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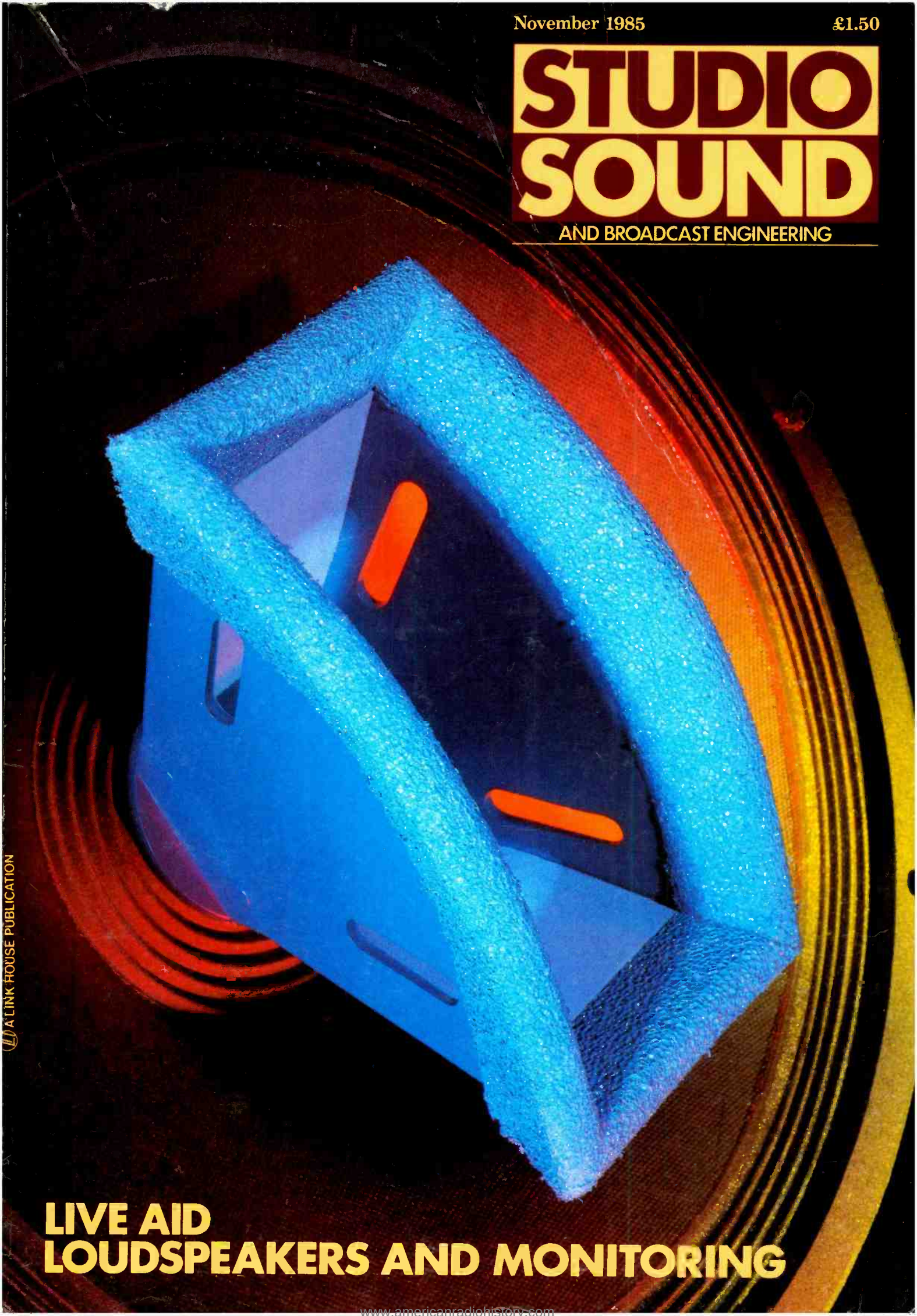

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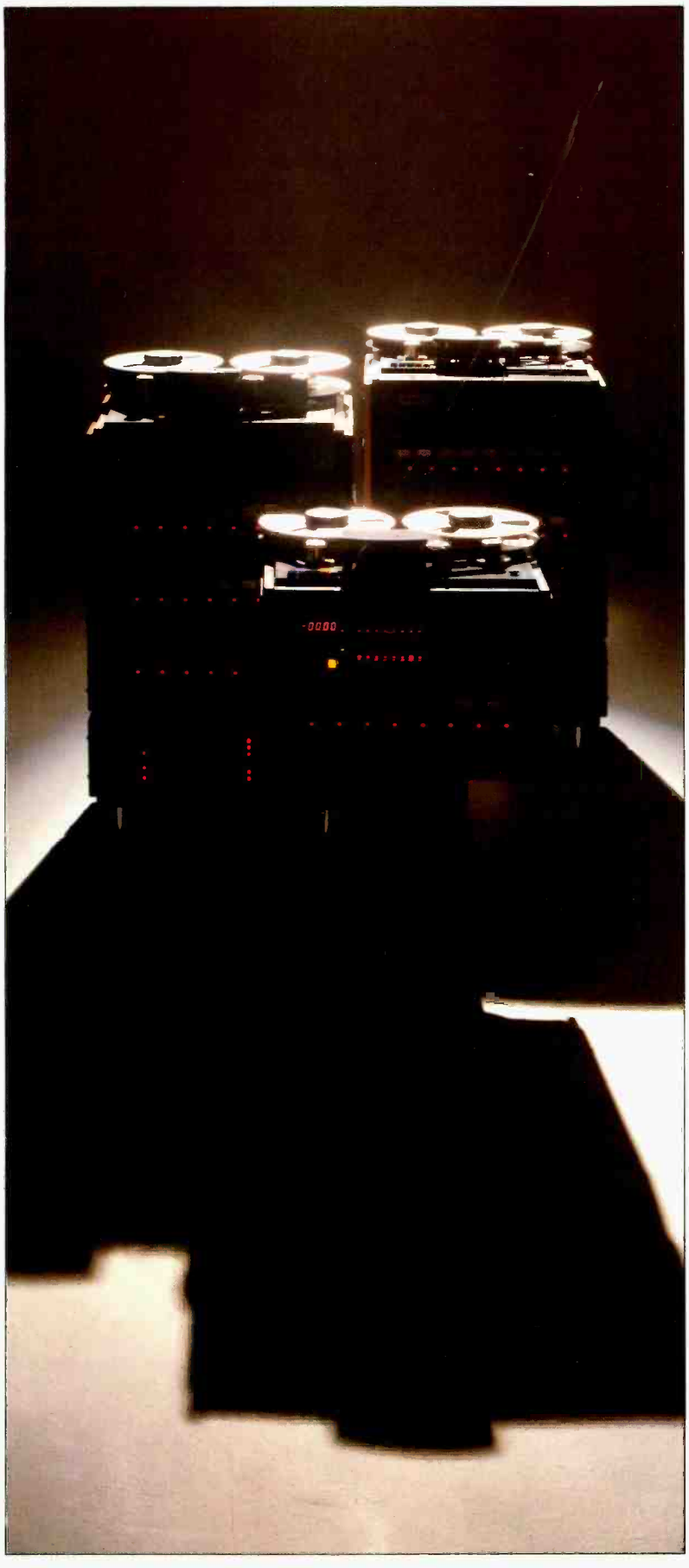

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COMMERCIAL MANAGER
Phil Guy

Editorial and advertising offices: LINK HOUSE, DINGWALL AVENUE, CROYDON CR9 2TA, GREAT BRITAIN
Phone: 01-686 2599
International: +44 1 686 2599
Telex: 947709

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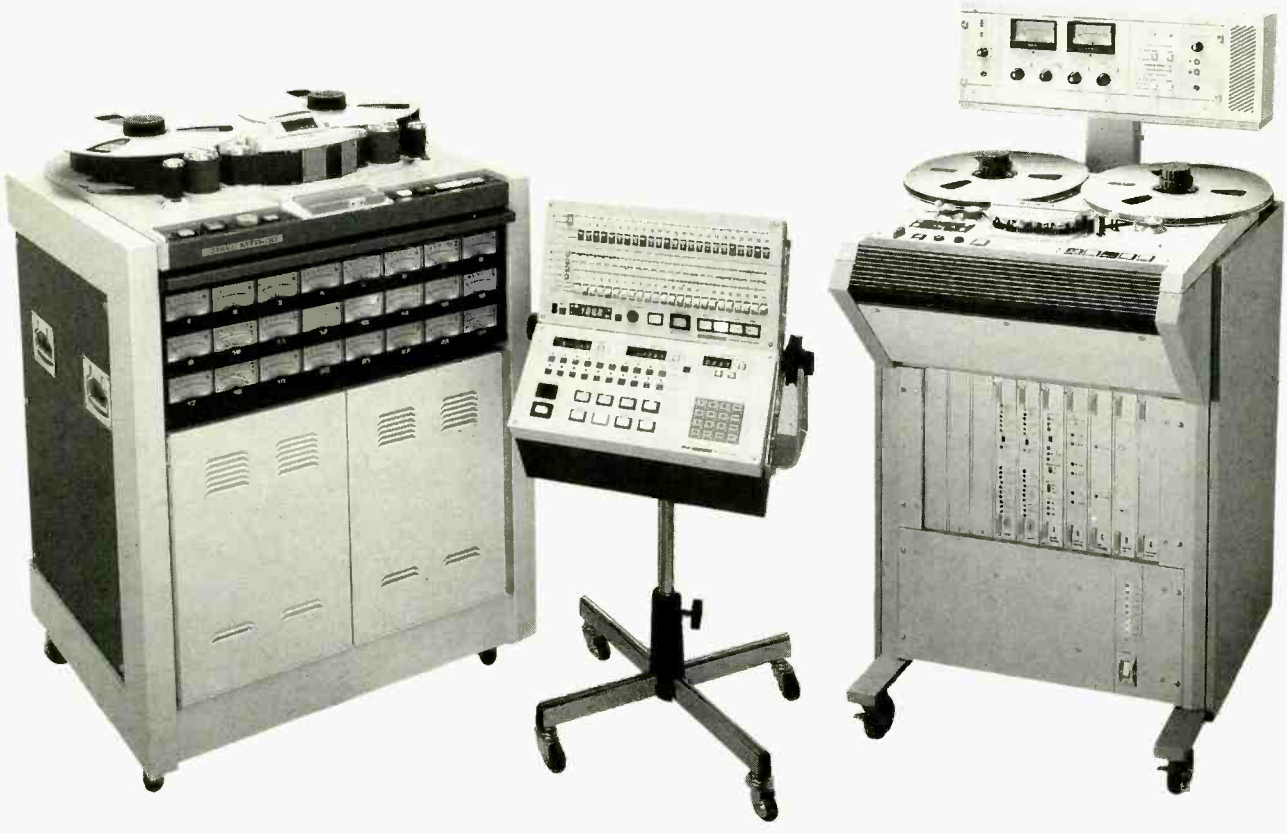

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EDITORIAL

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This month's comment from Keith Spencer-Allen

Monitoring the situation

There have never been so many different monitor speaker systems both suitable and unsuitable for monitoring use available at the same time. The recession within the hi-fi industry has forced many of the manufacturers from that area to look at the pro industry as an area with potential. We are quite frequently told by such manufacturers how their new monitor makes all others sound awful. Such an influx of new ideas is very valuable and I am sure that we can all learn from each other. It is just that these new entrants to the pro field need to learn how we use monitors and what we are looking for in such unit's. For example, marketing a speaker that provides an accurate image and neutral sound quality is all very well but if it cannot handle a little bit of level occasionally without complaining, then it is unlikely to find favour within the rock studio environment. Manufacturers who then proceed to reply that studio people monitor too loud any way are probably correct in some ways but are also definitely on a losing streak too. There are reasons for the way we work and if they cannot understand it perhaps they are not really invited to the party.

At the other end of the spectrum we have the designers who are forever developing a better Auratone. Again they have got it wrong. The Auratone *Cube* is one of the closest things that we have to an industry standard. That is what is important. We are not so naive (as was suggested to me the other day) that we actually think the *Cube* is suitable for quality monitoring. The concept of the mini reference monitor is alive and well—somebody please tell them. Rather than trying to change the industry, make something we want—although they won't be able to do that without understanding how we work. The nearfield monitor is an area where such designers might be able to show us a thing or two but drop the fancy marketing image—the stands and other paraphernalia—they are going to have to sit on the top of the desk, so size is a real problem.

This brings me to nearfield monitors in general. The way such units are perched on the top of the desk is a fact of life that seems difficult to equate with good monitoring conditions. I recently had to visit a major London studio and took the opportunity to look in one of the control rooms. Sat on the SSL we had *AR 18*s, Yamaha *NS10*s (with tissue paper mod), Auratone *Cubes*, Visonik *6000*s, and a pair of something I didn't recognise, bringing a total of five pairs not including the main studio monitors. Apparently such an array was fairly standard for that room. Now what is happening to make all these units need to be present at the same time in the control room? I can remember taking cassettes for the car radio and to play on the hi-fi at home. I also recall working with some producers who would rush madly around playing the cassette on absolutely everything they could cram their cassette into. We now however have all these units within the control room—this may be for the better or may not.

There is however one aspect that is not for the best—all these units are obscuring the direct signal path from the main monitors to such an extent that I don't really believe the sound is true any more. If you think that the surface reflection from the top of a console is bad then you really should try it after three or four sets of nearfield/mini monitors get between the HF horns of the main monitors and yourself—localised ghost images everywhere. If the nearfield monitor is such an important current issue, perhaps we should see some means of accommodating it within the control room design, although if it is to remain nearfield, this is probably impossible. If main monitors are positioned at 15 to 20 degrees from the horizontal, any speaker on the desk is bound to be an obstruction to the direct path. The other alternative is to forsake the nearfield concept and have a small pair of speakers mounted below the main monitors, should space permit.

Of course it is probably the nearfield concept that is more important than the size of monitors. The studio designer is now in a dilemma because such a monitor technique virtually removes the effect of the room—so what is it that is needed? Are some control rooms not up to high definition monitoring or is it the monitors themselves? The current interest in soft dome monitors would appear to rule out the latter, particularly as such systems also tend to sound better at lower listening levels. Is the problem therefore with the acoustics? This may be the case although if so, who is out of step with whom? One point that is going to be worth watching will be if the current generation of certified LEDE rooms reduce the tendency for nearfield monitoring within them as in many ways, this duplicates some aspects that such an acoustic design approach provides.

Whatever happens, the last few years has seen the emergence of the three monitor standard—main, near and minis. How we use them is our affair but be aware of what it is you are doing and if possible, why are you doing it. □

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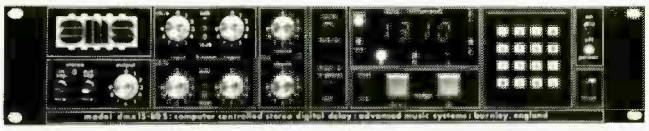

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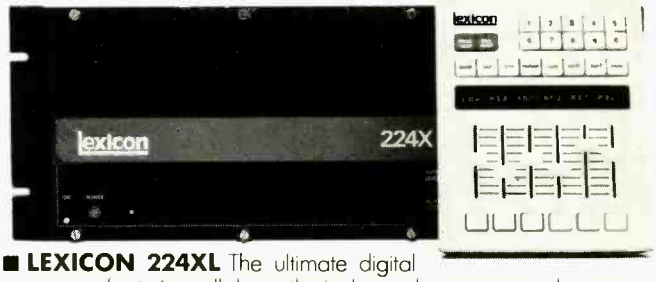

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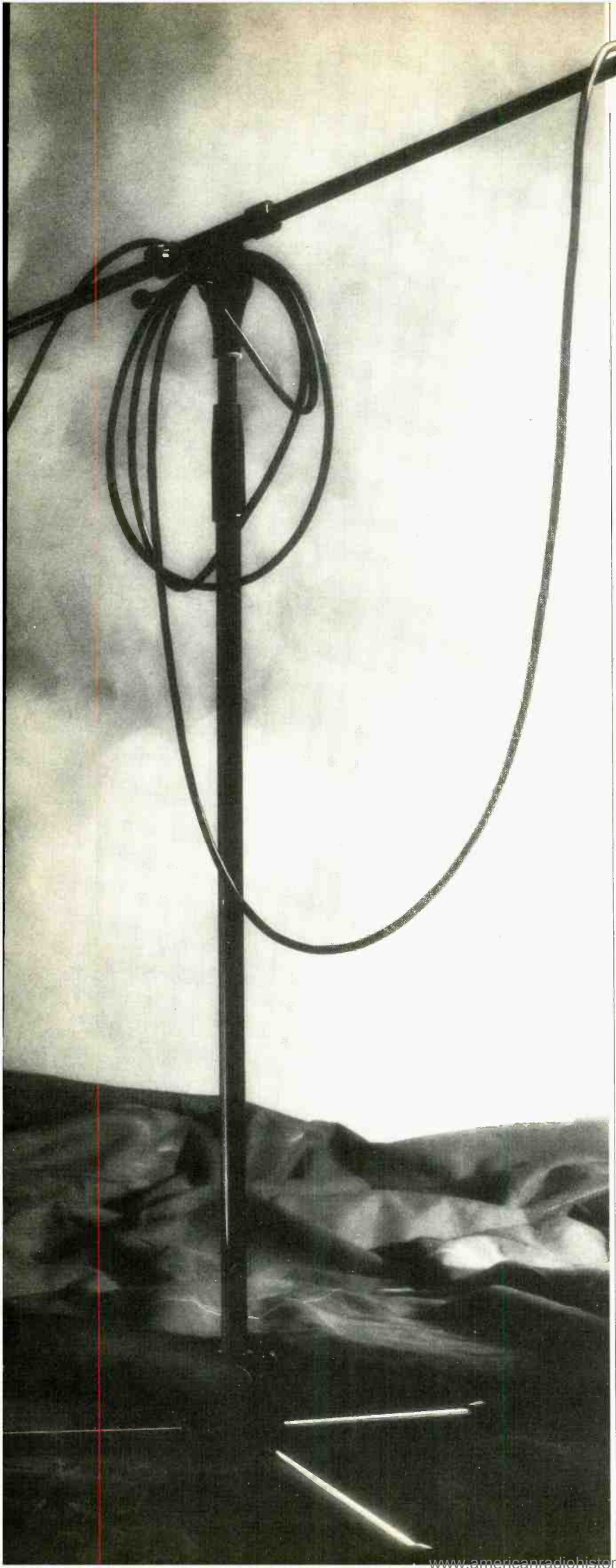

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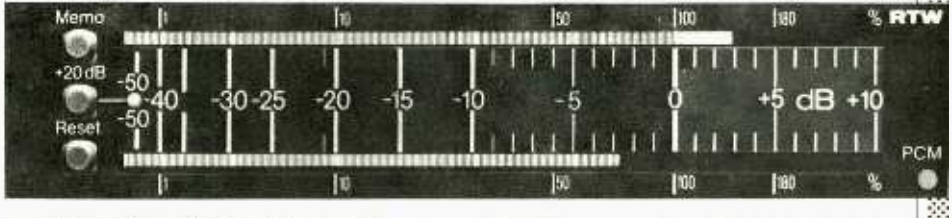

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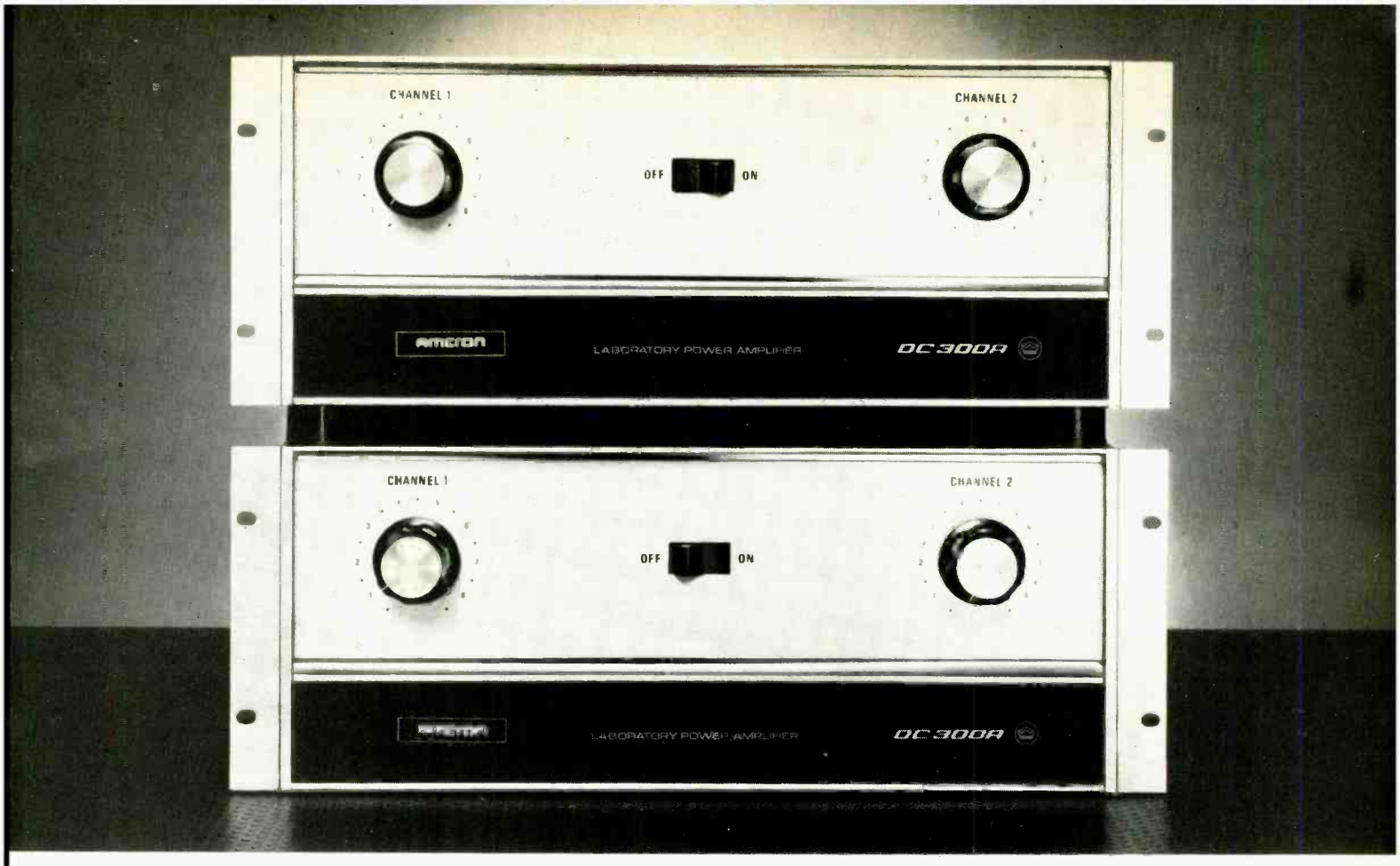

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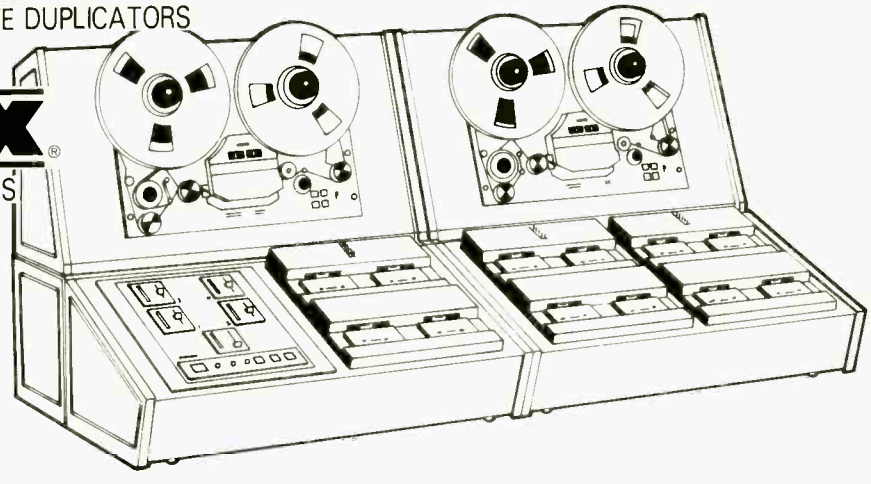

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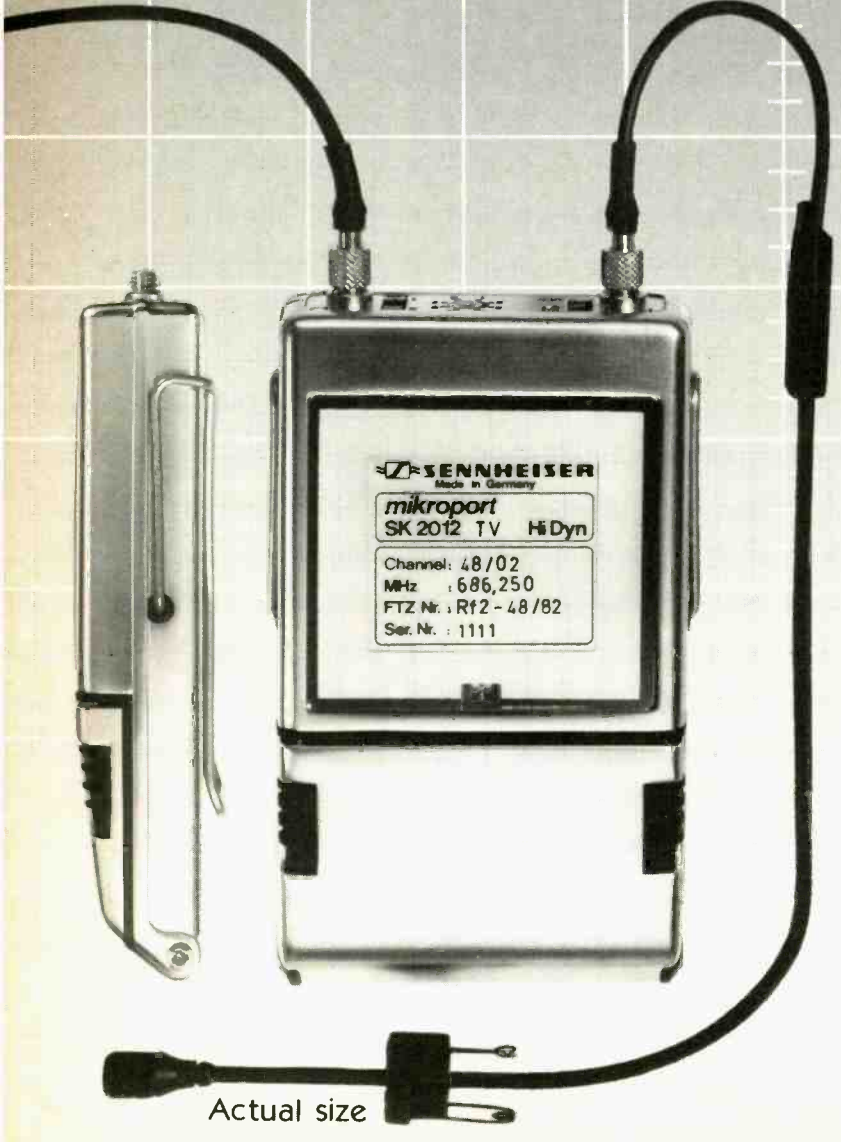

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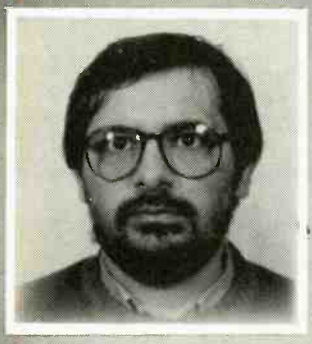

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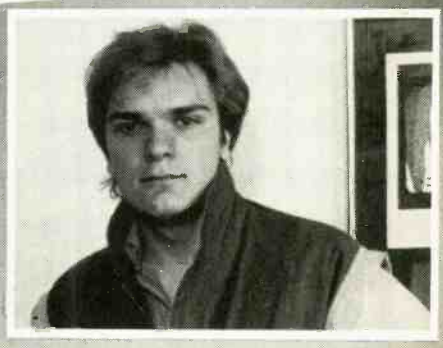

