional DAT machine to offer high sample-rate facilities

THE LIMITATIONS OF digital-audio technology can be divided into three areas, one qualitative and two quantitative. The qualitative aspect, the sound itself, will be the subject of debate for years whatever developments are made, and may or may not depend on advances in the other two areas. The qualitative elements are clearly defined—one is the available dynamic range, whose theoretical limits are set by simple mathematics: each bit of linear encoding equals 6dB of dynamic range, as it represents a doubling of the available signal voltage. The potential 96dB offered by the 16 bits used by most existing systems has had its adequacy questioned for some time, as the resulting 20 and 24-bit technologies attest. The second is the frequency response, with a growing belief that the accepted range of human hearing, stopping at 20kHz, is an over-simplification; that frequencies beyond this are important to our perception of what we hear and that failure to record such frequencies—which accepted wisdom defines as ultrasonic—will compromise the end result. Unfortunately the established sampling rates of almost all our digital equipment are unable to cope with a bandwidth much beyond 20kHz, so as far as the consumer is concerned built-in brickwall filters block out such frequencies for fear of aliasing artefacts.

The average consumer may not be too concerned with all this, but the old argument that the professional recording from which his end product results should be an order of magnitude better is a powerful one. And who is to say that, presented with a wider bandwidth in the future, said average consumer would not notice the difference?

This is the parameter that Pioneer has chosen to tackle with its high-sampling rate DAT recorders. The 9601 doubles the recorded sampling rate to a maximum of 96kHz, giving the theoretical possibility of recording 'audio' signals as high as 48kHz, on the assumption that this extended frequency response is at least as significant as the dynamic-range benefits offered by high-bit rates.

The 9601 is the first professional machine to feature Pioneer's new system, and its consumer roots show clearly in its styling and choice of facilities. Not that it clings to consumer standards as did the PCM-F1 *et al*; its inputs and outputs are pro balanced XLRs, digital I-O is AES-EBU as well as IEC and rack ears are standard. It is, however, unusual nowadays to find a pro machine in this price bracket without off-tape monitoring or any time-code facilities, although it does sport serial ports configurable as Sony 9-pin or EsBus for integration into an editing or synchronisation system. Quite how this is achieved in the absence of time code or any other kind of external sync is not clear.

Gaining the edge on the 16-bit, 44.1kHz standard: Pioneer's new 96kHz DAT

Perhaps this is not a problem, as the machine's selling point is clearly its extended high-frequency response, and I imagine it is most likely to find a home in the classical recording setup where interfacing with other systems is less important. Pioneer are staking all on whether or not the difference created by doubling the sampling rate is audible and significant, and at this point a reviewer may have to stick his neck out.

I have to say that I believe the 9601 sounds better than the standard DAT machine I used for comparison, which for the record was a Technics SV-360 famed for the quality of its convertors. I am not prepared to say that I could hear any additional HF extension, but the HF within the conventional spectrum sounded more natural, open and clearly defined. I would not stake much on being able to produce statistically valid identification on a true blind test, and it is all too easy to believe in a difference because you hope it is there; at the same time, I became sceptical as to whether the concept had much value and came away feeling that it did, even if it is only because the side-effects of the brickwall filters are taken an octave above where they would normally be.

The machine will down-convert high-sampled recordings to deliver conventional sample rates on its AES-EBU output, and when this is done (as it will have to be with currently-available consumer formats) the advantage is of course lost; at the same time, I was relieved to note that the process introduces no further degradation, and a down-converted 88.2kHz recording sounds identical to a standard 44.1kHz recording made simultaneously from the same source.

DAT as a medium has now reached such sophistication that the facilities offered by the 9601 will not sell it on their own, professional as they are. It stands or falls on its sonic advantages, and each pair of ears will have to make its own decision as to their significance. I would not take anyone else's word on such a sensitive issue, and neither, I am sure, will you take mine.

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New technologies

In this month's product preview Studio Sound goes in search of the latest launches. DAVE FOISTER reveals the best from mic preamps to control software

Crane Song's discrete class-A compressor-limiter

dbx 1650T and 1046

dbx has launched a high-end valve microphone preamp with built-in limiter amid very impressive claims for its performance. Four 6992 valves are used to achieve a claimed internal headroom of +40dBv, gain of 117dB and a dynamic range of 154dB. The valves were originally designed for Russian radar, and the line input can apparently accept the output from a 100W power amplifier without overload.

While the audio path is valve-only up to the Class A MOSFET output, control of the valves involves semiconductors and various features are built in to give long valve life and circuit protection. These include controlled power-up so that the HT is not applied until the heaters are warm, and automatic muting of each stage in the event of power anomalies.

Another new compressor from dbx is the 1046, giving four channels of compression with either dbx OverEasy or hard knee characteristics. PeakstopPlus limiting, stereo linking in pairs and hard wire bypass complete the facilities.

- *dbx Corporation, US.*
  Tel: +1 616 695 5948

ZYP monitors

A new British close-field monitor has appeared in the form of the Zyp A2S Studio loudspeaker. Boasting an impressive (but confidential) design pedigree, the A2S is intended to find favour in any small environment in which accurate audio monitoring is required. As such, it is tiny, measuring just 145mm x 225mm x 120mm, employs 26mm and 130mm metal-coned drivers and is designed for use in close proximity to a rear wall. The A2s is shielded and its specification claims 80Hz–20kHz response at 8Ω, and use with a 50W amplifier is recommended.

- *Presence Audio, UK.*
  Tel: +44 1444 461611.

Denon MiniDisc recorders

Denon has expanded its range of MiniDisc hardware with two new recorders, one portable and one full-size. The DN-1100R recorder is designed with theatre and PA use in mind but has applications in radio and sound effects work thanks to its Hot Start function. This allows up to ten different tracks to be assigned to independent Hot Start buttons for instantaneous playback, with cueing to the actual start of audio rather than the ID.

Alongside it is the DN-80R portable machine, designed for ENG applications and hence built on a specially rugged chassis with vibration-damped transport. A mono mode allows up to twice the normal capacity of a disc, 148 minutes, and the recorder can run for this long on a single, standard, video-camera battery.

- *Denon Electronics, US.*
  Tel: +1 201 575 7810.
- *Hayden Labs, UK.*
  Tel: +44 1753 888447.

Denon's DN-80R portable MiniDisc recorder has been designed specifically with ENG duties in mind

Crane Song STC-8 compressor-limiter

The STC-8 from Crane Song is an all-discrete Class A stereo compressor and peak limiter combining a high-quality audio path with a variety of special treatments. Engineered to provide musically transparent gain control without VCAs or optical elements, it can also emulate vintage equipment and create new sounds of its own, using a switchable enhancement circuit offering both analogue and valve-like warmth. To speed up access to the possibilities, several presets are provided with or without adjustable parameters, and full manual control is available using an interesting set of controls apparently replacing the conventional ratio parameter with one called 'Shape'. The separately adjustable peak limiter operates simultaneously from the same side chain, and full stereo linking is provided.

- *Crane Song, US.*
  Tel: +1 715 398 3627.

Clyde broadcast mixers

Clyde Electronics launched three new packages at SBES, two of them mixers for broadcast use. The Program Series on-air mixer is a scaled-down version of the successful Presenter Series 2, designed specifically for use in Community Radio, Educational and Hospital broadcasting as well as by RSLs and for OB applications. The Promo Series radio-production mixer is tailored for the needs of commercial production, and is intended to fill the gap between Clyde's top of the range Producer Series and lower-cost recording desks.

The Concept 30 is a complete low-cost studio package, using established equipment properly integrated and housed in quality technical furniture.

- *Clyde Electronics, UK.*
  Tel: +44 141 952 7950.

Sabine feedback control processors

Sabine's workstations have been upgraded to the ADF-1201 single channel and ADF-2402 dual-channel models. The units comprise powerful feedback control and parametric filter sets, and allow filter editing in graphic display screens. Improvements include an enhanced real-time-analysis feature, automatic filter tracking, a new 'lock fixed' filter option, pink noise and a brighter LCD screen. The filters are similar to those in the established FBX Feedback Exterminator range, but the workstations allow adjustment of all filter parameters and display those parameters in either graphic or tabular format.

- *Sabine, US.*
  Tel: +1 904 371 3829.

Synchro Arts VocALign for SADiE

The VocALign ADR software from Synchro Arts, reviewed in October's *Studio Sound*, has now been implemented in v3 of SADiE which is due for release at the end of the year. This will mean VocALign will be an option ☞

for both SADiE and Octavia workstations. The software allows automatic alignment of replacement dialogue, as well as accurately synchronised foreign-language dubbing and musical double tracking.

- *Studio Audio & Video, UK. Tel: +44 1353 648888.*
- *Synchro Arts, UK. Tel: +44 1372 811934.*

Raindirk broadcast console

In response to customer suggestions, notably from Amptec BV of Belgium and several broadcast companies, Raindirk has released a new broadcast console with flexible configuration and several user options. Alongside the chosen number of channels the system has eight subgroups, four master modules and a 12 x 8 matrix, and an 8-bus VCA fader system which can be bypassed on individual channels to maximise signal quality. Comprehensive EQ includes two full parametrics and swept HF and LF, and the channels also have six auxes and

Raindirk's broadcast console: a response to user feedback

IN BRIEF

Klotz VADIS

The VADIS (Variable Audio Distribution and Interface System) digital transmission system has been augmented with a new series of DSP boards. New modules now provide four channels of 4-band parametric EQ; 8/7, 16/15 and 23/24 n-1 matrixing; and 16, 32 48 or 64 channels of delay.

- *Klotz, Germany. Tel: +49 89 462338.*

Yamaha RM800

Yamaha has a new 8-bus recording console design for the semi-pro and project studio market. The RM800 is available in 16 and 24 channel versions and both incorporate in-line monitoring and stereo aux returns to bring the total number of mixdown inputs to 40 and 56 respectively. Channel facilities include switched 3-band EQ with swept mid and six aux sends with flexible configurations, and eight of the channels have phantom powered XLR microphone inputs and direct outputs to simplify 16-track recording.

- *Yamaha-Kemble Music, UK. Tel: +44 1908 366700.*

Wohler AES-EBU source selectors

A new range of digital audio source selectors from Wohler Technologies allows various configurations of AES-EBU signal routing for broadcast and industrial installations. Three models offer a choice of 8x1 selection (ARS-D81), 8x2 matrix with two discrete outputs (ARS-D82) and 16 in-1out routing (ARS-D161). Each occupies a single rack space and can be used with optional 10-segment digital level meters. CMOS membrane switches are used for source selection and the units can also be remotely controlled.

- *Wohler Technologies, US. Tel: +1 415 589 5676.*

APT remote machine control

APT's new RMC 240 remote machine controller uses the auxiliary data facility on all APT codecs to enable a wide range of DAT and ADAT machines to be remotely controlled over digital networks such as ISDN and Switched 56. It will control all standard tape transport functions and can operate in both transmission and reception modes.

- *Audio Processing Technology, UK. Tel: +44 1232 371110.*

Bag End Elf Infra-Sub

Bag End Loudspeaker Systems has added a sub-woofer to its range, which for the first time in a Bag End design is self-powered. It incorporates the same Elf dual 8-Hz integrator found in the Elf-1 system, along with a 400-Watt power amplifier and a new 18-inch drive unit. The claimed frequency response is 100Hz down to 8Hz from a 3-cubic-foot enclosure, and it will accept signal configurations up to full LCR, providing three line-level high-pass outputs.

- *Bag End, US. Tel: +1 708 529 6231.*

beyerdynamic headsets

New products from beyerdynamic include a complete range of headsets based on the DT108-109. This comprises the DT200 which comes with or without a choice of mic capsules and the lighter DT391-DT392. More condenser mics arrived including the form of the small end-fire MCE83 and the MPC65V boundary mic.

- *beyerdynamic, Germany. Tel: +49 7131 6170.*
- *beyerdynamic. UK. Tel: +44 1273 479411.*
- *beyerdynamic, US. Tel: +1 516 293 3200.*

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IN BRIEF

E-mu Darwin Disk Recorder

E-mu's new 8-track digital audio recorder, Darwin, features tape-style operation with jog-shuttle wheel, 44.1kHz and 48kHz sampling rates, MMC and MTC, SPDIF I-O, 40 locate points, 10-segment LED metering and an optional ADAT I-O card.

The unit is priced to compete with current tape-based, modular digital systems.

◆ *E-mu Systems, US. Tel: +1 408 438 1921.*

HHB Portadat upgrade

HHB's Portadat range now has an upgrade option providing a selection of headphone monitoring modes to deal with the varying demands of location formats. The unit replaces the clock backup battery access panel, and a rotary switch provides a choice between stereo, mono left or mid, mono right or side, mono sum and MS monitoring modes. It can be installed in existing machines by any authorised distributors and agents.

◆ *HHB Communications, UK. Tel: +44 181 962 5000.*

TL Audio Micro Series

TL Audio has broadened its range of valve-based processing still further with the launch of five 1U-high units to be known as the Micro Series. The new all-valve range comprises the MPA2 4-channel pre-amp, the MEQ1 2-channel 4-band equaliser, the MEQ2 parametric 2-band equaliser, switchable 4-band mono, the MC1 2-channe compressor, and the MO1 2-channel triode overdrive. Matching in styling but using solid-state circuitry is the MPA1 2-channe 100-Watt amplifier.

◆ *Tony Larking Professional Sales, UK. Tel: +44 1462 490600.*

KRK's active K-Rok range features integral Bryston custom amplification

two further stereo cue feeds.

◆ *Raindirk Audio, UK. Tel: +44 1366 382165.*

3G GA42 crossover

3G has replaced the GA4 electronic crossover with the GA42, configurable as two way stereo, three way stereo or four way mono. The unit's crossover frequencies are set by means of the GA card system as used on the GA4 (the cards are compatible with both) which are fitted behind a screw-on front panel to deter tamperers. Several sets of standard frequency points are available on the cards, which use Linkwitz-Reily 24dB per octave slopes. Each band has an individual level control and its own mute switch.

◆ *3G, UK. Tel: +44 1702 420647.*

Harbeth HL-P3ES

Harbeth Acoustics' successful HL-P3 loudspeaker has been uprated as the HL-P3ES and is being offered as suitable for monitoring. A deeper cabinet houses exclusive new drivers, a 110mm bass unit and a 19mm dome tweeter, and the crossover has been redesigned accordingly, now featuring a PC edge connector for rapid testing of the network. Pairs are matched to within 0.75dB, and antimagnet and shielding features are standard to allow A-V use.

◆ *Harbeth Acoustics, UK. Tel: +44 1444 440955.*

XTA control software

Accompanying the AES launch of XTA's DP200 digital equaliser is a Windows control software package designed to provide familiar and intuitive control across XTA's expanding range of Audiocore DSP products. These began with the DP100 delay processor, for which the software was initially developed, and future Audiocore products will also be supported by the new system.

◆ *XTA, UK. Tel:+44 1299 879977.*

KRK powered monitors

KRK's close-field monitors are now available in optional powered versions. The K-Rok, 6000, 7000B and 9000B models all feature Bryston-designed custom amplifiers delivering 200 Watts at four Ohms with distortion at less than 0.007% at 120 Watts. Also new is the RoK-Bottom powered subwoofer, with a 250-Watt amplifier (again by Bryston) driving a 12-inch polyglass long-stroke woofer to produce a maximum SPL of 110dB.

◆ *KRK Systems, US. Tel: +1 516 249 1399.*

◆ *Tony Larking Professional Sales, UK. Tel: +44 1462 480009.*

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Divide and conquer

With the recent split of AT&T comes the reminder that smaller businesses are often more capable than large ones. **MARTIN POLON**'s case study has particular resonance for the pro-audio world

ON 20TH SEPTEMBER 1995, AT&T, formerly known to nearly everyone as American Telephone and Telegraph, sent a shock wave throughout the financial and technology sectors in America (and elsewhere) by announcing that it was splitting into three separate operating units.

The first of these will focus on the 'core' provision of telecommunications service and technology, will continue to use the AT&T identity. This unit will maintain a research posture of some 4,000 employees to be known as the AT&T Labs. It will include the current communications services group, the wireless (cellular) communications unit and other service areas related to communications and financial solutions. This surviving business will have estimated billings in excess of $50bn in 1996.

The second unit will focus all of the AT&T consumer telephone and telecommunications manufacturing capability plus the activities of the Network Systems group, in addition to the microelectronic and other digital chip-making facilities. It will also include the largest part of the world famous Bell Labs research organisation (currently with 22,000 employees). This unit will be the one most familiar to the world audio community, what with its AT&T Digital Mixer Core and the licensing of numerous Bell Labs audio patents to major and minor companies in the audio firmament.

A third unit will focus exclusively on computer information systems (CIS) hardware and software. Viewed by some analysts as the 'weak sister' of the split, the CIS unit will have to compete with the likes of IBM. To some extent, the previously acquired NCR computers unit will be expected to perform at a more significant pace than it had under AT&T, but the unit could be successful in providing computer-technology solutions adapted for telecommunications connection.

The last two units have yet to be named although they may be able to license the AT&T name in some way. The entire dismemberment should take about a year to reach its conclusion.

WHAT HAS all of this to do with the recording studio or the audio industry in the US and elsewhere? AT&T is virtually invisible in the audio industry today—until you start looking for who is actually providing the T carrier or ISDN lines that link many of today's recording studios or you happen to notice an AT&T Digital Mixing Core in use in a recording studio. Yet no company has contributed more to the development of audio on both sides of the Atlantic then AT&T, who with its subsidiary Western Electric manufacturing arm and the Bell Labs research centre was also one of the largest suppliers of audio equipment in the world until well after World War II.

Consider the company's various contributions:

The invention and-or refinement of most of the ergonomically correct devices and techniques that we use in audio today. These include the patchbays, patch cords, phone plugs, faders, audio amplifiers, mixing consoles, broadcast remote units, transmitters and so on that dominated the broadcast and studio industry. The name Western Electric on audio and ancillary equipment, despite the virtual monopoly that AT&T had, was considered to be the equivalent of the 'sterling' mark on silver. After the 1948 US Government consent decree that ended AT&T's direct involvement in the audio industry by the mid-1950s, the existing audio equipment was much sought after into the 1970s. Even today, collectors still prize anything audio with the Western Electric logo and will man tables at conventions and trade shows such as the AES to solicit the equipment.

Western Electric was instrumental (along with RCA) in developing motion picture film optical sound, with the Bell-Lab-developed process of variable density optical recording. Done first with large phonograph records (Jolson: *The Jazz Singer*), then with variable density recording valves directly onto the 35mm film. Along with RCA, AT&T and Western Electric dominated the motion-picture industry, and not just in sound technology. AT&T's financial strength and bank connections had it holding a sizable share of the major motion picture studios, as well as financing and supplying nearly everything technical in the suburban and downtown theatres owned by the studios. The cost of equipping every production facility and motion picture theatre owned or controlled by the studios was so large that the studios had no choice but to turn to the developers of film sound for financing.

Western Electric devised the modern horn theatre-speaker system. The first stereophonic concert 'by wire' in the US on 27th April 1933, was done by a team from Bell Telephone Laboratories with Leopold Stokowsky working at the mixing console while his assistant led the three-channel 'miked' Philadelphia Orchestra in the Philadelphia Academy of Music. Three-channel stereophonic theatre-speaker systems played some 144 miles away at Constitution Hall in Washington, DC, linked via AT&T toll repeater offices in Philadelphia, in Delaware and Maryland and into the District of Columbia. These progenitors of the Voice-Of-The-Theatre speaker systems (later found in most motion-picture theatres in America), were placed behind a curtain to recreate the performance for those in Washington. The electronics including the repeaters placed every 25 miles in the wire circuits, delivered 60dB signal-to-noise ratio with a 40Hz–15kHz frequency response to the audience—and this was in 1933. Subsequently, Western Electric sound-reinforcement installations spread around the country including the Los Angeles Union Passenger Station with batteries of 18-inch electrodynamic woofers.

The Bell Telephone Laboratories also routinely recorded Stokowsky and his Philadelphia Orchestra onto test monophonic and stereophonic discs in the late-1920s and early-1930s. These demonstration recordings were made using the well defined and AT&T-patented predecessor of the 45-45 stereo LP-cutting system on 33 1/3 rpm vinyl records. AT&T helped to develop vinyl records using a ☞

plastic material developed, initially, by Union Carbide for moulding telephone handsets. Curiously, AT&T had developed the stereophonic recording option to a point where other partners were solicited from the record label community. Unfortunately, the Great Depression was felt to be too great a handicap to overcome for the introduction of a new music reproduction technology. By the time the US economy had returned to something resembling normality, AT&T along with Western Electric and the Bell Laboratories were deeply involved in government manufacturing for World War II.

Western Electric microphones were used by virtually every broadcaster, recording studio and film company. Along with the classics from RCA, WECO (Western Electric Company) microphones dominated every phase of the audio business. US President Franklin Delano Roosevelt and British leader Winston Churchill were frequently photographed behind Western Electric 639B cardioid mics and the famous 'Eight-Ball' microphones. So were band leaders Kaye Kaiser and Glenn Miller as well as 'thrushes' the Andrews Sisters and Dina Shore!

A company that has pioneered the development of audio technology throughout its history... is not going to ignore the field now that its corporate and collective hands are untied from governmental regulation

Western Electric studio mics for film production were so well made and designed that they continued into use at the US film studios well into the 1970s.

Western Electric transformers and line-treatment coils provided 50Hz–15kHz wire links between studios and transmitters all over the country from the 1950s to date, enabling the growth of FM broadcasting and hi-fi TV sound in the US.