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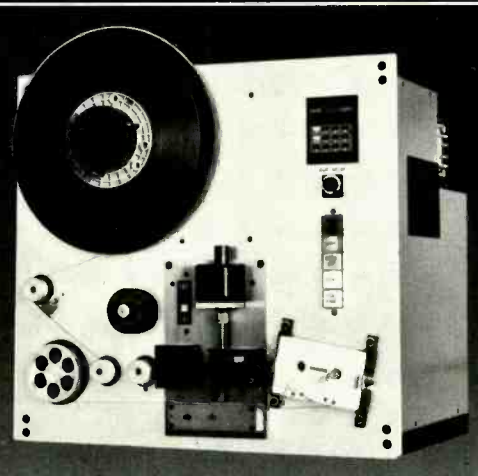

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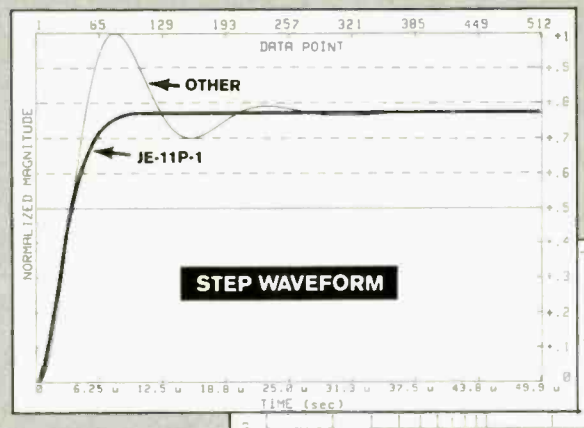

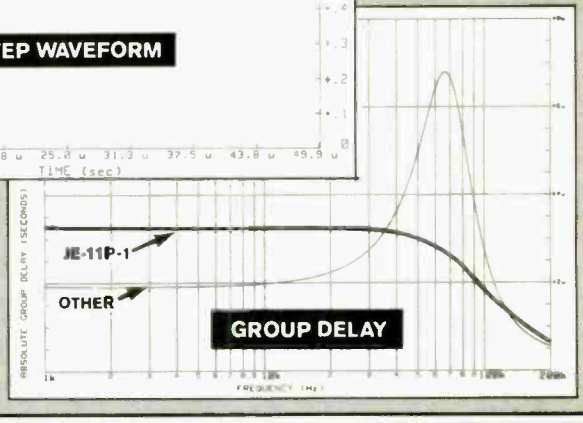

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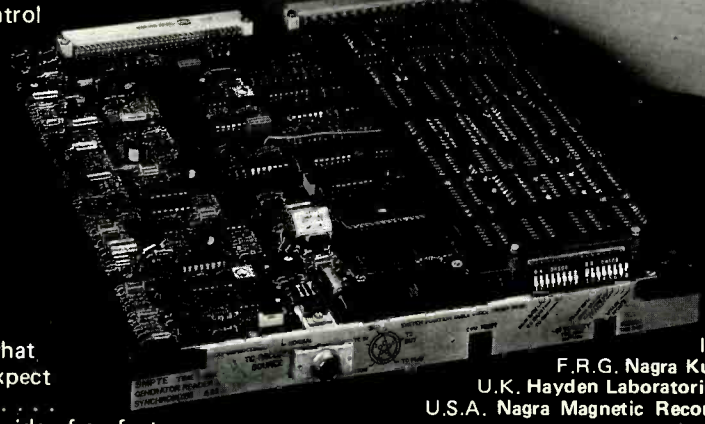

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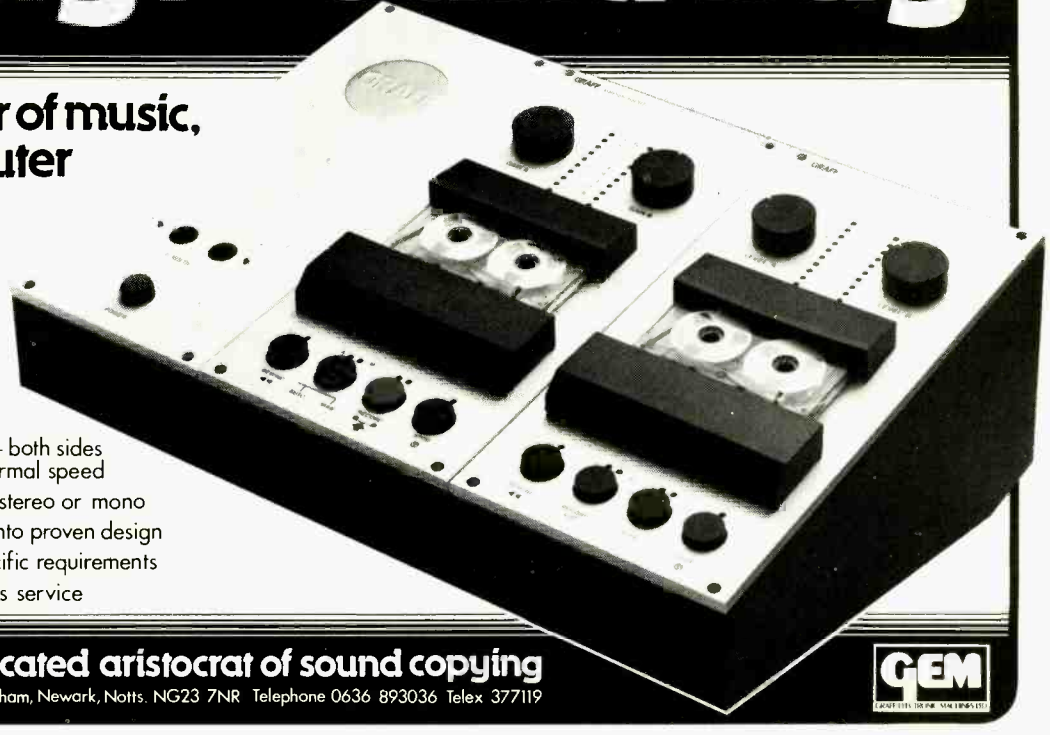

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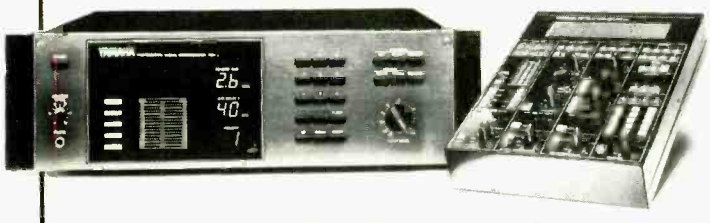

For the more demanding user, don't forget Yamaha's original REV 1 digital reverb with its full function remote control at £6595.

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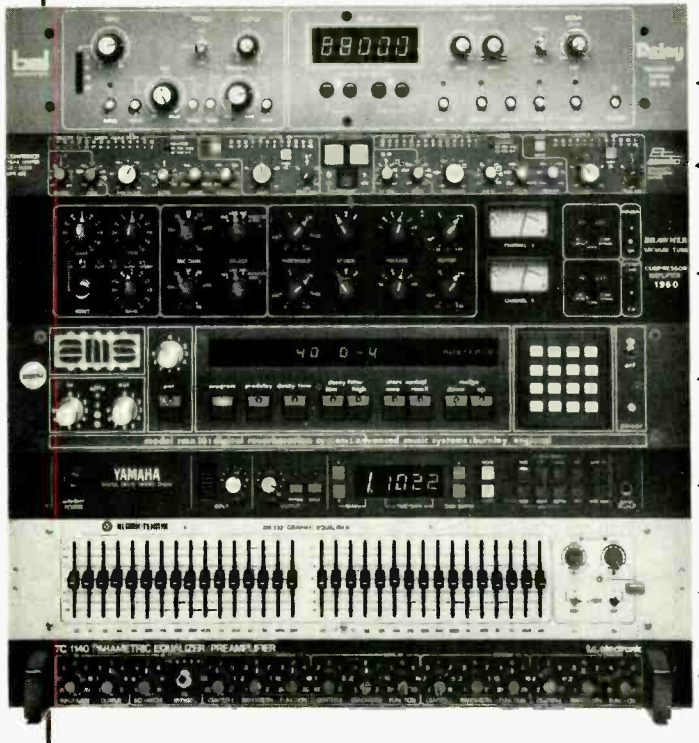

The newest from the BEL stable, the BD320 gives all the functions of the popular BD80, but with up to 32 (yes 32) seconds of delay. BD80 £695 (2 secs) + £200 per extra 2 secs. BD320 £1200 (8 secs) + £500 per extra 8 secs.

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For that authentic 60's sound, DRAWMER's 1960 valve compressor/pre-amp is a must. "Soft knee" compression, microphone inputs, side chain operation etc £750. (Don't forget the DL221 @ £325, and DS201 @ £275.)

The AMS RMX16 shown here is the state-of-the-art in programmable reverb. We also try to keep the DMX 15-80 DDL/pitch transposer, but demand is high so order now. RMX16 £4680. DMX15-80 £POA.

The YAMAHA D1500 is a low-cost, high-value programmable DDL with MIDI interface; it gives up to 1 sec delay, with 16 user memories. Our price is so low that we don't dare print it! £POA.

KLARK-TEKNIK's range of equalisers should need no introduction: they are simply the industry standard for graphics. We also stock other Klark-Teknik products, such as their excellent digital reverb and the DN60 analyser. DN332 (shown here) £525. DN360 £980. DN60 (analyser) £1650. DN780 reverb £3580.

TC ELECTRONICS TC2240/1140 are stereo/mono 4 band fully parametric equalisers offering 20dB of cut and boost. We think they are the best value and best sounding outboard EQ's around. TC2240 £330. TC1140 £195.

We also keep toys from Lexicon, Urei, Electrospace, dbx, Eventide and many more. Our demo room is ready for you to try before you buy; or take advantage of our mail order service for best prices and free delivery.

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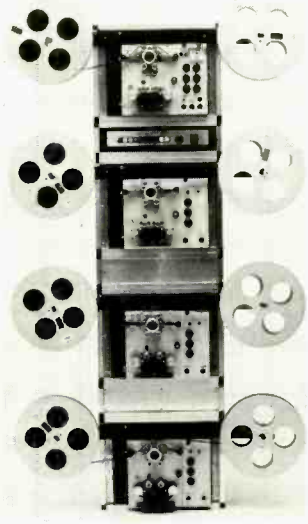

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CLUE will operate with either Sony Betamax recorders or V series U-matics or a combination of both.

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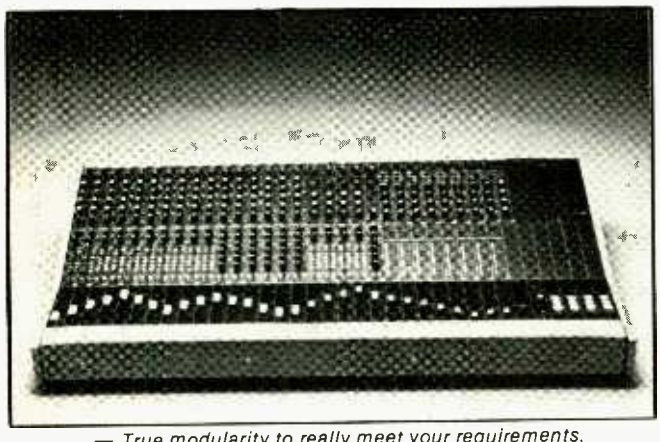

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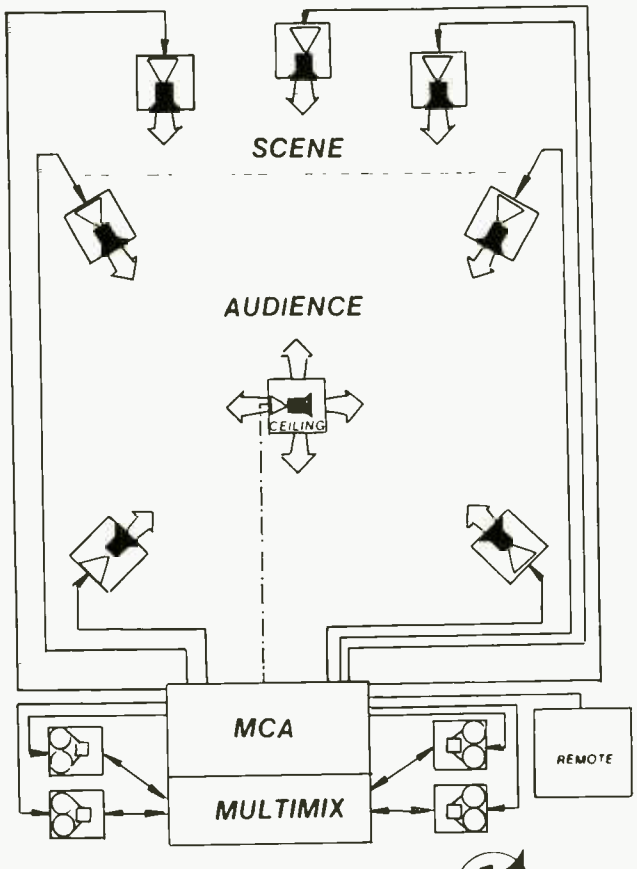

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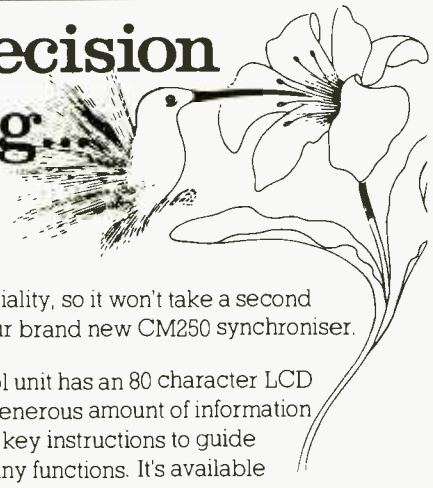

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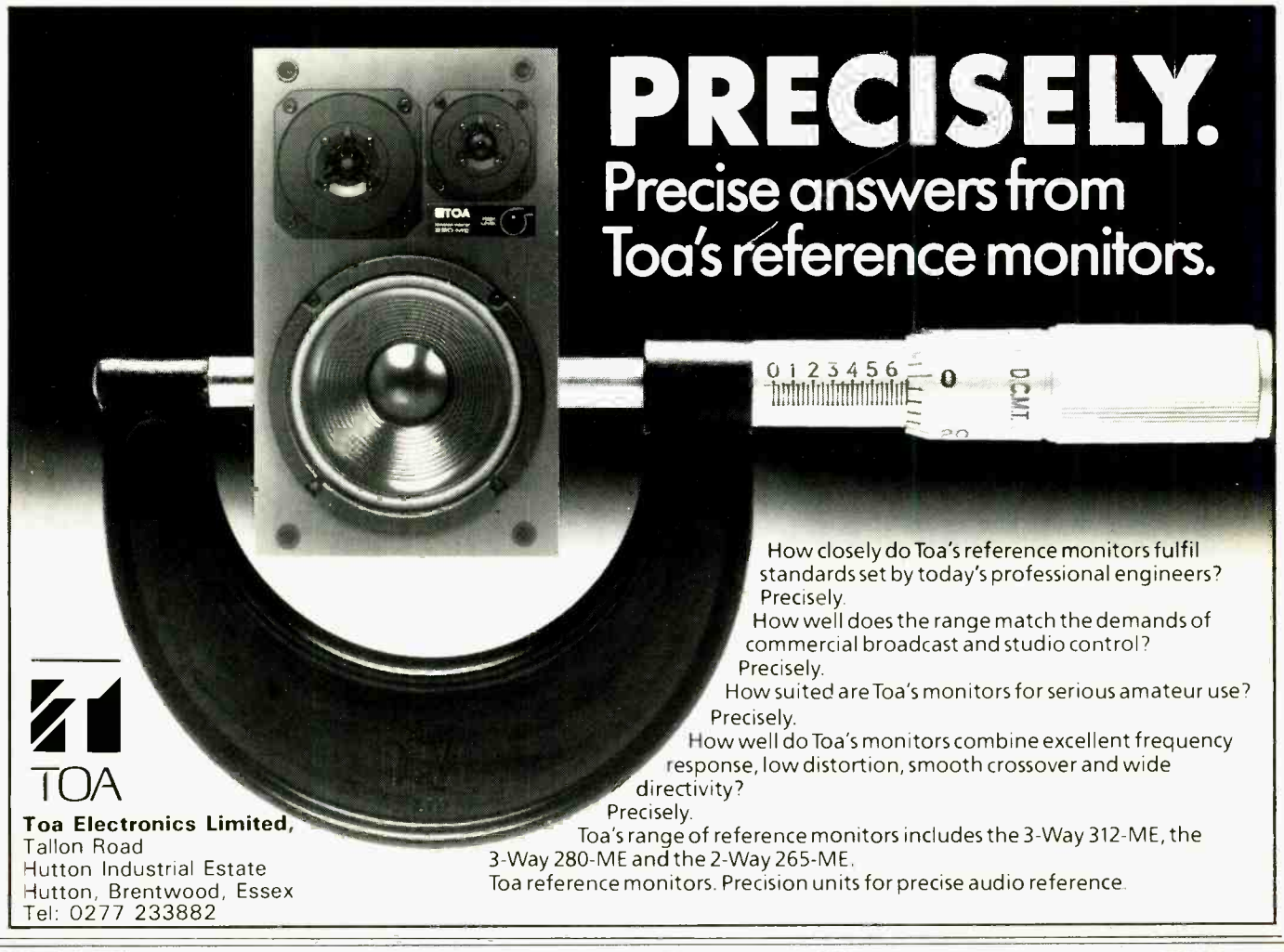

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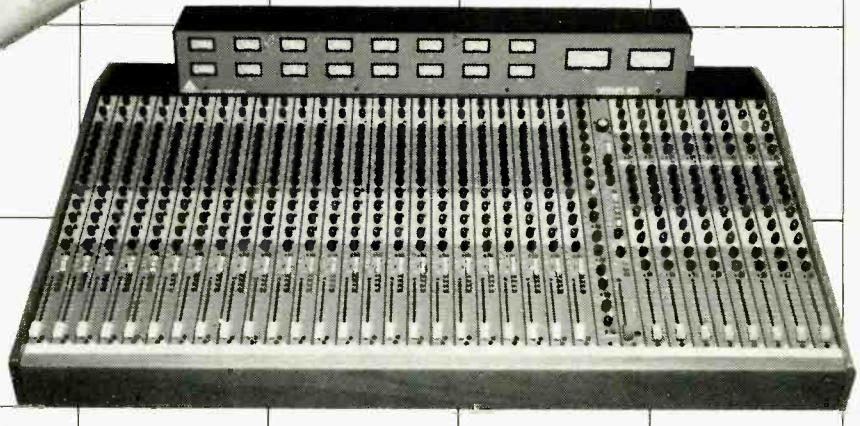

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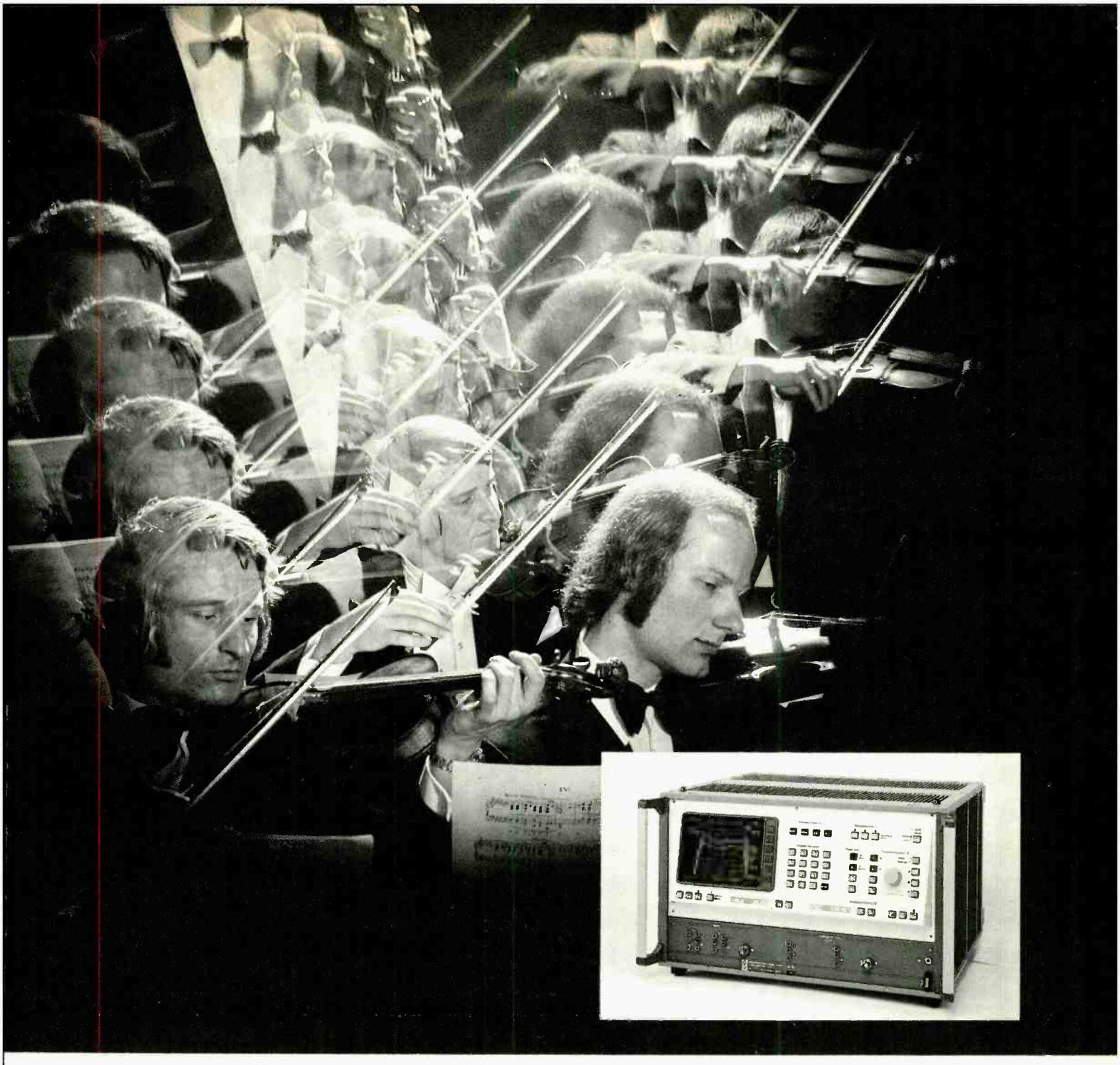

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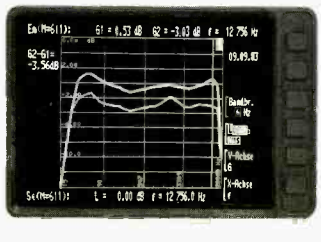

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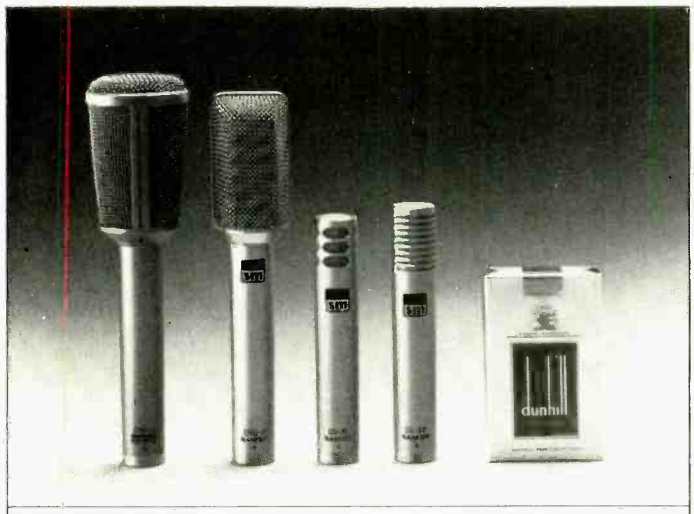

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Maker of world-acclaimed CU-41 double-condenser microphone releases new products to international market.

Sanken Microphone Co., maker of the CU-41 two-way condenser microphone, famed among sound engineers throughout the world for the transparency of its recording qualities (which make it perfect for compact disk recording), is pleased to announce the release of four more of its high quality microphones to the international market. The microphones are:

CMS-6 MS Stereo Microphone A small, lightweight, hand-held microphone for high quality outdoor radio, TV and movie recording. Comes with portable battery power supply and switchable matrix box. Freq. response 50Hz to 18kHz, dynamic range 108dB, self noise less than 19dB.

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E. A. SOWTER LTD. (Established 1941), Reg. No. England 303990
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TRAD

FOR SALE	£
3M M79 16-track tape recorder, mint cond.	6,250.00
3M M56 16-track	4,000.00
Studer A67 stereo, console	1,800.00
Studer A80VU stereo	3,200.00
Studer A800 Autolocate and remote	19,500.00
Studer A80 16-track	8,500.00
Studer A80 8-track	5,000.00
Studer B67 stereo, console VU	2,500.00
Studer C37 stereo, valve	650.00
Lyrec TR532, 24-track, 32 memory autolocater	12,500.00
Lyrec TR532, 24-track, autolocate	9,500.00
Lyrec TR55 stereo console 14 inch reels	2,500.00
M.C.I. JH24 24-track autolocate MkIII	12,500.00
M.C.I. JH110 stereo on console	2,500.00
M.C.I. JH110 stereo on console	2,000.00
Ferrograph studio 8 stereo on console	500.00
Ampex ATR700 stereo	700.00
Proline 2000 stereo on console	1,200.00
Q Lock 310 with 2 ATR interfaces	5,000.00
Dolby M24H noise reduction unit	7,500.00
Dolby M16H noise reduction unit	5,500.00
Dolby A360 noise reduction unit	each 375.00
Neve Kelso 10-2 portable mixer, flight case	4,000.00

FOR SALE	£
Trident series 80, 32-24	14,000.00
Trident series 80B, 32-24, 3 months old	19,500.00
Quad eight, 32-16-24	7,000.00
AKG BX20 XL	1,200.00
Master Room XL305 Stereo Reverb	900.00
EMT 140TS plate	2,200.00
Various Scamp modules	P.O.A.
J.B.L. 4315 loudspeakers	750.00
Audio and Design F500RS processor	500.00
J.B.L. 4350 speakers with BGW amps and crossovers	2,400.00
Quad 405/2 amps, new	215.00
Quad 303 amps, new	140.00
Electrospace Time Matrix digital delay, new	1,400.00
H.H. Mos Fet V800 amp	500.00
AMS 1580S digital delay, pitch change and deglitch, 90 days old	5,500.00
Amber test set	995.00
Turner B302 amp, as new	260.00
Crown DC300A amp	450.00
Fairchild 600 conex	350.00
Various second-hand microphones	P.O.A.
Drawmer Dual gate	200.00

The above prices do not include V.A.T

TRAD ELECTRONICS SALES LTD
149b. St. Albans Road, Watford, Herts, WD2 5BB, England
Tel: Watford (0923) 47988/9 Telex: 262741

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The new affordable SRV-2000 Digital Reverb from Roland

Another major breakthrough in digital technology from Roland: the Midi reverb! This professional, studio-quality effect is the perfect companion to today's Midi-controlled keyboards for creative sound processing.

The 32 Midi programmable memories can store all reverb time, pre-delay, room size, high-frequency damping, gate time and output level controls whilst providing instant access to pre-programmed sounds for keyboard patches or Midi sequencing of effects (a form of digital effects patch mixing). Precise programming of data such as the two-band parametric equaliser and low frequency shelving can be set for each memory location while confirming the values on the digital displays. This enables accurate tailoring of the SRV-2000 to your exact requirements.

For 19" rack-mounted use, remote switching sockets are provided for bypass, programme shift, etemity on/off and add-on.

Stereo outputs and 6 digital numeric readouts further enhance the SRV-2000's facilities.

Features:

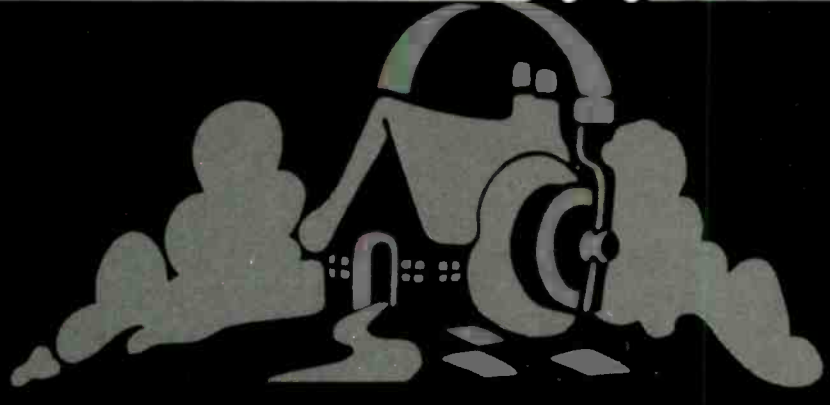
0.1–9.9 & 10–99 secs reverb time
0–100 ms. Pre-delay
32 Midi memories
2 band parametric equaliser
Low shelving equaliser
High Frequency damping
Variable room size
10–400 ms. Gate time
Programmable output level
6 digital numeric displays
Midi In & Thru
16-bit linear A/D/A

Please call in soon for a working demonstration of the SRV-2000 in our fully operational 16 track demo studio (1st floor).

The London Rock Shop

Full technical specifications may be obtained from: 26 Chalk Farm Road, London NW1 8AG
Tel: 01–267 7851/5381/1771

HARDWARE HOUSE



As UK distributors for Nady radio systems and Countryman microphones, we have brought together two products which between them can produce the high dynamic range and audio quality essential for live performance.

To find out more about these and our full range of technical and engineering services and equipment rental, phone us on:

01-986 6111

Hardware House (Sound) Limited
West Works, Chalgrove Road, Morning Lane, London E9 6PB

UK distributors for Nady radio systems and Countryman microphones.
Dealers for AMEK/TAC (live performance), Amcron, Court, JBL.

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DIARY

Address changes, literature received, events

Address changes

● Symetrix have completed their new manufacturing facility in Seattle and are now based at 4211 24th Ave West, Seattle, WA 98199 USA. Tel: (206) 282 2555.

● Musiflex have moved from their Fulham premises and are now at 8 Park Mansions, Elsynge Road, London SW18 UK. Tel: 01-870 9254.

● Crow of Reading have announced that the second phase of their reorganisation is now complete and as a result the company are now based at Hudsons House, 264 Bath Road, Slough, Berks SL1 4EF, UK. Tel: 0753 31181.

● Soundcraft's Sales and marketing departments have moved to offices adjoining the new factory which will leave only customer services and R&D at the Great Sutton Street premises. The new address is Soundcraft Electronics Ltd, Unit 2, Boreham Wood Industrial Park, Rowley Lane, Boreham Wood, Herts, UK. Tel: 01-207 5050.

Forthcoming events

October 12
AES, New York papers.
October 13 to 16
AES, New York convention.
November 5 and 6
ASSCE Northern Exhibition, Barton Grange Conference Centre, Nr Preston, Lancs.
1986 March 4 to 7
80th AES Convention, Congress Centre, Montreux.
March 10 to 14
Fiarex Electronics Trade Fair, RAI, Amsterdam.
November 12 (papers) 13 to 16
AES, Los Angeles.

People

● Roy C Blankenship has been appointed national sales manager at Symetrix. He was formerly with Michael Chafee Enterprises in Florida.

● Producer, R A Morten, president of Canadian-based Paje Productions has taken over as general manager of Florida Recording Studios.

Literature received

The Performing Rights Society Yearbook 1985/86 is now available. The yearbook includes a review of 1984, a Copyright Review section and an expanded reference section containing information about the PRS's licensing and royalty distribution procedures. Copies are available on request from the Public Relations Dept, Performing Rights Society, 29/33 Berners Street, London W1P 4AA, UK. Tel: 01-580 5544...A 12-page catalogue of cable, connectors and ready-made leads has been produced by Musicable. Copies are available from Musicable, 392 Farnham Road, Slough, Berks SL2 1JD, UK. Tel: 0753 821812...Gresham Wood Industries, the Essex based manufacturers of equipment consoles and cabinets designed to enhance and protect equipment have produced a new colour brochure describing their products and services. Copies available from: Grenville Jeary, Gresham Wood Industries Ltd, Bentfield End, Stansted, Essex CM24 8HS, UK. Tel: 0279 813132...Nimbus Records have produced a full-colour Catalogue and Compact Disc Review 1985. The 26-page booklet includes a full listing of all Nimbus releases along with features on location recording, CD manufacture and classical music. The catalogue is available from: Nimbus Records Ltd, Wyastone Leys, Monmouth NP5 3SR, UK. Tel: 0600 890682... Studios with computer systems may find the Inmac catalogue of interest. The latest 104-page catalogue features a wide range of computer-orientated accessories, peripherals, connectors and disks. Free copies from: Inmac (UK) Ltd, 16 Silver Road, London W12 7SG, UK. Tel: 01-740 9540.

MBI/Munro join forces

MBI Broadcast Systems and Munro Associates have joined forces to provide a comprehensive service for studio operators. With Munro Associates providing acoustic design, measurement and architectural services and MBI's specialist know-how in the field of broadcast design, installation and commissioning of studio technical systems, the new venture claims to offer facilites hitherto unavailable from a single source. Further details from either: MBI Broadcast Systems Ltd, 69 Ship Street, Brighton, Sussex BN1 1AE, UK Tel: 0273 24928 or Munro Associates, Warehouse D, Metropolitan Wharf, Wapping Wall, London E1 9SS. Tel: 01-480 7121.

We try harder

Unfortunately we misinterpreted a Soundcraft press release in the September issue (first item Contracts, Diary). The Indonesian Soundcraft dealer was referred to as Mr Utama. With hindsight we understand that Utama means 'Co Ltd' in Indonesian and the gentleman's proper name is Santoso Tandi, our apologies to you.

Unfortunately the wrong UK distributor for Marshall Electronic was listed in the October issue. It should be Britannia Row, 35 Britannia Row, London N1 8QH. Tel: 01-226 3377.

End of an era

After 29 years, production of the Quad ESL, the world's first commercial full range electrostatic loudspeaker has ceased. First demonstrated to a specially invited audience in London in 1956 and taking the London Audio Fair by storm the following year some 54,000 ESLs were manufactured in the ensuing years.

The Quad ESL, or 'Walker's Little Wonder', as it was nicknamed in the US, had enormous influence on the audio industry. Virtually every loudspeaker manufacturer had one in the laboratory as a reference standard, every recording company with pretensions to recorded fidelity used them as quality monitors, and virtually every reviewer has owned a pair at some time. Quad will manufacture parts for 15 years after a model has ceased production: service will be available for the Quad ESL until the year 2000.

Return of API

Earlier this year (June) the entire API audio product line was purchased by Wolff Associates and it has now been announced that the new company called API Audio Products Inc will continue to sell and develop the API range. Within the product range are modular equalisers including the famous *550A* (EQ), a mic preamp card, a line amp summing card, 8-way distribution amplifier and two new products—a motorised moving fader and a dual 4-band rack-mounted *550A* equaliser. Further details from API Audio Products Inc, 7953 Twist Lane, Springfield, VA 22153, USA. Tel: (703) 455-8188.

Correction

Sean Davies has asked us to clarify a number of points in the August Interior Motives feature: The acoustic redesign of Studios 1 and 2 at Sarm West was undertaken by SW Davies Ltd. Subsequently the isolation rooms in Studio 1 were installed by Eddie Veal, who also designed Studio 3 and undertook additional work in No 1 Control Room. Sarm East Studio, excluding the control room was rebuilt by SW Davies in November 1982 and remains unaltered except for the cosmetic finishes described in the article.

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Low-cost digital audio comes of age.

The Sony PCM series has now been available for several years. In this time recording and broadcast organisations, government, educational and industrial establishments, as well as individual users have all acknowledged the unique value of these units, and made them a new standard. It is the superlative quality of Sony PCM digital, coupled with extremely low cost that has brought about this professional acceptance of the range. This is borne out by the number of new ancilliary products from other manufacturers, that have further increased the flexibility and versatility of the range. Examples of these products are the 'CLUE' logging and editing system from HHB, as well as various interfaces which allow digital communication with the PCM 1610.

Sony has acknowledged that this acceptance by professional users necessitates a change of policy towards these products. Accordingly they have upgraded them from the domestic catalogue, and, realising the need for professional support and all that that entails, have appointed HHB as specialist dealers to represent them in the pro-audio market.

We are proud to announce this appointment, and happy to assure our customers of continued availability of the PCM range. The re-instatement of the PCM production line has been very largely due to pressure from end-users, who are after all the motivating force in the audio world. So if you are involved with audio recording and are still unfamiliar with Sony digital, then you owe it to yourself to call HHB – the No. 1 name in Digital Audio.

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THE SONY PCMF1 AND PCM701ES DIGITAL AUDIO PROCESSORS.

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DIARY

In brief, contracts

King verdict upheld on appeal

A decision announced by the US Court of Appeals for the Federal Circuit has affirmed the Judgement of the US District Court for North California issued on July 13, 1984 which found that a key patent owned by King was valid and had been directly infringed by Otari.

The original law suit which was filed in September 1980 concerned patent infringement of Kings US Patent No. 3,637,153 covering method and apparatus for loading magnetic tape into closed cassettes automatically and at high speeds.

A Permanent Injunction issued on July 13, 1984 remains in effect and prevents Otari from 'making, using, offering for sale or selling' seven infringing models, their equivalents or spare parts.

A second King patent at issue was declared not valid and not infringed. Damages will be redetermined at the District Court.

In brief

Hilton Sound now have a Mitsubishi *X-800* digital multitrack recorder available for hire throughout the UK, with the *X-850* becoming available in October. The Mitsubishi *X-800* is the first of the second generation digital multitrack machines and includes 32 digital audio tracks, two analogue tracks and four additional sync code data tracks. The *X-850* also includes a new 'razor blade' editing facility. . . a new audio cassette duplication service is being offered by Reading based Datagenic Ltd for medium volume runs of mono programmes including A/V formats. Stereo capability is planned for the end of this year. . . The University of Lowell, Massachussetts, is to offer seminars and workshops for the pro-audio community. Further details from the College of Music. Tel: (617) 452-5000. . . James Yorke Ltd, the Cheltenham based tape duplication and manufacturing group, have announced a full custom service facility. The new service includes everything from the manufacture of their own bulk tape through to recording, mastering, duplication, print and packaging design, and final delivery to anywhere in Europe. Customers may use any or all the services included in the package. James Yorke Ltd, Yorke House, Corpus St, Cheltenham, Gloucestershire GL52 6XH, UK. Tel: 0242 584222. . . Yellow Two Studios, Stockport, has joined forces with UK music production company Soundscapes to offer US firms a travel, accommodation, original music, full recording and audio post-production package. Further details Nick Turnbull, Yellow Two Recording Studios. Tel: 061-429 8480.

Ben Turner joins Finesplice

Formed last year by Tony Faulkner and John Boyden, Finesplice the digital post production facility has appointed Ben Turner as managing director. He will be responsible for the day-to-day running of the company and the development of services in the UK and overseas.

With the experience gained at Tape One Studios in London and over 300 CD masters to his credit he brings a considerable amount of experience to Finesplice which already provides editing, compact disc mastering and digital tape copying facilities.

Currently Finesplice are offering several introductory rates including a special price for all-day bookings and a reduced tape copying charge. Details from Ben Turner on Staines (0784) 65279.

Contracts

- London's Red Bus studios will become the first UK studio to instal the Harrison *series 10* console when they take delivery of the system early next year. The console will be fitted with 96 fully automated inputs with delivery scheduled for January 1986.
- Swiss amplifier manufacturers FM Acoustics has supplied 30,000 W of FM 600 A and 800 A amplification to the Sun Plaza Hall in Tokyo. Because the amplifiers had to be located close to the flown loudspeakers they were specially modified to allow status and level to be visually displayed in the main control room.
- Among recent purchasers of AHB's *Syncon B* consoles are the Chinese Tian Tjin Broadcasting Station, Tian Tjin province and the First White Swan Recording Studio in Canton. Aruba Recording Studios in the Antilles and Audiolab Studios in Santa Domingo have also installed the *Syncon B*.
- HM Electronics of San Diego have recently received an order for 53 HME *System 820* wireless microphones from Universal Studios for use in their television and film productions.
- Dyma Engineering of Los Lunas, New Mexico have recently completed the new Sunrise Video West studio facilities in Albuquerque. In the move to the new studios Dyma was responsible for the design and documentation and also provided most of the new equipment. Two complete CMX editing studios, tape room, terminal equipment, two audio studios and a 'live' TV studio were involved.
- Criteria Studios have recently installed two SSL *SL6000E* 48-input consoles with *Total Recall* and a Mitsubishi *X-800* 32-channel digital recorder in the new East Wing. Studio A (the old Studio E) has had some acoustic updates and Studio B— formerly the mastering suite — is now a new control room and home for the second SSL. Studio C has been updated with a 'live' hardwood floor and further acoustic treatment. The new facilities were designed by John Storyk of Sugarloaf View in conjunction with studio president, Mack Emerman and the studio staff.
- Audio + Design have recently installed 24-track *telcom* noise reduction for Castle Sound Studios, Pencaitland and Angel Studios, London.
- Valley Audio have now sold seven *Boxer* monitoring systems in the Nashville area. The *Boxer* system comprises electronic crossover, three specially prepared EAA amplifiers for bass, mid and top and softdome monitors comprising four 300 mm bass units, one 100 mm mid and a 38 mm tweeter.
- Discrete Research have recently finished building Billy Currie's Chepstow studio and are now providing a 24-track post sync, dubbing to picture (music and voice) facility at the Tape Gallery in London. Chipping Norton Studios refurbishment is also in hand and will result in a new machine room, a much larger control room and 50% more studio space. Other recent projects include work for Red Bus, Jam, Swanyard and Shuttlesound.

Music Lab expansion

Music Lab Hire has announced the completion of the first stage of a major investment programme. The company, which already has a large inventory of digital effects units, mics and tape machines, has taken delivery of two Otari *MTR90* 24-track machines, two *MTR12* mastering machines, one Dolby *SP24* system, four *Emulator* keyboards, two Linn *9000* drum machines, three Soundcraft *200* desks and Fostex 8 and 16-track machines.

Music Lab Hire announced a full 24 hr service last year and directors Paul and Richard Eastwood reported that business had almost trebled within the last eighteen months.□

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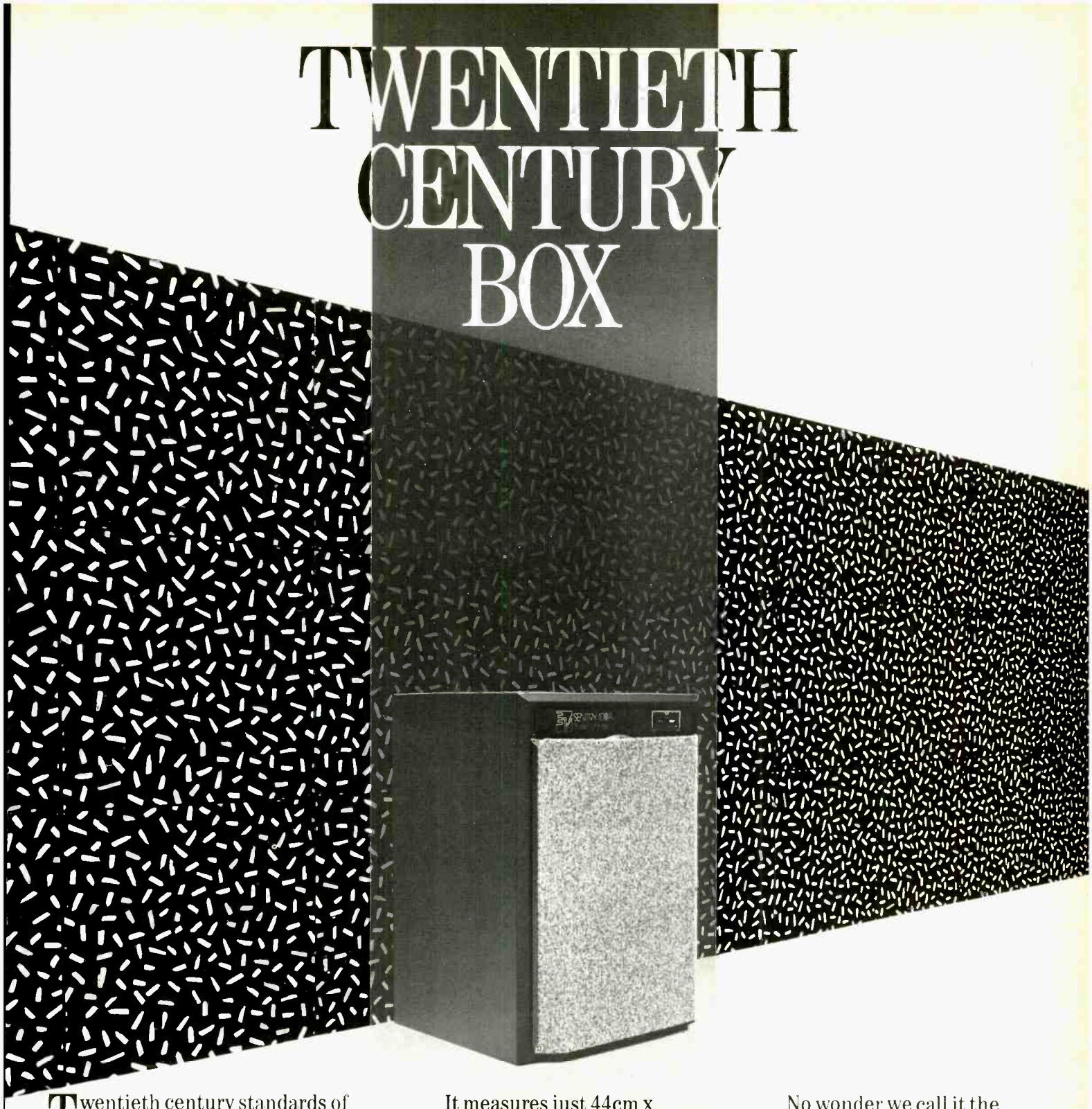
TWENTIETH CENTURY BOX



Twentieth century standards of quality and performance require the 'human engineering' of the Electro-Voice Sentry 100A monitor.

Designed specifically to meet the needs of the professional studio engineer, the Sentry 100A combines a full range of performance characteristics in an efficient no-nonsense package that's deceptively compact.

It measures just 44cm x 31cm x 29cm.

With its high efficiency, uniform frequency response, and superior stereo imaging across the critical bandwidth, you would expect a much larger enclosure.

Like all Electro-Voice products, we're confident that the Sentry 100A will still be giving startling performances well into the next century.

No wonder we call it the Twentieth Century Box.

SOUND THINKING ABOUT SOUND PRODUCTS · **SHUTTLE**SOUND

Unit 15, Osiers Estate, Osiers Road, London SW18 1EJ Tel: 01-871 0966 Telex: 27670 SHUTSO G.

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NEW PRODUCTS

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Equipment, modifications, options, software

Harmonia Mundi Acustica bw102 digital audio interface

The *bw102* is a professional digital audio interface unit allowing direct digital transfer between most existing digital formats. Direct transfer between EIAJ and Sony *1610* formats are possible with Mitsubishi and AES/DASH interfaces in preparation. Additionally 0 dB low noise transfers, phase correction and channel reverse are possible. The *bw102* also includes a digital limiter with a compressor section currently in preparation.

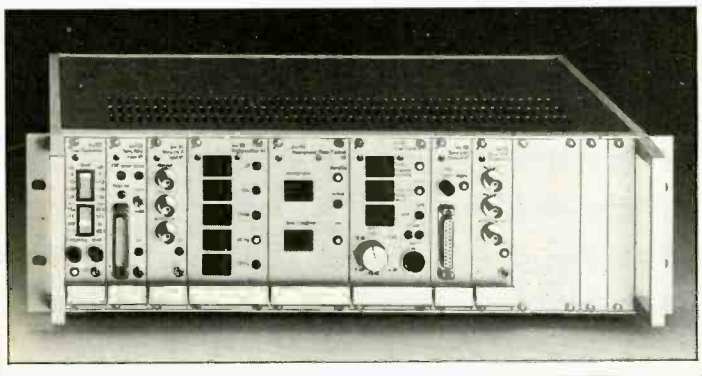
When used with consumer digital recorders the unit offers improvements by removing the DC-offset and pre-emphasis and corrects the 11 μs delay.

Displays include 14/16-bit quantisation, CRC, Mute (with switchable Hold and alarm), absolute clipping level, phase, L/R Reverse, HP-filter frequencies, level and sinewave generator frequencies. The modular design allows for different configurations and future developments including time delay for disc mastering and direct digital reverberation.

Harmonia Mundi Acustica GmbH, In den Sigristmatten 6, D-7800 Freiburg. Tel: (0761) 49 15 06.

USA: Audiotechniques Inc, New York. Tel: (212) 586-5989.

USA: Audio Intervisual Design, Los Angeles. Tel: (213) 653-0240.



Applied Microsystems CM250 synchroniser

The *CM250* synchroniser from Applied Microsystems comprises a compact control unit with an LCD display and a separate 1U rack which provides interfaces to all current video recorders from VHS through to C-format and a wide range of audio machines.

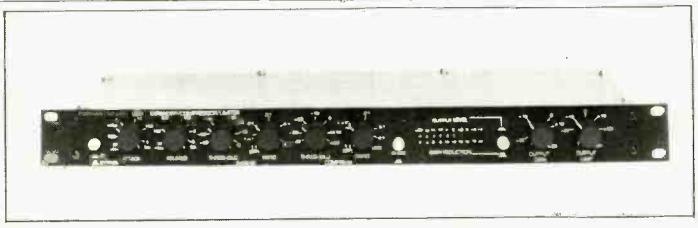
The rack contains two separate microprocessor controlled machine interfaces each of which includes a 9-cue autolocator identical to the *CM50* autolocator. The interfaces are selected by software and then stored in non-volatile memory (as is all important data such as offsets and cue points) so there is no need to make hardware changes for different interfaces apart from changing cables. The integral SMPTE generator and readers are also located in the rack.

Communcations between the three parts of the system are by an RS232 loop which enables an easy expansion to three or more machines locked together.

The *CM250* allows entry of offsets either manually via the keypad or automatically in which case it may be adjusted using the '+' and '−' keys. The code generator can be preset either manually from the keypad or automatically from incoming code in which case it regenerates the code.

When not in lock, the *CM250* may be used as a full 9-cue autolocator with shuttle between any two cues.

Applied Microsystems Ltd, Town Mill, Bagshot Road, Chobham, Woking, Surrey GU24 8BZ, UK. Tel: 09905 6267.



Furman Sound LC-X expander/limiter/compressor

The *LC-X* is a new single channel expander/compressor/limiter with 'soft knee' characteristics in the expander/compressor sections. Each section has its own threshold control with LED indication of the onset of each effect. The expander/gate and compressor/limiter/de-esser sections share attack and release controls. All sections are controlled by a single high performance VCA using a special thermal null system developed by Furman Sound. This corrects for any voltage offsets and is claimed to give excellent transient response, low noise and distortion and a wide frequency response.

Other features include variable output control (±20 dB), high/low line input/outputs, A/B bypass, ground lift and an interconnect jack for linking two units for stereo.

Furman Sound Inc, 30 Rich Street, Greenbrae, CA 94904, USA. Tel: (415) 927 1225.

EAR 822Q and 823MQ equalisers

Esoteric Audio Research has developed two valve (tube), no-loss passive equalisers. The *822Q* is a general programme equaliser and the *823MQ* is specifically designed for mid range control. The *822Q* features four low continuously variable frequencies (+14 to −18 dB); five high boost (0 to +12 dB, broad Q) and three high cut frequencies (0 to −18 dB).

The *823MQ* provides up to a +8 dB lift or a −16 dB cut at the following frequencies: 200, 300, 500, 700, 1, 1.5, 2, 3, 4, 5 kHz. A further mid frequency cut at 7 kHz is also provided.

Signal to noise is claimed to be 80 dB (+4 dB operating level) with THD 1% at +25 dB and 0.15% at +10 dB (20 Hz-20 kHz, Z out=40 Ω). The units are designed to operate for at least 10,000 hrs before valve (tube) replacement is necessary.

Esoteric Audio Research Ltd, Unit 11, Stukeley Meadows Industrial Estate, Huntingdon, Cambridge, UK. Tel: 0480 53791.

Fougerolle Picot N-10 digital recorder

First shown at the International TV Symposium, Montreux, the 2-channel *PICOT N-10* digital recorder is the result of a collaboration with Tele Diffusion De France and Fougerolle. The machine uses 16-bit linear quantisation and has four audio and one timecode track. Sampling frequency is 48 kHz (modifiable) and the *N-10* uses quarter inch tape running at 7½ in/s.

According to the manufacturer the recorder is equipped with sophisticated error correction circuits that can provide full correction for losses up to 1 cm of the magnetic track. Inputs and outputs are both analogue and digital (AES/EBU).

The *N-10* measures 90×65×60 cm and weighs 58 kg.

Fougerolle SA, ZI 10 rue Charles Cros, 95320 Saint-Leu-La-Foret, France. Tel: (3) 995 69 33.

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The world's best-selling multitrack and the extraordinarily successful Amek Angela console. Individually, remarkable products, together, an unbeatable combination. We are currently installing several such systems for a variety of customers' applications. The flexibility of the Angela, coupled to the performance of the MTR 90 make the system the most cost-effective choice available. Only ITA can supply both. Our 12 years' experience makes us the obvious choice for either product.

ITA doesn't end with Otari and Amek. We have the largest product range of any UK professional audio dealer and can provide installation, full back-up, a studio design service and full building capability.

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NEW PRODUCTS

NEW PRODUCTS

Equipment, modifications, options, software

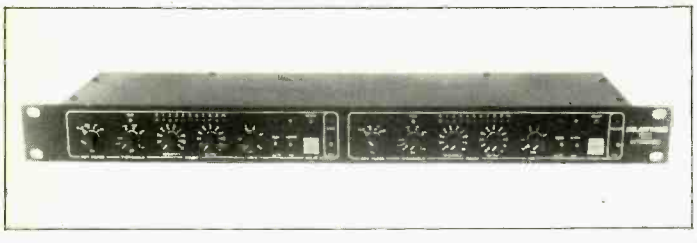
Stellavox TD 9 tape recorder

Stellavox has introduced a new professional standard tape recorder. The *TD 9* is a modular design and will accept ¼ in, ½ in and perfo 16 mm PE film. All transport functions are micro-processor controlled and the machine will accept 14 in reels. Other features include six speeds, synchronisation with or without timecode for film or video, computer interface, Selsync, vari-speed, locator, Preview, switching for tape with inside or outside wound oxide, line and battery supply and a monitor loudspeaker.

Stellavox, 2068 Hauterive, NE Switzerland. Tel: 038 33 42 33.

UK: Future Film Developments, 114 Wardour Street, London W1V 3LT. Tel: 01-437 1892.

USA: Zellan Enterprises Ltd, 250 West 57th Street, New York NY 10019.



Drawmer T102 Interface

Recently introduced by Drawmer is the *T102* interface. Essentially a triggering device enabling a number of single source events to be triggered automatically or delayed by a preset number of beats.

The *T102* is a two-channel device which can be linked so that one channel controls the start of the other. Triggering, pulse status, linking and count status are indicated by LEDs. A ready light also indicates that the device will start counting on the next trigger pulse. For single or continuous sequences a Manual/Auto reset is provided. Sequence length, delay count, threshold and key filter are all adjustable via the front panel controls. Designed to increase the versatility of the *DS201* Dual Gate, the *T102* can be used with other types of equipment including MIDI.

Drawmer Marketing and Sales Ltd, 6 Manor Road, Teddington, Middlesex TW11 8BG, UK. Tel: 01-943 1368.

USA: Harris Sound Inc, 9138 Santa Monica Boulevard Hollywood, CA 90046. Tel: (800) 233-1580.

USA: Martin Audio, 423 West 55th Street, New York 10019. Tel: (212) 541-5900.

In brief

Audio+Design: has developed the *Filmex*, a single ended noise reduction system designed to clean up old master tapes, remove background noise on overdub and edit tracks and clean up speech recordings. Based on the *Scamp* modular system the *Filmex* is a 2-channel system using an *S32* master interface module in combination with the *S27* bandsplit module and four *S30* expander/gate modules per channel. . . **ART:** has announced preliminary details of the *DR1* digital reverberation system. The *DR1* includes all the features of the *O1A* plus full function remote control; MIDI; stereo in/out plus stereo mix; reverse and gated reverb with additional effects and a programmable foot switch. The software control also enables multiple factory presets with 100 user presets each with 10 user programmable functions. The *DR1* has a 16-bit D/A output. . . **Prefer:** has developed a hand held vocal/music mic using a high sensitivity back electret with an ultra thin gold evaporated diaphragm. The manufacturers claim low distortion and handling noise and the inner pop filter is user accessible for vocal or music use. The *MPR-1425* has a transformerless floating output with a 3-position (on-standby-off) switch to reduce turn on clicks. Ummels bv, Hofdwarsweg 57, 6161 DE Geleen, Netherlands. Tel. (04494) 47373. . . **HM Electronics:** of San Diego has recently introduced a new handheld radio mic incorporating the Shure *SM87* condenser element. The System *87* is claimed to provide wireless performance identical to a conventional *SM87*. The transmitter is also claimed to be the smallest available using an *SM87* element. . . **Audio Technica:** cartridges are being fitted with LC-OFC (linear-crystal, oxygen-free copper) leadwires. As with speaker cables and interconnects, the linear crystal leads are claimed to improve signal transfer and linearity. . . **Oneac Ltd:** has added two new models to its *Micromate* range—the 1500 VA and the 2000 VA. These new mains conditioners have been designed to improve the reliability of computers and computer-based equipment while reducing system errors. . . **Rebis Audio Ltd:** has just announced the *RA226* sampler. The new Rebis module provides 8 s record/play expandable to 32 s with a 12 kHz bandwidth. . .