Western Electric successor companies included: Altec Lansing Corporation, Langevin Audio Products, Cinema Engineering, ERPI (Electrical Research Products Incorporated) and Westrex Corporation. These companies were the direct and linear descendent of Western Electric motion-picture sound engineering, sound reinforcement, recording studio and other audio products. Altec Lansing continued to manufacture Western Electric-developed audio products well into the 1970s. Other audio innovations landed here as well, such as the stereophonic LP record (initially spawned at the Bell Telephone Laboratories), which evolved via the nominally film-sound-orientated Westrex Corporation. AT&T-Bell Telephone Laboratories patents influenced audio-equipment design and manufacture from the 1930s to date, in terms of both basic historical audio engineering and current technology and have been licensed all over the world to thousands of users. It is not an idle curiosity that the Audio Engineering Society anthology on Stereophonic Techniques, has no less than seven papers from the the Bell Laboratories—most delivered at a time when AT&T was enjoined from active participation in the US audio industry.

AT&T telephone engineering standards and equipment first made true stereophonic television possible in the United States during the 1980s by providing 'hi-fi' channels for stereo audio that 'piggybacked' onto television video carriers.

In addition, the AT&T-Bell Laboratory research 'goliath' provided us either directly or as part of a team with other companies, specific innovations that have impacted the audio industry worldwide. These include the 78rpm phonograph record, the LP phonograph record, the transistor and semiconductor electronics, the stereophonic LP record, T carrier and ISDN links, the cellular telephone industry and many others. Even today, AT&T patents are licensed by those in audio interested in low bit-rate coding and other significant technologies. AT&T Digital Core mixers are in use in recording studios. The list goes on...

YOU COULD ARGUE that, as far as AT&T and the audio industry is concerned, that it's all over. But the relevance of AT&T now lies in its implications for the future. The significance of the move to split the company into functional groupings can be seen from the following issues:

A company that has pioneered the development of audio technology throughout its history, even to the point of obsession with stereophonic developments at at time when it had no useful way to profit from its research, is not going to ignore the field now that its corporate and collective hands are untied from governmental regulation. As multimedia takes hold, the likelihood of AT&T offering a variety of audio and video-based services and-or hardware to the home-studio user and for the audio industry increases considerably. For the the home consumer, utilising a nationwide network of fibre-optic lines and banks of computer and RAID servers, it will be possible to download and run feature films or video games. Games will be 'on demand' and films will be accessible from their start every five or ten minutes. The home telephone will act as the order terminal with the customer dialling the order and punching in the film or game desired from a 3-digit code and then hanging up.

AT&T is developing a business network to compete with the Internet. Mindful of such hackers and cyber-vandals, this is expected to succeed with businesses who want the sense of security—along with the technical sophistication and fibre-optic networks such a service can offer. For those recording studios who frequently interconnect with other facilities, a T carrier or ISDN link would be the ultimate way to guarantee success, without the fear of sabotage

IF AT&T DOES add audio and video services to the business 'mix', studios will have permanent fibre lines and will be able to dial up a recording link. It is not unlikely that AT&T will develop permanent audio and video digital terminals at much used facilities such as auditoriums, night clubs and concert halls. These facilities could be connected to any personal or project as well as mainstream recording studio with a phone call. A recordist equipped with microphones and an interface could connect for two, four or 8-channel digital transmission back to the studio with recording directly onto the studio's digital workstation. That would potentially empower a whole range of small studios and smaller record labels.

There is no doubt from papers recently delivered, to comments made by AT&T-Bell Labs staff that at some point AT&T could see itself distributing recorded music on demand from an elaborate server matrix via fibre-optic lines to the home. Charging only about 50 cents per album selected (for example), the ease of access and low price will eliminate pirating of recordings since the musical compilation can be downloaded for far less than the blank media needed to store it. The record labels would receive 90% of the fee, but the telecommunications server provider would thrive on the sheer volume of recordings downloaded into the home-audio environment.

The concept of dial-up fibre-optic links will also allow bands to audition a recording session just recorded in the comfort of their own homes via playback from the studio multitrack machine, including remote control. Similarly, artists could give a concert in one venue and 'phone it in' at a second facility to deal with last minute audience overflow.

Another area where major changes could provide new versatility to the audio services studio is that of wireless linkages. The small classical concert in a church could be covered by a 'commuter' recordist who uses two mics, an interface, a laptop computer and a fast wireless modem. That really would be an example of phoning the concert in.

IF THIS ANALYSIS looks like an paean to AT&T's involvement with audio, the arrow has hit near its mark. AT&T never bothered to sever its connection to so-called basic research nor did it lose the obvious focus of telecommunications that delivered and continues to deliver—audio. Even computer data is sent as audio between the send and receive modem. Too many companies in today's economy choose to sever the connection to product quality, research and development. For them, 'good enough' has replaced 'the best there is'. This is not the AT&T way.

AT&T has chosen to split itself up to reinvent itself to meet the technological demands of the next century—which includes heavy usage of audio and video services. What a remarkable contrast to the top-heavy empire building of such as Disney-ABC Television, CBS-Westinghouse and Turner Broadcasting-Time Warner mergers. Perhaps, AT&T knows something these other entities have missed? I sincerely hope so.

Dali-2T

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The men at Magnolia: Left to right Ed Carr Rerecording Mixer; Bruce Nazarian President and Dennis Patterson Lead Rerecording Mixer before the AMS Neve Logic 2 in the new studio

Magnolia Logic

Trading analogue for digital working creates specific concerns for postproduction facilities. **ALLAN VARELA** visits Burbank's Magnolia Studio for an in-depth view of the virtual future

THE GREATEST PLEASURE for the team at an audio postproduction facility is designing and installing a new studio room. Accordingly, the folks behind Magnolia Studios–located in Burbank, California–are thrilled with the facility's new THX digital dubbing stage. While excitement levels are high at Magnolia about the facility's digital direction, making it a reality involved more research, addressed issues beyond the studio doors and required more future vision than building a comparable analogue room.

In the past, an analogue room was essentially a simple exercise of buying a multitrack tape machine, some film dubbers, outboard gear and a console equivalent to pocketbook limitations. With digital technology, each new 'virtual' stage is, in effect, pioneering the future for all the stages to follow. Issues of compatibility between different Digital Audio Workstations and DAW compatibility with the digital console enter into the decision-making process. Also, facilities find themselves with a vision of what the 'virtual studio of the future' might be, then invest in current technology with the hope that the vision can be eventually realised. Building a new digital stage is very exhilarating, but the same excitement factor also carries an element of risk.

Bruce Nazarian, President of Gnome Productions, Plus Three Post Inc (an editorial company) and Magnolia Studios, describes the new room.

'Stage A is a new fully THX approved, digital dubbing stage. The room has an AMS Neve Logic 2 digital console with an onboard 16-track AudioFile system configured as a 2-man film-style console specifically for TV and feature-film dubbing. The monitor system is THX specified and uses a LCR and subwoofer configuration based on JBL components for the front wall. The split surrounds in the room are also JBL. The room right now is capable of doing everything up to and including 6-track discreet digital mixes.'

Magnolia is a fairly new facility additionally providing services for ADR in Stage B, Foley in Stage C and TV mixing in Stage D offering stereo and surround capabilities. Magnolia uses Crest, Hafler and Perraux amplifiers with JBL and Urei speakers. Otari MTR-90s with Dolby SR meet the analogue multitrack needs with Panasonic DATs and Tascam DA-88 for layback. Magnatek covers film dubbers. Stage B uses a Harrison board; Stage C a DDA console; and Stage D a Soundworkshop series 34c. Lynx systems provide machine control and a special mic preamp from Precision Analog Systems, the MPA-100, used in conjunction with a Neumann KRM81, handles Foley.

'We have been into feature film dubbing for the last several years,' Nazarian relates. 'Since 1994 we have been a full service company, however we have been hamstrung by not having our own feature mixing facility, so we have been hiring out other facilities and mixing there. This represents a full circle closure for us having all the facilities we need to completely package a show under one roof. Dennis Patterson, our Vice President, has come on as the mixing end of our facility.'

Magnolia is currently handling a season of Disney family movies for Walt Disney Television as well as working on two medium-budget independent pictures called *Livers Ain't Cheap* and *The Ice Cream Dimension*. Television animation is one of the mainstay businesses for Magnolia, garnering a Golden Reel Award for its work on *Sonic The Hedgehog*.

WITH AUDIO POST expanding, turnaround times shrinking and the pressure for multiple missions for a room,

the choice of a digital console is critical.

'We can appreciate the fluid architecture of a digital board because it allows us the flexibility of creating different desks for different specific purposes,' says Nazarian. 'A feature-film console setup is different to that of a TV-movie console setup. The Logic 2 allows us to change setups on a day-to-day basis without going through the nightmare which has been the traditional experience with analogue consoles.

'It allows us to be responsive to the hard-and-fast realities of what goes on in our business—the best laid plans always wind up changing. You need to be more responsive to that need more than ever.

'When one is entering into a venture where a room can't generate money unless it is running, the less downtime you have for setup, the more efficient the venture becomes.'

The choices of large-frame digital console are presently many. Magnolia chose the Logic 2 for several reasons.

'There is an interesting range of digital product that is available out there, all of which would like to provide the solution for what our job happens to be,' he says. 'Knowing that we are basically a digitally aware company in terms of where our editorial end comes from, the Logic 2 and its automation system became our system of choice. It is incredibly dynamic because everything on the surface of the desk is automatable. Every move that is made from a creative standpoint will be remembered and replayed.'

Allocation of console resources is another issue as, 'the Logic 2 is virtually a sonic playpen full of digital signal processing,' Nazarian continues. 'You point the DSP in the direction that you need it to go to configure resources in a useful manner. We can load up a tremendous amount of signal processing on the channels that need it and configure a lesser amount of signal processing on channels that don't. We are not, therefore, paying for redundant processing found on a typical rigid-architecture desk where many times it is not used.

'The desk acts like a traditional console by having a knob-per-function relationship. Even though you are flying a hardware surface that is talking to a tremendous amount of DSP that is actually doing the job, you can relate to this board like an analogue desk. You can relate to EQ knobs and aux sends and faders up and down without having to learn a new interface structure. You don't need to hit a status button and go to a computer screen to tweak an EQ, when what you really want to do is reach up to the high frequency knob and add 2dB at 10k. We can address this digital desk with a very analogue intuitive style.'

Perhaps the most important thing about the Logic 2 choice is the future—the digital console must also fit into DAW plans and address file interchange as well as process audio.

'The ideal is the straight wire concept where you sit down at a box, generate a great composition sonically, musically or sound-effects-wise and transport that composition in the digital domain to a playback source that is tied directly to the mixing console. That is our desired goal,' states Nazarian emphatically. 'That is where we are heading with our editorial endeavours, that is where Disney is going with its editorial endeavours and that is where everybody wants to go because it is the correct way of applying creative energies without duplicating or triplicating efforts just in transferring from one stupid format to another. Everybody acknowledges that getting laybacks out of the loop is the biggest single enhancement that we can possibly make.'

Because of the work style developed with Gnome Productions and Plus 3 Post, using interchangeable hard drives became the way of working for Nazarian. Using this method with large on-line libraries enabled Nazarian to mitigate 60%–70% of his previous layback load.

'It is a great way to work and it is exactly the way it should work.' says Nazarian. 'How long it will take everybody else to achieve this level is the question that is on the mind of every sound editorial company. We are hoping that manufacturers are seeing the light so standardisation of digital-audio file formats are the way of the future and that duelling workstations will be a thing of the past.'

Part of the problem with losing the duelling aspect of Digital Audio Workstations is the very different way that manufacturers approach audio file code and accomplishing tasks (see below): one system works in real time while another must rewrite the file; one system has 4-band EQ and another has only two. Other problems occur simply because of different processing chips: Motorola needs to see information differently than Intel or Transputer or Analog Devices.

'I believe that whatever standardisation is going to occur is going to happen because ☞

MAKING THE FUTURE FIT

IN THE BEGINNING there was tape, only tape and nothing else but tape and the machines wrought for tape were compatible. This was the way things were done and audio postproduction studios religiously expected it to be so. Then came the Digital Audio Workstation (or DAW) and clouds began to cover the audio garden. The temptation of the DAW was that it offered a completely new work paradigm. There was no rewind time, one could see a waveform on a screen, and cut and paste nondestructive editing became a reality.

While the world of tape was very stable: tape was in heaven and machines got better but not different, the world of the DAW offered a new concept called evolution. Computers started with software revision 1 and, with a bit of patience and corporate luck, subsequent revisions would maybe do what you needed them to do. DAWs improved, but every one was different and, therefore, incompatible: trouble in the garden. Now that we have lived through the development stage of audio computer technology, the screaming demand from the market place is for compatibility but conforming to compatibility isn't an easy job.

AMS Neve, a company that itself evolved from two into one, pioneered DAW technology with the AudioFile system. The AudioFile resides in their Logic 2 digital console and recent sales of film versions of the console to Disney and Magnolia in Hollywood and Howard Schwartz Recording and Sync Sound in New York has heightened the need for cross-platform read and write compatibility.

Doug Ford, Product Support Manager for AMS Neve, is in the thick of the compatibility issue that revolves around Open Media Framework (OMF) and Avid's Sound Designer II file format.

'Right now we have users around the world that, as a daily task, are reading and replaying OMF material on their AMS Neve AudioFile systems. Once a disk drive is mounted in the AudioFile from an Avid Media Composer, we are playing that audio directly from that Media Composer drive and performing an internal file conversion during the replay process.'

If the Logic 2-AudioFile was the last link in the chain, file import would be enough. However, in the film environment where you have temp dubs and an endless stream of approvals going on, it is necessary to export back to the editing department. This isn't quite so easy because the way an AudioFile performs tasks like a crossfade is very different than the same function on a Pro Tools III system.

'Crossfading creates a problem because some of the Mac-based systems have to render (rerecord) crossfades in order to reproduce them,' says Ford. 'The AudioFile looks at a crossfade very differently. One of the tricks we use with the OMF data is we have effectively unrendered the crossfade and returned it to what the AudioFile would understand which is two pieces of data playing off the disk and being crossfaded in real time. That gives us the flexibility to unpick any edit that has been previously done. In terms of export, one of the neat things is that Digidesign supports the restoring of a project that doesn't have those rendered pieces currently available. The session file actually allows the system to background recreate all those crossfades.'

With the OMF specification now supporting SD2, a dub stage Pro Tools system can plug directly into a Logic console and the two systems can cross feed each other. The onboard AudioFile becomes a high end film dubber. The console automation can also remember event settings like EQ or dynamics processing, so if the event is moved or repeated (such as a dialogue treatment that repeats several times in the course of the film) the Logic 2 can carry the event information to the new locations. This is how AMS Neve is fitting a pioneering past into a compatible future.

of market driven forces,' states Nazarian. 'Manufacturers almost need to get an incentive to be playing with the other kids on the block. With all the new dub stages that are coming on line, I think it is a good move to use the leverage of these studios to force standardisation and stabilisation of data formats. The manufacturers seem either reluctant or too slow to do this on their own.

'We are all eventually going to benefit from the fact that there will be some form of universally transportable standard for digital audio. The sooner it comes, the better for everybody. I support the use of the Sound Designer II standard or the OMF standard since they are the only ones even attempting to gain a standardised recognised audience. We can relatively easily communicate in those forms without putting a lot of transfer overhead onto the burden of the editorial companies like me.'

LOGIC 2 SUPPORTS reading and playing OMF files, with AMS Neve pledging write capabilities for OMF and Sound Designer II (SDII is now incorporated in the OMF format). There have been some complaints that SDII is inferior because it is slower than the fastest file formats. One message, however, is clear: people would rather have a little bit less speedy file format that interchanges than the ultimate that lives in a vacuum. The Logic 2 resides at Magnolia in part because of AMS Neve's interchange efforts thereby accommodating the future.

'We can see, as the developments continue, that we will be able to develop our editorial content from a variety of different platforms that are in tune with their particular jobs,' Nazarian says. 'It is great to be able to work on all the different systems and at the end of the day have all of the data come to the stage in a readily playable, standardised form. This is where we are going and where we will be shortly.

'The mandate is pretty clear. Incompatibility problems are going to force products out of the picture because of economic issues. People won't buy boxes that won't communicate with other boxes. Regardless of what editorial system we particularly choose, we still all must interact with the entire industry. In much the same way the 24-track became the standard way of getting audio from one studio to another studio, we are seeing that shake-out begin in digital data formats. We should be able to be creative with our work without having to deal with this nightmare boondoggle of data transfers in the midnight hour.'

Another standard that is gaining acceptance is THX (a division of Lucasfilm). THX is trying to set a quality standard where the artistic intent of a director seamlessly translates from the dubbing stage to the local theatre and to the home theatre. A select group of major directors will only work in a THX approved room. THX is a commercial as well as an artistic move for a dubbing stage.

'We are part of a mainstream industry that is trying to standardise its reproduction of sound,' Nazarian explains. 'We believe that THX is an excellent place to begin from. It gives our client base a good comfortability factor knowing that we are at least achieving a minimum standard of excellence. Of course we will achieve levels above and beyond THX (in terms of further sonic accuracy and room isolation), but it is important that the clients understand we can get for them excellent standards of audio playback. We believe that having the cachet of the THX trademark indicates to our clients that this is achievable for this stage rather than being a question mark. The bottom line is that there are a discernible group of clients out there where working in a THX room is of interest and a significant factor in making a studio choice. THX is a known commodity and in a buyers market that is very secure for producers to know.'

The final area of consideration for a dubbing stage is the audio format present on any particular film. As the 'D' in 'Digital' format also stands for 'Different' format, it comes as no surprise that there are currently three major digital release formats: Dolby Digital, DTS and Sony's SDDS. Add this to the different optical formats and you have a potential mixing mess.

'We have tried every variety of layback you could possibly conceive of,' claims Nazarian. 'We have print mastered to 6-track mag with Dolby SR and had a traditional soundtrack struck from that. We have done some of the shows to multitrack tape and made an LCRS optical encoded (Dolby or UltraStereo) shot directly from multitrack tape. We have, in the case of the film *Gettysburg*, done DTS mastering on a Sony 3348 and converted to the DTS digital masters. We did a theme-park ride for the Legend River Project currently running in The Hall Of The Americas. We did a DTS 5.1 master to that on a DA-88. It is still a matter of which format the show is, whether it is film or television, what the producers want and what eventual release medium they are going to. This dictates the constraints put on our mixing choices.

'I think it would be very beneficial for the audiences and for those of us in the sound industry if we continued the trend toward the 6-track kind of mixing and that kind of separation of elements rather than the LCRS matrixing. Matrixing is inherently difficult to deal with and tough to achieve consistent results on.'

Magnolia's digital dubbing stage is just the tip of the iceberg for the Hollywood community as many new stages will open in the next year. This is an extremely exciting time for audio, but with all the problems and issues surrounding everything digital, it kind of makes you yearn for the good old days of analogue and mono—not!

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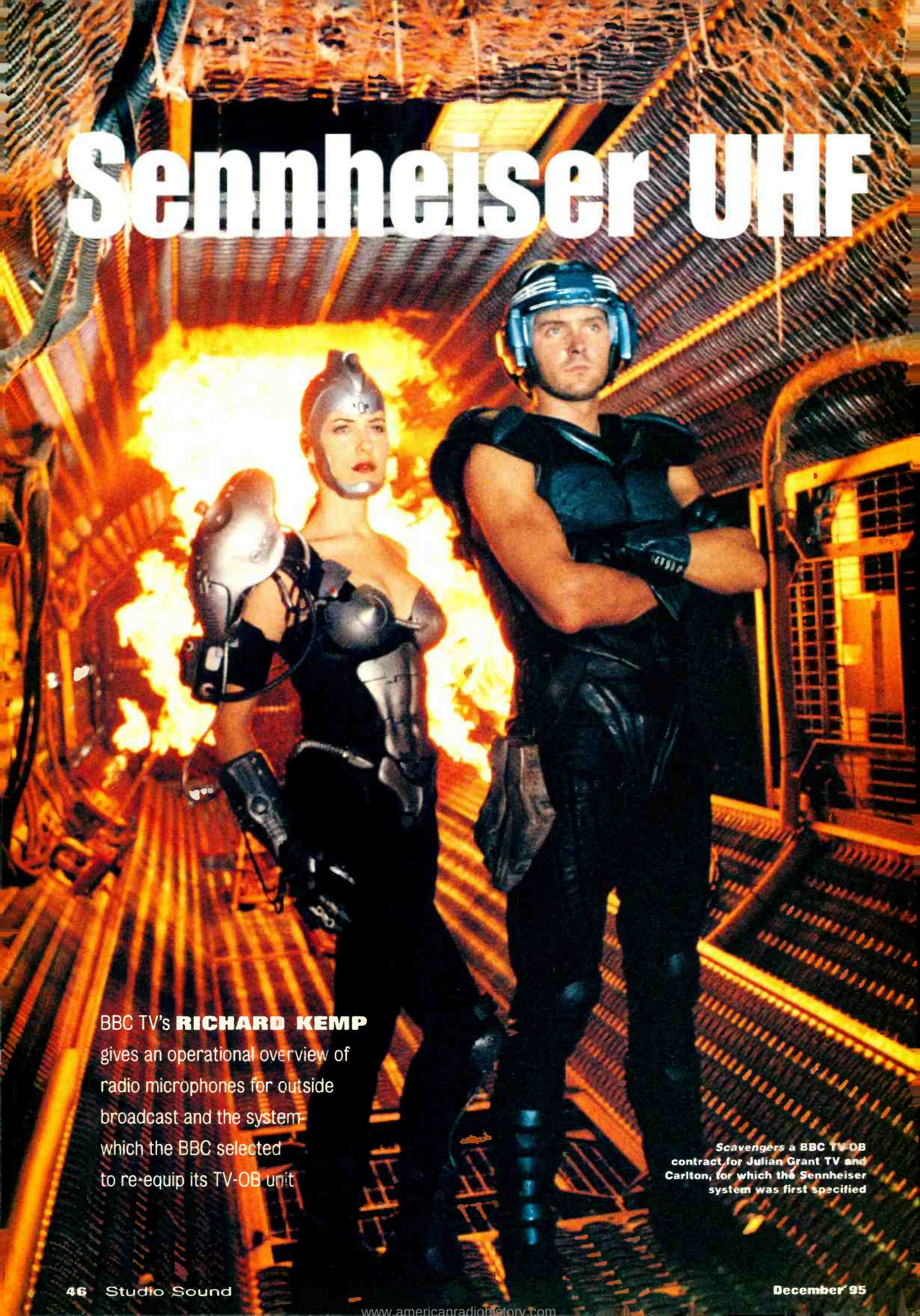


BBC TV's **RICHARD KEMP** gives an operational overview of radio microphones for outside broadcast and the system which the BBC selected to re-equip its TV-OB unit

Scavengers a BBC TV-OB contract for Julian Grant TV and Carlton, for which the Sennheiser system was first specified

Radio Systems

FOR 20 YEARS or so now, I have been closely involved with the operation of radio microphones. My experience has left me sceptical of claims to the effect that 'our new system will offer everything you want and be interference free'. But when Sennheiser made a claim along such lines, some three years ago, I took the opportunity to put its prototypes to the test on a variety of complex and prestigious BBC TV-OB productions. They did indeed show considerable promise and certainly outperformed the systems we had learned to love. And to hate.