Audio Engineering Services delay mods

Audio Engineering Services are providing an interesting service for owners of digital delay units. With their *SX300* series modifications virtually any digital delay unit can be transformed into a sound sampling device. Two units are currently available—the *SX301* and the *SX303*.

The *SX301* consists of an extra PCB, 10-way ribbon cable and hand held control box. All these are fitted without drilling holes or making any major alterations to the original delay unit. When not in use the control box can be disconnected and the delay unit used as normal.

The *SX303* includes pitch control and two triggering options. Pitch can be adjusted manually over a 2-octave range or via a 1 V/octave output and the sound can be gated or 'one-shot' triggered as with the *SX301*.

All modifications are fitted free of charge if the delay unit is sent to Audio Engineering Services. On-site installation takes about an hour and is charged according to location. Other services provided by Audio Engineering Services include a 'high' and 'low' tech custom design/build service; PROM programming; Delta MIDI interfaces and general servicing and repair including 24 hr call out.

Audio Engineering Services, 'Chelmer', Woodham Walter, Maldon, Essex, UK. Tel: 024541 2641.

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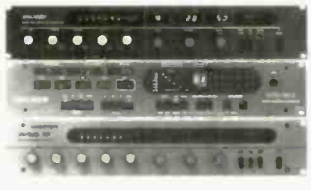
WORDS FAIL US.

Trying to describe the MSP126's capabilities in words is no easy task. After all, several of it's effects are unlike anything you've ever heard before.
Let's just say that the MSP (Multi-tap Stereo Processor) has a range of appealing and unusual effects that alter stereo perspective in a way that will at first intrigue, then impress and finally amaze.
The only way to really appreciate what the MSP126 can do is to hear one. Call us for a demonstration, our place or yours.



The MSP126 is one of the Ursa Major range of digital signal processors, which also includes the StarGate 323 and 8X32 digital reverberators and the new StarGate 626 reverb/delay system.
Ursa Major products are distributed exclusively in the UK by ITA.

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NEW PRODUCTS

NEW PRODUCTS

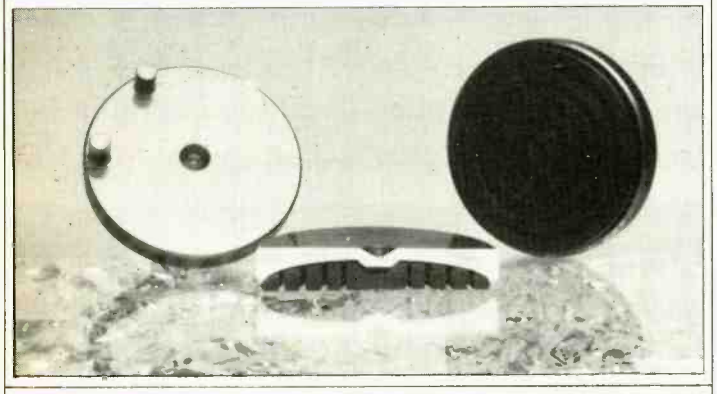
Equipment, modifications, options, software

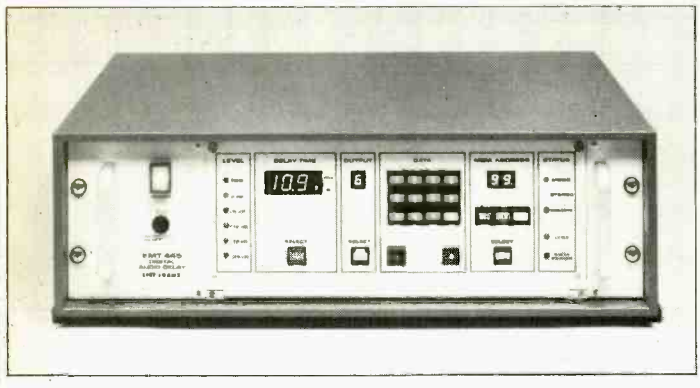
BTR jackscrew mounts

BTR Silvertown has developed a series of anti-vibration mounting plates. The BTR STAM mounts consist of a cast circular plate with linked elastomeric moulded concentric rings on the underside. The mounts are available in diameters from 1.5 in (37 mm) to 10 in (260 mm) with three grades of firmness—soft, medium and hard.

The BTR STAM mounts are designed for jackscrew fixing and are normally supplied with a recess in the upper plate to ensure accurate location. The larger sizes are also available with location pegs. Although the floor should be as level as possible, no special preparation or skills are needed for installation.

BTR Silvertown Ltd, Horninglow Road, Burton on Trent, Staffs DE13 0SN, UK. Tel: 0283-31155 Ext 309.





EMT-Franz digital delay and magnetic disk recorder

German pro-audio manufacturer EMT-Franz have released a digital delay unit, the *EMT 445*, and the *EMT 448* digital audio spot recorder. The delay unit uses a 48 kHz sampling frequency with 16-bit resolution and can provide a stereo delay time between 1 ms and 10.9 s (×2 in mono) with full audio bandwidth up to 20 kHz. A 99 memory keypad can be used for preset delays and the unit has a two lead remote control.

The *EMT 448* is a digital short duration storage unit with frictionless recording on Winchester drive. Each drive can store up to 14 programmes with any playback sequence. Programme duration is between 25 s and 7 min. An RS232 port provides for computer control and calibration tones of indefinite length can be generated in the unit using minimum storage capacity.

EMT-Franz GmbH, Postfach 1520, D-7630 LAHR, West Germany. Tel: 07825-1011.
UK: FWO Bauch, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Tel: 01-953 0091.
USA: Gotham Audio Corp, 741 Washington Street, New York, NY 10014. Tel: (212) 741-7411.

CMS-2 MS-type microphone

Sanken new microphones

Sanken have announced four new microphones. All are of the push-pull DC bias condensor type with titanium diaphragms. The *CMS-6MS* is a lightweight portable microphone system and can be ordered with the new *CMS-MBB* battery power supply and switchable matrix box (M-S or L/R). Maximum SPL for 1% THD is 127 dB and the sensitivity is 0.56 mV/0.1 Pa. The *CMS-6* has a dynamic range of 108 dB with a frequency response 50 Hz to 18 kHz.

The *CMS-2* is a mid/side mic system with a dynamic range of 129 dB and a frequency response from 20 Hz to 18 kHz. Max SPL (1% THD) is 145 dB and the sensitivity is 0.28 mV/0.1 Pa. The *CMS-2* is small and light and is suitable for either TV or radio broadcasting or recording.

The *CU-32* and *CU-31* have similar specifications, the maximum SPL (1% THD) is 148 dB, frequency response is 20 Hz to 18 kHz. The overall dynamic range of the two microphones is 129 dB with sensitivity set at 0.355 mV/0.1 Pa. Pickup with the *CU-31* is end on to the microphone whilst the *CU-32* pickup is at right angles to the microphone body.

UK: Stirling Audio Systems Ltd, 1 Canfield Place, London NW6. Tel: 01-625 4515.
USA: Martin AudioVideo Corp, New York. Tel: (212) 541-5900.
USA: Studio Supply Company, Nashville. Tel: (615) 366-1890.
USA: Audio Industries Corp, Hollywood. Tel: (213) 851-4111.

Otari MTR12 Series II master recorder

An updated version of the *MTR12* 2-track recorder has been announced by Otari. The recorder has been strengthened structurally and the cosmetic finish improved. The transport system has also been refined both mechanically and electronically for better tape handling. Easier timecode interfacing has been provided. All previous features have been retained and the electronics are fully compatible with the earlier machines.

UK: Otari Electric (UK) Ltd, 22 Church Street, Slough, Berks SL1 1PT. Tel: 0753 822381.
USA: Otari Corporation, 2 Davis Drive, Belmont CA 94002.

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THE NEW MASTERING STANDARD

Through decades of cooperation with leading specialists from radio, television and music recording studios, Studer machines have been perfected into professional tools that are appreciated world wide. This valuable experience has resulted in the birth of the Studer A820 – setting new standards for tape recorders to satisfy the most diverse requirements.

The concept of the A820 generation is based on traditional values such as stability, precision and ruggedness – pre-requisites for maintaining demanding specifications over a long service life.

Key elements are not only a superb tape transport with DC motors, advanced servo circuits and flexible audio electronics, but also a software concept that goes far beyond current ergonomic considerations and optimises performance when the A820 is interconnected in a system with other audio and video machines making it the ideal post-production tool.

Its features include:

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- ☐ Brushless DC capstan motor
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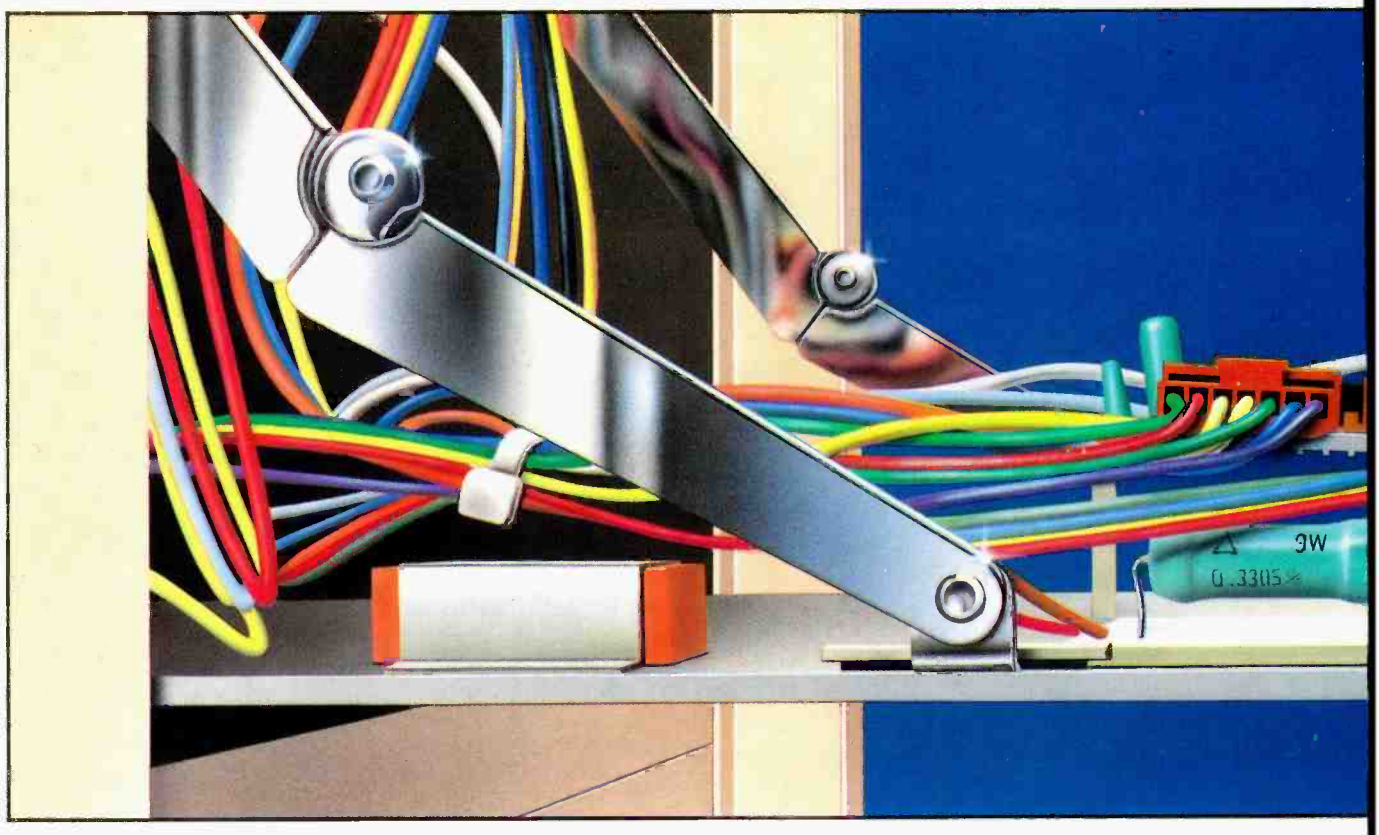

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4040 Nuess 1
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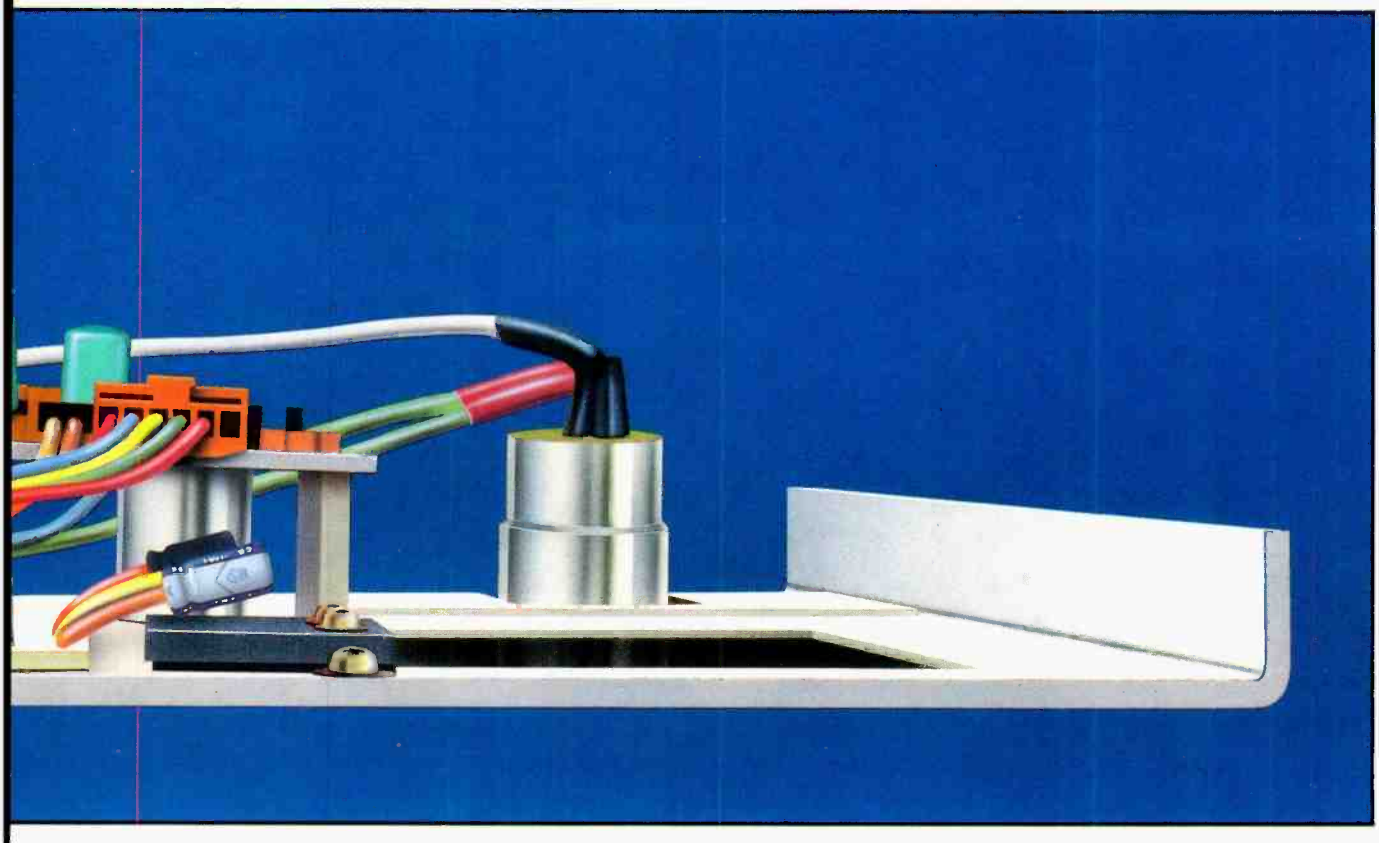


This panel protects the mother board at the heart of the Otari MTR 12. And it's hinged to allow easier access.

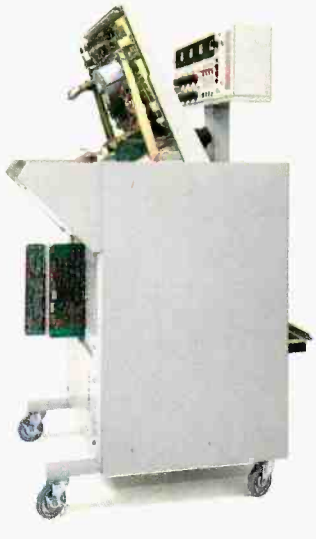
The MTR 12's power supply is fully modular, too, for fast diagnosis and repair.

Even the transport assembly is hinged, for total accessibility.

In fact, every area of the MTR 12 shows that Otari did more than design a recorder with superlative performance. They also made it easier for you to keep it that way.

All of which goes some way towards explaining what makes the MTR 12 the most professional of ¼" or ½" two-track mastering and production recorders.

Otari's advantage can be summed up in one word.



Detail.

A passionate attention to those things that make a professional's life that little bit easier.

Naturally, because it's Otari, the technology is true state-of-the-art. It's the only recorder of its type to offer 7.5, 15 and 30 i.p.s. And the only design that lets you incorporate IEC format centre-track timecode, with the capacity to resolve mono and stereo pilotones, all in the same machine.

Other than these features, you'll find very few options on the MTR 12. For the very simple reason that the MTR 12's standard specification makes it one of the most complete professional recorders you can buy.

But Otari's attitude can best be shown by the way they build a 24-hour a day mastering recorder to the utmost standards of reliability. And then make it as accessible as they can, for maintenance.

After all, Otari reason, just because they have bent over backwards to make the MTR 12 more reliable, there's no reason why you should have to do the same to keep it that way.

OTARI®

For more information on the MTR 12 or other Otari products, contact
Turnkey Studio Systems, Brent View Road, London NW9 7EL. Telephone: 01-2024366.
Industrial Tape Applications, 1 Felgate Mews, Studland Street, London W6 9JT. Telephone: 01-7489009.
Stirling Audio Systems Ltd, 1 Canfield Place, London NW6 3BT. Telephone: 01-6254515.

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PUK

DESIGN FOR DIGITAL

Denmark's Puk Studios has become a place of great international interest in a short space of time. They have chosen the untried path rather than the conventional route. Janet Angus visited, studied and reports

One of Denmark's larger recording facilites, Puk Studio's recent expansion and re-design has focused the recording world's attention on the most unlikely site for an innovative recording facility.

Previously a monastery and more recently a remote farm, Puk is a good hour's drive from Jutland's largest town Aarhus and the journey ends down a winding track across flat countryside to the studio.

The facility has been in operation since 1978 on a much lesser scale. The transformation and expansion which it has undergone in the last two years is no less than dramatic. Christened after owner John 'Puk' Quist, the studio has caused a stir for a number of reasons: the control room is designed on LEDE principles; the console is a Calrec *UA8000* with *MasterMix* automation; the facility is of huge proportions; the design set out to capture as much of the atmosphere and picturesqueness of the countryside as possible; and there is a monitoring system which turns the traditional concepts of control room monitoring upside down.

The original facility is a relatively modest affair which runs alongside Studio A. Puk himself seems to have been the type of client any studio designer could ask for. His attitude throughout the whole project has been to do everything absolutely right—whatever the cost and even though the project was financed almost exclusively by loans he had the courage to spend over three times the original projected figures.

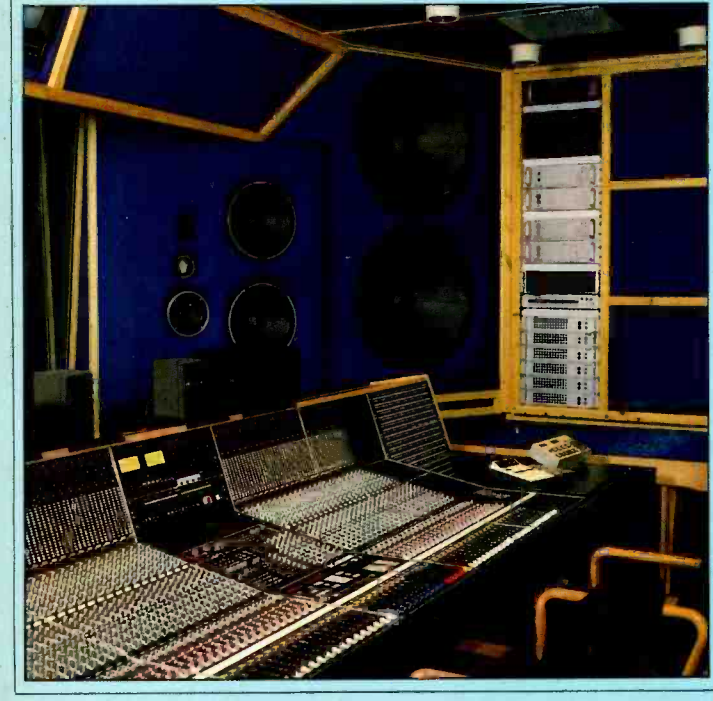
Danish audio company SLT supplied most of the equipment and designed the monitor system in conjunction with consultant Andy Munro with whom they worked on the whole project. Having established with Puk that the LEDE design was what was needed, Andy Munro was finally approached for various reasons including England's relative proximity to Denmark, the requirement for a unique design, as well as his personal attitude, the Danes having found the American approach rather aggressive and overpowering.

Having presented Andy with their field and told him that in principle they could do whatever they liked, it took a further 12 months of discussions and exchanging of ideas before the final design decision was reached.

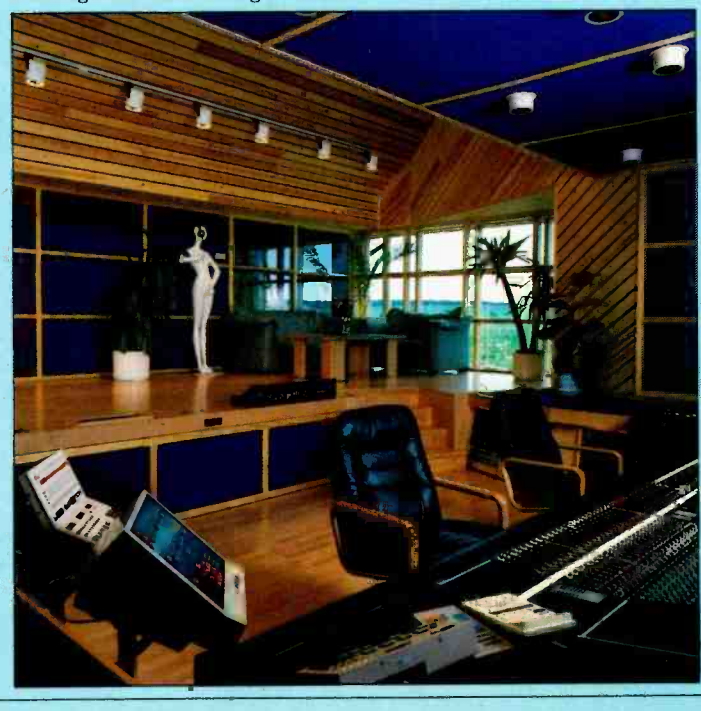
SLT's Ole Christensen outlined their conclusions thus: they wanted an LEDE room. They also wanted to take advantage of the views and have very light and airy surroundings, particularly wanting to capture the northern light. It was important that artists playing in the control room should have a good sound in their playing position. They didn't want a traditional control room: "They all sound different anyway and you can't play loudly in them without getting a confused sound". They wanted space, so that to all intents and purposes the control room became the recording room: "Everyone should be able to play in the control room with amps in the studio so that they can all feel involved in everything. It is psychologically good to have the musicians looking down on the producer and engineer instead of the other way round." This was what prompted the large 'stage' area at the rear of the control room.

As for the monitoring system, Puk told Ole that he wanted to be able to operate at very high volume: "I want to wind the speakers up. I want no compromises and we had to get it right from the start. There was no room for error." Ole's major role appears to have been indulging in a tremendous amount of research. Equipped with a degree in electroacoustics and years of electronics work he read and talked to many experts in the field.

Monitors and racks are symmetrically placed in Control Room A



Seating area on the stage behind the console



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"The specification was all textbook stuff. The studio is built on clay soil which is dead and a bit elastic—perfect isolation material! Part of the problem was wanting so much daylight and trying to capture the views, all those windows needed acoustic isolation.

"Our design approach was to look at the theory and then just go all the way. Caution only slows you down. Sometimes you have to say 'scrap everything' and look at the basic theory, research, talk to the scientific experts like Bruel & Kjaer and taking a combination of all these factors into account, draw logical conclusions. With things like the air conditioning, it was not worth risking spending half as much on a system which might not work—better to go straight for the best and most expensive and get it right first time.

"I don't say that the LEDE design is the only correct way to do it or even that it is totally correct. What I do say is that the TDS measuring system used by Bruel & Kjaer shows that you should not have reflective surfaces round the monitors. Practical experience shows this to be also true. Research by the hi-fi companies such as KEF and B&W shows that cabinet reflections are also to be avoided. The proximity of the speakers is then brought into question. There are basically two opposing groups in control room design: the LEDE vs traditional. To claim that LEDE is the one fixed solution is too much, but it is definitely along the right lines."

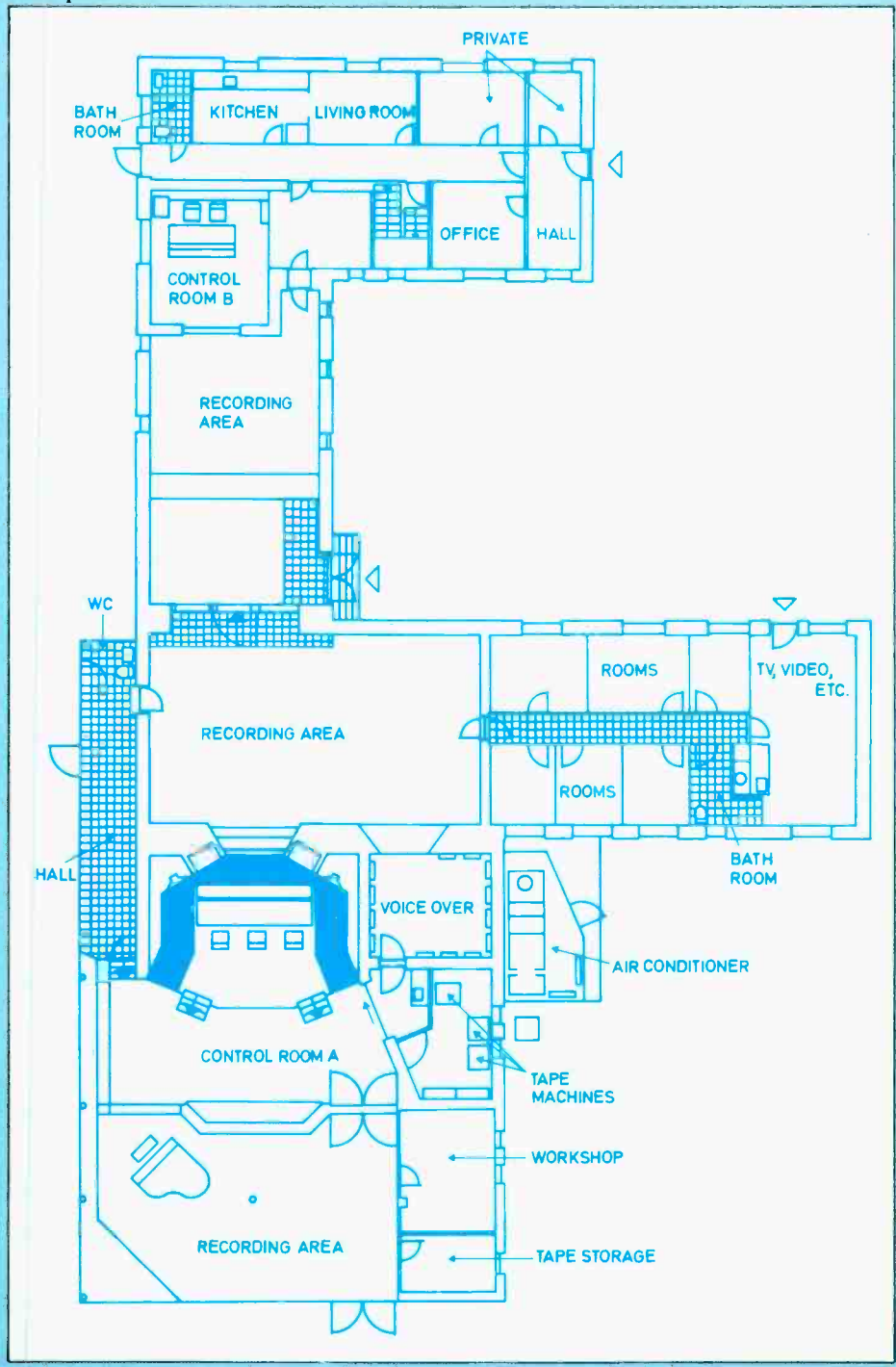
The room itself is extremely difficult to describe. It is very big—almost 100m². The 'stage' referred to earlier does not really feel like that, more like sitting in the upper part of the bar in a Scandinavian hotel! Although it is away from the mixing console in that it is placed behind and above, you do not have the impression of having been removed from the heart of the matter—quite the reverse.