When the programme *Scavengers* came along with its demanding sound production and completely metal set, only two new systems were available to us to evaluate. Of these, the Sennheiser EM1046 met our requirement for flexible frequency utilisation and consistent transmitter and receiver performance. It is fully synthesised, covering a maximum RF bandwidth of 24MHz in any of the authorised UHF radio microphone allocations, and employs UHF sound and HiDyn Plus with 2:1 companding at Tx and Rx. It is, however, incompatible with HiDyn.

The EM1046 receiver may be tuned in 5kHz steps, the EK4015 Battery Rx is pretuned to 32 channels, and both the pocket SK50 and the hand-held SKM5000 transmitters are pretuned to 16 intermodulation-free channels. Further changes in frequency can be achieved through PROM and EPROM changes.

The receiver racks are capable of taking three or eight receivers. The 3-way EM203 has an 'iffy' external power supply but it is small, lightweight and nonradiating (RF). The 8-way EM1046 has its own plug-in power module at the back of the rack. I have learned to accept that, despite ICs and surface-mount technology, modern equipment does not come lightweight—the EM1046 complete with receivers, power, RF and audio modules and so on weighs in at 25kgs. When packed for transit it is a 2-person lift off the luggage carousel. The 3-way is lighter but will not fit into the SQN bag pouch.

The front of each Rx unit carries an alphanumeric LED display across the top, ON-OFF switch (Sennheiser calls it 'STAND-BY') and monitoring keys at the bottom, with 2 x 16 LED bar-graph displays calibrated for deviation and signal strength. To the right are four keys for programming various Rx functions and frequency. Above the bar graph are diversity indicators. The bar-graph displays are the first I have used on a commercially available system that are of a sensible size and with meaningful scales adjacent—field strength in millivolts, percentage deviation with peak hold of approximately 4s.

Right: SKM5000 selectable frequency 50mW hand-held transmitter

On the far right-hand side of the rack there is the audio and power monitoring panel. Although small, it has the essentials: ON-OFF switch, power indicators (rack rails and head amp power-circuit mode and overload), remote switch, headphone monitoring and level control. This monitoring control is easily accessible, sensibly tracked and comes with an extremely useful feature; a 20dB gain switch, ideal for checking heavily attenuated Txs. But unless you want to blow your favourite speakers, take care when investigating *ppp* crackles with maximum gain on the monitors.

Monitoring of each receiver is achieved by selecting the appropriate headphone key. Only one Rx can be monitored at once—this is restrictive but it is the only operation that does not require care and thought.

The LED display can be programmed to display either frequency or brief text or to delve deeper into the inner brain of the Rx, to show, among other things, customer identity, software and hardware arrangement and serial numbers. The battery-test function is very simple and practical, but is prone to indicate briefly erroneous conditions under certain circumstances—nothing is perfect.

Nominal output levels are +12dBm, which is enough to eliminate the noisy cable problems but too high (without the pad) for older PA desks. The RF module, with diversity input N-type females and head amp power switches, is centrally positioned and awkwardly functional. Space prevents better layout and the head amp DC switches operate in the horizontal plane; easy to switch on but difficult to switch off. It is here that nonstandardisation creeps in. On the 3-way rack: BNC female inputs with vertical phase DC switches. Perhaps, Sennheiser envisaged the 3-way being more of a mobile unit as it only has a DC input which at least avoids the IEC input found in the bottom corner of the 8-way.

Considering the temperatures generated by each receiver (the front-end oscillator consumes 300mA, the price for a highly selective and sensitive front end) ventilation of the 8-way rack is almost nonexistent —ventilation is recommended.

AN ANTENNA splitter module is available, so up to three other racks can be fed from one aerial system. The head amp can be externally powered, filtering seems excellent but the nature of the system dictates it must be wider than necessary.

The EK4015 receiver is the star of the system. It is not the smallest on the market and lacks an internal battery compartment, but it does possess 32 preset channels over a 24MHz bandwidth, selected by a 16-way rotary and one 2-way slider switch; mic or line outputs; good controllable monitoring from a separate 3.5mm stereo jack; and adjustable squelch. It is not a miniature clone of the EM1046—the spec shows you that, but it works extremely well in hostile RF environments with its own aerials or high gain external ones of your choice, and it sits conveniently on the rear or side of most hand-held professional cameras. Additional EK4015s can be added in cascade by attaching to the special threaded screw leads.

Power is via a standard DC co-axial plug 4.5V–12V. The output cable has a 0–40dB attenuator, (screwdriver adjustable) built into the XLR which could be embarrassing if forgotten when using with mic level output. The LED display is minimal; Ant A & B; RF better than 10µV and audio (following peaks). The only drawback is the lack of Tx battery-condition display or any indicator of the receiver's own power-source state.

THE SK50 TRANSMITTER is an unusual shape but it is functional and is easy to conceal. It has a recessed ON-OFF switch, easy to locate but not too easy to operate—users who frequently seek privacy might find this a problem. The audio input attenuator is stepped in seven 6dB steps, with one position for Dynamic or other low-impedance sources. The 16-position channel selector is surprisingly well aligned although a credit-card-sized fresnel pocket lens gives increased confidence in correct-first-time channel selection. I find it annoying that the channel selector warrants a 16-way switch while the audio input sensitivity only an 8-way one. For television use—on musicals one day, intimate drama the next—a wider range of attenuation would be most useful for both the MKE2-4 (Red Dot) and low impedance Dynamic mic inputs. Currently, to achieve the best from the system an alternative stock of MKE2s must be held and-or permanent internal modification to the input stage made.

The battery compartment is an unusual feature, it is completely removable and contains the logic for battery-state ☞

ON THE AIR

MANY RADIO-MIC SYSTEMS are simply revamps of preceding models with new packaging a hint of new technology. Often, however, these only work in relatively ideal situations—that is, without intermodulation and proximity problems, in clean RF environments, and with transmitters equidistant from the receiver and each other. Sadly, such conditions are not typical of outside broadcast situations, where positioning is impossible to plan in advance and the RF environment is cluttered with constant talkback systems, radio links plus all the RF clutter associated with electronic equipment.

In the UK, the VHF (173MHz –220MHz) spectrum has become almost unusable for reliable simultaneous multichannel use. Happily, technology has kept ahead of the problem and UHF (specially allocated slots between 478MHz and 862MHz) has the answers—but at a cost.

At higher operating frequencies, filters and aerials are smaller which, together with modern ICs, surface-mount technology and state-of-the-art manufacturing processes, have made it possible for radio-microphone equipment to be progressively smaller, lighter and supposedly more durable. Further, through the development of digital synthesis technology, it offers multiple-frequency operation. Consequently, the most important link in the chain —the receiver—has better sensitivity and selectivity, an effective diversity system, a low noise floor and be manufactured in a robust enough fashion to withstand the environmental and physical rigours of outside broadcast use.

The broadcaster requires flexibility, simplicity and easy access for testing. Consistency and tight tolerances are essential requirements if receivers and transmitters are to be interchangeable, as multifrequency systems are supposed to be, or when having to work one transmitter with several receiving locations. Most importantly, there should be no gimmicks—the risk factor is already high enough in the broadcast world. At this stage in the game, it is difficult to imagine a valid replacement for common sense, good planning and operational techniques to permit the effective use of radio microphone systems, whether they be single-channel or 42-channel systems.

detection. The case is made of ABS and only time will tell if it can withstand the rigours of daily use. The pin connections both on the unit and in the Tx seem delicate and the unprotected components adjacent to the transmitter socket are particularly vulnerable. The basic B50 holds two AA cells but there is a 3-cell (B250) option available. This increases battery life from approximately five to eight hours. Rechargeable ('accu') packs are of identical size (BA50 and BA250) and the battery state is indicated by a 5-way LCD. The mimic on the EM1046 is shown numerically in percentage terms and LOW BATT indication seem to be considerably shorter than that for primary cells. While not wishing to be environmentally unaware, I have found accus a weak link in the system for OB. Further, the LCD is difficult to read quickly in bright light and it cannot always be assumed that replacement rechargeables are readily available. The primary cell packs, however, are easy to remove, the cells go in the same way round, and no screwdriver or gaffer tape is needed to hold them secure. Even presenters can change them.

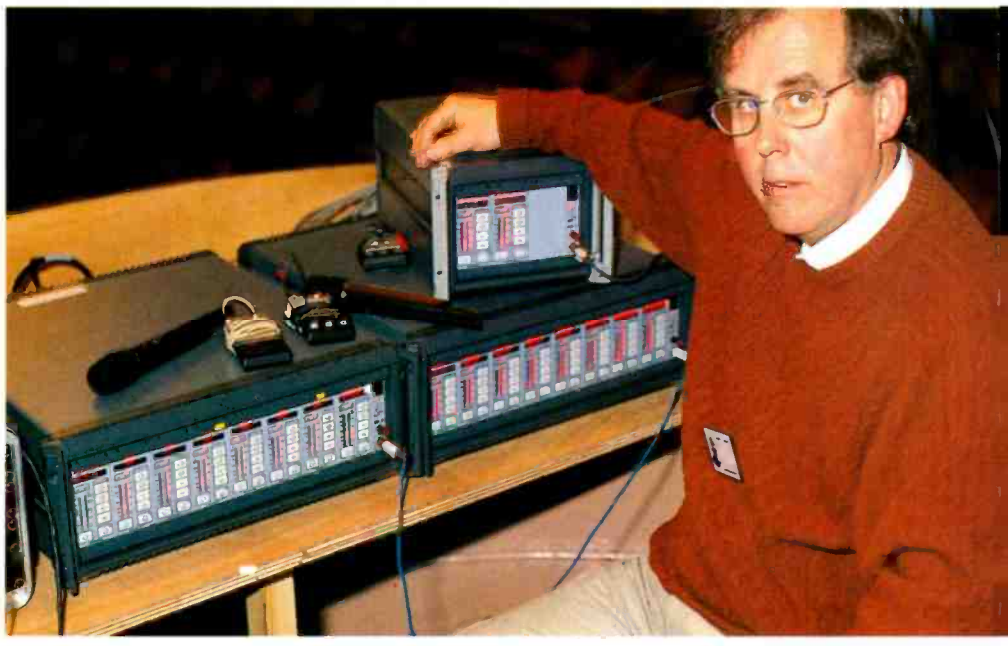
The hand-held SKM5000 is exceptionally well engineered and graceful looking. The ergonomic design has given us the worlds first hump-back microphone– my initial reaction was 'how am I going to hold that comfortably?' In practice, the hump fits behind the finger joints, the Sennheiser symbol is seen by the world and everyone is happy. If RF range is critical, it is easy for the hand to slip over the aerial unit, and even HiDyn Plus cannot get you out of that one. These problems seldom arose with the wire or helical system–perhaps the aerial would have been better placed in the capsule head.

At present super-cardioid and omni condenser capsules and a dynamic super-cardioid are available, with wide-cardioid and cardioid condenser capsules to appear in the near future. The input-level attenuator is accessed by removing the head and is a 5-position switch in 10dB steps. The adjacent bass-cut switch is severe but ideal for close working and windy environments. The capsule is well protected by foam behind the wire mesh windshield but for location work on very windy days and for some pop singers a specifically designed wind gag to match the lines of the microphone would be welcome.

The body-pack transmitters and the EK4015 receiver bring yet more connector types into the world. Audio connectors are 3-pole screwed miniature Lemos and the RF, single-pole screwed Lemo. Both fit securely and only time will tell how reliable they are. Regrettably special tools are required to repair and make them.

I HAVE TO CONCLUDE that these radio-microphone systems work exceptionally well. The transmission path is excellent, even in hostile RF environments and diversity operation undetectable. HiDyn Plus, like all companding systems, is only as good as the engineers-operators who set the equipment up. The equipment is expensive but then it does not have any real competition in what is the most technically demanding end of the market. Until we move into digital transmission paths (and new problems), we must teach producers and directors that radio mics impose a severe risk element on a production.

We have made many outside broadcasts now with the Sennheiser systems and the systems have performed faultlessly. One important aspect of running radio-mic systems (especially big ones) is often only identified in the field–backup. On this score, too, Sennheiser have left us no room to complain.



Richard Kemp with EM1046 receiver systems in the Shaftesbury Theatre, London

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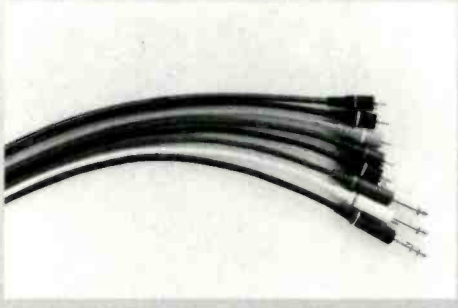

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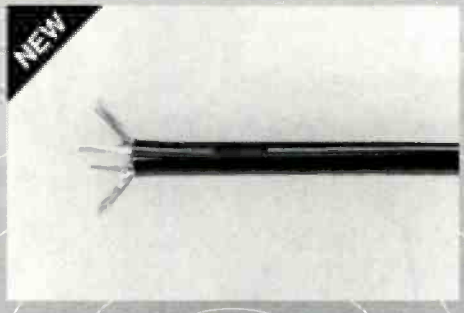

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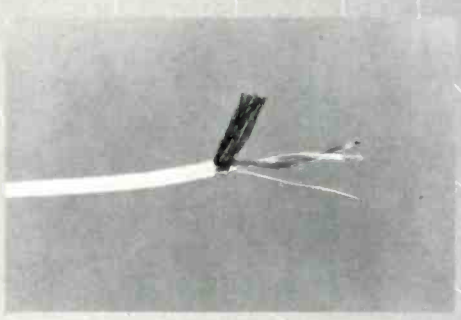

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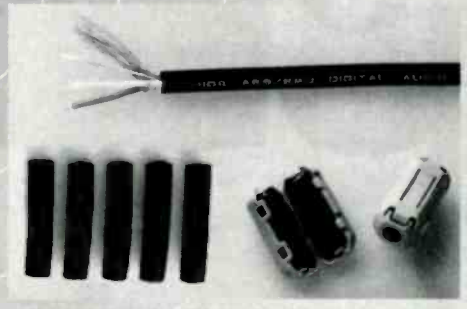

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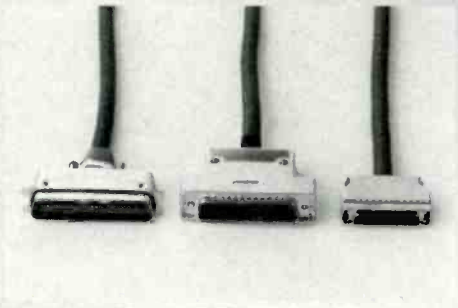

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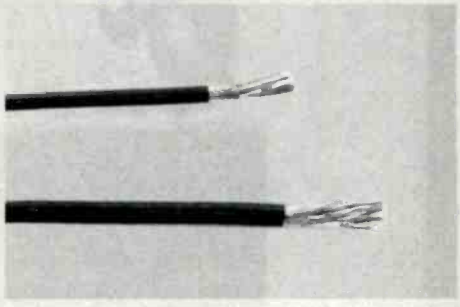

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TECHNICAL DATA

SPECIFICATIONS

Sampling Frequency (Recording)	96KHz. 88.2KHz. 48 KHz. 44.1KHz
Sampling Frequency (Playback)	96KHz. 88.2KHz. 48 KHz. 44.1KHz. 32KHz
Quantisation Resolution	16-bit linear
Channels	2 (stereo)
Frequency Response	96KHz sampling: 2Hz - 44KHz
	88.2KHz sampling: 20Hz - 40KHz
	48KHz sampling: 2Hz - 22KHz
	44.1KHz sampling: 2Hz - 20KHz
Signal to Noise Ratio	90dB or better (48KHz sampling)
Dynamic range	90dB or better (48KHz sampling)
Wow and flutter	±0.001% W.Peak or less

INPUT / OUTPUT TERMINALS

ANALOGUE

Input Connector	XLR
Input Level / Impedance	+4dBu. -10dBv / 10kΩ (at +4dBu)
Output Connector:	XLR
Output Level / Impedance	+4dBu. -10dBv / less than 100Ω

DIGITAL (AES/EBU)

Input Connector	XLR
Input Impedance	110Ω
Output Connector	XLR
Output Impedance	less than 110Ω

DIGITAL (SDIF2/IEC TYPE II)

Input Connector	Coaxial RCA
Input Level / Impedance	0.5Vp-p / 75Ω
Output Connector	Coaxial RCA
Output level / Impedance	0.5Vp-p / 75Ω

REMOTE CONTROL INPUT

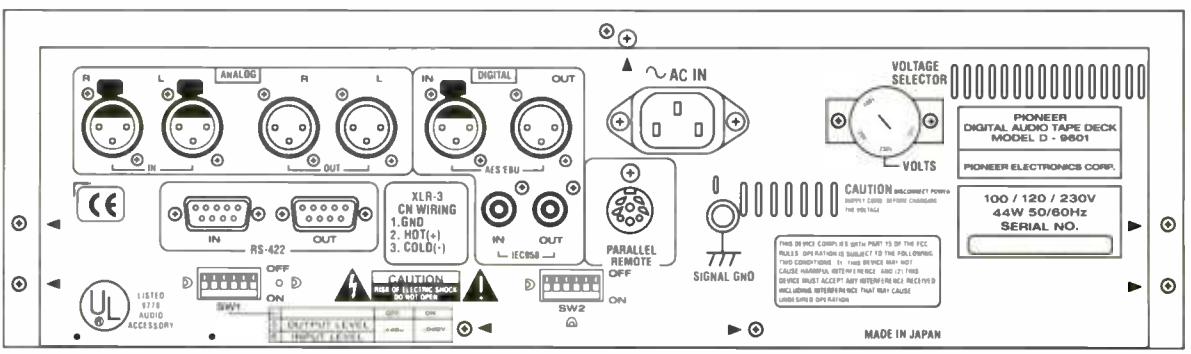
Parallel	DIN 8-pin
RS422 Serial	D-sub 9-pin

TRANSPORT

Drum Diameter	30mm (1.18 ins)
Drum Speed	2000rpm/4000rpm
Tape Speed	4.075mm/sec. 8.15mm/sec.12.225mm/sec. 16.3mm/sec
	0.16 ins/sec. 0.32 ins/sec. 0.48 ins/sec. 0.64 ins/sec

GENERAL

Power Source	AC 100V. 120V. 230V. 50/60Hz
Power Consumption	44W
Dimensions	483 x 134 x 355mm
	19 x 5.25 x 14 ins
Weight	7.6Kg / 16.75lbs



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Big buck: big bang

While broadcasters wait for digits to change the face of broadcasting, the moguls are doing it with their money writes **KEVIN HILTON**

It's not cool to be a conspiracy theorist these days. Come to that, it probably never was a particularly fashionable pastime even when the world was secretly looking for a good plot to explain why everything had changed.

There are exceptions, of course –Oliver Stone gets away with it at the cost of being written off as a bit of a ranting paranoiac. Pretty much everybody else is dismissed as a geek, much like Mulder's creepy mates in *The X-Files*.

So we'll just have to find a different way to regard how Rupert Murdoch has practically sewn up the digital future for his News International-News Corporation conglomerate by acquiring the Advanced Products Division of NTL.

When the news broke, I definitely reacted, but I can't say that it was with shock or surprise. Any surprise was reserved for certain colleagues, who failed to see the significance of the move. Has Big Bad Rupe permeated our lives so much that we can only regard his imperial behaviour with sheep-like acceptance?

The facts are that the high-technology arm of News Corp, News Technology Group, has absorbed the Advanced Products Division and retagged it with the cumbersome title Digi-Media Vision (DMV).

In its new home, the company will work alongside News Digital Systems (NDS) and News Datacom (NDC), companies that have already gone some way to securing lanes on the information highway for the canny Australian-American who already has broadcast interests–both satellite and terrestrial–around the world.

NDS is the hub, managing News Corporation technology companies and developing software for subscriber management systems. NDC pioneered card-based conditional access systems (CASs) in the burgeoning, analogue days of satellite TV, developing the now-household names VideoCrypt and NewsCrypt.

News Corp used satellite channel BSkyB to establish its CASs. The station's stronghold is the Astra bird and other operators using this gateway also govern their subscription services by using VideoCrypt.

Much in the same way as he formed strategic alliances with dish manufacturers when Sky first launched, Murdoch has engineered the situation such that he has virtual control over who uses what, where and when. And with the formation of DMV, he has the potential to do much the same with key elements in the digital transmission chain.

Murdoch has made this possible by virtue of his voluminous wallet, which has also enabled him to buy the exclusive rights to broadcast major sporting events, ones that were once available to everyone through either the BBC or ITV.

Now, hardened sports fans have to subscribe to satellite channels if they want to see the top-flight contests in both soccer and boxing, while the terrestrial stations are barely hanging onto cricket, rugby and the lesser footy leagues.

Media moguls have always existed –William Randolph Hearst would probably be doing much the same as Murdoch had he lived today–but it's a question of levels of megalomania. Richard Branson pitches up for most things, but he doesn't have the same killer instinct as Rupert (unless the beard and comfy sweaters are just a front). In fact, Branson is one of the unluckier moguls. In just over a year he has missed out on both the franchise for the UK National Lottery and the licence for Channel 5, which brings us to a second conspiracy theory.

The Lottery is now run by a company called Camelot, whose chair is Sir George Russell. This noble knight splits his time between counting the cash speculated by the eager British public each week, and deciding who does what in commercial television, for he is also chair of the Independent Television Commission (ITC).

Branson was strangely low-key after the decision on C5 went against him. Most of the shouting came from CanWest and partners, the consortium behind UKTV Developments, which submitted the highest bid. Under ITC rules, this would usually ensure an entrant of the prize, providing they passed the quality threshold–which UKTV did not.

Neither did Virgin, which put up the same amount as the eventual winner, Channel 5 Broadcasting. Reviewing their application, it is obvious that the new licence holders put some thought into the programming, including laudable mentions of higher education, consumer help and current affairs, but there is still a serious lowest-common-denominator element, notably aged favourites from the vaults of partner Pearson (Thames).

Heading up the new channel is ITV veteran Greg Dyke, an undoubted populist who rescued TVam (although it eventually lost its licence) by creating the puppet Roland Rat (for which I personally resent him because it gave me the irritant of Kevin the Gerbil).

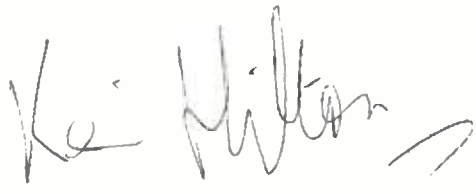
Dyke has also said that he will not be drawn into auctions for sporting events,

> Murdoch has engineered the situation such that he has virtual control over who uses what...

which means that C5 may end up showing highlights of the Five Nations Marbles Championship.

C5 is going to happen, but it has not been a quick or easy path to the eventual airing in January 1997: the restricted coverage, the rejection of the first-round applicant, and now the final appointment of a broadcaster that some see as unworthy. To make matters worse, if Channel 5 Broadcasting had failed the quality test, then the fourth applicant, New Century, would have won the licence, despite bidding the lowest amount.

One of the figures behind this group was our old friend Rupert Murdoch. Now, he may have said that he wasn't really interested in the fifth terrestrial channel, but it was all a little close for comfort. Pass me that X-file, would you?



The Hidley-

ERIC STARK, Chief Audio Technician at Crawford Post Production and previously Chief Engineer of BOP Recording Studios gives an insight into a new phase of studio design

Infrasound era

WHILE I WAS WORKING at BOP Studios in South Africa, one comment heard time and time again from artists, producers and engineers was that 'If you can't make your instruments sound good in these rooms you should give up playing'. This was a reaction to studio recording spaces that I had never before encountered. In time, it became apparent that the improvement in musical intonation and creativity could only be attributed to the linear sonic integrity found within BOP's Hidley-Infrasound rooms.

Artists were thrilled with the opportunity to have an accurate interactive relationship with the performing space. We found a more natural approach was achieved without players having to 'overblow', as they do, in short reverb environments or 'underblow', as they do, in artificial live areas. In the acoustically accurate studio environments of BOP, artists were able to relax and play naturally with better concentration. EQ tended to be used more for the enhancement of the instruments and equipment rather than to correct room acoustics. The transparency of the acoustic signal permitted less reliance on artificial EQ and reverbs, with emphasis on natural sonic integrity.

As for the control rooms, it was at BOP where I realised that most recording studio acoustical designers are currently headed down the wrong paths. I am referring to the sonic neutrality and the absence of 'masking' reverberations, or noise, achieved by designer-builder Tom Hidley's symmetrical acoustical room 'unloading' of the main control-room monitors. While many designers resort to trappings and diffusers to deal with unwanted reverberation, Tom Hidley's design for the removal of these undesirable properties resulted in clarity, precise stereo imaging, tightness and a sonic reality extending right down through the low end (to 9Hz at 3dB down).

Left: Masterfonics Infrasound-ready control room is designed to handle frequencies down to 10Hz. Below: Tom Hidley (left) and author Eric Stark (right) in Marrakesh

Substandard recordings with extraneous noise sourced from other recording studios and locations became far more apparent and thus more easily dealt with due to the ability to accurately identify anomalies in the content of external product and clean it up. This was especially evident in the low end. By being able to identify and eliminate unwanted noise, the effects of unwanted summing and cancellations which affect the audible music timbre can be eliminated.

Recently, I was setting up a new pair of monitors for evaluation in a US studio. Someone put one of their favourite CDs on and it was unsettling to watch the cones extrude and overwork themselves during a playback of what should have been a 'pristine' recording. Thinking there must have been a problem with the monitors, I searched for the cause. After finding nothing unusual–except that the amps were very hot for the listening levels being used–I analysed the CD and found that the extreme low-frequency content was unusual and erratic. Either the recorded snare drum was about 50 feet across or some unwanted infrasonic extreme low-frequency information had crept in during the recording or mixing. The low infrasonic signal was doing its best to tear up the speakers by using most of the current I was supplying from my amplifiers in an attempt to make the speakers recreate the low end content. This occurred because energy was diverted from the audible range to generate the 'inaudible' low-frequency content.

HERE I WILL be drawing from a paper included in the *Proceedings of the Institute of Acoustics, 1994*, entitled 'Control Room Reverberation is Unwanted Noise'. The room-design principles discussed in this paper are those of a Tom-Hidley-designed 20Hz room. Authors, Keith Holland (Institute of Sound and Vibration Research, Southampton University), and Phil Newell discuss the Hidley concept of the 'nonenvironment room'. Their combined research resulted in a proposal for the abandonment of the concept that control rooms should possess any 'representative' reverberation.

I quote from the introduction: 'It has been customary practice in most situations to produce control rooms with reverberation times approximating to, or slightly less than, some statistical "average" domestic listening room. Numerous methods have been used in attempts to remove peaks and dips in the reverberation times of the rooms, which create idiosyncratic coloration of the monitoring conditions. This has led to musical balances which may not "travel well" when reproduced in other rooms. Despite 50 years of efforts to produce rooms which subjectively sound both consistent between themselves and "typical" of the outside world, the general state of inter-room compatibility is still not good. This paper argues that only by minimising control-room monitoring RT can greater commonality be achieved; but this requires the abandonment of any adherences to the old policy of mimicking any perceived domestic "norm".'

A daunting proposition, to say the least, but Hidley has designed and built over 500 rooms worldwide in his quest for the perfect monitoring environment. I had the good fortune of being the chief engineer at BOP, a $22m project which resulted in both control rooms and recording rooms which were the first to break the 20Hz barrier. The goal was to create consistent rooms which equate to the end product and the consumer's listening environment. Studios which are properly designed and built for today's digital capability can better produce recordings which work in the broad range of today's listening environments. Additionally, a project that goes from studio to studio will have a commonality essential to a superior end-product.

When we venture below 20Hz, we enter the very bottom of the sound pressure spectrum. BOP was the first facility in the world to achieve what is now known as Hidley-Infrasound. Hidley's first 30Hz monitoring-and-room design was completed in 1983 at Sedic Studios in Tokyo, utilising Kinoshita 30Hz monitors. In 1986, the 20Hz room was introduced at Masterfonics in Nashville, complete with Hidley-Kinoshita 20Hz monitors. Nomis Studios in London brought Hidley's revolutionary 20Hz design to the UK in 1988.

The completion of BOP Studios, South Africa, in 1991, truly introduced the acoustically measurable breakthrough of Infrasound. This was achieved by the capability of the Hidley-designed room to support the acoustical requirements of the Kinoshita 10Hz Monitor. In 1995, Hidley completed The Tracking Room at Nashville's Masterfonics, which is considered 'Infrasound ready' by Hidley, only because audio monitoring is provided by the 20Hz rather than the new 10Hz control room monitors. It is, however, an acoustical advance on the BOP design and is lacking only the new 10Hz monitor system to be complete. The next Hidley-Infrasound facility is an $80m project set to break ground in Morocco, 1996.

> 'The anechoic chamber is not a comfortable place in which to work, so the goal seems to be an anechoic type of environment in which human beings feel good'

The infrasonic region of the sound pressure spectrum, that which is below what is considered the human hearing range, has impact on what we perceive as audible sounds above 20Hz. Sound pressure in the infrasonic region has a harmonic influence on the frequencies above. An earthquake has fundamental frequencies in the region of 1Hz, and you hear the harmonic effects above 20Hz before the shaking is felt. What is taking place in the 10Hz–20Hz region in the studio is heard in the octaves above, especially in the 30Hz–50Hz range where most control room monitors become energised.

The sources of inconsistency between control rooms are in the monitoring systems and the actual acoustic properties and designs of the rooms themselves. The most problematic area is in the low frequencies. To cope with these inconsistencies engineers and producers have resorted to near-field monitors, those which they know and trust and which work equally well in any studio. Granted, these small monitors in some instances do relate well to certain consumer listening environments, but there are one or two octaves of low frequencies that are being ignored with control room close-field monitoring.

ON THE CONSTRUCTION side of the equation, according to the research paper previously quoted, there have been a number of design concepts developed to create studios which smooth out the modal responses of rooms and provide a reverberation time-frequency performance which does away with the inconsistencies derived from individual room characteristics. Helmholtz resonators are tuned to absorb undesirable frequencies which may predominate a rooms RT. The Live End, Dead End approach of Wrighton & Berger utilises an absorbent front half of the room to leave a suitable time interval between the incident waves first pass of the ear, and the subsequent 'life' or pseudoreverberation produced in the rear half of the room.

Again, according to the above paper, 'A further means of achieving a more uniform RT with frequency is by means of quadratic residue diffusers, which by suitable placement in a room can achieve a high degree of very diffusive reflections, free of the discrete and possibly unwanted specular reflections which can predominate at certain frequencies in conventional rooms.

'Among others, there is the Geddes approach of the steeply double-sloped wall, sloping in the vertical and horizontal directions, designed to disrupt the stronger axial and tangential modes in order to drive all modes into the less regular and more easily controlled oblique form.

'In addition, there are a variety of multifaceted approaches which attempt to scatter the modal energy into a broader overlap. Typically, this design uses monitors tailored to the room, so that patchworks of reflective and absorbent surfaces are positioned to yield overall desirable RT-frequency characteristics. Bass trapping and low-frequency absorbers are used to deal with the less directional frequencies below 300Hz'.

Perhaps luck has played a part in those particular studios which are known for their desirable RT specs, but perception is another matter. We are still looking for the studio which equates best to the real world. With today's top artists selling 10 million records a year worldwide, we now have to consider consumer listening environments which include stone and brick, wood and bamboo, empty rooms as well as those heavily furnished, plus automobiles and even headphones. To give these consumers the best, we are looking for studios which eliminate any significant degree of reverberation at all.

THE ANECHOIC CHAMBER would provide the optimum studio monitoring and imaging environment. Unfortunately, anechoic rooms are extremely unpleasant quarters for human beings. Many people find them unnerving, unnatural and even stressful. According to the aforementioned research paper, 'When loud music is reproduced under such conditions, there is cause to believe that it triggers a fear response in many people, when the dynamic range exhibited between the silence and the music causes their brains to warn them of impending danger. In nature, such wide dynamic ranges are usually only experienced in times of natural disaster, where great energies are being released.

'Anechoic conditions are repeatable in any given frequency range, hence their scientific value for comparative and absolute measurements. Monitors with optimum amplitude-phase compromises and transient responses perform with a greater degree of reality than in conventional rooms. Anechoic chambers provide the best environment for detecting fine detail and enable pinpoint stereo imaging'.

The anechoic chamber is not a comfortable place in which to work, so the goal seems to be an anechoic-type of environment in which human beings feel good. 'The solution lies in a control room with "dual acoustic" properties, one for the monitoring and one for the people working. If the front wall is made to be both massive and reflective and the main monitor system is flush-mounted, then the wall itself provides for the proper radiation of the low frequencies but is not "seen" by the monitors. However, pleasant specular reflections will be returned to the person within the room in response to their speech and actions, but nothing of the musical

Many audio test instruments now have analog and digital input/output connectors. That doesn't mean they are all the same. Most use DSP circuitry for both analog and digital domain stimulus or measurements, so signals pass through A/D and D/A converters inside the instrument when testing analog devices. System Two's true Dual Domain architecture means analog signals are generated and measured by analog hardware, digital signals are generated and measured by digital hardware for uncompromised performance in both domains. Test equipment specs must be sigificantly better than the best devices they measure. With high-performance pro and consumer audio devices often providing response flatness of 0.03 dB or better and distortion around -100 dB, your audio test equipment specifications are even more critical.

ANALOG PERFORMANCE	Audio Precision System Two	Tektronix AM700	Rohde & Schwarz UPD
Generator Residual Distortion	harmonics -120 dB THD+N -108 dB 20 Hz-20 kHz	harmonics not spec'ed; THD+N -86 dB 20 Hz-7.3 kHz (low distortion mode)	harmonics -115 dB w/low distort option; THD+N not spec'ed
Analyzer Residual THD+N	-108 dB 20 Hz-20 kHz, 0 to +30 dBu	-79 dB 20-100 Hz -86 dB 100-400 Hz -90 dB 400 Hz-6.6 kHz	-110 dB, freq. & amplitude range not specified
Generator Frequency Response Flatness	±0.01 dB 20 Hz-20 kHz	±0.1 dB 20 Hz-10 kHz, +0.1/-0.2 dB 10 kHz-20 kHz	±0.05 dB 20 Hz-22 kHz
Analyzer Frequency Response Flatness	±0.01 dB 20 Hz-20 kHz	±0.1 dB 20 Hz-20 kHz	±0.03 dB 20 Hz-22 kHz

Compare what we bring to the table

Audio Precision introduced the first test set able to generate and measure audio signals in both the analog and digital domains. That unit, the System One Dual Domain, remains a popular Audio Precision product today. As time has passed, in addition to generation and analysis of the embedded digital audio program signals, new needs have surfaced for intensive testing of the AES interface pulse train itself.

Today, audio professionals often find that digital interface problems including jitter, inadequate bandwidth and excessive line noise cause degraded performance or even system operational failures. System Two answers these and other needs by including complete measurement of every parameter specified in AES3, the governing document for the AES digital interface. Trouble-shooting today's problems requires measurement of jitter, eye pattern, pulse amplitude, delay and noise of the interface itself. System Two does all this and adds impairment signal generation capability for simulation of interface problem signals, as well as high level status byte readout and control.

Compare for yourself... we believe System Two brings the most and the best to the table.

AES/EBU & CONSUMER DIGITAL INTERFACE MEASUREMENT CAPABILITY	Audio Precision System Two	Tektronix AM700	Rohde & Schwarz UPD
Jitter measurement	Yes	Yes	No
Injection of jitter	Yes	Yes	No
Variable rise & fall output	Yes	No	No
Eye patterns	Yes	Yes	No
Injection of noise and interfering signals	Yes, normal mode or common mode	No	No
Channel Status Bytes	Yes	Yes	Yes

Our worldwide force of representatives will be pleased to provide further information and an on site demonstration.

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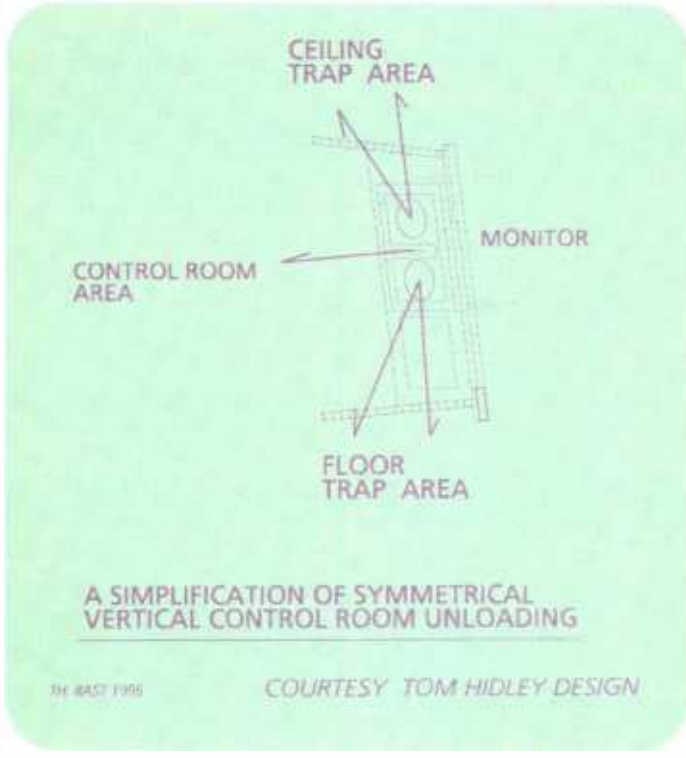

Fig.1: Simplification of symmetrical vertical control room unloading

signal from the loudspeakers should return to the front wall and hence to the listener'.

To accommodate our need for a pleasant environment, a reflective floor can be used. The reason for this is that our ears are much more sensitive to position and coloration by disturbances in the horizontal plane than in the vertical plane. Quoting again from the Institute of Acoustics paper, 'Being restricted to largely two-dimensional movement over the surface of the earth, in fact usually moving very little during our lives in terms of distance from a floor, it is not surprising that evolution has tended in this direction. Until the introduction of the air-launched bomb and the land mine, humans have had no real threat to their existence from predators attacking from above or below.'

This studio design and monitoring principle was introduced by Hidley in the mid-1980s as the nonenvironment control room. 'The concept is very tolerant of shape and size variations with anechoic properties, meaning as close to zero reverberation as possible. Another way of grasping this concept is the Monitor-Dead room. When properly built, this type of studio allows a return to the use of large monitors with consistently excellent results because of the purity of the critical listening environment. The close-field monitors once again become a secondary reference to the consumer's domestic environment'.

ESSENTIAL TO the 1990s Hidley-Infrasound design is the Bass Pit Trap. Without this, the pressure information from 20Hz downwards becomes very bumpy. The reason for this is that there is such strong radiation of infrasonic frequency pressure from the sides and the rear of the cabinets, which to date cannot be contained in the same fashion as with normal monitors. The most elaborate of the off-the-shelf monitors, such as Genelec and Quested, have a bandwidth that gets down to, at best, just below 28Hz (±3dB). Other than Hidley-Kinoshita, no-one, to my knowledge, is manufacturing a studio 20Hz energiser at this point, that is, a 20Hz (±3dB) monitor to 120 SPL. As a result, very little testing is done down to 20Hz, let alone into the infrasonic region. Tests conducted by the South African Bureau of Standards have verified that Hidley's goals were achieved at BOP Studios and are now a matter of public record.

When you listen to a current Hidley room-monitor combination, you immediately notice the detail in the low end. What is being experienced is the result of symmetrical acoustic room unloading. The first studios in the world to utilise the Bass Pit Trap which affords symmetrical room unloading were at BOP in 1991. This was followed by the first such room in America, The Tracking Room at Masterfonics in Nashville, which opened in October of 1995. These are the first operational control rooms to have a '3-D' trapping system in relation to the main monitors which are open to the room. The floated floor is 16 inches of concrete supported on 3Hz heavy industrial isolation springs. In the area between the bottom of the float slab and the top of the base slab below, there is a proprietary trapping network which Hidley will not publicly elaborate on at this time.

Consider this: in every control room in the world, except those at BOP and at the Masterfonics Tracking Room, there are traps or diaphragm surfaces in the sidewalls, traps or diaphragm surfaces in the ceilings, but not the floor. The monitor wall goes down to the floor and finds concrete rigidity. There is a 90°, 100°, or 105° monitor wall-to-floor intersection, and then the floor moves out toward the console and onward to the back of the room. The woofer sends its signal omnidirectionally, feeding out, up, to the side, and down (**Fig.1**). Unloading is possibly fine to the sides and top of the room but when you get to the floor there is rigid concrete. Consequently, the radiation characteristics of the woofer to the room and listener were not linear or symmetrical in control rooms built over the last 50 years. As much monitor low-frequency energy gets to the floor as to the ceiling and the two side walls. But the energy going to the floor has a different reflective relationship to the room than all other areas of the room near the monitor. This fact brings to the room 'acoustic phase distortion'.

This is because the floor is rigid and the other three surfaces are unloading traps or diaphragm surfaces. You are putting an asymmetrical low-frequency wave front into the room if you are not symmetrically unloading the room. However, with Hidley's floor Bass Pit Trap, the room opens up and sounds natural. You hear greater detail and precise positioning of the bass. For the new Masterfonics room, Hidley has also designed, and SSL has manufactured and installed, a console-shell modification to divert the splash from the control room monitors off the rear of the console cabinet into the front section of the Bass Pit Trap. This addition completes the equation for symmetrical room unloading of the main monitors.

Again, from the research paper, 'In such a dry monitoring environment is there a tendency to use too much reverberation in the mix? In the absence of any low-frequency reinforcement from the room itself do the monitors sound bass light, leading to mixes which are bass heavy?' My experience leads me to an emphatic 'no' to both questions. What reverberation that is applied is in relation to a lower background ambience, so it can be heard much more clearly. You suddenly become aware of the individual spaces in which the recordings were made. Problems and distortions are heard where they should be heard, in the control room, which can be used for quality control in the recording and mixing phases of a project. Working with large and accurate monitors in a well-designed studio removes the guesswork of the low end.

With the introduction of the Hidley-Infrasound studio, engineers are realising that control-room reverberation is really only unwanted noise. 'Like tape noise or nonlinear distortion, control-room reverberation masks detail by introducing a noise floor below which it becomes very difficult to hear other noise, distortion or low-level signals. This unwanted control-room noise covers up the low-level signals which provide clues to the spaces in which the instruments were recorded. Tape noise —which is becoming a thing of the past—has previously masked control room problems. The problems will become increasingly more evident as consumer listening becomes more and more sophisticated. The public pays its money and it's our job as professionals to make sure it gets a quality product, regardless of whether they listen in their elaborate home theatre or while driving to work.