Because digital recording requirements were to be the main consideration here the room itself had to be very quiet. The air conditioning system had to be exceptionally quiet: the system chosen is designed to Danish broadcast standards and, as Puk explained: "It's huge. It was a big shock to me. I had no idea what it was going to involve. It ended up costing £30,000—but I wanted the best so that is what I had to pay."

The room itself gives an unusually wide dynamic range. Details such as the control room window needed re-thinking. In the first instance normal glass windows were installed but the sound isolation achieved did not meet the specification and it was replaced with 0.7 in thick laminated glass. There are three panes each consisting of three layers: glass/plastic/glass, and the result is very dead; each pane is more effective than three layers of normal glass.

The interior design is by local architect Mogens Hansen who, along with Puk built a live room on the back of the control room. A large wood-clad space it commands views across the countryside. This is a good example of Puk's attitude and determination to achieve the best possible facility. The studio is slowly spreading out across the land. He will not remain static with either the physical building or the equipment within it—so long as the industry continues to change, so will he.

Floor plan



Monitor system

One must wonder what makes a man spend an absolute fortune on a speaker system which has never been tried or proven in any way. Puk seems to have that rare quality of trusting other people's judgement to a degree far beyond that of the average man. His explanation: "I can't understand the sort of people who build a very expensive and very very nice studio and then end up having to monitor on the small speakers."

Looking at the traditional monitoring systems, it was decided that these were too harsh and at high volume, a violin for example would hurt your ears. "The JBLs and Altecs etc—are all designed by concepts made in essence during the 1930s and which haven't really changed. These concepts were made when amplifier power was very scarce and therefore they had to use horn-loaded speakers to achieve adequate volume."

Whilst reading for his degree Ole wrote a paper on horn-loaded speaker design and concluded that one could not expect such a system to sound 'properly'. "That's why there is a huge difference in quality between speakers of the BBC style which you cannot play very loud and the traditional high volume American-style monitors.

"Peter Ladegaard of B&K and I set out to design the ultimate speaker system using the TDS measuring system, and applied a lot of power—approximately 4,000 W per side. The loudness was one of Puk's requirements and it is an unfortunate law of physics that if you want to play low frequencies (ie 20 Hz as opposed to 40 Hz) you need four times

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the movement of air and therefore you need cones four times the usual size. The 20 Hz requirement is for the digital recording room. In an analogue room the machines will act as a filter for anything below 40 Hz and the normal studio monitoring will not let you hear it. Nowadays, however, with digital recording and compact discs you can't afford to mask these things. Although this system might seem like overkill it is actually the logical conclusion and is in line with the changing recording requirements of today."

The system is designed entirely on theory and was only put together one day prior to the studio's first booking. Ole: "Luckily it worked! I was pretty sure it would, but I was still a bit nervous—I think Andy was too, after all his reputation was at stake."

One of SLT's designers Knud Rosenskjold was called upon to design the necessary crossover for the system. He had previously designed the power amplifiers, already in use in the original Puk studio. Ole: "I don't do very much of the design work—it is more of an organisational role getting the right ideas together with the right people in the right place at the right time. I do, however, take full responsibility for the speaker system because nobody believed it would work! In fact, the structure for mounting the 30 in speaker is built of very thick wood (instead of concrete like the rest), at Andy's insistence so that if they didn't work they could be removed again."

The system finally arrived at after much discussion and measuring is 5-way and consists of two 30 in and two 15 in Fostex, 8 in JBL, JBL *2445* and a Fostex tweeter per side.

Ole: "For the mid range we tried a lot of horns. They had to be very big which gave a lot of reflections and phase cancellation problems. Finally we decided not to use horns, but rather a large dome tweeter. A normal JBL loudspeaker has a 4 in dome tweeter with a titanium membrane which works very well."

The monitor wall is totally dead and the speaker mountings are completely isolated from the room to avoid transmission of speaker vibrations.

So what does it sound like? If you stand at the back of the stage and walk up (or rather down) to the console mixing position the sound will change only in level. You are not, however, aware that this is what is happening until you try to say something. The normal criterion for judging high volume is the amount of distortion generated. Here you can only judge by trying to speak. It did not hurt my ears at all but it did practically knock me over! That was loud!

Comparing the sound against the Yamaha *NS10Ms* there was more detail on the main monitors although the actual balance did not change. Behind all the speakers there are absorbers ensuring no reflections from the speaker cabinets.

Outside engineers who are not particularly used to working with digital recording and are furthermore thrown by a monitoring system which acts as a magnifying glass, take a while to get used to things. Time and again engineers and producers are being shown out to the machine room to hear the noise which the tape recorders are making and told: 'This is what you are used to hearing in the background in the control room all the time; that's why you can hear all those extra things now.' One's usual references are confused. Similarly turning up the volume—because there is no distortion—you can turn it right up and it is only when you try to talk to someone that you discover how loud it is.

Ole finally said that if you did work with the system at full volume for too long you will, eventually, hurt your ears. Puk describes it as his ears getting warm. Puk: "It is so clear. You hear everything; reverb, the minutest bit of panning. People cannot believe the pinpoint accuracy you can achieve from such large speakers. Then when they are convinced, they start wondering about what it would be like in a small room or in the car—but of course it sounds great."

Ole Lund Christensen is preparing an AES paper on the system. SLT would be very happy to supply it to anybody else and they are currently working on a smaller version.

Console

When it came to buying the mixing console for this facility the choices at the time were SSL or Neve; there was nothing currently available on the American market which they felt would have suited their purposes. The reason they looked at the Calrec was that Polar Studios in Sweden had done a lot of research into various console possibilities and eventually chose Calrec to custom build for them. Being familiar with the expertise and knowledge to be found at Polar, the Puk team decided to take a look. The console they finally bought was the *UA8000*—a mixture of traditional Calrec and the Polar specifications.

The console is a 64-channel frame, fitted 56; each channel has in essence, two inputs: when mixing there are two times 56 channels available and all sections can be switched line or monitor.

Features include console split left and right, with zoned auxiliaries. The four mono sends and four stereo cues can provide eight mono and eight stereo sends on a single channel which can be combined with the main mix signal so that, for example, the musician may hear in his foldback the main mix plus any extra tracks he should require. The mic input has two different circuits—one transformer and one electronically balanced, switching automatically depending on the gain setting. Should you require a lot of gain it selects the transformer to give low noise; if you need a little gain, electronic balance is selected to give low distortion at high levels. It is simple to use: the operator simply turns the gain switch. There is no pad because the mic input will handle any kind of level—even line level.

The console also houses the *Soundfield* microphone controller, and Audio Kinetics *Q.Lock* and the *MasterMix* automation. Apart from all that, Puk felt that it offers all the usual features of an 'SSL-type' mixer as well as having two VCAs rather than one per channel.

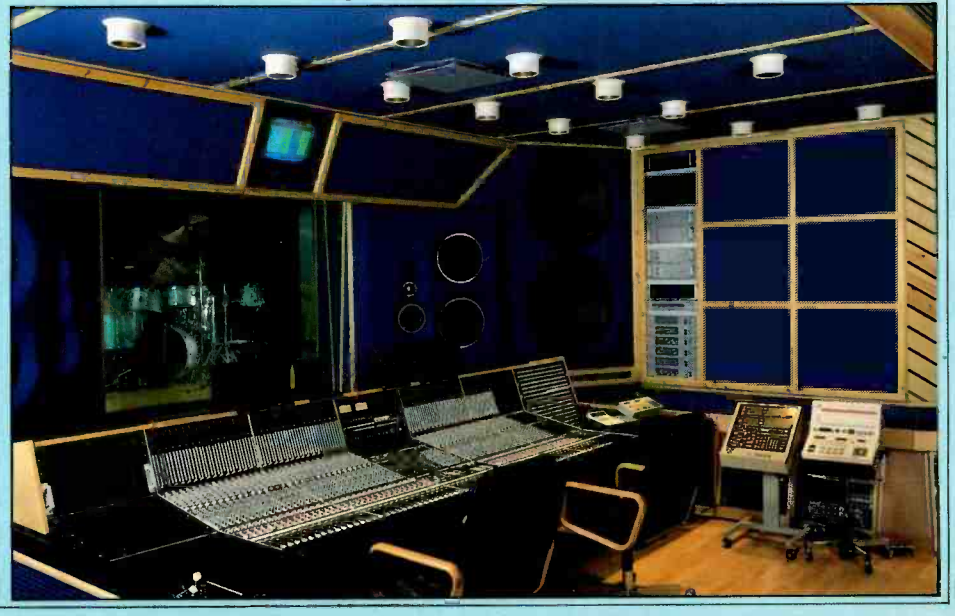
The craftsmanship evident in the Calrec was also important to Puk. Ole: "It is built in the traditional way with individual cassettes screened the way consoles used to be built. All the legending is engraved instead of just painted on. It gives better crosstalk and less hum due to the shielded design. Once again, the only disadvantage is the cost."

Equipment

Choosing the digital equipment was not easy—all they could do was look at the systems available from 3M, Sony and Mitsubishi, read and listen to everything said about them and then finally choose.

They are very pleased with the Mitsubishi they finally selected although Puk is quick to point out that should something better come along he will not hesitate to change. He is puzzled by studio owners who agonise over equipment choice saying it has to last for ten years so it has to be right. "Of course it doesn't have to last for ten

The blue material around the console area is covering absorbers while the back of the room is covered in Scandinavian pine and is therefore reflective



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PUK
DESIGN FOR DIGITAL

years. If things change you just have to go with them."

Ole: "The only difference to us between this Mitsubishi *X800* 32-track and the newer *X850* is the look of the remote and the lack of razor blade edit, but we remain sceptical as to the quality of the razor blade edit available so far and don't feel we are missing out by not having it. The machine tape transport is the same as that on the Otari *MTR90* so it is very easy to work with."

Puk: "Compared with the Mitsubishi, the Sony *PCM F1* sounds much harder; it was designed for the consumer market not pro audio—the Mitsubishi has a much warmer sound. You would not always be able to hear the distinction but in this control room you can hear everything."

Tape recorders: Mitsubishi *X800* 32-track and *X80* 2-track digital. Two Otari *MTR90* 24-track recorders, two Otari *MTR10* 2-track recorders, Tandberg and Harman-Kardon cassette machines and a Sony *PCM F1*.

Ancillary equipment includes: two AMS *15-80S* DDL, two Eventide *Harmonizers*, Eventide Flanger, Lexicon DDL, Aphex *II Aural Exciter*, Aphex *Compellor*, two dbx *165A* compressors, dbx *903* compressor, dbx *902* de-esser, dbx *904* noise gate, Audio+Design *Transdynamic processor*, Audio+Design *Vocal Stressor*, Klark-Teknik *DN30/30* graphic equaliser, EMT *251* reverb, EMT *140* stereo plate reverb, Lexicon *224XL* reverb, AMS *RMX 16*, Quantec *QRS* and Klark-Teknik *DN780* reverb.

Synchronisers are *Q.Lock* and *Dr Click*.

Additional monitoring includes JBL *4350*, JBL *4333*, JBL *4312*, JBL *4311*, Visonik *David*, Yamaha *NS10M* and Auratones.

Puk Studios use the following microphones: Calrec (including *Soundfield*), AKG, Neumann, Bruel & Kjaer, Electro-Voice, Shure, Sennheiser and Sanken.

Instruments on offer are: Synclavier, Fairlight *CMI*, Bosendorfer grand piano, Oberheim *OB8*, Hammond *A100*, Rhodes piano, Slingerland drum kit and Latin plus assorted other percussion.

Recording areas

Apart from the live room already described, where the Bosendorfer grand piano lives, there are two other recording areas belonging to Studio A.

The isolation room, part of the Munro project, is the only dead area in the entire building. It is full of custom-made screens which match the control room decor. The studio area itself is all wood—pine ceiling and floor with moveable rugs at one end. This room was originally part of the farm and retains the old beams, from these curtains are hung which may be pulled across as and when required.

Studio B

In comparison, Studio B doesn't look all that much although the recording area is every bit as impressive. The control room is an original and both areas were built by Puk himself without any guidance from anybody. In fact, the only thing that has been changed recently is that the recording area's egg boxes have been replaced with brown Illsonic tiles!

This studio however is what the whole set up is all about. Puk himself started out as a bass player and became very keen on recording. He recalls with mirth those far off-days and the early equipment that always broke down but he loved it and it has stayed in his blood ever since. The farm belonged to Birthe, now his wife; Puk moved in with his gear and set up shop as a studio.

The studio has been the scene of many of Denmark's biggest selling records including *Midt om Natten* (Middle of the Night) which was later made into a film and sold 400,000 copies; a good selling figure in Danish terms is around 50,000.

From those modest early days the studio is now based around the original Soundcraft Series *2400*—Serial no. 0001—and Otari *MTR90* and *MTR10* machines.

Monitoring is on JBL *4333*s modified with bigger mid range drivers and Fostex tweeters; small monitors are Auratones. The monitor power amps are SLT. Outboard equipment includes *Kepex* noise gates, dbx *118* dynamic range enhancer, Drawmer gate, Drawmer compressor/limiter, AMS *15-80S* DDL, Klark-Teknik digital reverb, Eventide *Harmonizer*, Gemini *Easyrider* and a *Scamp* rack.

The recording area is live at one end in what used to be a drum booth (beech floor and pine ceiling and wall slats with trapping behind), and damped down at the other with the aforementioned Illsonic tiles.

These days the studio is used mainly for Danish productions and jingles as well as a programming base for the Fairlight and Synclavier, etc.

Munro Associates

The Puk project started for Andy Munro and his associates when they were contacted by SLT in Denmark to discuss the update of Puk's studio complex. "The existing studio seemed to be an American-style rock'n'roll studio which I thought was very professionally built, with a good dead American 'Westlakey' space and a very good live room. It was all finished in nice Scandinavian woods with a standard of carpentry the like of which I have never seen in the UK."

The control room on the other hand was the worst he had ever set eyes on. "It was atrocious. The room had never been designed as such and it was all wrong. The monitoring was lopsided and there was no front to back distance in the control room. It just couldn't be improved."

The brief was to build the ultimate control room, making no compromises whatsoever; even when the designers themselves wanted to compromise because they felt it was starting to go over the top they had their wrists slapped. So here was every designer's dream.

Ole Lund Christensen, managing director of SLT briefed Munro and together they sat down and worked out the parameters for a purpose-built digital control room. "To the best of my knowledge that was the first time that a ground upwards digital control room was ever discussed—this was in 1982."

The parameters they decided were: an enormous dynamic range of around 90 dB; an extended frequency response, and as far as distortion was concerned, system non-linearities of non-existent proportions. In other words flat to zero, no background noise and a monitor system with no distortion. The only way this could be achieved was to build a very large room to eliminate the low frequency standing waves. The resulting room is nearly 100 m^2.

"The monitors had to extend down to 17 Hz—we decided that was the lowest we could find anything capable of driving down to. The monitor system needed to be one you could relate to in terms of Urei or Eastlake but with extended low frequency using subwoofers crossing over to give an extra octave, because that's all you need. They always have a choice whether to use them—they can switch them out.

"We had to maintain the dynamic range for digital. The lowest practical ▷

Isolation room with Synclavier II and Fairlight

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noise floor in a working control room is NC 20dB. You can't treat it as an anechoic chamber. It had to easily match the dynamic range of the digital machines, including the drivers and the amps. There was nothing commercially available that could do that and maintain low distortion. ATC *Softdome* did not have enough sensitivity and headroom to match the design brief, although it is a very good system. In this situation it would not have been loud enough for the job."

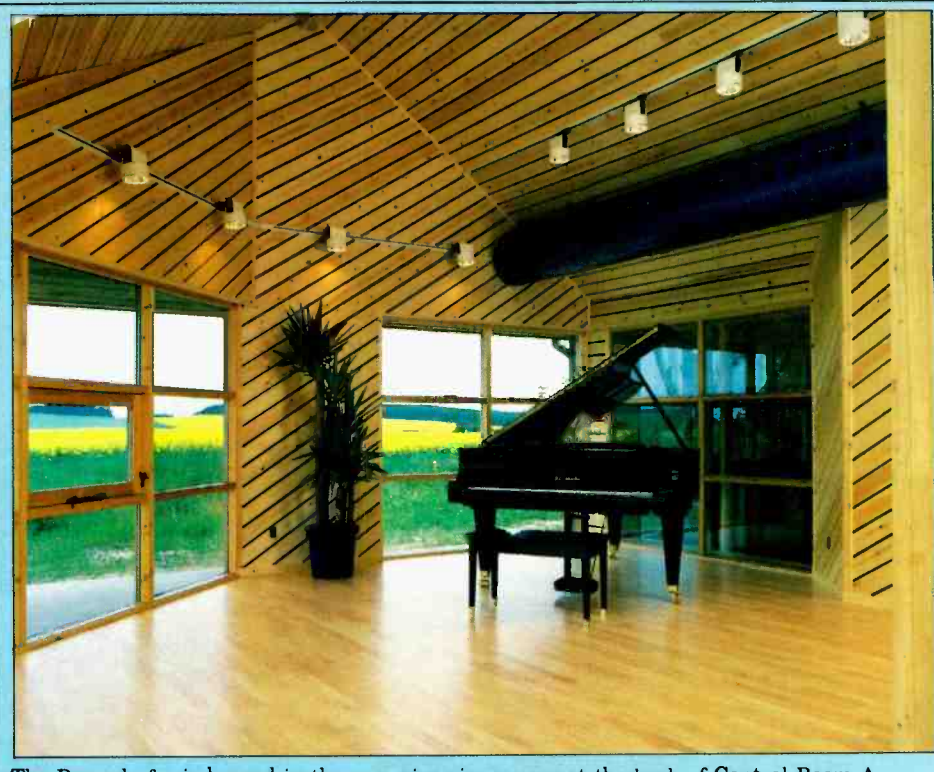
In the end SLT and Andy Munro designed their own system. The result was a system which in theory gave incredibly high sound level, acceptably low distortion, which would only work with a very carefully worked out electronic crossover. Because the crossover was a one off it was impractical to follow the normal R&D processes of building models and testing until the right formula was found. The man who built this crossover is SLT's Kund Rosenskjold who carried out the calculations, made it up and aligned and tuned it on site with Andy using the *Tecron TEF10* analyser, making anechoic measurements in the control room using time delay spectrometry. "The *Tecron* is the only machine in the world that will give anechoic measurement in a live room. Without Knud's crossover the monitor system would never have worked, and I must emphasise his contribution. My measurement and his electronics knowledge combined to make the system work.

"I don't think the distortion performance is quite as good as a good softdome system but compared to any current horn-loaded system, it wipes the floor with them. They wouldn't have worked in there. It is a rock'n'roll system with less distortion than any other. If anybody else wants one it will cost them £15,000 just for the parts! So, as such, it is unique and is quite likely to remain so."

Because of the SPL and low frequencies involved Munro decided the monitor wall should consist of dense concrete blockwork, so the actual housings of the monitor cabinets are in dense concrete. Thus they maintain the transient response and frequency response down to design specification, "Which is nothing less than miraculous I should point out."

The monitoring is driven by a 5-way amp system consisting of custom-built SLT MOSFETs in bridge mode, very carefully quality matched and giving a total power of something like 4,000 W per side. It is designed to give peak transient sound pressure levels in the region of 140 dB with comfortable maximum SPL of 130 dB. "The point is not to generate sound pressure levels of 140 dB, but to get a minimum headroom of 10 dB even on what would normally be considered to be peak levels."

As for the rest of the room, it had to have an acoustic performance to cope with it all. They utilised fairly radically modified bass absorbers for down to 20 Hz low frequency damping. "We actually changed our thinking about bass traps as a result of that. We have decided that they are a waste of time in that situation. To make them work at all they would have to be rather large—4 m deep in fact, which in normal control room architectural terms is out of the question; a studio cannot normally afford to lose that much space. So we had to design an alternative. We now use heavily damped membrane absorbers, which I don't think anybody else uses."



The Bosendorfer is housed in the new airy piano room at the back of Control Room A

The basic design of the room is on the LEDE principle, which was a client requirement from the start. It was most unusual for a client to even know about such fine details and for Puk to be so positive about what he required was refreshing. For more information Andy Munro wrote an article on the subject in *Studio Sound* back in October of 1980.

The general atmosphere of the room is one of space and openness. At the back Puk wanted to create the impression almost of playing on stage, the audience being down at the mixing console. "Puk wanted a totally state of the art recording set up technically, while at the same time wanted the musicians to feel as though they were playing in a club."

The back end of the control room then is a stage, 11 m wide at its widest point. The raised playing area is itself larger than most control rooms. It does not cause monitoring environment problems because of the time delay. If you produce a sound in the live area you will hear it at the console as if you were sitting in the audience listening to a band on stage. If you produce a sound on the monitors, your perception of that sound will not be influenced by sounds from the stage because they are so different. Acoustic treatment at the back of the room prevents sounds bouncing back to the mixing console, avoiding echoes.

In order to satisfy noise requirements, the removal of low level clicks and pops etc, a machine room was built for almost all fan-driven pieces of equipment. Those that had to remain in the control room are housed in an acoustically designed racking system. The performance of the air conditioning system also had to be below the ambient noise level of the room itself.

It was equally important to have no noise breakthrough from the studio, which it is especially difficult to achieve at low frequencies; there is a limit to how much isolation you can get. So the control room is in a totally physically detached building and the separation between the rooms is therefore excellent.

The existing studio lacked a very tight acoustic isolation room for vocals and instruments with no acoustic coloration. This is built in a separate shell, but the separation requirements are not as great here as for the main room.

The design of the building as a whole involved things such as the abundance of windows and therefore daylight. This is controlled by the roof overhanging the windows, creating a shadow in summer, but allowing the sun in during the winter, maintaining a consistency in the level of light. The finishes reflect the original design of the studio. All the hardware and ironmongery is Scandinavian, the only UK materials being the bass absorber material. □

Monitor specification

SLT/MA5 5-way system: each unit comprises 2×800 mm sub bass, 2×400 mm bass, 1×200 mm low mid, 1×100 mm dome high mid, 1×44 mm HF. Five-way stereo electronic crossover with full group delay compensation.
Nominal sensitivity: 109 dB for 1 W output from each power amplifier.
Frequency response: 17 Hz to 21 kHz.
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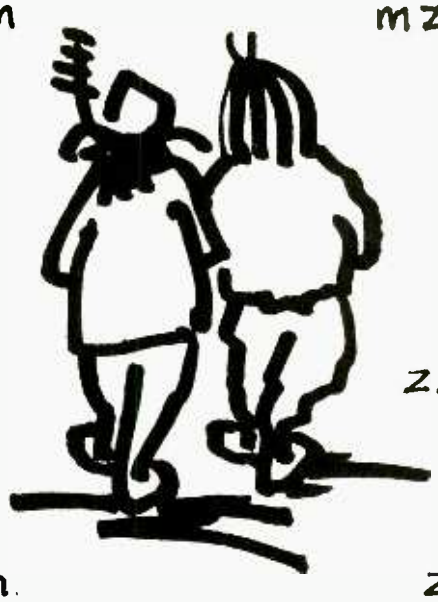

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STUDIOFILE

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Studio 44, Monster

Control room

Somewhere between The Hague and Rotterdam in the little town of Monster, there is a most peculiar studio.

The multitrack machine is a Tascam *58* and the mixing console an Allen & Heath *System 8*. A demo studio you might say. But this studio produces CD masters for Japan, and people like Art Blakey and the Jazz Messengers, Hank Jones, Georg Mraz, Joe Farrell, Chet Baker and the late Percy Mayfield all recorded albums here. In the last two years over 80 jazz albums were recorded by sound engineer/owner Max Bolleman; so it's no demo studio.

Let's start at the beginning. In Holland Max is a well known jazz drummer but since it is rather difficult in Holland to make a living playing drums, Max works as an optician. About three years ago he started a 2-track studio.

Max says: "All the recordings I make concern jazz music. Overdubbing is very rare, so I saw no point in buying a multitrack machine. Soon though, I discovered that time was a problem. Most jazz musicians don't like waiting around just to get the sound right. As soon as they are ready it's playing time and if the tape is not rolling, the atmosphere could be lost. Therefore I start working before the musicians come in. In most cases I know who's coming, know his sound from other records or live gigs so I choose the mic and try to set the gain, EQ and even the compressor. Then I bypass everything and when they come in to play and are warming up I listen to the instrument to judge the sound and find the right spot for the mic. Then I check if the decisions I made were correct. If necessary I discuss the sound with the musician: 'is this really the sound you like?' I see no point in recording them as they are, if that's not the way they like to sound. One of the functions of a studio is to improve the sound without affecting the personality, it must remain recognisable. So one has to make artistic decisions at high speed but I am used to it now. To illustrate this point it takes me three to five minutes to get the drum sound right. If I don't make it in five minutes, I won't make it at all. If this occurs, which is very rare, it keeps me awake overnight. I simply can't stop thinking about what went wrong."

After some time Max bought a Tascam *A-3440* with dbx to record critical signals separately. All recording was and still is done in real time and the only purpose of the 4-track machine was to have better control over the mix. After a short time this machine was replaced by a Otari *5050* 4-track. The dbx *150* units were used again and two Revox *PR-99* 2-track machines and some dbx compressor/limiters were bought. A lot of records were made with this equipment several of which received good reviews in German and British jazz magazines.

As time went by a new Yamaha *C-7* grand piano and more equipment was bought including a Lexicon *200* digital reverb, the Allen & Heath Brenell *System 8* 16-8-2 console and Bruel & Kjaer microphones. Max decided to buy a Tascam *58* to postpone all mixing decisions to a remix session. The sound during the recording session still remains extremely important. If the sound is not right during this session, Max realises that it could never be good. 'Fix it in the mix' does not exist. Depending on the number of instruments, most of the time only the drum kit is mixed down to a stereo signal during the recording session. Two more dbx *150* units were bought to complete the set-up. For digital mastering a Sony *PCM-701ES* plus *SL-C9* is used. Transcription to the industry standard *(PCM-1610)* can be done at Phonogram or Adriaan Versteijnen's Digital Editing Room. In most cases CD masters are recorded directly on the digital set. They are released through Bae State, a subsidiary of RCA Japan. Other labels Studio 44 works for are Timeless and Criss Cross both Dutch companies specialising in jazz. The seven-year-old Timeless label is distributed in over 40 countries.

The Tascam *58* has a sticker with 'Ampex' on top of the Tascam logo. Max explains: "Musicians who see the name 'Tascam' all react the same: 'Hey, Tascam, I have one at home, nice machines'. But you can see that they think 'Why don't we do this at my place?' They forget that I have over 20 condenser mics, a Lexicon, a stack of compressors etc. Furthermore they don't realise that my Tascam cost five times as much as their *3440*. To avoid long discussions I put the sticker on. It works perfectly, and don't forget that it is not the machines which make the music. The old Rudy van Gelder records are collector items now because of their sound but those albums were recorded with the equipment of 20 years ago. With jazz there is no budget to buy all the equipment pop studios have. And even if there was such a budget, it would be used differently. When I bought the reverb, for instance, I compared several units, all sounding great and the one offering even more programs than the other. Since all units could make the sounds I wanted, I bought the cheapest one. The thing is that it sounds right. With the grand piano it had to be an expensive one because there is a large difference in sound. I went to the Yamaha distributor and picked out the best sounding one (each piano has its individual sound and quality, despite the same type number). So, if you're interested in recording jazz you better keep your budgets as tight as possible. You should only invest in equipment that really matters to the sound and forget about the gadgets that are important in pop studios.