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Nanotech punches in

The future of hard-disk recording rests not on smarter software or new comms standards but entirely on the emergent field of nanoelectronics writes **CHRIS EDWARDS**

The hard-disk drive is currently revolutionising the recording, post and broadcast industries, but as the techniques needed to support digital recording move out of the domain of specialised hardware and into that of the general-purpose computing business, digital recording may not stop at the concept of the disk.

You will have difficulty finding a SCSI drive today that does not support what the computer industry blandly calls multimedia. As far as audio is concerned, this means that the stream 'playout' does not stop momentarily if the drive has to deal with something else. This was caused by the way in which hard drives were designed: the information that lets the head find a particular track was stored on only one of the disk surfaces inside and, as the drive warmed up, the disks expanded at different rates which caused problems finding data. The way round the problem is to perform what is called thermal calibration. Unfortunately, this sometimes used to happen unexpectedly, even when the drive was in use.

More recently, the problem has been solved by embedding the position information between the tracks on all of the disk surfaces, or by interrupting the recalibration if a request for data comes in from the computer.

Designing drives for multimedia–as far as the drive manufacturers are concerned–means pushing up the capacity and transfer speeds in roughly equal measure. It is relatively easy to do both at the same time because the capacity of a drive depends largely on how many bits you can pack on a track. If you keep spinning the disk at the same speed, putting more data in the same space means that it can be read more quickly. This is fine for video work where there are rarely more than a few video streams being mixed at once. Consequently, the transfer rate of the hard drive is rapidly approaching that needed for broadcast-standard video.

It is not so much of an advantage for multitrack recording and playback where, unless you are using the hard-disk recorder as though it is a multitrack machine, it is the speed of access to sound samples that may be scattered across the drive that is important–the drive takes time to sweep the head across the disk to find the right track for the data, then it has to wait until the fragment of data spins round before it can pass it back to the computer. Five years ago, hard drives had access times in the order of 20ms to 30ms; now, they will retrieve data in about 12ms to 20ms. This access time limits the number of tracks that a drive can practically handle. To work around these limitations, hard-disk recording systems perform a juggling act with the sounds stored on disk, looking ahead at what will be needed and using RAM in the computer or controller to store those samples temporarily.

At the moment, RAM is an expensive commodity, costing more than ten times as much as hard drive capacity on a per-megabyte basis. But work is under way to bring this cost down, even if the price differential between hard disk and RAM is likely to stay where it is. RAMs typically use 2Mb devices: the next generation, ready in a couple of years, will push this to 8Mb. If you consider that the most commonly bought SIMMs have about 8Mb on board today, that figure will go up to 32Mb. At the start of the next century, we will be looking at 32Mb chips, ushering in PCs and similar systems that can hold more than 500Mb of high-speed memory.

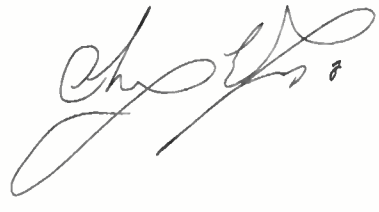
At this point, things start to get interesting because conventional microelectronic-fabrication techniques begin to run out of steam below 0.1µm–the physical feature sizes necessary for high-density RAMs. This is where a new area of science appears.

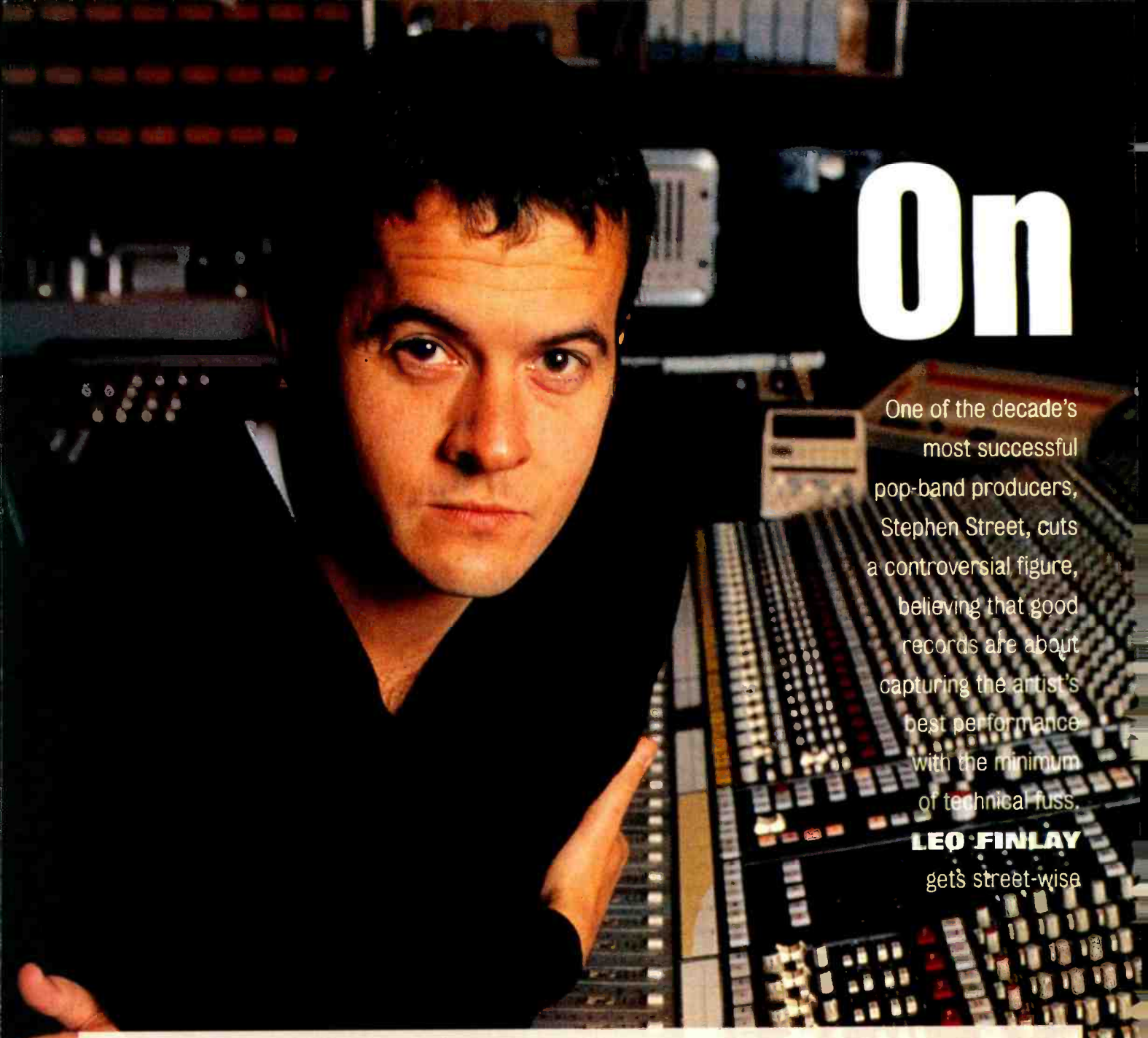
Nanoelectronics is a technology currently in development that will make it possible to produce electronic devices with circuit elements that are measured in nanometres (nm), ten to a hundred times smaller than current devices.

Such a technology will make it possible to build digital recording systems that do almost everything in memory and only resort to hard drives or tape for backup. Potentially, a digital recording system based on RAM could then handle an unlimited number of tracks, to the extent that the concept of the track becomes meaningless except for those systems designed to look like conventional multitrack recorders. Depending on the amount of processing horsepower available, effects could be added to individual sound samples and no longer on a track-by-track basis. These systems would have the advantage of being more efficient as the processor would not be spending much of its time managing the data on the disk; more could then be invested in the digital mixing and effects processing stages.

Nanoelectronics will make it possible to produce devices with circuit elements ten to a hundred times smaller than current devices

Although the density of RAMs should increase dramatically, there is no guarantee that they will begin to challenge hard drives in terms of cost per megabyte. It turns out that similar techniques will be used to create the data-recording surfaces of hard disks and the memory elements of RAMs. Work has already started on the next generation of hard drives, based on a technique known as the giant magneto-resistive effect. The heads in these drives are likely to be built using nanoelectronic techniques and the recording surfaces themselves may also be treated in the same way to boost capacities way beyond the present 10Gb point.





On

One of the decade's most successful pop-band producers, Stephen Street, cuts a controversial figure, believing that good records are about capturing the artist's best performance with the minimum of technical fuss. **LEO FINLAY** gets street-wise

HE'S HAD NO.1 ALBUMS in the UK with The Smiths, Morrissey and Blur and cracked the US market with The Cranberries. But Stephen Street is in his own words, 'the luckiest bloke alive'. It's a strange admission, but it sums up the attitude of a man who firmly believes the better an act, the better the production and, consequently, the record too.

Street is a pragmatic figure, who chooses to record predominantly in London's Maison Rouge and Townhouse studios because, 'they're easy to get to from where I live, and easy to get home from to see the children'. This attitude is mirrored in the 35-year-old's approach to his job—he likes to keep things simple, and coax the best performance out of the act, rather than make them fit into his vision of what they should sound like.

'When a producer takes complete control of a band and starts pushing it this way and that, you end up with a homogenised product,' he says. 'You should never lose sight of the fact that the act is the artist, and the personality and sound they have is what got them signed by a record company in the first place. 'If it ain't broken don't fix it, will always be my philosophy. A lot of producers take the song and put it through a Fairlight and muck around with it, and make a "producer's record". I thought we'd gotten over this a long time ago, because so many records made this way in the 1980s now sound so utterly dated.

'I do use computers, but very much in the background. I use them as a glorified click track, something to keep the drummer roughly in check. I'm not going to start putting every performance through a computer, because it might sound great in the studio but in a few years it will have no breathing or movement.'

But we are talking about one of the decade's most successful producers, so he must make some use of modern technology.

He says: 'I'm not a Luddite, by any means. I have an Akai sampler, an E-mu Vintage Keys module, a PowerBook, a Logic system and all the latest sequencing stuff, but I use it as an aid not as the be-all and end-all. Some of my favourite tracks have been recorded when I've turned the computer off and done it live. I find it most exciting when the artists have to rise to the occasion.'

Street has read *Studio Sound*'s interview with Steve Lipson—in which Lipson regaled us with tales of his favourite equipment—and admits to being flummoxed by much of it.

'Most of the stuff he's talking about, I've never even heard of,' he laughs. 'I get excited about a good-sounding Telecaster guitar or a nice snare sound. I'm not that bothered about the latest electronics to arrive on the scene.'

Lipson admitted that he had previously been a slave to his gear, spending a week getting a hi-hat sound right with a Synclavier. Again, Street feels this is absurd.

'I could have told him that 10 years ago. I prefer to take a practical approach, which is basically about admitting that there is nothing magical about production. It's all subjective in the end, and deciding when a performance is good enough.'

He also sees Trevor Horn's approach to the job as over the top.

'I'm not slagging Trevor off, because the ABC and Frankie albums were great,' he says. 'But I was making albums at the same time and spending my time miking

Street level

'You should never lose sight of the fact that the act is the artist, and the personality and the sound they have is what got them signed by a record company in the first place'

the amps rather than worrying about the kind of technology Trevor saw as all-important. He's always used gimmicks in his work, but back then we were trying to be purists in the way The Beatles and Stones were.

Street is more than happy to use 30-year-old Beatles recordings as his bench mark of excellence: 'George Martin was a genius. He clearly altered the whole course of pop music. The Beatles were just four scallies rocking away in Hamburg and Liverpool, until they were introduced to this classically-trained English gentleman.

'All The Beatles wanted to do was make R&B records and sound American but he brought out the Britishness in them which is what made them so great.

'*Revolver* is my favourite album of all time, and that was done on 4-track. Sometimes I sit down and weep when I've spent two months in a modern studio making an album that is crap compared to *Revolver*.'

If Street ever feels he's over-complicating matters he takes himself back down to terra firma by listening to The Beatles or even older jazz recordings: 'Some of the greatest jazz recordings were done straight to 2-track, without being quantised or filtered or anything.'

Surprisingly, another producer-engineer whose work he admires is the controversial Steve Albini, who was severely criticised for his work on Nirvana's *Nevermind* follow-up, *In Utero*.

'I think he's great, he always gets a really impressive natural feel to a band's sound. *In Utero* sounded enough like *Nevermind* to produce a few hit singles and, even though Scott Litt remixed "Heart-shaped Box", I think Albini did all the hard work by getting it down in the grooves in the first place. I also love The Breeders first album he did, because of the incredibly natural drum sound.'

This is one of the reasons why he chooses to do so much of his own work in Maison Rouge: 'There's a great drum sound there, which comes together really quickly with help from their House Engineer, John Smith. The snares really go 'honk' and ring out

'I'm a much bigger lover of that method of production than of the glossy, MIDI, up-heavy approach.

'I also feel there's a good vibe at that studio, and I really like those old Eastlake-designed rooms. The other reason I'm fond of it and Townhouse is that both studios have got SSL desks, which ergonomically is a very well-laid out desk. I'm quite happy to record on other desks, but I like to mix on SSL because the computer is very easy to use. Surrey Sound is another nice studio, which has a DDA desk, which again is a very clean desk with good recording capabilities.'

Street has, of course, recorded all over the world but takes a practical approach to it: 'It doesn't matter where you are, you're still stuck in front of a desk and speakers with a job to do,' he laughs.

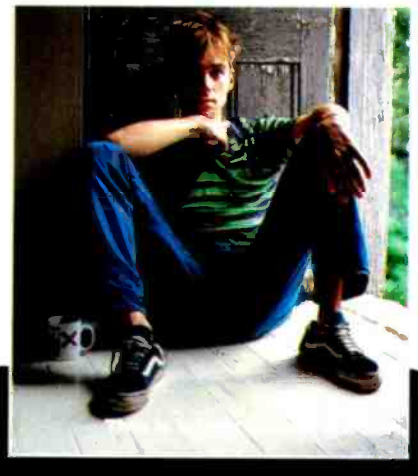
Another current project is a a live Blur album for the Japanese market. The day after this interview, he is jetting off to Tokyo to record his charges doing two nights at the renowned Budokan. So is he excited about this opportunity to record in the place where Bob Dylan and Cheap Trick recorded seminal live works?

'Blur want me to do the album for continuity, but I'm really not that fussed about it. The only pressure on me is that I'll have to report back to the band after the first night and tell them where they went wrong. I'll just have to sit back and let them give it to me and I'll deal with it later. Obviously, there'll be one or two little fixes done in the studio afterwards—I hate to admit it, but it happens.'

The Blur project won't be his first live album, as he's already done an Unplugged-style Pretenders album this year. This, he feels, was a much more worthwhile thing to do.

'I like the spate of Unplugged albums, because they actually give a new life to the songs. The Nirvana album is particularly brilliant because, for once, Kurt didn't have to scream to be heard. And Chrissie Hynde has been around for a long time now, so this works as a needy retrospective.'

He adds: 'I've just done another two songs in the studio with Chrissie in five days, which is very fast for her. It's the ☞



BLUR

BLUR ARE THE ONLY BAND that Street has ever chased. After hearing their debut single, *She's So High*, he contacted their label who sent him in to do some tracks. One of these, *There's No Other Way*, became the band's first UK Top 10, and was the start of a beautiful relationship.

Street says: 'I felt Blur were the first British band since The Smiths who were really special. But, whereas I learned the ropes with The Smiths, I was able to pass on a lot of knowledge to Blur. They so obviously had star quality, that my only job was to get it on tape properly.'

Blur frontman, Damon Albarn, was keen to get a fresh perspective on the band's sound for their second album. The band tried a few leading luminaries, including XTC's Andy Partridge, but ended up inviting Street back into the fold.

'It was only when they tried other things that they realised I had something special to give,' he says.

Now the band describe him as the fifth member of Blur; a tag which causes a few problems: 'Blur are now so successful that everybody wants to knock them and being so closely associated does put other bands off. I'm not trying to be big headed, but a lot of them could do with the benefit of my experience.'

Blur have a reputation for being a very traditional band, but Street sees hidden depths: They push out on tangents the whole time,' he says. 'A band like Oasis could never have come up with a fun disco track like *Girls And Boys*. The band put that down together as a demo, but when I heard it I knew it would have to be programmed to succeed. We programmed it up to 120bpm—the classic disco beat—but, with Graham Coxon's guitar it still sounded like Blur.

'I rarely use gimmicks, but this one was fun, and it gave them their first Top 5 hit.'

way she wants to work, after years being waylaid by producers who'd spend months putting everything through a computer.'

He's not about to get into any arguments over the varying merits of analogue and digital either, as he's prepared to see the advantages of both

'I'm right in the middle on this one,' he says. 'I recently acquired a Tascam DA-88 and use it all the time now for recording vocals, which are then comp'ed down on to 24-track analogue.

'I like analogue for cutting my backing tracks, because I really like to cut little bits of tape out to tighten things up, or to cut two different takes together.

'People often tell me that digital is better for this, because you can do off-takes and bounce from one machine to another. But if one take is great until the second verse, and the next one is better from then on, it's easier to just physically cut the two together.'

He speaks for the purist in everyone, when he adds:'That's the way the Beatles used to do it, and if it was good enough for them, it's certainly good enough for me. Digital comes into the equation when I've used up all the 24 tracks and also when I'm doing vocals and want to do a few takes and comp that back on to multitrack.'

International playboy: Morrissey

STREET'S REPUTATION has been built on working with solid, gigging bands, from The Smiths and Triffids to Blur and The Cranberries. And he admits to feeling a tinge of sympathy for those who have to spend their time with solo artists.

'If you've just got a singer to work with, there's a lot more pressure on you to pull the whole thing together. Take Steve Lipson with Annie Lennox. He did a fine job, but it must have taken a lot of preparation. Annie obviously has a great musical talent, but she hasn't got the wherewithal to put the music together.'

Street has rarely been in this situation, except with Morrissey directly after The Smiths break up. At the time, everyone felt the split was temporary, and Street forwarded some of his compositions to Morrissey as potential future B-sides for the band. But the reformation never happened, and he found himself as cosongwriter and producer.

'There was a hell of a lot of pressure on me at the time, and I ended up making myself ill through nervousness and exhaustion. But it was the big break for me, because it gave me the chance to prove I wasn't just a knob-twiddler.

'Having worked with The Smiths gave me an insight into what I could write to inspire Morrissey. I had given up bands and songwriting to engineer and produce, but if he'd asked me then to form a band with him, I would have jumped at the chance. He didn't though and, in the long run, I'm glad. But I can still look back and say I cowrote *Viva Hate*, which was a great record as well as being a number one album.'

THE SMITHS

THE SMITHS WERE the most influential UK band to come out of the post-new-wave scene, and gave Street his first break into big-time production. He was working as a house engineer for Island when the band came in to record their UK Top 10 hit, 'Heaven Knows I'm Miserable Now', and asked him to engineer.

'I jumped at the chance,' he recalls. 'I'll always remember that Johnny Marr was delighted that I knew who they were, because so many other people they'd worked with before didn't.'

As a result of his efforts, Street was asked to engineer The Smiths self-produced second album, *Meat Is Murder*. At first he felt blessed to be in the company of his idols, but he soon had to get down to hard work.

'Morrissey told me he wanted the sound of cows being murdered in an abattoir on the title track. I had to hunt through some BBC effects records of cows mooing and make up some industrial noises on my own and feed things back and put it together. I thought at the time it was too obvious, but looking back on it I can see it was great because it gave such a chilling feel to the song.'

Street was to produce the band until their demise, and still rates them as one modern rock's greatest bands and one, who despite being hailed as the saviours of guitar music, who were always willing to try something different.

'Johnny Marr surprised me when said he wanted no guitars on the opening track to *Strangeways Here We Come*: 'A Rush and a Push and This Land is Ours'. But it worked astonishingly well. And, even though they had a very serious reputation, they could get away with silly songs like 'Girlfriend In A Coma' still sounding like The Smiths.'

After the split, Street became Morrissey's cowriter and producer, with occasionally irritating results. 'Morrissey wasn't very good for helping out in the studio. He'd come in, do his vocals and leave. And he had the maddening habit of saying, 'I don't like that' and disappear without offering an alternative.'

The pair split acrimoniously but Street is glad of the lift his association with both The Smiths and Morrissey gave him: 'If I hadn't worked with the band, and co-wrote Viva Hate I'm bloody sure I wouldn't be in the position I'm in now. It showed people I wasn't just a boffin, but that I also had a definite feel for creative music.'

'My favourite band in the 80s was The Smiths and my favourite 90s band is Blur, and I've worked with them both'

The reason Street is glad he didn't jump the fence into being an artist is that he's extremely precious about his production, a fact which could well mean he'll never work with The Cranberries again.

'Myself and Dolores O'Riordan fell out big time over the last album,' he sighs. 'She demanded a coproduction credit because she'd written the string lines. And, while I'm the first to admit that all bands in some way co-produce their own albums, I just said, "So you think that's production?"'

He adds: 'A producer is someone who oversees an entire project from start to finish. It's about being there every moment of the day, not just when the singer is doing his-her own bit. The only person I'd ever consider giving a co-production credit is Damon Albarn, because he brings so much to every project. But he has never asked. Dolores issued threats through her management that she'd never work with me again if I didn't agree, and I said, "fine".'

While admirable, the thought of someone waving goodbye to millions is enough to make most of us weep. And you can be sure that many other producers would swallow their pride, split the credit and guffaw all the way to the bank. But Street is made of sterner stuff, and it's this mix of pride and professionalism that's made him one of the world's most popular producers. But even he admits to finding it difficult to listen to his work after completion.

'Ultimately I hate everything I do,' he says. 'I love it when I'm doing the mix, but a week later the doubts creep in and I think, 'why did I do that, why didn't I use that instead'. But that's because I listen to a song, not as a song, but as a series of vocals, bass, drum and reverb.'

'I get a thrill from knowing that while I'm sitting talking to *Studio Sound*, someone in California is listening to a Smiths album, and someone is getting a buzz off a Blur record in Asia. That's the kind of bloke I am; knowing my stuff is out there in the marketplace and that people are buying it gives me my greatest thrill. I will always get more excited about emotional things than the latest bit of kit.'