Studio 44 has a very comprehensive headphone cue system built around the Fostex 10 in 2 line mixer. The outputs of all eight subgroups are buffered and fed to the eight inputs of a chain of six line mixers. Furthermore the main console's aux lines are fed to the bus ins and the reverb's outputs are fed to the remaining two inputs. The main console's aux mix is available at the line mixer's headphones output even when all controls on it are down. Communications make use of the same lines. Furthermore each instrument or group of instruments can be mixed on top of this and reverb can be added to personal taste. There is a master volume control and a headphone jack. The built in headphone amp is replaced by a 5 W type to have sufficient power. Studio 44 equipment includes: Tascam *58*, 8-track recorder with four dbx *150* units; Revox *PR-99* master recorders, one equipped with dbx *150*; Sony *PCM-701ES/SL-9*; Tascam *PE-40* parametric EQ; Allen & Heath Brenell *System 8* 16-8-82; Lexicon *200* digital reverb; dbx *165A* and *160X* comp/limiters; and the usual mics *U87*, B&Ks, AKG *414P48* and so on. Monitors featured are Tannoy *Little Reds* and 15 in monitors; Auratone *5C* and Nikko *Beta* amps.

At the end of this year a larger studio will be available. The control room will measure 5×6 m and the studio 8×11 m. Height will vary between 3.1 and 5 m. The plans are ready but need the government's approval since no 'industry' was planned there; the local officials do not foresee any problems however.

Hans Beekhuyzen
Studio 44, Herenstraat 44, Monster, 2681 BH, The Netherlands.

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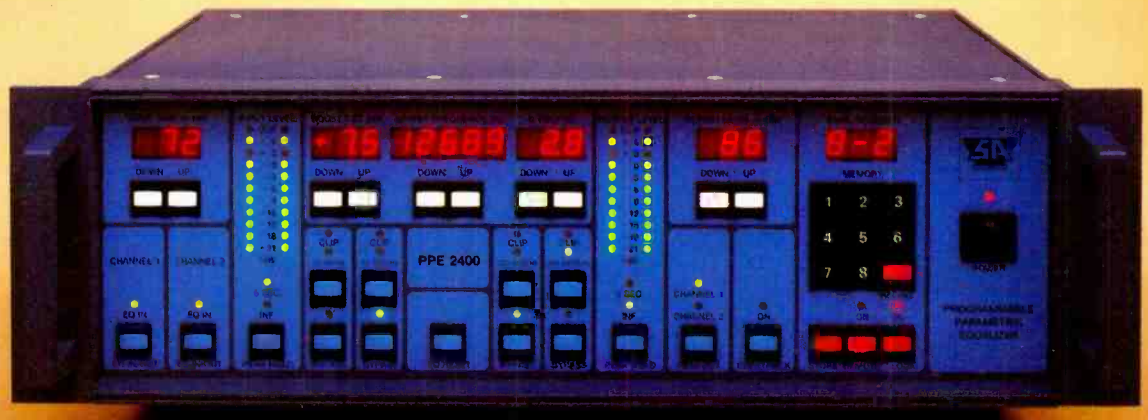

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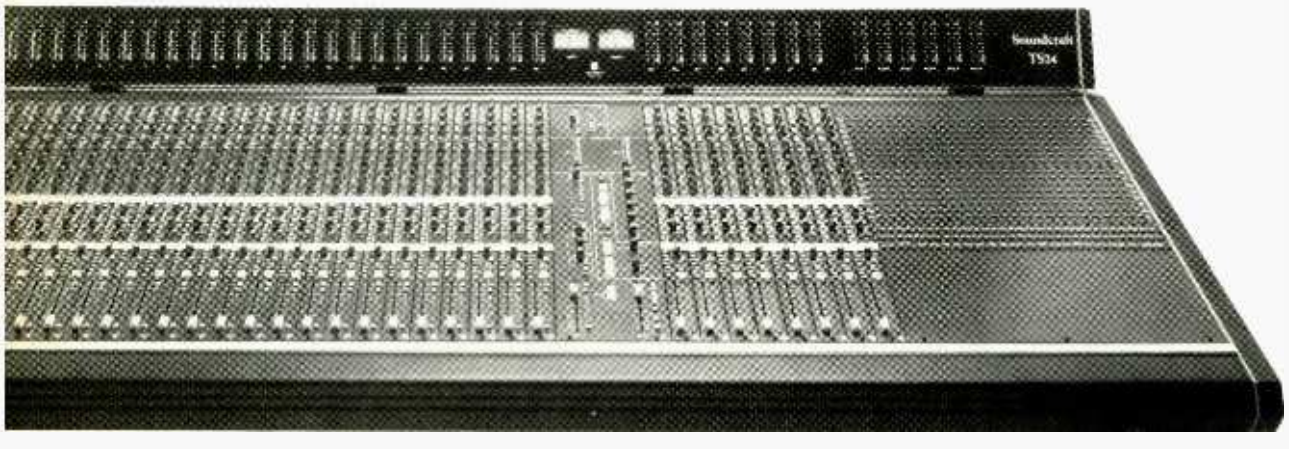

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OVER 50 YEARS

HISTORY OF SANKEN MICROPHONE

Masao Konomi traces 60 years' of development of this Japanese microphone manufacturer

Rihei Takeuchi now 82 years old and chairman of Sanken Microphone Co Ltd, still has vivid memories of his elder sister's voice singing the Scottish folk song *Annie Laurie*. Her voice was reproduced on a hand-made waxdisc and turntable he made when he was just 12 years old. Since then he has been a prolific inventor and entrepreneur.

In 1925 at the age of 22, he arrived in Tokyo from his hometown of Chitta, 300 km to the west of Tokyo and found work in a small loudspeaker company. Unfortunately the firm went bankrupt eight months after he arrived. Since then, he has worked only for himself. His two younger brothers later joined him. Sanken's name resulted from the trio of Takeuchi brothers. ('San' in Japanese means three).

His entrepreneurial activities began in 1925 when he designed and manufactured radio receiver fuse tubes. Aside from running his own company he also used his engineering talents to assist his friends in resolving a variety of engineering problems in such diverse areas as ship's radios, cone speakers for crystal radios, dynamic speakers and even 35 mm movie cameras. By 1933 he had moved from a somewhat unstable start-up enterprise to a more solid one with the company receiving a long-term contract to supply components for electromagnetic oscilloscopes from a rapidly growing electric instrument maker.

It was during this time—1933—that Rihei Takeuchi obtained his first patent for the anti-agglomeration of carbon particles in carbon microphones. He also developed a moving coil microphone and a moving magnet microphone. In 1934 the company began producing moving coil microphones and in 1935 developed a globe-shaped dynamic microphone for film recording use at the request of Mr Ibuka (the current honorary chairman of Sony). This microphone was called the 'Takeuchi microphone' following Mr Takeuchi's contributions. Mr Ibuka also acted as his patent attorney when Mr Takeuchi filed for a patent of a microphone diaphragm mounting.

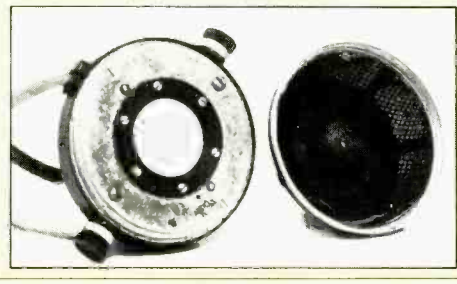
In 1939 NHK the Japan National Broadcasting Corporation wanted a miniature dynamic microphone. The following year Sanken successfully developed a stand microphone for announcers.

Rihei Takeuchi

During World War II, Sanken suffered because some key engineers were drafted and lost. In 1947 shortly after the end of World War II Sanken succeeded in developing the model *MCM-1*. This was a dynamic microphone with an aluminium diaphragm. It was used primarily for radio broadcasts and more than a 100 units were sold.

In 1948 a microphone diaphragm was developed using polystylol. Sanken introduced the *MS-1*, *MS-2* and *MS-3*—a new series of dynamic microphones incorporating the new diaphragm. During this time JVC started buying microphones from Sanken on an OEM basis and have since become one of Sanken's best customers.

The Takeuchi microphone—1935



Miniature dynamic mic—1940

NHK's interest in Sanken microphones continued with the purchase of the *MS-2* microphone for outdoor use in 1950. In 1951 a research programme began to develop a miniature microphone. In 1952, the company developed their first pencil-type microphone the *MS-4* again in collaboration with NHK.

In 1954, as a result of Neumann's successful introduction of the *M49* condenser microphone, Sanken began research with NHK to develop a condenser microphone. Toshiba also began purchasing microphones from Sanken on an OEM basis. Since then, Toshiba has also been one of Sanken's best customers.

In 1956, the company was incorporated and a new *MS* series of microphones—the *MS-5*, *MS-6*, and *MS-7*—was introduced, all of which were moving coil microphones. The *MS-5* is an omni-directional pencil shaped microphone with 20 mm polystylol diaphragm. The frequency response extends from 50 Hz to 10 kHz with a sensitivity of −72dB. Its main application is for outdoor and indoor interviews. So far Sanken has sold more than 5,700 units. The *MS-6* is a shortened version of the *MS-5*, and the *MS-7* is a portable version. In 1959, the *MS-6S* which is hung around the neck was developed.

In 1964, working in conjuction with the NHK Research Laboratory, Sanken developed the *MU-1* moving coil type microphone. The *MU-1* was primarily developed as a speech microphone and was used extensively at the Tokyo Olympics.

The *MU-1* was the first small sized omni- and uni-directional microphone with a front/back ratio of 30 dB from 100 Hz to 6 kHz. The prominent thought behind this project was development of a microphone with a good feedback margin so avoiding the possibility of feedback during the speeches of dignitaries in the huge Olympic stadium. Sanken is proud that the Emperor and Mr Brundage then

MCM-1—1947

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president of the Olympics Committee made speeches using the *MU-1*.

Broadcasting engineers from all over the world have also admired the *ML-1* microphone, which is a cap-mounted close-talk moving coil microphone, because of its fine sound quality. The microphone is good for outdoor broadcasting as it does not pick up neighbouring sound such as wind, ambient noise or the voices of other announcers nearby. This microphone may be the first one to use double tubes from a mouthpiece to a microphone unit mounted in front of the ear. The double tubes enable the *ML-1* to have a figure-of-eight polar pattern up to 2 cm in front of mouth and to have a very flat frequency response from 50 Hz to 10 kHz so that speech can be recorded with little distortion. In addition, the *ML-1* has a significantly reduced sensitivity below 1.5 kHz to any sound coming from a distance of 1 m, eliminating neighbouring sounds such as general ambient noise and nearby voices. It is also light to wear. Broadcasters all over the world have referred to the *ML-1* as a 'magic microphone'. Almost all the microphones used at the Tokyo Olympic Games were made by them—a notable achievement.

In 1967 a uni-directional dynamic microphone the *MU-2*, was jointly developed with NHK. After almost 18 years this microphone is still popular in Japan for interviews. It is small and it covers a low frequency range with little handling noise. During this year Sanken and NHK developed the *CUS-101* a miniature-sized uni-directional condenser microphone which uses 2.4 micron thick polyester as a diaphragm. The objective of the design was to make the microphone small enough so that it would not be easily noticeable in a TV broadcast. The small size has made this a popular microphone in Japan and so far over 1500 *CUS-101*s have been sold. In addition the quality of voice recording is assured by its condenser capsule. An important feature of the *CUS-101* is the well designed shock absorption mount, which eliminates even the knocking sound when the *CUS-101* is put on a table. Finally, another important feature is that the *CUS-101* can be applied to many situations because numerous adaptors have been developed.

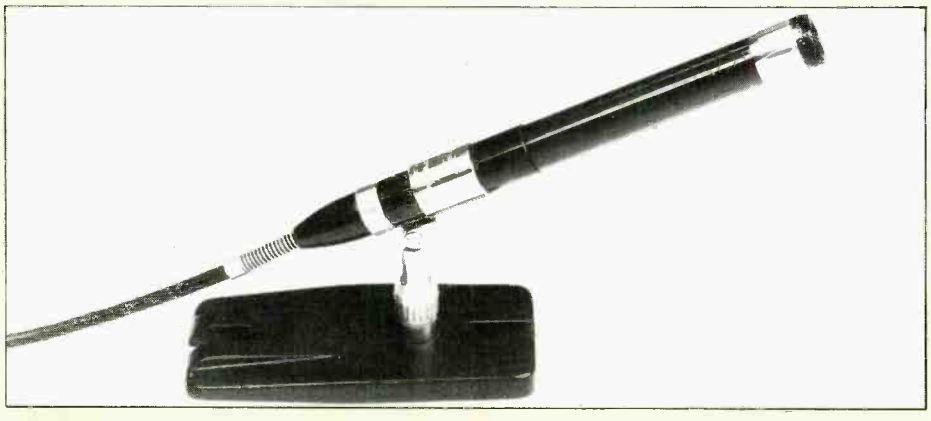
For the Sapporo Winter Olympics in 1968 Sanken developed the *CL-201* and *CL-202* condenser-type microphones. These microphones are designed for hand-free head mounting. The biggest technical challenge was to produce a microphone that was free from moisture problems. The Olympic microphones would be used in environments ranging from −20°C to room temperature. They had to go from outdoor to indoor and vice versa without performance deterioration. Conventional microphones performed unsatisfactorily, as condensation tends to form on the diaphragm, resulting in sound quality deterioration. Extensive research was conducted to eliminate this problem. Since the introduction of the *CL201* and *CL202*, all Sanken microphones have incorporated designs against moisture formation. Another important part of the design was the microphones' ability to be less sensitive to ambient noises and pick up human voices effectively.

In the course of manufacturing the *CUS-101*, Sanken started looking for a metal diaphragm because of anticipated stability against temperature changes and humidity. Titanium is light, strong, corrosion-free and immune to changes in temperature, so Sanken felt titanium foil might prove an ideal material for use as a diaphragm in their condenser microphones. After extensive research Sanken decided to use titanium for all their condenser microphones. Having made the decision, Sanken have now observed a significant improvement in performance stability of their microphones and a longer life.

In 1975 an *MS*-type stereo microphone, the *CMS-2* was developed. Its diameter is only 43 mm and its length is 176 mm. Its overall performance specification are the same as the Neumann *SM-69* but the microphone is much smaller. Such miniaturisation is feasible due to Sanken's original 'push-pull' capsule design. Due to this design, sensitivity is increased by 6 dB over a non-push pull microphone of the same size. This 'push-pull' design successfully integrated the three conflicting design goals: a wide dynamic range; a wide frequency response and small size. The microphone is suited for local broadcasting stations, since it is a small yet very high quality stereo microphone. In addition, because of its small size, when used in a TV studio the microphone does not obstruct vision.

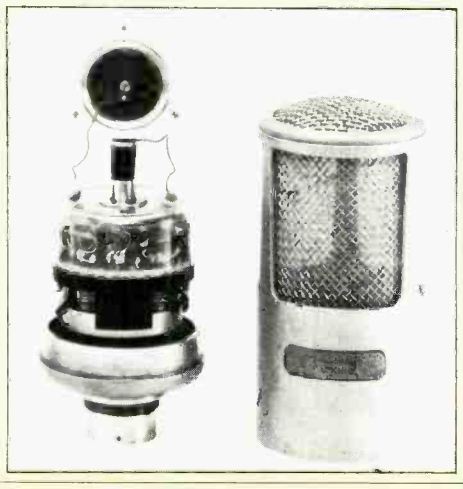
In 1979, in anticipation of the digital audio era, NHK and Sanken launched a ▷

MS-5 omni-directional mic—1956



MS-1/2/3—1948

Condenser mic—1954



MU-1—1964

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OVER 50 YEARS

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joint development programme for the *CU-41* uni-directional double condenser microphone. Dr Mizoguchi chief microphone designer of NHK at the time, and engineers of Sanken predicted then that after the introduction of digital audio equipment, the two ends of audio systems, microphones and speakers, would be found to be considerably lacking. In other words, they would not live up to the engineering specifications achievable by digital audio technology, which are almost entirely based on electronics. Based on this analysis, they set themselves a design goal to develop a microphone which would be well matched for a digital audio system.

After careful examination of the design specification, they came to the conclusion that the microphone needed to sound as transparent as possible. Sanken's definition of a transparent microphone is a microphone that converts sound to electrical signals with the least distortion of the targeted sound. Such distortion could come from non-linear frequency response, self-generated noise, clipping of a large volume of sound, different polar patterns at different frequencies, and proximity effect. After a few years of strenuous efforts they succeeded in developing the *CU-41*.

The performances given in **Table 1** have been achieved by incorporating a double condenser capsule configuration. A wide frequency response and a wide dynamic range are two conflicting demands in microphone capsule design. Dr Mizoguchi and Sanken engineers came to the conclusion that by having one capsule it would not be feasible for a microphone with a cardioid polar pattern to have a frequency response covering from 20 Hz to 20 kHz with a flatness of ±1 dB and with a dynamic range of 125 dB. The two capsule design solved this dilemma. The small capsule is mounted approximately 2.5 cm above the larger capsule. The small capsule handles higher frequencies and the larger capsule lower frequencies at a crossover frequency of 1 kHz. The two ouputs from the two capsules are combined electronically to produce one output. Possible phase differences between the two capsules have been controlled for all practical purposes and reduced to a minimum level.

Unique to the *CU-41* is an acoustic circuit mounted in the back of the large capsule which almost eliminates proximity effect. The *CU-41* uses one micron thick titanium diaphragms, which assures stable operations under humid conditions and different temperatures, and a long life because of titanium's corrosive-free nature. It also has a well-shielded structure, resulting in significantly lessened effects from electromagnetic interference. Also a well-designed structure prevents *CU-41* from picking up handling noises.

The *CU-41* has been proving itself to sound and recording engineers around the world that it is one of the highest quality general purpose microphones with an honest, clear, clean and almost distortion-free sound. The *CU-41* is now being accepted as very suitable for compact disc recording.

Sanken believe that by using the *CU-41*, sound and recording engineers will be freed from sound characteristics peculiar to other microphones; if they want to change the texture of sound, they can do it at the console or a later stage audio processor. In other words, their creativity will not be bound by the peculiar texture of the microphones used.

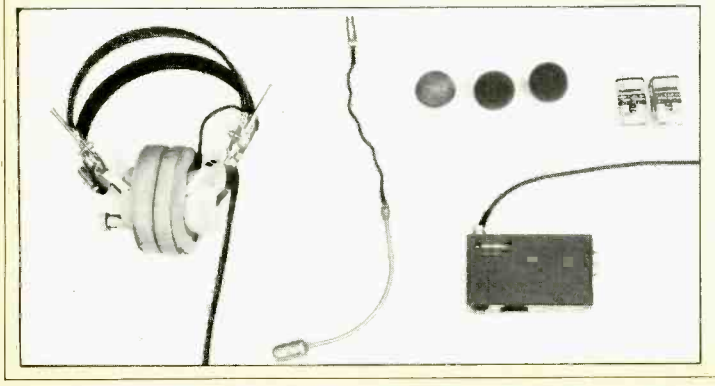
There is a growing awareness among audiophiles in Japan that the quality of microphones used for CD recordings is very critical, since such shortcomings can be heard. As a result, recording engineers should be wary of recording music for a compact disc with mediocre microphones. After having invested in expensive digital recording equipment it would be a waste of their investment to ruin the quality of the original sound by using mediocre microphones. Once the original sound is recorded, currently available signal processing systems would provide any colour or texture of sound they like. It is therefore, very important to pick up sound in a form as close as possible to the original sound. Sanken's experience would suggest talented sound engineers and producers easily understand this concept.

As a company Sanken are open to listening to the needs of professional recording people and broadcasters. With its long experience in microphone innovation and design, Sanken feel that they can meet all professionals' needs. If they cannot, at least they will be able to give their customers a detailed explanation as to why they cannot. At the end of the day however, Sanken want to remain small, and do not have the capacity to respond to extremely large demand. □

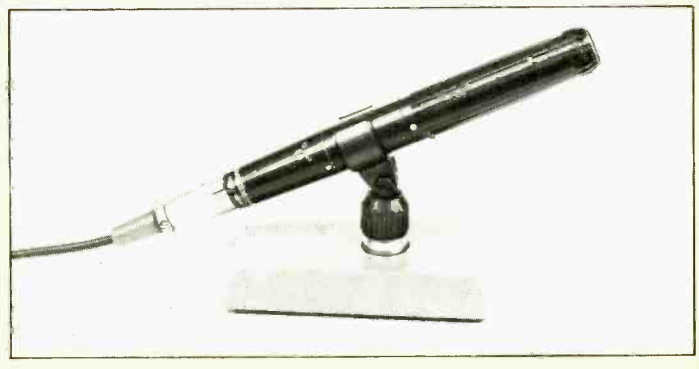
TABLE 1
Manufacturer's specifications of the CU-41.
Frequency response: 20 Hz to 20 kHz±1 dB.
Self-generated noise: less than 15 dB per IEC.
Dynamic range: 125 dB.
Maximum sound pressure: 140 dB with 1% distortion.
Polar pattern: uniform cardioid over audio frequency range.
Proximity effect: significantly lessened.

ML-1 cap mounted close talking moving coil mic

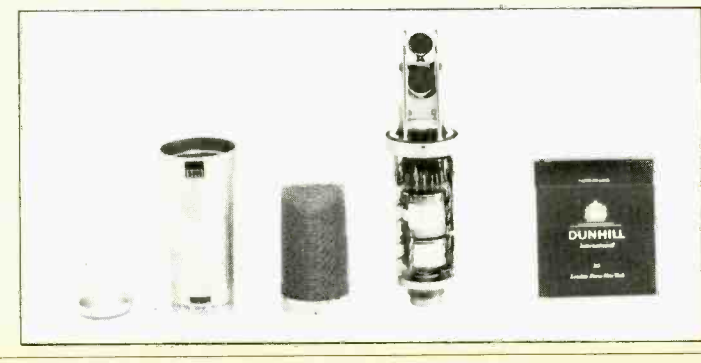
CL-201 developed for the Sapporo winter olympics—1968



MU-2C—1967



CU-41 launched with digital in mind—1979



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ALTEC
Altec Corp, 1515 South Manchester, Anaheim, CA 92803, USA. Tel: (714) 774-2900.
UK: Audix Ltd, Station Road, Wendon, Saffron Walden, Essex CB11 4LG. Tel: 0799 40888.

9842-8AD: 2-way control room monitor.
9844A: 2-way control room monitor.
9845A: 2-way control room monitor.
9849-8A/D: 2-way control room monitor.
A7X: 2-way control room monitor.

APL
Acoustic Physics Laboratories, 3877 Foxford Drive, Doraville, GA 30340, USA.

Control Room Monitor: 5-way, triamped control room monitor.

AURATONE
Auratone Corporation, PO Box 698, Coronado, CA 92118, USA. Tel: (619) 297-2820.
UK: Scenic Sounds Equipment Marketing Ltd, Unit 2, 10 William Road, London NW1 3EN. Tel: 01-387 1262.

5C: 1-way, nearfield, 30 W RMS.
5MC: 19 in rack with 3×5C units.
T5: 2-way, freefield, 40 W.
T6: 2-way, nearfield, 80 W.
T66: 2-way, nearfield, 100 W.
QC66: 3-way, nearfield, 100 W.

B&W
B&W Loudspeakers Ltd, Meadow Road, Worthing BN11 2RX, UK. Tel: 0903 205611.
USA: Anglo American Audio Company Inc, 345 Nugget Avenue, Unit 22, Scarborough, Ontario, MIS 4J4, Canada. Tel: (416) 297-0595.

801: 3-way, freefield, 50 W minimum.
802: 3-way, freefield, 80 W minimum.
808: 3-way, freefield, 700 W.

BOXER
USA: Valley Audio, 2821 Erica Place, PO Box 40743, Nashville, TN 37204-3111. Tel: (615) 383-4732.
UK: Discrete Research Ltd, Unit 15, North Field Industrial Estate, Beresford Avenue, Wembley, Middlesex HA0 1YB. Tel: 01-900 0355.

Boxer 4: 3-way, control room monitor, 4000 W.
Boxer 2: 3-way, control room monitor, 2400 W.

DAVIES
SW Davies Ltd, 30 Strutton Ground, London SW1P 2HR, UK. Tel: 01-222 5587.
UK: Audio Design Calrec Ltd, PO Box 182, Reading, RG2 9BA. Tel: 0734 861088.
USA: Audio Design Calrec Inc, PO Box 786, Bremerton, WA 98310. Tel: (206) 275-5009.

841: 3-way control room monitor including 2-way active crossover 200 W min.
831: 3-way control room monitor including 2-way active crossover 200 W min.
821: 3-way control room monitor including 2-way active crossover 200 W min.

EASTLAKE
Eastlake Audio (UK) Ltd, Unit 2, 10 William Road, London NW1 3EN, UK. Tel: 01-262 3198.

JM3T: 2-way active, control room monitor, 400 W and 100 W.
JM7T: 2-way active, control room monitor, 400 W and 100 W.

ELECTRO-VOICE
Electro-Voice Inc, 600 Cecil Street, Buchanan, MI 49107, USA.
UK: Shuttlesound Ltd, Unit 15, Osiers Road, London SW18 1EJ. Tel: 01-871 0966/7/8.

Sentry 100A: 2-way, nearfield, 300 W.
Sentry 100EL: 2-way, nearfield, includes amplifier.
Sentry 500: 2-way, freefield, 400 W.
Sentry 505: 2-way, wedge front, 400 W.
Sentry 3: 3-way, freefield, biamped 500 W.

FOSTEX
Fostex Corp, 512 Miyazawacho, Akishima, Tokyo.Tel: 0425-45-6111. Telex: 2842-203.
UK: Bandive Ltd, Brent View Road, London NW9 7EL. Tel: 01-202 4366.
USA: Fostex Corporation of America, 15431 Blackburn Avenue, Norwalk, CA 90650. Tel: (213) 921-1112.

LLS/4: 4-way, control room monitor, 350 W.
LLS/3: 3-way, control room monitor, 225 W.
LLS/2: 3-way, control room monitor, 150 W.

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300W into 8, per channel
dx1000A
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800W into 4, per channel
450W into 8, per channel
dx2000
2000W into 4, mono
1200W into 8, mono
1000W into 2, per channel
600W into 4, per channel
300W into 8, per channel
dx3000
3000W into 4, mono
1600W into 8, mono
1500W into 2, per channel
800W into 4, per channel
450W into 8, per channel

*dx3000 bridged mono

Hill Audio

Hill Audio, Inc., 231 Marquis Court, Lilburn, GA 30247 USA (404) 923-3193 TLX 293827 HLAD
Headwater Industries, 635 Caron Ave., Windsor, Ontario N9E 5B8, Canada (519) 256-2454
Hill Audio, Ltd., Hollingbourne House, Hollingbourne, Kent ME17 1QJ, England (062 780) 555 TLX 966641 HILL

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G700 Mini reference: 2-way, nearfield, 40 W.

GAUSS
Cetec Gauss, 9130 Glenoaks Boulevard, Sun Valley, CA 91352, USA. Tel: (213) 875-1900.
UK: HHB Hire and Sales, Unit F, New Crescent Works, Nicoll Road, London NW10 9AX. Tel: 01-961 3295.

7480: 4-way, biamped, control room monitor.
7350: 3-way, biamped, control room monitor.
7351: 3-way, biamped, control room monitor.
7528: 1-way coax, nearfield, 200 W.

GENELEC
Genelec, PO Box 36, 74101 Ilsalmi, Finland. Tel: 358 77 13311.
UK: Future Film Developments, 114 Wardour Street, London W1V 3LP. Tel: 01-434 3344.

1019A: 2-way biamped, nearfield.
S30: 3-way triamped, freefield.
1022A: 3-way triamped, freefield.
1024B: 3-way triamped freefield.
1025A: 4-way 4 amps, freefield.

HIDLEY
Tom Hidley Design (Cote D'Azur) Ltd, 9 Lancaster Mews, Hyde Park, London W2 3QQ, UK. Tel: 01-402 7071.

Custom Hidley/Kinoshita 2-way designs available in five versions, 600 W.

JBL
JBL Inc, 8500 Balboa Boulevard, PO Box 2200, Northridge, CA 91329, USA. Tel: (213) 893-8411.
UK: Harman (Audio) UK Ltd, Mill Street, Slough, Berks SL2 5DD. Tel: 0753 76911.