Street readily convinces you that he is, above all, a fan of music. Throughout he talks about being a fan of The Beatles and Nirvana, as well as most of the bands he's worked with. Modest to the end, he repeats that his success is all down to luck: 'If it hadn't been for that chance meeting with The Smiths, I don't know where I'd be.

'I've been incredibly fortunate. My favourite band in the 80s was the Smiths, and my favourite 90s band is Blur, and I've worked with both of them.' Shaking his head, he sighs softly, 'incredibly lucky.'

Golfer Gary Player once said, 'the more I practice, the luckier I get'. Surely the same applies to Street. And, for once, he lets his pride shine through: 'I go through periods of self-doubt but, at the end of the day, I must be doing something right.'

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Capturing a singer's best performance on tape is more than a matter of mics and levels—it extends to medicine, nutrition, posture and psychology. **DAN DALY** knows what producers and engineers should know about singers and it's not all conventional wisdom

Singing psychology

THE SINGER STANDS in the centre of the brightly lit recording room, her hands clasped behind her back, head pitched back, throat arched, squarely on her mark. On the music stand is a bottle of *Coke*. On the other side of 'the glass', the producer and engineer are talking among themselves; she watches them between takes. It sounds like a pretty standard vocal overdub session–but what is wrong with this picture?

Any number of things, according to a leading Nashville vocal coach, whose analysis of the scenario provides an opportunity to launch into a larger look at what it takes to make the difference between a passable vocal performance and an outstanding one. (And a rather slick transition at that, right?)

'For starters, that's about the worst position a singer could take for singing,' says Renee Grant Williams, commenting on the scene above. She is probably Nashville's foremost vocal coach and a vocal consultant to country singers including Rodney Crowell, Randy Travis and Michelle Wright, among others. Williams, whose credits include stints as one-time Director of the Vocal Music Division of the University of California's Berkeley campus, faculty member at the San Francisco Conservatory of Music and Opera Division Chorus Master at Alberta's Banff School of Fine Arts, believes body language is critical in getting a good performance and is something of which engineers and producers should be more aware.

'Most singers, even veteran ones, wonder what to do with their hands while they're singing in the studio–especially if they're used to performing live and holding a microphone. They often put them behind their backs, and that puts the natural line of the body off kilter and denies access to the natural support structure of the body. Most vocal support occurs by contracting the abdominal area. That's where the power comes from. With the hands behind the back, it's impossible to get all the power you need, and you'll lose your endurance faster. The hands should be at the sides. And you have to let the singer move around some.

'The engineer has to be prepared to ride the input fader a bit. A good singer can stay loose and flexible without there being a change in the directionality of the vocal that affects how the microphone picks it up.

'The microphone is often set too high. When you have to raise your head to sing you're putting additional strain on the throat. The best approach is to put the microphone at lip level, then move it downward about a half-inch. If the singer is using proper breathing techniques, there will be a slight contraction in the abdominal section which will have them bending forward slightly.'

So much for posture and mic placement. But Williams can be just as intense when it comes to nutrition. 'Soft drinks often contain lots of sugar and caffeine,' she says. 'Caffeine dries a singer's throat out quickly, as well as give you a productivity spurt that causes the overall productivity of a session to decline faster as the rush wears off and exhaustion replaces it. Don't think about milk,' she adds; 'it's mucus-producing and some people are not aware that they are mildly allergic to dairy products in general, which also hasten mucus production and fatigue.'

Instead, she suggests warm water with lemon and honey. And if the throat gets scratchy during the course of the session, she advocates relaxation. Singers should also avoid 'quick fixes' like sore throat lozenges, which mask irritation and can let the source of it cause actual damage to the throat as they anaesthetise it. Then comes the environment.

'Studios are usually pretty well air-conditioned–mainly for the comfort of the equipment, not the singer. I recommend that vocalists bring a sweater or a scarf for the throat to sessions even in the summer.' Williams believes that this will help delay the contracting effect that cold air can have on the moist membranes of the throat.

Finally, there is the psychological effect on a vocalist, isolated in a sound-proofed environment, able to watch the producer and engineer who have his or her career in their hands–talking, gesturing, possibly laughing. Laughing? Laughing about what? Until that talkback button is pushed, every insecurity that goes into being an artist starts working overtime. (It is inevitable that something funny that happened to one of them that morning; if your producer and engineer are laughing at your vocal while you're in the studio singing it, it's definitely time to question your choice of a technical-artistic support team.)

'Communication is incredibly important,' stresses Williams. 'Try to let the singer in on as much as you can about what's going on in the control room.'

So what seemed like a fairly routine recording scenario can be quite complex when viewed from another perspective. And in talking to Williams and to a few noted engineers and producers on the subject, it becomes apparent that all those articles about how to select vocal microphones only scratched the surface of what there is to know about recording them.

A RECENT SURVEY of engineers and producers superficially yielded the more common nostrums of achieving (or in some cases, extracting) vocal performances: after a choice of microphone, mess around with the room lighting (something Kit Lambert, manager-producer of early Who recordings, took to the level of performance art–he put on veritable light shows with the rheostats to get Roger Daltrey's screams just right), periodic enquiries of how the singer feels, and so on. But upon reflection, some other specific techniques came to light that, collectively, could add a chapter to this aspect of recording.

'I want to know the quirks in a singer's voice before I get into the studio with him,' says Rob Feaster, on a break from engineering and producing The Sky Kings for Warner Brothers Records. Feaster, who has engineered recordings for Travis Tritt, Living In A Box and The System, finds attending live performances in anticipation of starting a recording project quite useful in evaluating what a singer is like.

'How he sings live is a good indication of how he approaches vocals, so I think you should go see a gig before starting,' he says. 'Make mental notes about where he's comfortable in relationship to the microphone. Another thing I've found that makes people comfortable is to sing any part changes or corrections to them yourself. It puts you on the same plane as the singer. It builds a rapport with them like nothing else can sometimes. See–we're in this together.'

One more insight from Feaster lies in building the cue mix. While most engineers consider the headphone mix a critical component of getting a good vocal–or any other type–of performance,

Feaster's approach is deconstructive: he'll build a mix in the headphones, then sometimes take it apart piece by piece until the vocalist has a track that he or she can relate to at the moment, even if it's completely different that what the basic track recording was or will become.

'Some of the best rock vocals I've ever gotten have come after I've cut the tracks in the headphones down to as little as an acoustic guitar,' he says. 'Any variable you can come up with is fair game. And sometimes it's amazing what it sounds like when you play the vocal back against the full track.'

David Leonard has engineered for John Mellancamp, Dwight Yoakam and Indigo Girls, among others. He, like other engineers, makes increasing use of cue systems that put the mixing up to eight discrete tracks of a song at the fingertips of the singer. On a recent project, one of those eight included a channel of reverb tapped off an aux send on the desk, allowing October Project vocalist Mary Fahl to control the level of effect on her voice.

Upon reflection, Leonard realised the degree to which he customises sessions for vocals, depending upon the nature of the vocalists themselves. 'Mellancamp will stand there for eight hours straight singing, as long as the band is playing,' he says. 'Ninety-five percent of his vocals are done on the tracking sessions. He needs to have good visual contact with the rest of the band, and now that he's producing himself, he doesn't need quite the same degree of visual communication with the control room. On the other hand, if he's overdubbing vocals, he wants to spend as little time as possible doing that.

'With Indigo Girls, they play acoustic guitars while doing their vocals in the studio, the same way they perform live. That's the gist of their performance character; you can't separate the two. It's the only way to get the dynamic from them. So you have to accept leakage of the acoustics into the vocal tracks. And when you comp the vocals, you have to look for comps that have matching guitar playing. It makes it harder, but that's what you have to do to get a good vocal performance in that case.' Which, he adds, was less of a problem than recording vocals for Bette Midler, an artist Leonard recorded earlier in his career. Midler did not want to be seen as she sang, so she requested–and got–blinds to cover the glass between recording and control room. And Leonard himself was asked to leave the room for The-Artist-Formerly-Known-As-Prince's vocals on *Purple Rain, 1999* and *Around The World in a Day*; TAFKAP preferred to do his own punching in solitude.

'You'd patch him in, get levels and then leave him alone,' Leonard recalls. 'He'd call you if he needed to change tracks or something.'

Speaking of bizarre vocal sessions, Nashville Engineer-Producer John Guess, who produced two records for Linda Davis and has engineered for a broad array of country acts including Patty Loveless, recalls an early session in California with Glenn Campbell, in which the Rhinestone Cowboy asked him to turn out the lights in the studio for his vocal sessions. After listening curiously to some thrashing about in the darkened room and then some strange-sounding takes, Guess went to investigate and found Campbell flat on his back doing vocals. 'He said he could breathe better that way,' Guess remembers with a laugh.

AS SOMEONE WHO works both as a producer and an engineer, Guess sees different requirements for each role in eliciting good vocal performances. As a producer, he thinks the most important thing is that the artist be intimately familiar with the song, not as unusual a concept as one might think in a place like Nashville, where songs and artists are often put together at the last minute.

'It takes time to develop an interpretation,' he says. 'And that's the time during which a performance is developed.'

As an engineer, Guess' decisions revolve around microphone choices and cue systems. But he always builds a careful mix in the cue before presenting it to the artist, even if they'll have their own control over it with an in-studio cue system later.

'The 'phones can be deceiving,' he says. 'The first time an artist hears the track over the headphones can make a difference in how they approach the vocal.'

The division of responsibilities between producer and engineer on vocal sessions is clear from both points of view: the engineer's role is subordinate to that of the producer when it comes to aesthetic decisions. All the engineers I talked to indicated that they always defer to the producer in terms of what gets kept and what doesn't, and they are definitely diplomatic when it comes to making suggestions that cross the line from technical to aesthetic. But the producer's position often allows him or her to clear out of the room and clear the ears more often than the engineer or singer can. That means many of the minute-by-minute mechanical aspects of the sessions are abdicated to the engineer. Pitch problems are a prime one. When he begins to encounter them, and after he tries the usual techniques like asking a singer to take one side of the headsets off, Guess starts to pull out or lower the fretless instruments in the cue mix, such as steel guitars or violins. Their portamento characteristics can often lead vocalists' pitch astray. Other subtle things he's noticed in the cue mix is the potential for certain reverb reflections to cause chorusing of the effect, again leading to unwitting pitch variations. Renee Grant Williams cautions that pitch problems often signal that a singer is tiring and needs a break. Aside from rest, though, she offers a corrective in the form of a smile.

'If someone's starting to go flat, I've found that simply asking them to smile –whether they feel the emotion or not –shifts the pitch right back up,' she says. 'It's something muscular, the way the voice lifts as the facial muscles do. It really works. You can actually hear a smile on a song.'

However, one attempts to correct pitch, remember that it's as much a source of pride to a vocalist as tone is to a sax player. Diplomacy is a 24-hour characteristic. 'The first time I ever did a vocal with Rod Stewart, on his *Camouflage* record, I remember saying to him that he wasn't singing as sharp as I thought he usually did,' recalls John Guess. 'That drew a stare at me from him. No one had ever said that to him, that he had this tendency to sing at the top edge of the note. I felt funny about it, but he focused right in on it and then he was in fine form.'

SEVERAL ENGINEERS and producers told me they now worry less about getting a single perfect performance than about assembling as many complete takes as possible and comping them together later.

'The main thing is that this allows you to focus on the positive aspects of the performance,' explains Mike Poole, whose *oeuvre* ranges from the traditional country of Radney Foster and Pam Tillis (on whose latest recording he is Associate Producer) to the fashion-forward country of Canadians Prairie Oyster. 'Going for complete takes is a more holistic way of recording vocals. It encourages the singer to take some chances and sing a song all the way through without worrying about each individual note. You can assemble the vocal later.'

This doesn't mean the engineer's work all comes later, though; Poole says he is always trying to anticipate fader rides, boosting and cutting words and phrases on each comp track as he records them.

One last area that engineers should consider in looking for performances rather then just recordings is the run-up to punches. David Leonard makes a point of staying out of input until just before the punch itself, giving the vocalist as much track with vocal as necessary to stabilise pitch and timing. On the other hand, according to Renee Grant Williams, too long a run-up will exhaust the singer and increase anxiety. One suggestion is to use as many location storage points as your machine remote will allow; you won't get every spot each time and it often makes sense to pass on a difficult one and come back to it later. With its location stored, you'll be back to a familiar point for the vocalist in the song. And finally, say few engineers, don't be afraid to blow off an entire session if the singer's voice simply isn't up to it. It's a difficult decision, but one that can save time, money and a record in the long run.

Vocals are possibly the most intense aspect of recording music. The manner in which engineers and producers have approached them are appropriately complex and, as we've seen, go far beyond the common wisdom of simply making the singer comfortable. If the experiences container herein can be distilled, the two main results would be: be willing to be sensitive and responsive to the nature of the singer, and accommodate that as much as possible; and to keep communications open during the sessions as much as possible. If you're going to crack jokes on the other side of the glass, let the singers in on them. They need a laugh, too.

New measurements allow meaningful differences between speaker cables to be seen. **BEN DUNCAN** tests a selection of cables and reports some eye-opening results with genuine implications for professional studio monitoring

The cable connection

EVEN IF YOU'VE only glimpsed at the contents of hi-fi magazines in the past decade and a half, you are unlikely to have missed seeing reviews of exotic cables. Even in pro-audio magazines, there is the occasional mention of special cables for audio. In domestic hi-fi, line-level cables have been renamed interconnects. This magnifies mystique, and legitimises the high prices, yet it's a redundant word, as electronic connections have to be 'inter' for anything to happen at all. Meanwhile, the permutations of conductor and insulator qualities, constructions and aesthetics are immense. So are some of the prices, as exotic speaker cables cost up to £100 (UK) —or more—per metre.

While hard-line objectivists cried 'Fraud!', in an open session at the Institute of Acoustics' Reproduced Sound conference in 1990[1] Dr Keith Holland and Philip Newell used a custom subtracter-amplifier to make cable losses and errors audible. In some monitoring systems, cables costing more than the amplifiers may well be justifiable. Still, purchase would be less worrying for professionals if there was evidence of some kind of progressive, price-linked merit. Instead, as almost anything you do differently with cables changes some aspect of sonic quality in any system having sufficient resolution, there is an almost random diversity in audio-grade cable constructions and little (if any) in the way of coherent, solid justifications for the different approaches. It is salutary to learn that long-term listening tests[2] can have a low-price speaker cable ranking second against highly expensive types. A number of makers (particularly in the US) hide their ignorance behind the misuse of impressive-sounding but almost meaningless phrases like 'time compensated' (try delay-compensated) and 'phase noise' and 'phase coherence'.[3] Many manufacturers simply copy. Such products can sound better in particular ways and in particular instances but the real innovators are few, and those who really have a handle on what they are doing, even fewer.

ABOUT 20 YEARS AGO, a few perceptive people noticed differences in the depth of bass, or resolution of vocal detail when different cables were substituted for the 'bell wire' and 0.75mm² mains cables that were the norm for speaker wiring in homes and recording studios respectively.

Having discovered that wire matters, an early approach was to use much thicker wire, as an aid to damping. This reduced inductance, enough to make a marginally stable, badly designed and generally flaky amplifiers 'go RF' and expire. The ensuing panic and apparent noncommunication between cable experimenters and amplifier designers explains the *raison d'etre* of low capacitance, 'spaced-eight' (O-O) speaker cables.

Over the past decade, the ideas of some original thinkers as to how loudspeaker (as distinct from line) cables should best be made to transfer audio accurately, have converged in the opposing direction. In a 1991 AES paper on cables,[3] down-to-earth US Audio Consultant Fred Davis attacked the ideas of cable makers that factors explicit at RF (notably characteristic impedance) were of any relevance over the length of any practical speaker cable runs. By modelling the speaker's energy storage (alias reactance), he demonstrated that even cable resistance was not the most critical parameter. Instead, the cable's series inductance was the keynote. Moreover, he argued that shunt capacitance across the cable had no influence and that contrary to popular opinion, very high values would not cause HF loss. The same conclusions were arrived at independently by Swedish- ☞

THE TEST GROUP

THE VARIETY of cables tested alongside the Supra Ply (D) includes examples of generic types that are universally used or accessible (A, B, C), or easily made up (E, F). Other purpose-made audio-grade cables (G-X) were needed to contrast against. They had to be practical and immediately wireable—many audiophile cables are not. In A-Z order:

A: 'Bellwire' is 0.5mm² CSA comprising 16 0.2mm (16/0.2) strands of plain copper in an oval sheath, alias '2192Y'. Commonly used for table lamps as well as low-budget speakers.

B: 'Connectronics' is this maker's plain, 2.5mm CSA 2-core in a heavy, circular PVC sheath, with about 30 strands. Made for speakers, rugged enough for touring, it is like a 20A mains flex.

C: 'Monster Cable' is the LF section of the budget bi-wire speaker cable, sold by Harman UK for install, in 1991. The measured conductors comprise at least 100 thin strands of OFC totalling about 2.5mm CSA, cased in transparent, soft, circular PVC, with a black, rippable, circular PVC sheath. The unused HF conductors are a thin solid core, not unlike like Cable 5. They are inside the sheath but were wholly unconnected during tests.

D: Jenving's Supra Ply 2.0 comprises 240 tin-plated strands totalling 2.0mm² CSA that are above 99.9% OFC, in a rectangular, maximum capacitance profile. The quite thin, 'Ice Blue' PVC insulation is specially stabilised, that is emission of chloride ions is low. The overall transparent sheath is ordinary PVC.

E: Twisted 0.5mm² solid-core wire. PVC insulated with no sheath, and twisted about 1 TPI. The diameter follows a theoretical optimum for low-dispersion audio transmission developed by Dr Malcolm Hawksford, as originally published in *Hi-Fi News*[7].

F: Twisted 1mm² wire, comprising 32 strands of plain 0.2mm, PVC insulated and loosely twisted about half TPI, with no sheath.

G: Sonic Link, AST-150. Comprises 30 strands of 0.25mm tinned copper, insulated and sheathed in silicone rubber. The sample was blue. Similar physical characteristics to an arctic-grade, 2-core, 1.5mm² mains flex, that is dressability is a notch above common PVC.

H: Sonic Link, 3-core, audio-grade, mains cable. The third core was not connected at all. A 2-core version is usually available. Each core comprises 19 thick strands of 0.25mm silver-plated copper, with PTFE insulation—including a thin but extremely rugged sheath. Doing much stripping would be taxing without special PTFE strippers.

THE JENVING APPROACH

TOMMY JENVING has been making special cables for audio in Sweden since 1976, beginning with a chunky speaker-cable, Supra 2.5. The idea of Supra Ply came more recently, and laterally, through developing and patenting a shielded mains cable called Supra Safe. The idea was to protect studio equipment and humans alike from 50Hz (60Hz) AC fields. While researching into reducing power-line radiation, it was found that low inductance was the key, and that high cable capacitance was unimportant. Realising that the pulsating, high-peak current flow conditions in speaker cables are similar to mains wiring into DC power supplies, Jenving was able to ask: 'Why are exotic speaker cables made with low capacitance as a main feature, and consequent high inductance?' The answer seemed to be that such wares are fundamentally of wrong design, even if some second and third-order details are accomodated.

Unlike almost any other cable maker, Jenving has no trouble clearly outlining the logical design philosophy of Supra 2.0 in plain English. A number of other cable makers—such as Kimber and Goertz in the US—have converged on much the same minimum inductance approach, but their products use more exotic, ultra-costly materials (such as over 99.99998% pure silver) and they are oddly unable to explain their approaches so coherently. Jenving divides relevant parameters into the 'dynamic' (stuff that varies with frequency) and 'static' (the stuff that doesn't).

Cable resistance that is low relative to speaker voice-coil resistance is essential for good damping but as the test results show, it is only the beginning of the story. Characteristic impedance is also frequency invariant—but its relevance in the audio range is truly negligible, even at ultrasonic frequencies and over the silly lengths used for flying PAs.

Turning to the 'dynamic' parameters, namely capacitance and inductance, Jenving reminds us that the two work in opposition; minimise one and the other will rear-up. The frustrations of cable design are hidden until skin effect (including the related proximity effect) is recognised. This works like extra inductance—an added, rising resistance with frequency. It occurs because locally circulating 'eddy' currents in conductors cause the apparent inner core resistance to increase with frequency, such that the skin of the conductor appears to have the least resistance to current flow. Using the embankment of the M25 motorway to overtake the world's biggest orbital car park is a tempting analogy. The counter-intuitive outcome is that fat, low resistance conductors develop unexpectedly high resistance both at high audio frequencies (above 2kHz) and to transients.

Some cable makers try to overcome this by paralleling thin and fat wires. The Jenving approach is to use zoned tin plating to progressively increase the (DC) resistance of the conductor towards the outside. The higher resistivity of tin largely defeats the skin effect (so that a high CSA conductor can be used without transient and hf losses and errors), while its relative inertness prevents oxidation of the (almost) oxygen-free copper conductors. The cable is completed with a covering of special PVC having low emission of corrosive Chloride Ions. Although many audio grade cables use notionaly superior insulators and conductors such as PTFE and Silver, such niceties seem irrelevant until basic details are mastered. Previous extensive testing by Colloms[6] certainly shows that cable sonics has had little corroboration with the mere excellence of the materials.

based Tommy Jenving, who proceeded to make the idea reality (Sidebar 1).

THE TESTS OUTLINED here for the first time, arose out of a challenge—to validate the claims made by Jenving. Leading up to this, MicroCAP IV (PC-based) simulation of loudspeaker-amplifier interfaces had already been used to demonstrate energy 'tails' when a stimulus stopped. Taking this into 'realspace', the Dual Domain version of the Audio Precision test set has a DSP-based FFT-test routine which allows sine waves to be graphed over time (**Fig.1**). It is analogous to using a storage scope or performing transient analysis with a simulator. **Fig.2** shows a pair of 1kHz sine tone bursts, in a 6ms window, offset vertically for clarity. In the measurements that follow, these tone bursts will be the stimulus at the driving end, and signal received at the destination end, of the Cable Under Test (CUT).