SLT-1: 2-way, nearfield, 50 W.
4401: 2-way, nearfield, 60 W.
4312: 3-way, freefield, 80 W.
4411: 3-way, freefield, 150 W.
4425: 2-way, freefield, 200 W.
4430: 2-way, control room monitor, 300 W.
4435: 2-way, control room monitor, 375 W.

KEF
KEF Electronics Ltd, Tovil, Maidstone, Kent ME15 6QP, UK. Tel: 0622 672261.
USA: KEF Electronics of America Inc, 14120-K Sullyfield Circle, Chantilly, VA 22021. Tel: (703) 631-8810.

KM1: 3-way triamped, freefield, including amplifiers.

KLEIN + HUMMEL
Klein + Hummel, Zeppelinstrasse 12, D-7302 Ostfildern/Kemnat, West Germany. Tel: 0711 455026.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ. Tel: 01-953 0091.
USA: Gotham Audio Corp, 741 Washington Street, New York NY 10014. Tel: (212) 741-7411.

092: 3-way triamped, freefield, including amplifiers.
096: 3-way triamped, freefield, including amplifiers.
098: 3-way triamped, nearfield, including amplifiers.
OY: 3-way biamped, freefield, including amplifiers.

KLARK-TEKNIK
Klark-Teknik plc, Klark Industrial Park, Walter Nash Road West, Kidderminster, Worcestershire DY11 7HJ, UK. Tel: 0562 741515.
USA: Klark-Teknik Electronics Inc, 262a Eastern Parkway, Farmingdale, NY 11735. Tel: (516) 249-3660.

Active Monitor: 2-way, freefield, including amplifiers.

LOCKWOOD
Lockwood, Lowlands Road, Harrow, Middx, UK. Tel: 01-422 3704/0768.
USA: Randy's Roost, RCA Buildings, 30 Music Sq West, Nashville, TN 37203. Tel: (615) 254-8825.

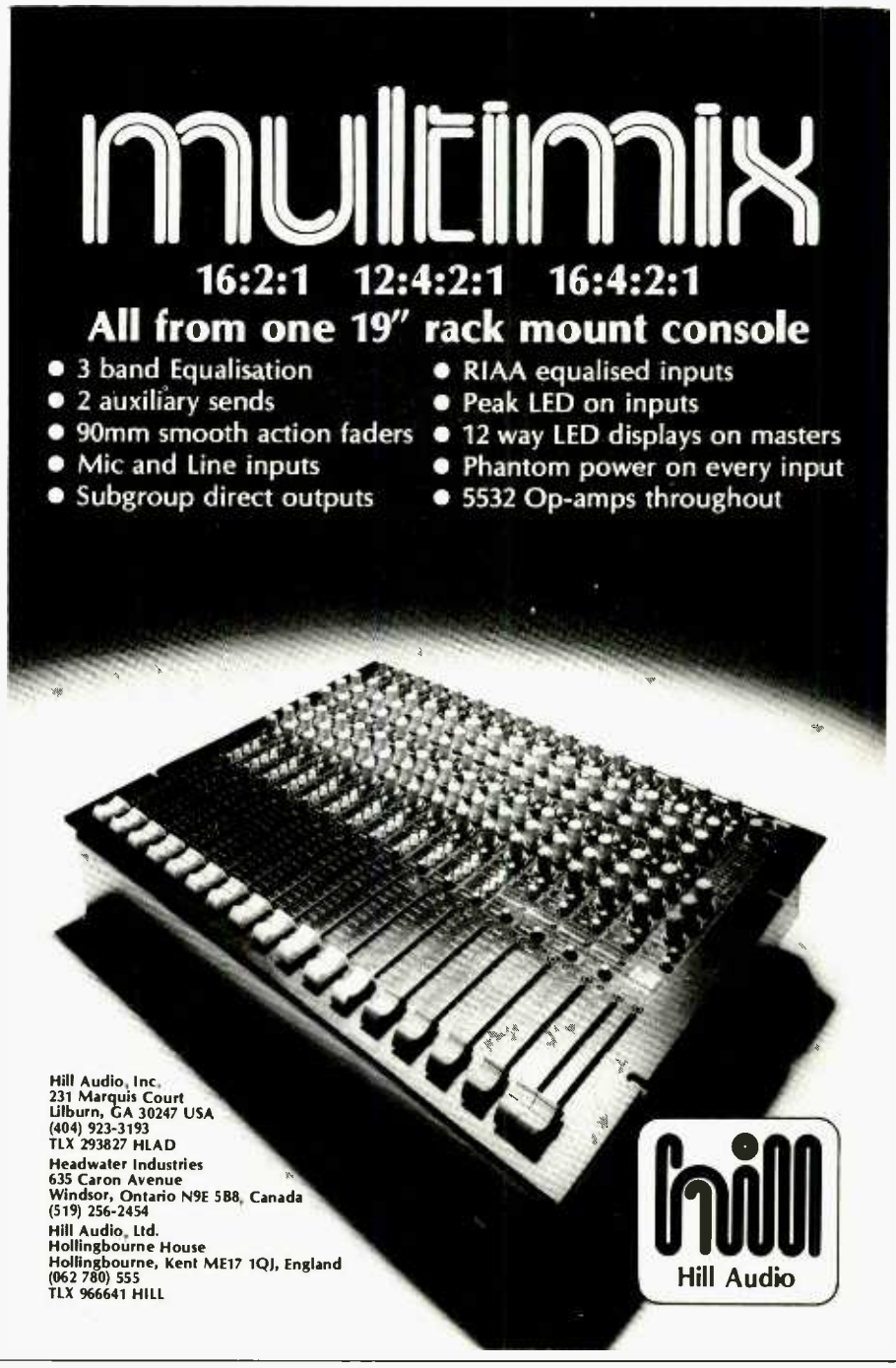
Universal Major: 2-way, freefield, 120 W.
Studio Academy 1: dual concentric, freefield, 85 W.
Studio Academy 2: dual concentric, freefield, 60 W.
Studio Academy 3: dual concentric, freefield, 50 W.
Miniature Monitor: 1-way, freefield 60 W.

MEYER
Meyer Sound Labs Inc, 2832 San Pablo Avenue, Berkeley, CA 94702, USA. Tel: (415) 486-1166.
UK: Autograph Sales Ltd, 2 Spring Place, London NW5 3BA. Tel: 01-267 6677/01-485 3749.

833: 2-way, freefield, 400 W.

MUNRO
Munro Associates, Waterfront 'D' Warehouse, Metropolitan Wharf, Wapping Wall, Docklands, London E1 9SS. UK. Tel: 01-480 7121.

SLT/MA5: 5-way, control room monitor including 5×500 W amps and electronic crossover.
3-way softdome: 3-way, control room monitor, power handling dependent on units specified.



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MONITOR SURVEY

QUESTED
Quested Monitoring Systems, The International Business Centre, 29 Glasshouse Street, London W1R 5AP, UK. Tel: 01-734 6080.

Q4125B: 4-way, active control room monitor, 6.2 kW.
Q412: 3-way, active control room monitor, 3.8 kW.
Q215: 3-way, active control room monitor, 2.9 kW.
Q212: 3-way, active control room monitor, 1.8 kW.
Q115: 3-way, active control room monitor, 1.6 kW.
Q112: 3-way, active control room monitor, 1.2 kW.
Q209SB: 4-way, control room monitor, 2.5 kW.
Q209: 3-way, control room monitor, 1 kW.
Q205A: 2-way, nearfield, 400 W.
Q205P: 2-way, nearfield, 400 W.

ROGERS
Swisstone Electronics Ltd, 310 Commonside East, Mitcham, Surrey CR4 1HX, UK. Tel: 01-640 2172.
USA: Naiad Products Inc, 1051 Clinton Street, Buffalo NY 14240.

LS3/5A: 2-way, nearfield 50 W.
LS5/8: 2-way, biamped, freefield, includes amplifiers.
LS5/9: 2-way, nearfield, 100 W.
LS5/10: 2-way, freefield, 350 W.
Studio 1: 3-way, freefield, 200 W.

SPENDOR
Spendor Audio Systems Ltd, Station Road Industrial Estate, Hailsham, Sussex BN27 2ER, UK. Tel: 0323 843474.
USA: RCS Audio International, 1055 Thomas Jefferson Street Northwest, Washington DC 20007. Tel: (202) 342-0400.

BC1: 3-way, freefield, 55 W.
BC3: 4-way, freefield.
SA1: 2-way, nearfield, 40 W.
SA3: 2-way, freefield, 100 W.
SP1: 3-way, freefield, 90 W.

TAD
Technical Audio Devices, 5000 Airport Plaza Drive, Long Beach CA 90815, USA. Tel: (213) 420-5700.

TAD-1: 2-way, biamped control room monitor, 600 W.
TAD-2: 2-way, biamped control room monitor, 300 W.

TANNOY
Tannoy Ltd, The Bilton Centre, Coronation Road, Cressex Industrial Estate, High Wycombe, Bucks HP12 3SB, UK.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Tel: 01-953 0091.
USA: Tannoy North America Inc, 97 Victoria Street North, Kitchener, Ontario, Canada N2H 5CI. Tel: (519) 745-1158.

Dreadnought: 2-way, freefield, 1000 W.
Super Red/M1000: dual concentric, freefield, 500 W.
Buckingham/M2000: 2-way, freefield, 1000 W.
Classic/M3000: dual concentric, freefield, 500 W.
FSM: 2-way, freefield, 700 W.
SRM10B: dual concentric, freefield, 250 W.
Little Red/SRM12B: dual concentric, freefield, 350 W.
DTM8: dual concentric, nearfield, 120 W.
SRM12X: dual concentric, freefield, 350 W.
SRM15X: dual concentric, freefield, 500 W.

UREI
JBL Inc, 8500 Balboa Boulevard, PO Box 2200, Northridge, CA 91329, USA. Tel: (213) 893-8411.
UK: Harman (Audio) UK Ltd, Mill Street, Slough, Berks SL2 5DD. Tel: 0753 76911.

Model 811B: coax, control room monitor, 150 W.
Model 813B: 2-way, control room monitor, 150 W.
Model 809: coax, freefield, 100 W.

VISONIK
Kurt M Bruns (GmbH) & Co, Nordkanalstrasse 46, 2000 Hamburg 1, West Germany.
UK: Uher Sales & Service Ltd, Unit Q1, Cherrycourt Way, Leighton Buzzard, Bedfordshire LU7 8UH. Tel: 0525 383277.
USA: Visonik of America, 701 Heinz Avenue, Berkeley, CA 94710. Tel: (415) 548-4005.

David 6000: 2-way, nearfield, 40 W RMS.

WESTLAKE
Westlake Audio, 7265 Santa Monica Boulevard, Los Angeles, CA 90046, USA. Tel: (213) 851-9800.
UK: Britannia Row Ltd, 35 Britannia Row, London N1 8QH. Tel: 01-226 3377.

HR-1: 4-way, control room monitor, 1800 W.
HR7: 4-way, control room monitor, 450 W.
SM-1: 5-way, control room monitor active, 3600 W.
TM3: 3-way, control room monitor, 1800 W.
TM4: 3-way, active control room monitor, 1800 W.
TM5: 2-way control room monitor, 1800 W.
TM6: 2-way control room monitor, 1800 W.
BBSM-4: 2-way, nearfield monitor, 150 W.
BBSM-5: 2-way, nearfield monitor, 180 W.
BBSM-6: 3-way, freefield monitor, 180 W.
BBSM-10: 3-way, freefield monitor, 360 W.
BBSM-12: 3-way, freefield monitor, 540 W.
BBSM-15: 3-way, freefield, monitor, 600 W.

YAMAHA
Yamaha Nippon Gakki Co Ltd, Hamamatsu, Japan.
UK: Natural Sound Systems, Unit 7, Greycaine Road, Watford, Herts WD2 4SB. Tel: 0923 36740.
USA: Yamaha International Corp, Box 6600, Buena Park, CA 90622. Tel: (714) 522-9011.

NS 1000M: 3-way, freefield, 200 W.
NS 10: 2-way, nearfield, 50 W amplifier.

Akai (UK) Limited-Electronic Music Division, Haslemere Heathrow Estate, Silver Jubilee Way, Parkway, Hounslow, Middlesex TW4 6NF.
Telephone: 01-897 6388
Telex: 892555 AKAIUK G.

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Peter Bonner Musical, 12a Grove Road, Eastbourne, E. Sussex.
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Rod Argent Keyboards, 20 Denmark Street, London WC2.
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E & S Electronics, 2 Upper Fant Road, Maidstone, Kent.
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Rock City Music Ltd, 10 Moseley Street, Newcastle-upon-Tyne.
North Mansfield
Carlsbro Sound Centres, 182-184 Chesterfield Road, North Mansfield, Notts.
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LETTERS

LETTERS

Letters should be marked 'For Publication' and sent to the Editor at the Croydon address on page 3

Hearing damage

Dear Sir, Over the past decade or so the growing concern over noise in the workplace has generated an equal concern on the part of studios and mixers regarding hearing damage as a result of monitor levels well in excess of the safe figures published for noise. While such concern is natural, it is, I think, unnecessary, and disregards a very large body of data on the subject.

I started recording music in 1955, under the tutelage of Bill Putnam, whose monitor levels were even then legendary. I think Bill maintained a monitor level of something about 120 dB SPL at 0 VU so that the monitor would go to pain if he got overmixed. Saved his having to constantly watch the meter. I recall with mixed feelings hearing the wonderful sound he got on Ellington, Basie, Kenton and such. But, as I was recording for him, and was four feet closer to the speaker than he was, I went to pain at about minus three.

In any event, I learned, and in doing sessions on my own, I used the same monitor levels—still do. Additionally, I know several other mixers with similar experience. None of us have any hearing loss attributable to high monitor levels. Age, yes, although the people I know have pretty good top end response for a bunch of old fogies.

In light of all that, I think it can be safely said that the danger of high monitor levels has been greatly exaggerated. The danger does exist, and I've been hurt but it's not what's commonly thought to be.

It is fundamental to western music that all the permissible chords for a given melodic note are contained in the harmonic structure of that note, between the fourth and sixteenth harmonics. For that reason it can be said that every instrument in a band or orchestra is playing the same note, usually the bass note, with the various sections merely playing different harmonics of the root.

It comes down to having to hear only one thing at a time. The harmonics of the bass note overlay it in even multiples, with the result that the eardrum pumps smoothly in and out without strain.

The same cannot be said of noise, which contains any number of unrelated frequencies, and of a band playing out of tune, which can be accurately described as noise. In fact, the first clue that the band isn't quite in tune is the impulse to turn the volume down.

Well equalised monitors are a special case. I stretched an eardrum once in a concrete control room with subsonic stuff, not knowing it was there, and it was miserable. It would be well to be very sure that everything that the monitors put into the room can be heard, so one's ears can defend themselves.

In sum, while noise is ruinous to hearing, music ain't noise, and a great deal of experience among high level mixers indicates that thunderous monitors do not damage one's ears.

Yours faithfully, Malcolm Chisholm, 721 Brompton Place, Chicago, IL 60657, USA.

Aphex Aural Exciter

Dear Sir, Thank you for the July review of our Type 'B' Aural Exciter. However, there are some minor inaccuracies that I must bring to light.

Firstly—the Drive indication on the Type 'B' is tri-colour, green/yellow/red with yellow being the desired region of operation. Secondly, the Type 'B' has an operating level switch on the rear to allow it to operate at −10 or 0 dBm operating levels for the widest application.

Yours faithfully, Jon Sanserino, Aphex Systems Ltd, 13340 Saticoy Street, North Hollywood, CA 91605, USA.

Wilf

Would the writer of a letter who signed himself 'Wilf' but did not include an address or any means of contacting him, please contact us so that we can publish your letter and discuss certain points?□

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IMPORTANT ASPECTS OF POWER AMPLIFIERS

With all areas in the signal chain coming under closer scrutiny the choice of power amplifiers for monitoring deserves equal attention. In this article Manuel Huber of FM Acoustics considers the aspects of power amplifier design which relate to the professional user

All amplifiers are designed to fit into a certain market place and price range. Cost considerations are a major factor limiting the possibility of marked improvements in amplifiers but this limitation is understandable when considering the evolution of amplifier designs during the last 30 years. In the fifties basic valve (tube) designs were common and with lower overheads in those days not too expensive to produce. As such designs were kept simple, they did not have too many gross design faults. The actual manufacturing quality varied tremendously though. When the first solid state devices became available most manufacturers rushed into designing transistorised units. New levels of measured performance were achieved which could not be matched by valve designs. However, the limited capability of the semiconductor devices then available and the lack of experience resulted in units with rather poor reliability and 'disappointing' sound quality. Even today quite a few amplifiers have changed little since these first generation transistorised designs.

The selection of a power amplifier for a certain application depends on many variables such as: required sound pressure level, listening distance, room acoustics, reverberation, damping, real load impedance etc. One of the quality determining points not too well known is the interface between amplifier and speaker. While a certain amplifier may work fine with some speakers, it might not interface well with other seemingly similar speakers. This is very often due to the impedance/phase characteristic of the speaker and its variation when driven by a dynamic (music) signal. The concept of measuring impedance needs rethinking. The drive requirements of modern loudspeakers are much underrated. In addition to the static resistance which varies greatly over the frequency range (a typical speaker with a nominal 8 Ω rating can easily vary from more than 50 Ω to 2 Ω), there are often huge phase changes that approach a cosine Ø of 1 (the worst case where the maximum current is required at exactly the same time when the amplifier achieves its maximum voltage swing). The phase is also changing with frequency not exactly simplifying matters. In terms of a roughly comparable resistive rating this would correspond to a load resistance of between 1 and 50 Ω for a typical dynamic driver. There are few amplifiers that fulfil such requirements. Most amplifiers' protection circuits—be they voltage and/or current limiting, input stage, driver stage or other forms of limiting—will activate and cause compression, limiting or distortion by non-linearity.

If this was not enough, there is a third phenomenon that aggravates the situation. After excitation the voice-coil/diaphragm assembly tries to return to the normal central position. When the voice-coil moves back the magnetic field in the gap induces a current called back-EMF (electro-motive force) which is fed back into the amplifier's output stage. The already strained output stage is additionally required to dissipate this huge impulse current. The larger the excursion, the worse the situation. This happens mostly at low-frequencies and results in compressed, ill-defined bass reproduction. In practice with certain amplifiers one can measure and often actually see that the cone travel of the bass driver increases linearly up to a certain power level after which it does not increase any more despite increased measured power from the amp. Using a well-designed amplifier on the same speaker the cone travel increases to the limit of its linear excursion. Obviously the cone is driven more linearly and without compression resulting in an improved transfer of bass signals. In more than one installation it has been possible to eliminate monitor equalisers altogether just by changing to a different power amplifier. Here we see why it is of utmost importance to keep the output impedance (including the speaker cable and connector resistance) as low as possible. When using an amplifier that is free of a limiting protection circuit, speaker cables cannot be massive enough. In a typical top class studio installation a cable square section of at least 10 mm^2 (AWG 7) but preferably 16 mm^2 (AWG 5) is recommended.

Obviously connectors must be able to accommodate such square sections. **Fig 1** shows the special 200 A load connectors that are used on the larger FM Acoustics power amplifiers in comparison with a high quality 4 mm standard plug normally used. However because of instability and other possible problems, many amplifiers may need the additional cable and connectors resistance (with all the non-linear effects!) to work at all. The lower the output impedance of the amplifier the higher the damping factor and the less negative influence the back- ▷

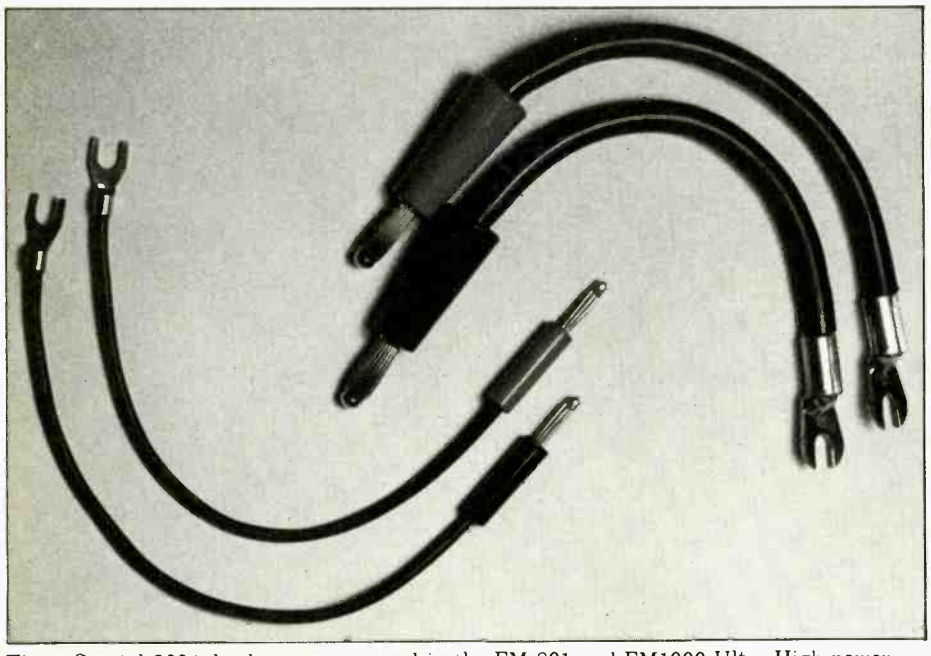

Fig 1: Special 200A load connectors used in the FM 801 and FM1000 Ultra-High power amplifiers in comparison with a high-quality standard 4 mm banana connector

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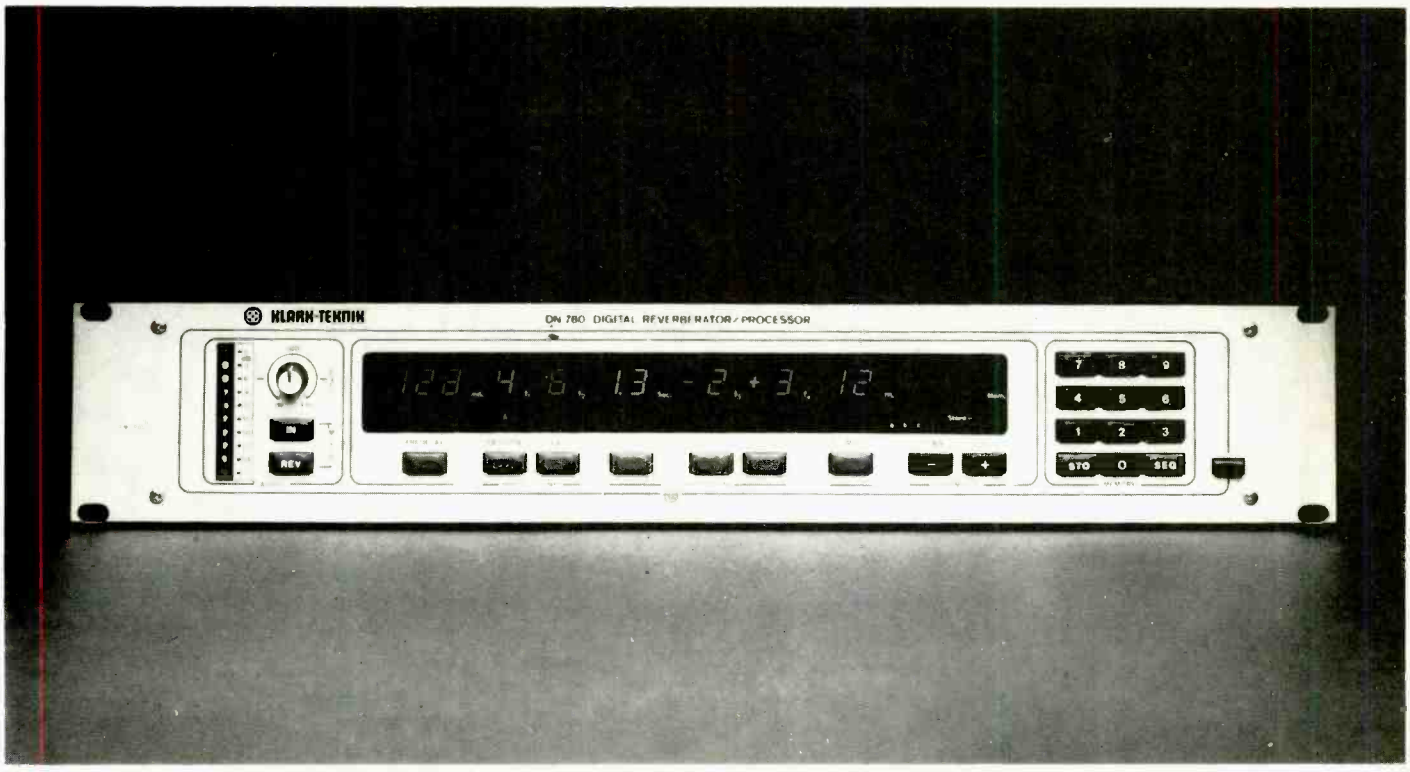

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IMPORTANT ASPECTS OF POWER AMPLIFIERS

TABLE 1

Amplifier	Rated continuous RMS power into 8 Ω	4 Ω	Maximum theoretical peak sound pressure level	Effective max peak SPL measured at microphone position
Brand A	450	700	122 dB	119 dB
Brand B	225	360	120 dB	116 dB
Brand C	150	250	118.5 dB	115 dB
Brand C bridged	500		121.5 dB	117 dB
Brand D	250	400	120 dB	112 dB
Brand E	230	350	120 dB	113 dB
Brand F	300	500	121 dB	121 dB

EMF can have on the output stage.

It must be remembered, the majority of today's amplifiers use quite a lot of negative feedback. Via the negative feedback false error correction signals are introduced by the back-EMF which can make the amplifier misbehave. A high damping factor *per se* is not sufficient. It is important how the damping factor/low output impedance is achieved. Most designs rely on high negative feedback margins to achieve good damping when measured with static signals. However the situation with a dynamically changing load is quite different. There are better solutions that avoid the disadvantages associated with large negative feedback margins. An amplifier should be optimised and stable even when there is no feedback applied. Then a small amount of negative feedback (which in itself is nothing more than an error correction signal applied to correct the non-linearities of the preceding amplification stages) can be added at the optimal points in the circuit. It is always a better solution to avoid non-linearities in the first place rather than trying to correct for them later on in the circuit!

For the power amplifier the combination of the above mentioned phenomena result in a very complex load that is changing with frequency and in addition dynamically with the music signal! Traditional design theory indicates that output currents in the region of 5 to 15 A are required as a maximum but peak current requirements of up to 100 A were found when driving standard dynamic monitor speakers! It is not unusual to find that amplifiers specified for continuous 2 Ω operation fail to drive speakers with a nominal impedance of 8 or 4 Ω without noticeable compression, limiting or instability effects. Some monitor speakers even present a dynamic impedance roughly comparable to 0.5 Ω resistance! Such impedances put extreme stress on the output stage and the power supply of an amplifier. As power supplies of amplifiers are generally not designed for such extreme requirements, one will often find them collapsing under peak demand with all the negative influences stated below. This is one reason why amplifiers with similar sine-wave power ratings often have astonishing differences in actual sound pressure level when driving a real-world load such as a loudspeaker. Often they also sound rather different when driven with music despite identical or similar steady state performance. If a system measures fine but does not sound right trust your ears and not the (static) measurements! Somewhere there will be a weak link or an interface problem.

Bridging is not recommended as each channel of the amplifier sees a load that is twice as demanding as normal. The higher current required can cause early action of current limiting and protection circuitry with the aforementioned negative effects on the audio signal. Rather than bridging use a higher powered non-bridged amplifier.

The majority of amplifier circuit designs use the same basic technology and come from the same school of thought. Furthermore tests and review procedures all over the world are based on similar specifications obtained with static measurements and—more often than not—with dummy loads only. Such results do not bear any resemblance to actual performance impressions obtained when the amplifier and speaker are driven by real-world signals. There is almost no practical application where the amplifier/loudspeaker combination is used for static signal transmission. Despite this fact the currently used measurement techniques are based on the false assumption that static signals will make amplifiers and loudspeakers behave similar to when they are driven by music or dynamic signals. The measurement results from such tests are therefore bound to be misleading. It is the ability to control the load under dynamic conditions that determines the accuracy of reproduction. Unfortunately until today no accepted criteria nor measuring instruments existed that provided meaningful and repeatable results using non-static signals and loads. However in actual use simple tests can show startling differences between amplifiers.

In a top class studio in Germany the following interesting test results were obtained. The signal was either pink noise or music equalised to be flat at the microphone position. The ¼ in B&K microphone was positioned at the centre of the mixing desk at a distance of 3 m from the biamplified monitors. The amplifiers sounded astonishingly different. One of the major differences, the maximum SPL could be measured. The maximum sound pressure levels were achieved by the different amplifiers as shown in **Table 1**.