Fig.3 shows the test setup. The signal is read at both ends of the CUT. This poses at least one awkward question: what cable to use for these sense connections? On one hand, they are each about 1.9m long and their own reactance can be expected to affect the results. On the other hand, as sense cables, they are not passing any appreciable current. This explains why the 'obvious' course of using the CUT for sensing too, was not adopted—since according to Jenving and others, the optimum cable characteristic for the sensing or line level condition is the opposite. The sense cabling was partly isolated with stand-off resistors whose value is governed by the need to:

(i) maintain a reasonably low source impedance in the sense cabling;

(ii) not increase the AP analyser's noise floor unduly;

(iii) not unduly degrade the analyser's CMR.

Sample rate:	192kHz
Steps:	377
Trigger:	free running
1kHz & 125Hz test conditions	
Test level:	+1.63dBu/0.93v*
1kHz MSR:	2 on, 4 off
125kHz MSR:	2 on, 6 off
15kHz test condition	
Test level:	-3.4dBu/524mv*
15kHz MSR:	2 on, 4 off

* as applied at the loudspeaker end of the CUT

Fig.1: AP test settings

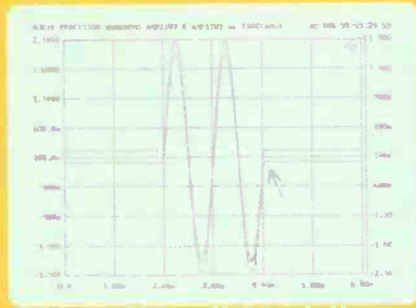

Fig.2: Two test tone-bursts. In figs.4–28, the arrowed area is magnified about 25 times

To keep CMR > -80dB, 10-year-old (hence stable) Holco metal-film resistors in each pair were matched to better than ±0.006% at room temperature. For all the tests, the sense cables were identical lengths (within ±2%) of identically coloured Musiflex cabling, taken off the same reel.[4]

Optimum cable placement in a crowded lab required some lateral thought. First, the CUT needed to have both ends relatively near one another so that the sense cables could be the same length without coiling or folding. But the tested cable could not be tied back on itself as this would cancel some inductance, and would not represent a real condition of use. Second, the CUT had to be kept away from other parallel cables, EMI sources (any one of three PCs and VDUs) and any substantial areas of ferro-metal (such as steel test-equipment casings) to avoid warping the immediate electromagnetic

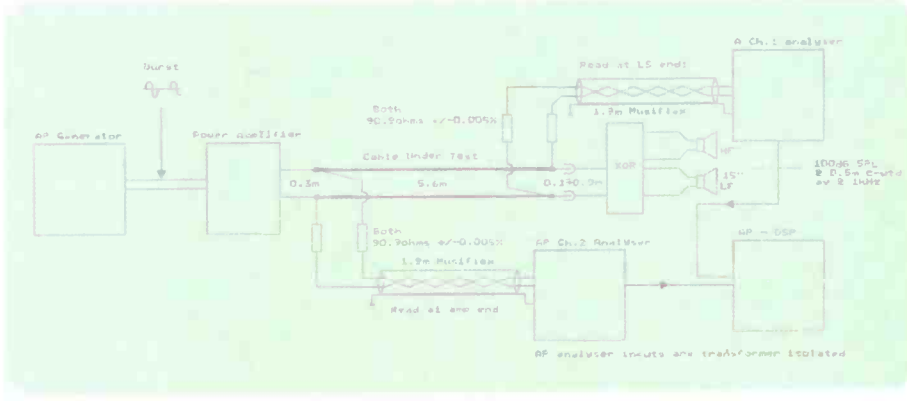

Fig.3: The test setup uses standard DSP-aided test equipment from Audio Precision

Mum – there's 455 missing!

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Studio Sound

Table 1	
Supraply	0.7
Connectronics	0.8
Sonic Link blue	1.0
Sonic Link mains	1.3
Twisted 1mm	1.3
Monster	1.5
Bellwire	1.6
Twisted 0.5 solid	3.6

environment. Repeat positioning is then less critical. The solution was to hang the cable from a wooden roof beam. The cable's n-shaped length (2.2m up, 1.1m across and 2.2m down) was then well distanced from compromising influences, as well as being mainly orthogonal to them.

The loudspeaker chosen for testing was a modern, full-range, 15-inch, dual-concentric, made by Tannoy. The load included the associated, high-quality, 2-way passive crossover, developed by designer Mark Dodd to 'high end' standards. Inductors are all air-cores, and capacitors specially chosen and modified polypropylene types. The 0.9V rms test signal used for the LF and MF testing, while enough to develop 100dB SPL at 1kHz and 0.4m, represents only 0.125W into the nominal 8Ω. The higher excitation required by the majority of less efficient monitors—as well as by the majority of more SPL-hungry monitoring-users—would seem likely to increase any differences.

The rising impedance versus frequency of the modest 150W, 8Ω per channel lab test amplifier (which has a conventional 2-pair MOSFET output stage followed by a small, <1μH air-core output inductor) and the speaker-crossover combination, are considered typical of their genre, and invariant. Variations in contact resistance are of concern, so reputable (European and US) XLR connectors were soldered to both ends of most of the tested cables. All visibly tarnished pins were cleaned with alcohol. Connections were made with the test signal muted, to avoid degradation by arcing. Some cables had cores that were too thick for solid termination. Others arrived with high quality 4mm bunch-pin plugs ready fitted. These were plugged into short (6-inch) 4mm-to-XLR conversion tails, made with the same heavy PTFE wire as the Y-splits.

FOR ANYONE UNCONVINCED that loudspeaker cables can affect music reproduction and equally for those who can readily perceive differences but have given up hope of measuring them, here at last are some easy-to-grasp pictures of what's going on. Each graph is a magnification of the point immediately after the sine wave burst stops—as arrowed in **Fig.2**. Ideally, there would just be a resumption of a straight, central, horizontal line. But cables, passive crossovers and speakers are all energy-storage devices—ranked in order of ascending energy storage.

In theory, the stored energy should be clamped right down on and gotten over with quickly, by virtue of the high NFB still used in most professional power amplifiers —the test unit included.

THE FIRST TEST is with a 1kHz burst (**Fig.4–Fig11**). In each graph, one response is almost flat. This is always the more tightly controlled response at the amplifier output. Deviations here indicate deficiencies with the amplifier's NFB control. The other, wilder or more wavy response is the imperfect damping at the speaker end. The different sizes directly show the ability of the cables to aid the action of the amplifier's NFB. The ranking (based on the distance between the first negative impulse and subsequent positive peak, in grid units and rounded to two significant figures) is shown in **Table 1**.

In this and all subsequent tables, the top of the list indicates best performance. Notice that even at this midrange frequency, the damping-in-time varies. For example, the purpose made top two cables have clearly damped to a low level after the first three half-cycles, whereas with some of the others, a distinct gap remains well after the third half-cycle. Also, the negative peak excursion is considerably smaller than the positive in some (bell wire and solid core), where the difference between successive half cycles of damping is less pronounced for the Connectronics and Supra Ply. As these two apparently present the smallest or else shortest 'damping demand' on the amplifier, the difference may be accounted for by the NFB needing to act less. A curious feature—considering their physical differences—is the peaking similarity between the Monster Cable and bell wire.

HF testing was carried out at 15kHz (**Fig.12–Fig.19**). In all cases, the signal shows large but well damped ringing at the driven end. This is a common power amplifier imperfection. Notice how much the peak amplitude of the larger of the two plots—which is always the signal at the speaker end—varies. Again, ranking (**Table 2**)

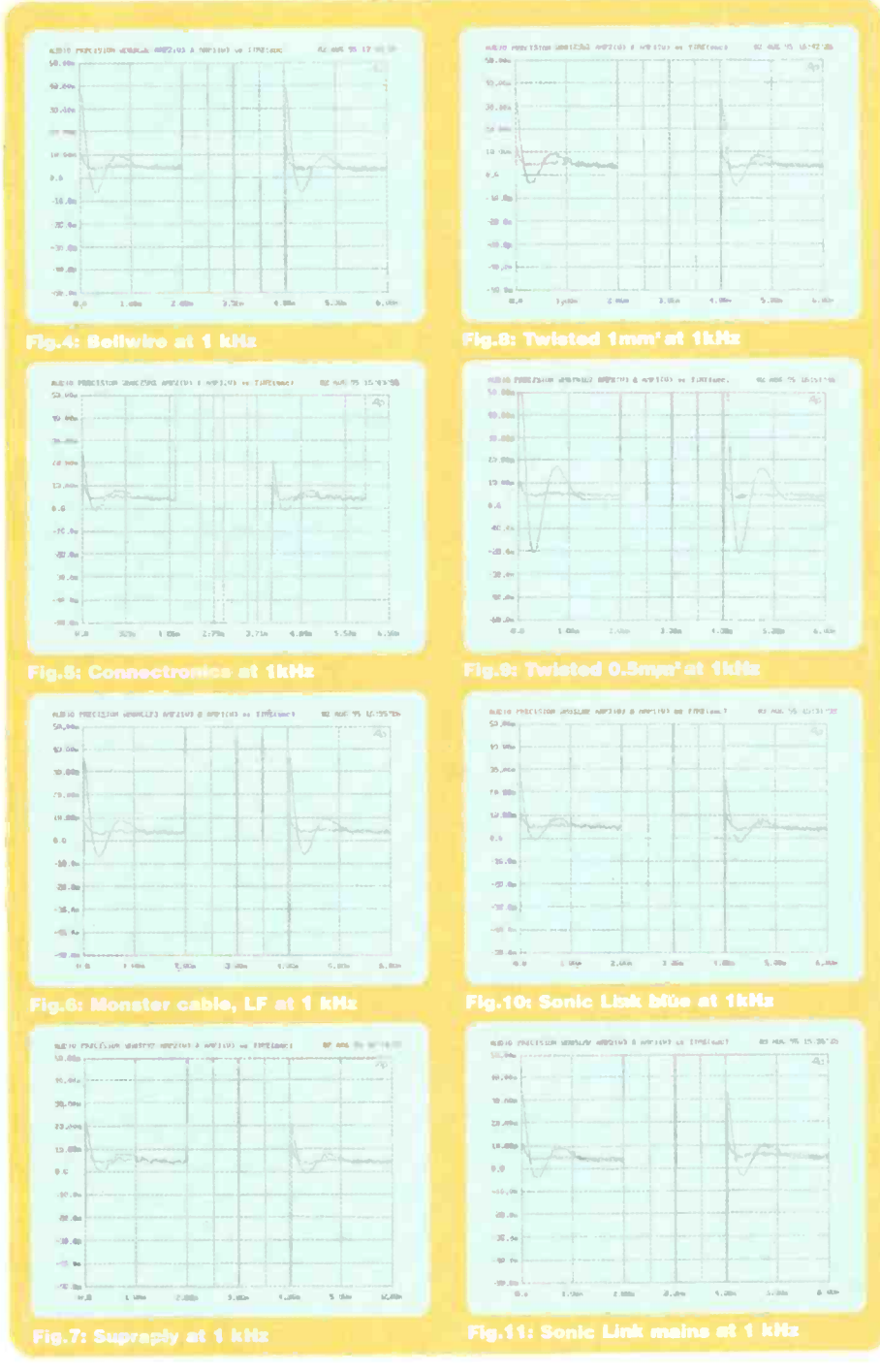

Fig.4: Bellwire at 1 kHz

Fig.8: Twisted 1mm² at 1kHz

Fig.5: Connectronics at 1kHz

Fig.9: Twisted 0.5mm² at 1kHz

Fig.6: Monster cable, LF at 1 kHz

Fig.10: Sonic Link blue at 1kHz

Fig.7: Supraply at 1 kHz

Fig.11: Sonic Link mains at 1 kHz

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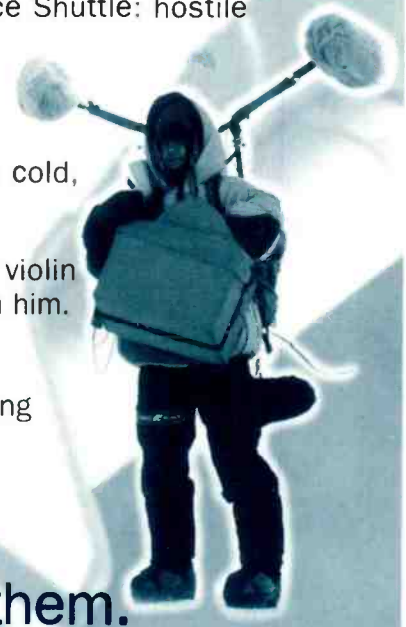

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Table 2	
Supraply	5.7
Sonic Link blue	5.8
Connectronics	5.8
Twisted 1mm	6.0
Sonic Link mains	6.1
Monster	6.2
Bellwire	6.2
Twisted 0.5mm	7.0

Table 3	
Supraply	1.0
Connectronics	1.3
Sonic Link blue	1.6
Sonic Link mains	1.7
Bellwire	1.8
Monster	2.0
Twisted 1mm	2.0
Twisted Solid 0.5mm	2.1

is based on the difference in grid units between the first and second half cycles. Surprisingly at such a high frequency, some of the fat, low resistance cables are damping best—if not in the order one would predict from their CSA.

As the ranking method is *ad hoc*, you may ask what happens if it is changed?

In **Table 3**, the ranking is the difference between the send and receive waveforms, with the cable having the least overall difference first. Again the difference is in grid units: Testing next at 125Hz (**Fig.20–Fig.27**), the spread is similar and no less interesting. The best damped ranking, again based on the vertical grid units between the first two half cycles is shown in **Table 4**. Notice that at the point where the sine wave starts again, the destination signals in the bell wire and 0.5mm solid-core cables have not wholly reconverged on the drive signal (look for the tiny gap), demonstrating not just poorer damping, but also excess

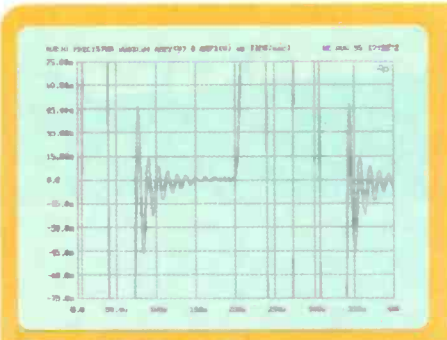

Fig.12: Bellwire at HF

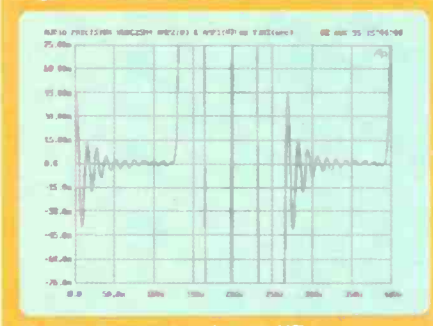

Fig.13: Connectronics at HF

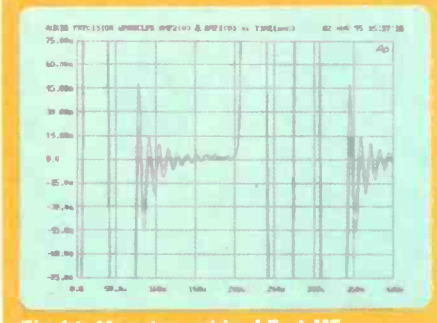

Fig.14: Monster cable, LF at HF

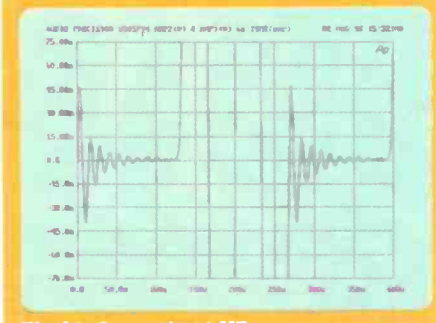

Fig.15: Supraply at HF

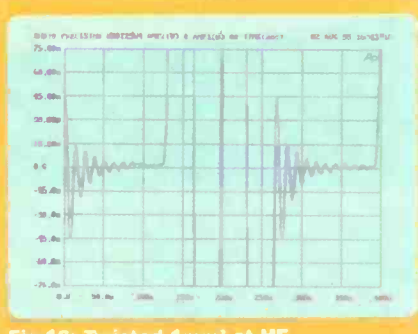

Fig.16: Twisted 1mm² at HF

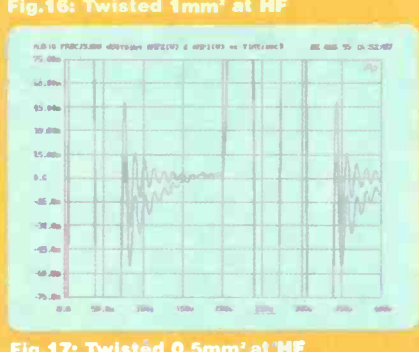

Fig.17: Twisted 0.5mm² at HF

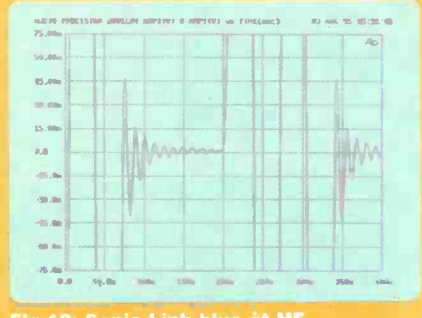

Fig.18: Sonic Link blue at HF

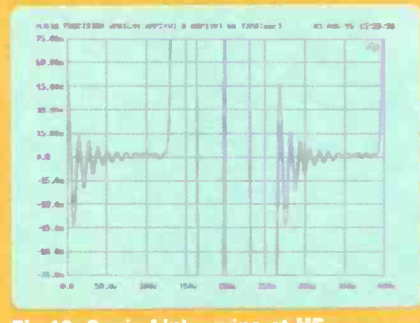

Fig.19: Sonic Link mains at HF

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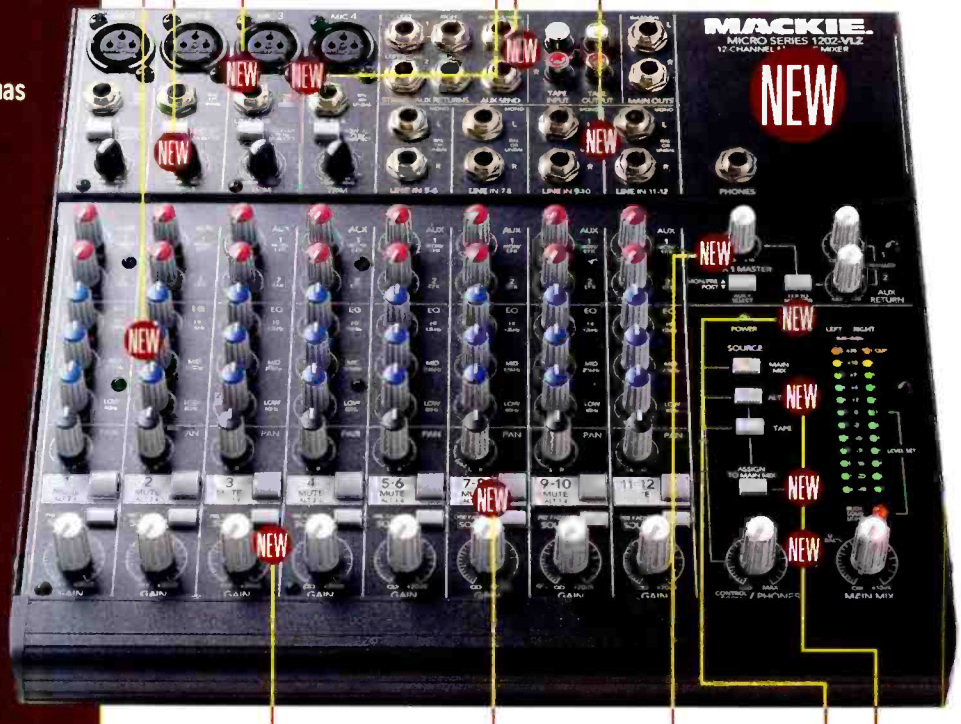

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CAVEATS IN THE REAL WORLD

THE 'BEST' SPEAKER CABLE for a given situation is a complex issue—even without advertising hype and misinformation. If your power amplifier turns into an RF oscillator because it cannot handle high or even modest capacitance (and some otherwise reputable designs an easily do this), you would likely find the sonics better with a lesser (but less capacitative) cable. If no one bothers to check for RF, using suitable equipment (at least a 35MHz scope), entirely wrong sonic decisions can be made. If RF occurs, then to use the low inductance cable that speakers need, you should consider:
(i) having the amplifier 'put down' to maintenance stock or sold;
(ii) having the amplifier re-engineered for proper stability, using parts costing as little as £20;
(iii) less drastic, moving the amplifier(s) next to (or much nearer) to the monitors, so the cable capacitance (which is always a product of length) is slashed.
Another pitfall is with valve amplifiers, and also transistor amplifiers with zero or low overall negative feedback. Their damping can be so poor (far worse than the situation seen in Figs.12-19) that the cable's damping differences documented here may be swamped, again leading to a different optimum.

dispersion or sluggish settling—and likely differently at other frequencies.

A NATURAL FOLLOW-ON question is 'How much are these results down to the cable's own characteristics, as opposed to the speaker's?' In **Fig.28** and **Fig.29**, the worst and best performing cables were connected to an 8Ω, 1kW-rated test load that is almost purely resistive. Now the differences are smaller—but still clearly discernible on this scale. So we may conclude that cables do exhibit measurable energy storage, but that a speaker's own energy storage usually swamps this.

Next a control was run: the best performing cable was reconnected the next day and replotted. Repeatability was very close. Small differences are due to the finite

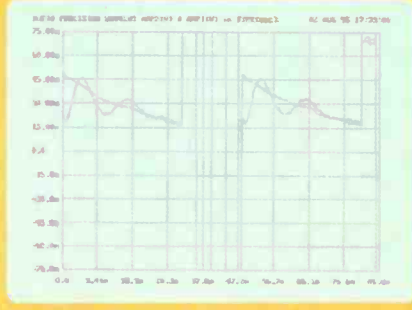
Fig.20: Beliwire at LF

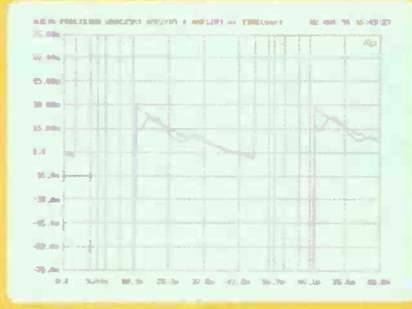
Fig.21: Connectronics at LF

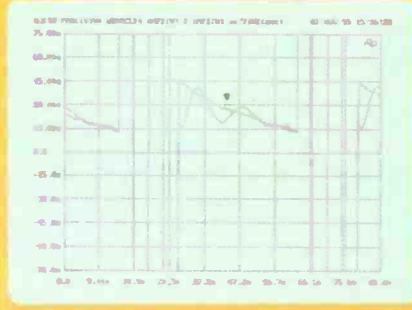
Fig.22: Monster cable, LF section at LF

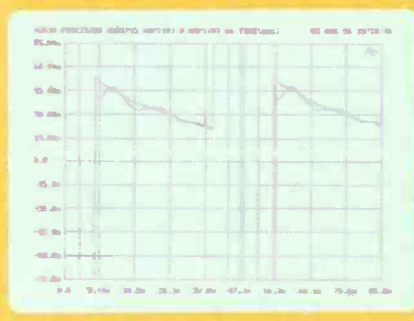
Fig.23: Supraply at LF

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Table 4	
Supraply	0.4
Connectronics	0.6
Sonic Link blue	0.8
Sonic Link mains	1.4
Twisted 1mm	1.4
Monster	1.7
Bellwire	1.8
Twisted Solid 0.5mm	4.8

Table 5	
Supraply	0.5
Sonic Link blue	0.35
Twisted 1mm²	0.7
4mm² 2-core mains	1.25
Monster cable	2.1

Table 6	
Supraply	1.0
Sonic Link blue	1.1
Twisted 1mm²	1.3
4mm² 2-core mains	1.7
Monster cable	2.2

certainty of the FFT and screen pixels, and variations in contact resistance in both the XLR connections and the AP's relays. One more test demonstrated that the differences hold in an active system—where the speaker cable connects (almost) directly to a drive unit. Rather than radically change the test conditions, the test speaker was retained, but its internal passive crossover was bypassed and the LF section of the dual concentric was directly driven. The existing two internal runs of lightly twisted 32/0.2 PVC-insulated wiring was replaced by one run of the same 0.6m length of a similar wire. Testing was at 125Hz and 1kHz. As direct connection to bass drivers usually relates to high-power systems, the thinner cables were not retested. Instead, chunky 4mm² 2-core mains flex as widely used in PA and installs was added. The AP plots are omitted as they are so similar to those shown already.

At 1kHz the numeric ranking is as follows, again based on difference between the initial positive peak at the speaker and amplifier end (**Table 5**).

At 125Hz, the difference between the first positive and second negative peak at the speaker end is expressed in grid units. Notice how some of the differences in **Table 6** are numerically reduced without the crossover's energy storage to battle against.

LARGE DIFFERENCES between different cables connecting a loudspeaker driven with a discontinuous signal (representing a music transient) has been demonstrated clearly for the first time, using industry-standard test equipment and without recourse to exotic techniques. At 45mV relative to 1.3V peak drive, alias

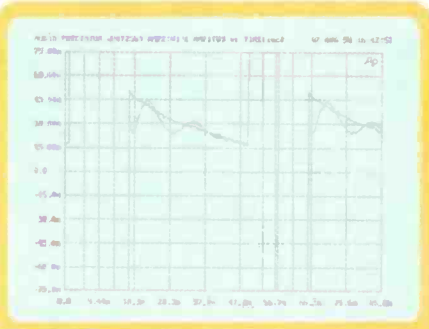

Fig.24: Twisted 1mm² at LF

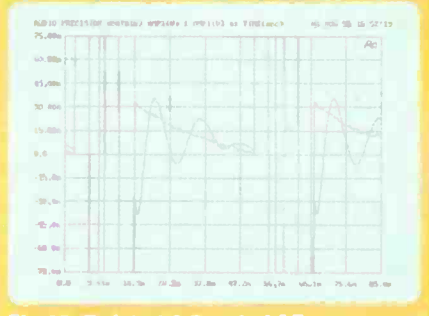

Fig.25: Twisted 0.5mm² at LF

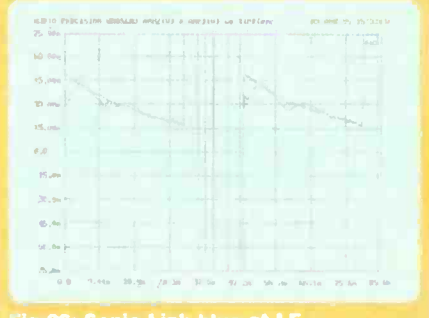

Fig.26: Sonic Link blue at LF

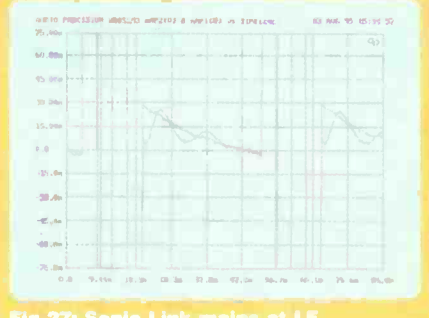

Fig.27: Sonic Link mains at LF

-29dB down—or one part in 28—the size of the largest perturbations is surprising.

With the best-performing cables, perturbations are reduced to about 1/10th of this, or -50dB down. Hence the measurements show how cables expressly designed for audio, *and in particular* for speakers, can improve damping perturbations by at least 20dB. Settling time is also shortened with the better cables. The results clearly demonstrate the limitations (at least with a full range speaker) of the conventional, simplistic approach of using the fattest wire, as well as the futility of using a thin solid core[5], on the grounds of damping. The results also illustrate the logic of making special cables for mains—considering that mains current into any DC power supply is a burst waveform, much as simulated here.

It is clear from the tests that Supra Ply is a star performer, as claimed. Against a wider range of audio-grade cables, it would be unsurprising if one or two of the other low inductance types were strong competitors. But the point of this article is simply to show that cables do differ measurably in ways that relate to music. The measurements provide a way of short-listing serious contenders and eliminating 'spaced-eight' cables from serious consideration, after which readers must make their own decisions based on cost and relative sonics in the context of their monitoring system(s).

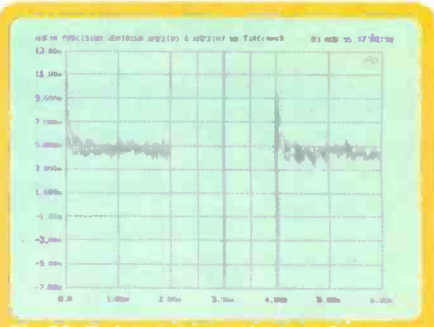

Fig.28: Twisted 0.5mm² into an 8Ω resistor

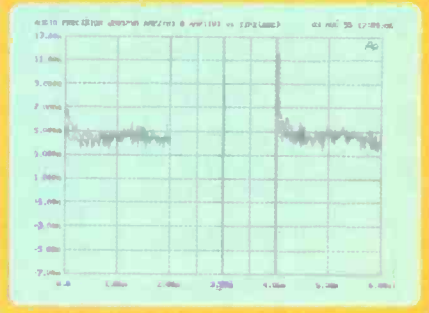

Fig.29: Supraply into 8Ω resistor

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ABBREVIATIONS

CSA: Cross-Sectional Area. Wire is usually circular, and a 1mm diameter circle has a CSA of only 0.79mm². CSA (not the diameter) defines current capacity for a given temperature rise

CUT: Cable Under Test (after DUT)

MSR: Mark-Space Ratio, the on-off periods of a burst waveform

NFB: Negative FeedBack, that is error correction

OFC: Oxygen Free Copper. Raw copper contains oxygen and has random crystallinity. Successive annealing and related processes remove impurities, including oxygen. When oxygen levels are below say 1ppm (part per million), the copper is considered free of oxygen, hence OFC. In reality, the surface at least, will eventually re-oxidise. Yet it is reported (at least with silver) that tarnishability ceases when purity exceeds 99.99999%

PVC: Poly Vinyl Chloride. Nobody makes capacitors from PVC because its dielectric losses are so high, that is it steals energy. Yet all cables are in part elongated capacitors. PVC (like most plastics) also emits chemically reactive substances (like plasticisers and chloride ions), that can oxidise conductor skins, making them semiconducting and diodic

SHEATH: the outer, secondary insulation over the conductors, which turns n wires into cable.

TPI: Twists (or Turns) Per Inch

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Footnote: ' signifies a technical review

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UK AES Conference: Putting the Acoustics Back in Loudspeaker Design Imperial College, London, UK.
Tel: +44 1628 663725.
◆ *January 9th–12th*
MacWorld Expo
Las Vegas, US.
◆ *January 15th–16th*
The Live! Show London, UK.
◆ *January 18th–21st*
NAMM Convention
Anaheim, US.
◆ *January 21st–25th*
Midem Cannes, France.
Tel: +33 1 44 3444 93.
Fax: +33 1 44 34 00 13.
◆ *January 30th–February 1st*
SortExpo 96
Santa Clara Convention Centre, Santa Clara, US.
Fax: +1 303 745 5712.

February 1996

◆ *February 6th–8th*
The ISON & Broadband User Show Olympia 2
London, UK.
Tel: +44 1733 394304.
◆ *February 9th–12th*
Milia Cannes, France.
◆ *February 11th–14th*
SIEL 96 Paris, France.
Tel: +33 1 45 22 35 40.
◆ *February 13th–15th*
Video Forum 96
Wembley Conference and Exhibition Centre, London, UK.
Tel: +44 1273 857800.
◆ *February 13th–16th*
Expo Comm Mexico 96 including Wireless Technologies Mexico 96
World Trade Centre, Mexico City, Mexico.
Tel: +1 301 986 7800.
◆ *February 15th–18th*
World Audio Visual Entertainment Fair
Bangkok Convention Centre, Bangkok, Thailand.
Tel: +662 95066014.

March 1996

◆ *March 11th–14th*
DSPx 96 San Jose Convention Centre, San Jose, US.
Tel: +1 203 840 5652.
◆ *March 12th–15th*
Aseanplas 96 Jakarta, Indonesia.
◆ *March13th–17th*
Musikmesse and Pro Light & Sound Messe
Frankfurt, Germany.
Tel: +49 69 7575 6662.
◆ *March 26th–30th*
The Pro Audio Show
The Holiday Inn Crown Plaza, Karachi, Pakistan.
Tel: +9921 498 4012.

April 1996

◆ *April 4th–7th*
Broadcast Thailand
Queen Sirikit National Convention Centre, Bangkok, Thailand. Tel: +66 2 503 2199.
◆ *April 14th–18th*
NAB Radio 96 Los Angeles, California, US.
◆ *April 16th–18th*
REPLITech Europe 96
Jaarbeurs Congress and Convention Centre, Utrecht, The Netherlands.
Tel: +1 914 328 9157.
◆ *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 12th–14th*
NSCA St Louis, US.
◆ *May 14th–16th*
Midem Asia Hong Kong.
Tel: +33 1 44 34 454 44.
◆ *May 17th–20th*
BTV China China Foreign Trade Centre, Guangzhou, China. Tel: +852 2862 3460.
◆ *May 25th–28th*
Pro Audio, Light & Music China 96 Beijing Exhibition Centre, Beijing, China.
Tel: +852 2861 3331.
◆ *May 28th–30th*
7th Conference and Exhibition on Television and Audio Technologies
Thermal Hotel Helia, Budapest, Hungary. Tel: +36 1 153 0127.
◆ *May 19th–June 1st*
Expo Show 96
St Petersburg, Russia.

June 1996

◆ *June 1st–4th*
Nightwave 96 Exhibition Centre, Rimini, Italy.
Tel: +39 541 711249.
◆ *June 4th–6th*
REPLITech *San Jose, US.*
◆ *June 4th–7th*
Broadcast Asia
World Trade Centre, Singapore.
Tel: +65 338 4747.
◆ *June 6th–9th*
Montreux International Radio Symposium and Technical Exhibition including 1st Interactive Media Symposium and Exhibition
Montreux, Switzerland.
Tel: +41 21 963 52 08.
◆ *June 10th–15th*
Americas TELECOM 96
Rio de Janiero, Brazil.
Tel: +41 22 730 6161.
◆ *June 19th–21st*
Audio 96: Technology & New Media (APRS)
Olympia, London, UK.
Tel: +44 1734 756218.
◆ *June 20th–22nd*
World Lighting Fair 96
Pacifico Yokohama Exhibition Hall, Yokohama, Japan.
Tel: +81 3 3706 5687.

July 1996

◆ *July 10th–12th*
Pro Audio & Light Asia 96
World Trade Centre, Singapore.
Tel: +65 227 0688.
◆ *July 12th–14th*
Summer NAMM
Nashville, US.

August 1996

◆ *August 7th–10th*
MacWorld Expo
Boston, US.
◆ *August 15th–18th*
Popkomm
Cologne, Germany.
◆ *August 26th–29th*
Windows Solutions Expo & Conference
San Francisco, US.

September 1996

◆ *September 4th–8th*
CEDIA Dallas, Texas, US.
◆ *September 7th–10th*
British Music Fair
Earls Court, London, UK.
Tel: +44 1442 215435.
◆ *September 12th–16th,*
IBC 96 RAI, Amsterdam, The Netherlands.
Tel: +44 171 240 3839.
◆ *September 17th–19th*
Interactive Multimedia Association Expo
New York, US.
◆ *September 18th–23rd*
photokina KölnMesse, Cologne, Germany.
Tel: +49 221 821-0.
◆ *September 24th–29th*
Live 96 Earls Court, London, UK. Tel:+44 181 233 9306.

October 1996

◆ *October 24th–26th*
Broadcast India 96 Exhibition & Symposium
World Trade Centre, Bombay, India. Tel:+91 22 215 1396.

November 1996

◆ *November 5th–9th*
PT/Expo Comm China
China International Exhibition Centre, Beijing, Peoples Republic of China.
Tel: +52 525 592 3257;
US Tel: +1 301 986 7800.
◆ *November 6th–9th,*
AV & Broadcast China 96
Beijing Exhibition Centre, Beijing, China.
Tel: +852 2862 3460.
◆ *November 7th*
21st SBES The Metropole Hotel, NEC Birmingham, UK.
Tel: +44 1491 838575.
◆ *November 8th–11th*
101st AES Convention
LA Convention Centre, Los Angeles, California, US.
Tel: +1 213 258 6741.
◆ *November 15th–18th*
Tonmeistertagung
Stadhalle, Karlsruhe, Germany.
Tel: +49 2204 23595.

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EMC: Testing times?

With much of the initial impact of EMC legislation dissipated, Ben Duncan offers a personal diary of RF problems

A WHILE BACK, I was testing a new power amplifier made by a respected pro-audio manufacturer. Before listening, and while performing a standard measurement using frequencies swept from RF to below audio, there was a burning smell. And the amp died.

The manufacturer felt this was unreasonable testing–despite the fact that most professional amplifiers passed this test. What was agreed upon was that the supersonic frequencies that had caused the problem would usually only be present with enough level and persistence to do damage if some equipment in the path was oscillating above audio frequencies, or 'gone RF'. The manufacturer was adamant that this would only occur in studios that were badly ('unprofessionally') wired or used equipment of a lesser standard. When equipment that is damaged in circumstances deemed inappropriate by the manufacturer, then the manufacturer is unlikely to pick up the repair tab. The pass-the-parcel potential in trying to get someone to accept responsibility is immense.

Prior to this, another reputable manufacturer's amplifier had shut down on me each time it was switched on and hooked up to the monitors. Suspecting a fault, the manufacturer sent a second unit, which did the same. And a third. As the speakers were healthy and nominally 8Ω –hardly an 'adverse load'–the protection was puzzling. Eventually, a scope was hauled into the listening room and showed something it hadn't in the lab–that the power amp was broadcasting 30V of RF as soon as it was hooked up to the monitors.

Discussion with the manufacturer revealed that the amplifier's designer had omitted the usual output choke in order to get the sweetest HF performance. It transpired that this arrangement worked fine when used with standard 2.5mm² PA speaker cable; the trouble arose because my listening-room speakers are wired with a high-quality cable which has lowered inductance but higher capacitance. If the problematic amp had not had 'intelligent' protection, it could easily have radiated RF without anyone being aware, eventually frying the tweeters while spuriously interfering with other equipment and irradiating anyone in the vicinity.

So the average engineer may have no idea that their mixer is a badly designed, potential amplifier (and tweeter) killer. RF oscillation can remain latent or small, appearing or growing enough to damage equipment only when some cables are changed or rerouted, or new equipment is introduced. RF oscillation can be set off by an unlucky combination of amplifier plus speaker cabling.

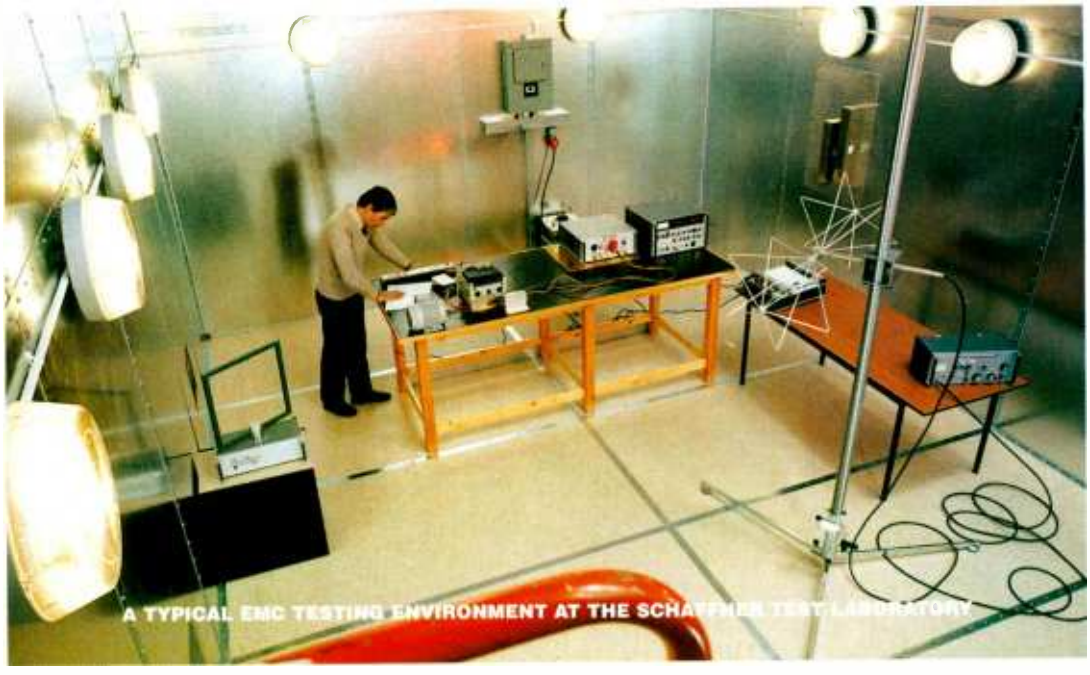
Sometimes, broadcast RF is audible as voices or music, through accidental demodulation. A silent sign is when power amp(s) run hot when there's nothing loud playing. At other times, strong RF in the air causes nothing that's directly audible, but sound quality is marred by 'phasiness' and smeared detail. The latter two symptoms could have other causes–so just how do you know for sure if it is RF?

The simplest, surest way to confirm that your studio's signal path is free or otherwise from RF contamination is with an oscilloscope. Performance is not critical as we are not measuring anything precisely, but just checking on its absence (we hope). The foremost measure of scope performance for this work is bandwidth, which should be as many MHz as you can get. I'd suggest that 10MHz is the barest minimum–it's enough to show the low-band RF oscillation that most power amps are capable of. If reception of external RF is suspected, 100MHz or more–ideally up to 1GHz–is the ideal. At least scopes do not stop dead at their band limits and will at least show frequencies 10 to 30 times higher as some sort of fuzz.

Probing is best done across the various output terminals, with the (audio) plug covers removed. In this way, you can monitor existing connections. Reason: equipment can be fickle and may not oscillate or receive RF if you disturb the normal cabling! For the same reason, 'x10' probes (the head part of a good scope probe) should be used; these help to make the scope's loading effect doubly 'invisible' to the system. As most cheap scopes have unbalanced inputs, some care may be needed with grounding to avoid adding a large 50Hz trace to screen. With small levels of RF contamination, music signal traces are 'thickened' or 'furry', as if out of focus or going mouldy.

Gross contamination (AM modulation) is seen as an envelope much bigger than the audio wave shape, but with the edges following its shape. There's no reason why a scope shouldn't be left hooked up across the monitors, giving an attractive visual display while performing a on-line RF early-warning service. When installed on their side, each channels' trace looks like the vibrating string that could have made the music.

There are three points arising: don't assume that RF oscillation can only occur with low budget equipment; checking for RF at power amp outputs is especially important whenever hardware including cabling, is changed; more scopes should be released from labs and workshops, and allowed to reside (and provide attractive, non-invasive system-status monitoring) in control rooms.



A TYPICAL EMC TESTING ENVIRONMENT AT THE SCHAFFNER TEST LABORATORY

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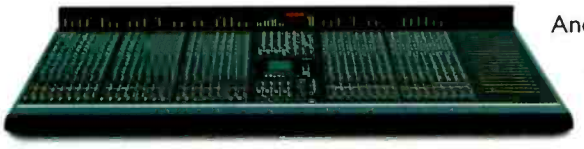

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