As can be seen there are dramatic peak sound pressure level differences for amplifiers with similar sine-wave rating. Differences of up to 8 dB are surely worth consideration! A further informative test that shows the limitations of certain amplifier designs can be done by routing a signal with a tight bass and bass drum through channels of a mixing board and run the amplifiers at middle to high levels. Then use the equalisation at around 40 Hz to 80 Hz, add and respectively subtract equalisation and observe the changes in sound quality. When subtracting bass all amplifiers will reduce the bass level and many may clean up when doing so. However when adding some dBs in the low-end it becomes apparent that certain amplifiers are not able to reproduce accurately the difference after a certain power level (still below clipping) has been reached. This is due to several facts such as the amplifier's power supply running out of capacity (under-designed transformers or so-called 'dynamic' power supplies, limiting action of power MOSFET transistors, etc). These will be discussed in detail later.

In another test two amplifiers with similar sine-wave power output were compared on a standard 2-way horn-loaded PA system. Not only could the equalisers be set flatter with amplifier A resulting in up to 4 dB less equalisation at certain frequencies but also the sound pressure level over the whole frequency range was about 2 dB higher as well. At 65 Hz, the SPL difference between the two amplifiers was a rather shocking 9 dB! When considering that both amplifiers provided about 500 W RMS into 4 Ω load and that the loudspeaker's nominal impedance was 8 Ω (a single 15 in bass driver with a passive crossover and compression mid/high frequency driver), such large SPL differences make the usual watt per dollar evaluation rather obsolete. I have seen similar results reported from various tests and trials in different parts of the world.

Specifications should not be a major factor when selecting a power amplifier because few manufacturers guarantee minimum specifications for each and every product leaving the factory. Typical specifications will not really tell you much about the true value of a certain component, only guaranteed minimum specifications together with carefully controlled listening tests will provide meaningful information. Almost all manufacturers quote standard specifications such as output power and distortion. However, in professional applications other specifications can be as important: load ▷

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IMPORTANT ASPECTS OF POWER AMPLIFIERS

impedance drive capability, input impedance at different settings of the level controls (should obviously not vary with different settings), maximum mains overvoltage, power consumption, operating temperature and operating humidity, etc, and last but not least how long the manufacturer will guarantee the availability of spare parts.

It is now generally accepted that balancing transformers do limit the performance capability of high class audio equipment. Electronically balanced input circuits are a better solution. However they have to be truly balanced with a common-mode rejection of at least 60 dB and stable input impedance over the whole audio frequency range. Integrated circuits are easy to use but there is no IC that can equal the performance of a carefully designed discrete Class A input stage.

Today most amplifiers use similar circuitry, typically ICs on the input, a couple of drivers and an output stage. This makes the design seem very straightforward but the demand on the few amplification stages is too high. Multiple stages having a limited amount of gain are preferable as the linearity of each stage and of the whole circuit is improved.

Quite a few amplifier designs are using power MOSFETs in the output stage. While power MOSFETs make amplifier design easy, with certain advantages like a higher input impedance and a negative temperature coefficient (protecting the devices from thermal runaway), the disadvantages are not often mentioned. The drain-source resistance on the chip of the MOSFET is temperature dependent and acts as protection (higher chip temperature= higher resistance with a corresponding reduction of output power). When analysing such a mechanism one must again consider dynamic signals not just sine waves. While the temperature of the transistor case varies within reasonable limits, the chip itself heats up extremely fast with the protection resistor tracking accordingly and limiting the output current. This results in a compression effect that can be audible. It is mostly noticeable with longer duration (low-frequency) signals which would confirm test reports indicating a lack of accuracy in the bass reproduction of power MOSFET design.

Other designs such as switching and digital amplifiers have yet to prove their fidelity and long term reliability especially in professional applications where all kinds of interferences and unknown influences can cause trouble for even analogue amplifiers. Digital and switching circuits are much more vulnerable in these areas.

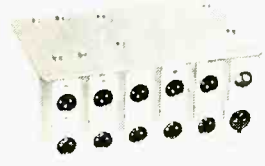
The importance of power supplies in audio electronics and especially in power amplifiers is still considerably underrated and judged on the basis of simplistic assumptions. One of these is the belief that dual power supplies are necessarily better than a single power supply. This is not the case. The reason for dual supplies is economical rather than technological. In relation to power, smaller standard transformers are cheaper than larger ones. This is due to the much larger quantities that are manufactured. With today's technology a single power supply can be designed to achieve near-perfect stability, regulation and separation for all parts of the circuit. Obviously it is necessary to use advanced design concepts. A single large power transformer has one major advantage over two smaller transformers: if there is a large impulse signal on one of the channels a dual transformer design can only supply half of the total capacity while a single transformer can supply the majority of power to the channel that needs most of the power at this moment. This results in more stable rail-voltages and more dynamics.

The rating of power transformers in audio amplifiers seems to follow other rules than the ones used in standard transformer design theory. This is partly acceptable as the transformers do not work with a continuous steady state signal (but then certain types of modern music with a lot of low-end content do require almost the same amount of continuous power as a steady state signal!). However there are limits: one salesman tried to convince me that his amplifier would put out 2000 WRMS bridged into 2 Ω. I recognised the toroidal transformer as a unit rated at 800 WRMS continuous. Interestingly the power rating on the transformer label was scratched off on this display unit. . .It should always be remembered that there is no perpetual motion. If you produce 2000 WRMS output from a circuit you must feed the circuit with a bit more than 2000 WRMS (and this at high temperature where transformers and other components must be derated for safe operation!).

Another myth is that power supply capacitance *per se* is of prime importance. One can often hear statements such as: "because of the fact that amplifier X has 40,000 μF of power supply capacitance it has a better bass than amplifier Y which only uses 20,000 μF". The reality is quite different. Let's take an example of an amplifier delivering 100 W into a 4 Ω load. To be able to supply the amplifier circuits with enough current to reproduce a single 30 ms impulse, an electrolytic capacitance reservoir of several hundred thousands of μF would have to be provided! Such a high capacitance is not obtainable within reasonable size and reliability (electrolytic capacitors are some of the most critical components in respect to life expectancy). It would also be very large and expensive; in practical terms—an impossibility. More important than capacitance *per se* are the ESR (electrical series resistance) and the maximum ripple current of the capacitors used (both of these can vary tremendously from one make of capacitor to another even if they have the same capacitance/voltage rating), the long term and short term capacity of the power transformer, the wire size, the type of connectors, in short the resulting total impedance of the power supply. The lower this impedance, the better the performance because the power supply can react immediately and without limitations on the current demands of the amplifier circuits. Only the total assessment of such variables will give an exact picture of the quality of an amplifier's power supply. It is amazing to see manufacturers use huge diameter mains cables (looking very impressive) and then inside the unit (at a place the customer is less likely to see) undersized transformers, marginal internal wiring, low-power connectors or DC rail voltage fuses etc. are used. It must be realised that a fuse is an non-linear element and downgrades performance considerably.

A 'soft' power supply may initially look advantageous, as the manufacturer can ▷

10 OUTLET DISTRIBUTION AMPLIFIER 3



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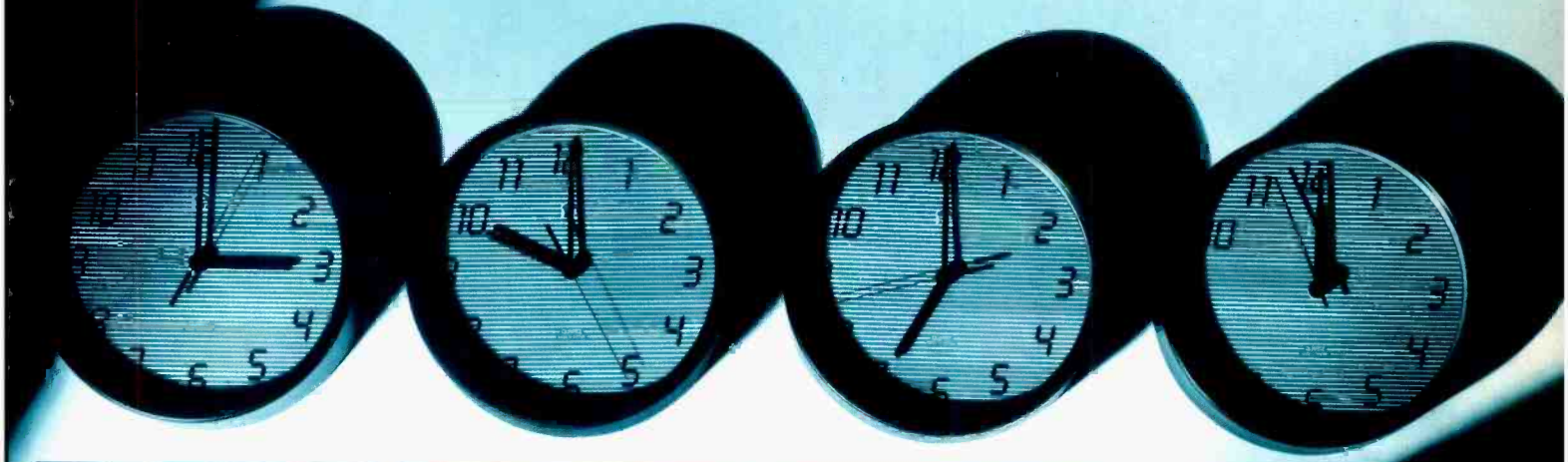

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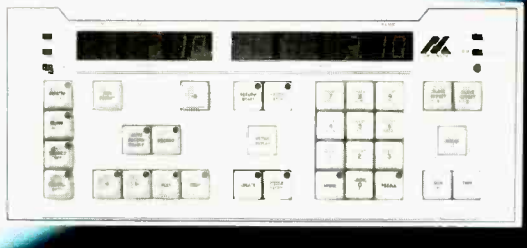

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claim more 'headroom' but in reality such a power supply can only produce the necessary current for a few milliseconds. After that it collapses, the voltage drops and dynamic limiting of the output stage occurs. In addition one has to bear in mind that transfer curves of transistors vary with voltage. A collapsing voltage changes the transfer curves and therefore the linearity of the amplifier. This results in a change in characteristics and a corresponding change of the sound quality with dynamic signals. The smaller the power supply voltage variation under different load conditions, the more linear the output stage works. This is the reason why amplifiers with a good 'headroom' specification and a corresponding 'dynamic' or 'soft' power supply cannot reproduce music with accurate dynamics. The power supply of a top-class power amplifier should be 'hard', of lowest impedance, stable and have as much continuous and peak current capability as possible.

The extreme current requirements in high-power amplifiers demand a different approach to wiring, connectors and PC. board layout as well as material selection. Tracks that carry high-power must be as wide as possible to lower resistance. Current transfer and resistance can be further improved by using printed circuit boards with thick copper plating (70 μm or better 105 μm) instead of the standard 35 μm. High-power connections must be hard wired and soldered or at least be done with appropriate high-current connectors. Another important aspect is the internal wire size which should correspond to the maximum current capability of the unit. Standard output binding posts can handle up to 16 A. For higher currents such connectors are not satisfactory anymore. **Fig 2** shows the inside of an *FM 801* precision high-power amplifier. Note the large sized wire and soldering of high-power connections. This guarantees a high damping factor and allows optimum current transfer. Always use the largest wire size that fits into the installation. Because of their non-linearity speaker fuses are an absolute taboo. The same applies to light-bulbs connected in series with the drivers. Long before light is emitted by the bulb its resistance has increased tremendously introducing non-linearity.

Another requirement that is sometimes underrated is the stability and impedance of the mains supply available, for example, while the *FM 801* amplifier draws a mains current of 11 A continuous at 240 V it can request as much as 40 A from the mains for an impulse of up to 50 ms (and that can be repetitive!). From this it is obvious that the performance of a high-power amp can be limited by a marginal mains supply, cabling or marginal connectors.

Protection systems should not only safeguard the amplifier from abuse and dangerous working conditions but also the speakers from malfunctioning of an amplifier. Some designs rely on DC line-fuses and/or speaker-line fuses (remember that fuses introduce non-linearity!). This is certainly not acceptable. The + and − DC offset should be monitored continuously and in case the amplifier's offset starts to rise or fall for whatever reason, the protection circuit must switch off the output to the speakers instantaneously. In some amplifier designs DC protection circuits will still allow DC voltages of 15 VRMS or 20 VRMS to pass without switching off. With such protection circuits and with other systems using a delay the speaker may already have been damaged before the amplifier switches off. If an amplifier's DC offset reaches the region of 1 V something is not working properly and it should switch off immediately.

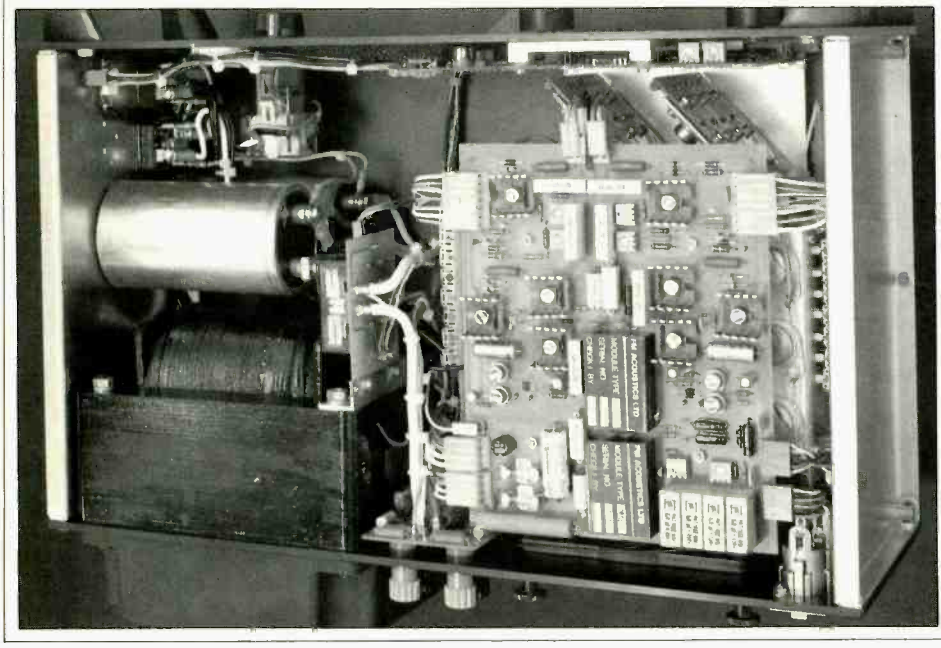
Overheating protection is used in practically all designs. Depending on the type of cooling system used, one can settle for a thermal sensor on the cooling fin or it may be an advantage to mount the thermal sensor right on to a power transistor housing. It is very important that the protection circuits react fast. Some designers still believe that power transistors can handle continuous temperatures of 120°C or even 150°C (such values are quoted in data-sheets of some semi-conductor manufacturers) but such temperatures destroy the device in due course. The lifetime of a transistor depends to a large extent on the number of thermal cycles and within these thermal cycles on the actual temperature difference. This is one reason why it is *not* a good idea if amplifiers run cool on standby because as soon as a signal arrives, the chip reaches high temperatures with a resulting large temperature variation. As transfer curves vary with temperature as well it is better to bias the transistors so that the temperature variation between no signal and full load remains within narrow tolerances. This results in a better linearity of the amplifier (class A design). To achieve a long lifetime of the transistors, the temperature protection should activate around 80°C. This is a conservative rating with enough reserve for worst case situations.

Most amplifiers for commercial use employ steep filters at the input to protect against HF instabilities, RFI and parasitic oscillation and very low frequencies. There is nothing to be said against such HF and LF protection other than the negative influence on the phase and frequency response. Therefore such filters should be linear-phase and should not generate any kind of overshoot when fed with a step function or an impulse. The widely used Butterworth and similar filters that produce an overshoot are not acceptable.

The sound engineer should be warned when such dangerous HF signals are present somewhere in the system. Most of the time they originate in the equipment preceding the power amplifier. A good solution is the use of phase coherent HF filters together with an HF detector circuitry and an HF warning light.

One of the most critical points is protection against short circuits. Even today a large number of amplifiers use either a voltage or current limiting or a ▷

Fig 2: Inside view of an FM 801 Precision high-power amplifier. Note heavy gauge wiring. High Current connections are handsoldered



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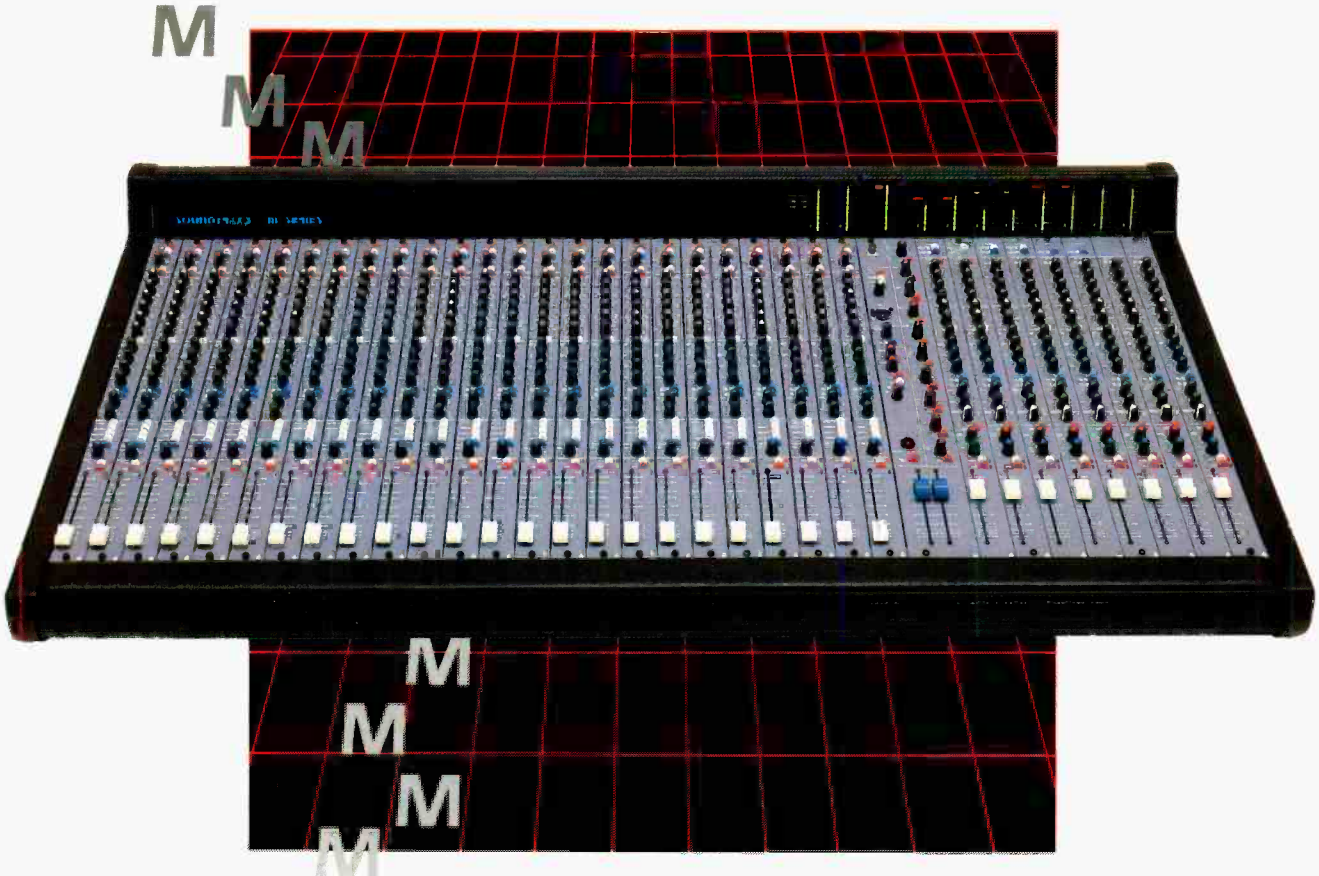

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combination of both. As we have seen, such protection circuits are not only triggered when a short circuit or dangerous impedances are present; as they react almost instantaneously, they can also be activated by back-EMF, speaker phase, etc. When operating they often distort the signal badly and some even oscillate which sounds terrible but can also be lethal for the speakers.

A well designed short circuit protection should not be able to influence the audio signal in any way, but still protect the output stage from true short circuits. This is not easily accomplished and requires elaborate circuitry and analysing techniques. Switch-on thumps can become dangerous especially in biamplified systems using electronic crossovers. Therefore an amplifier should be void of any switch-on thumps and incorporate a turn-on delay.

If the amplifier uses a fan it can run full speed in most commercial applications but not in a recording studio. To keep the transistor temperature at an optimum level, and to minimise dust and dirt build-up, it is advantageous if the unit has a two-speed or vari-proportional fan including an easily replaceable air filter. If there is a build-up of dust on the boards humidity could make the dust conductive with a resulting short circuit. Even protection circuits can develop a fault. To reduce failure possibilities to a minimum, a separate backup protection circuit should continuously check the operation of the standard protection systems. To give the engineer easy clues about the type of fault or protection, it would be beneficial to include different indicators for each protection type on the front-panel. This catches the engineer's eye immediately and he can react accordingly.

One of the most important points when considering a power amplifier for professional use is long-term reliability. To be able to evaluate the potential of a certain product in this respect, it is helpful if one has some knowledge of construction, quality of electronic components etc. It is a good idea to lift the cover and have a close look how a unit is designed and manufactured. Transformer size, cooling area, solder joints, contact material, tidiness of wiring and quality and type of components used are of prime importance. A closer inspection will already give clues about possible limitations. If an amplifier's protection system consists of a speaker line or DC-rail fuse, one should be alarmed. Check details such as the power rating of the power transistor's emitter resistors and have a look at how many amplification stages are employed within the amplifier. Be aware that in this case the more stages that are used, the more linear each stage will be working and the less static and dynamic distortion it will add. Bearing this in mind the circuitry should not be unnecessarily complex. Power MOSFET designs have a tendency to underrate the requirements on the driving stages. When considering the output capability do not draw final conclusions from the number of output transistors that are used: the same *TO-3* case may house a standard chip with a square section of 4-8 mm^2 while for instance in the specially made *FM 17418* power transistor the square section of the chip is 28 mm^2! As the current and power capability and dissipation depend on the size of the chip a single *FM 17418* transistor obviously performs the function of quite a few standard power transistors with better reliability. Furthermore it is better to use fewer more expensive high-power devices instead of many cheaper transistors. The less devices that are paralleled in the output, the smaller the tolerances and the more accurately the amplifier will reproduce signals. Because of their longer lifetime metal-can transistors should be used, especially in stages that have considerable thermal cycles such as pre-drivers, drivers and outputs.

In case of relays—be they used in a power line or in a speaker line—one should be aware that the contacts burn and age over the years. This increases the resistance of the relay contact, which in turn has a detrimental effect on the power supply impedance, the damping factor etc. A good solution is relays with multiple high-power contacts. Special contact materials can help too. For instance in the high-powered *FM 801* with its huge output voltage and current capability (180 V pp and 100 A), we use an eight contact relay with a contact rating of 16 A for each contact for the greatest long term stability. Such points may not make any difference when the unit is evaluated and tested initially (its relay contacts being still new) but become increasingly important the longer the amplifier is operating. The quality of one single component can make the difference between an accurate product that is reliable in the long term or one that needs constant maintenance. Even if the circuitry of a power amplifier is duplicated 1:1, the actual quality between units can still vary because of the different quality standards of the parts. Of course heavy-duty components are considerably more expensive (they can easily double the unit's final cost) but in the long run the money spent on better components will pay off.

Space considerations do not permit a more in-depth discussion of power amplifier design. Also it is not my intention to go into details about characteristics of certain circuitry as most readers are users rather than designers. I hope I have been able to shed some light on certain important aspects. Some might think that the facts are only important to those who cannot settle for anything less than the absolute best but for professional audio—be it studio monitoring, public address or other—these facts are indeed significant. It is clear that the initial investment in a totally professional, high quality product is higher. However when thinking in terms of *total* cost (less depreciation because of higher reliability, long term stability requiring less servicing, extended life expectancy and higher resale value of the unit etc) an initially more expensive product will very often come out at a considerable lower total cost. In most other industries, purchase decisions are made on such realistic evaluations and not initial cost. The following may not be a popular thought in so-called 'modern' marketing but if more manufacturers start to disregard manufacturing costs/sales price as the only important aspect and commit themselves to excellence there will be a new generation of products that are much more accurate and will stay at the top longer.□

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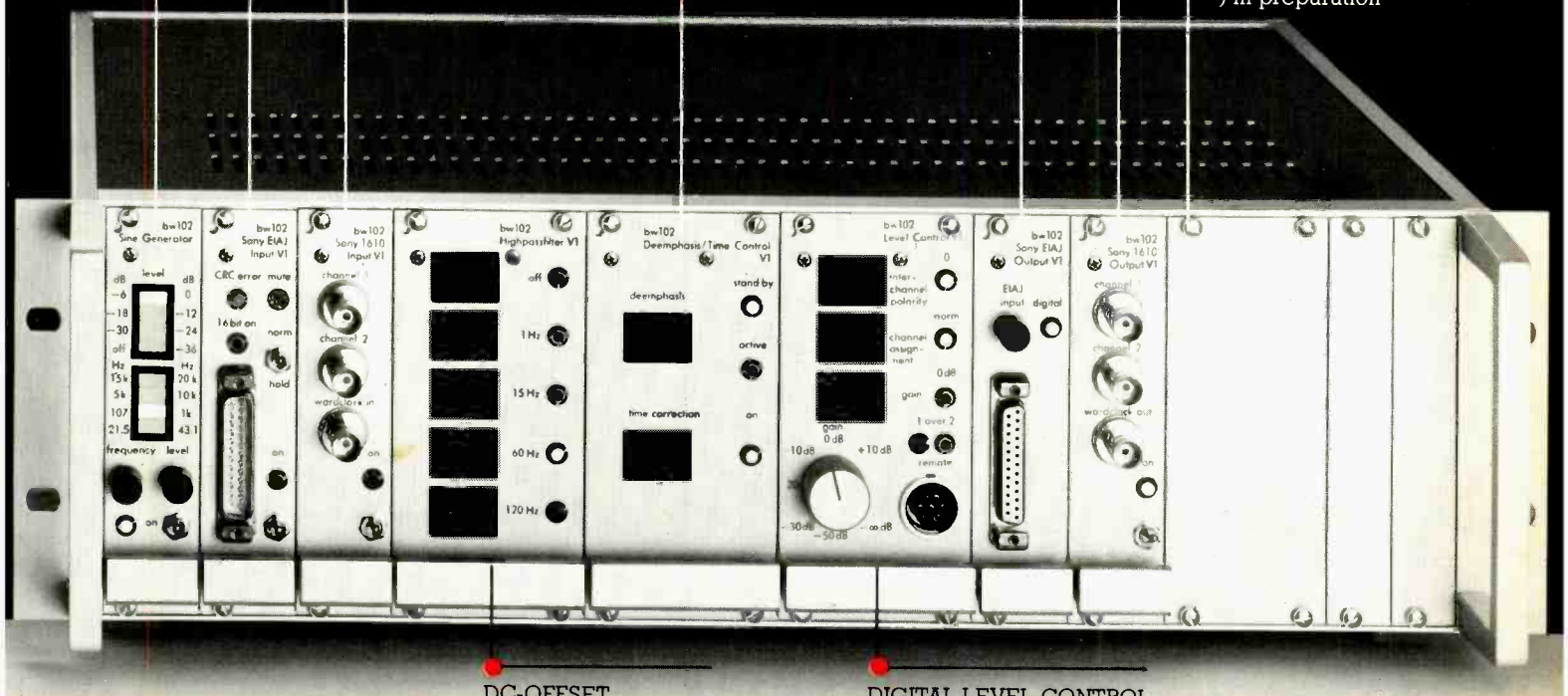

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INTRODUCTION TO LOUDSPEAKER REVIEWS

We will shortly commence a series of speaker reviews. In this article Neil Grant describes the review procedures and details the measurements to be made

Objective speaker analysis is always preferable to the more emotive subjective discussion of a speaker system's performance—not only are there a finite number of adjectives applicable to speaker systems, but they tend to be open to personal interpretation and bias. On the other hand objective analysis has always been open to criticism that speakers which measure similarly don't necessarily sound in any way related. The reason has simply been that measurement techniques and their accessibility have lagged behind system development to the extent that we have been measuring too few of the aspects of a speaker's performance to define accurately the factors that identify that particular unit.

Time delay spectrometry (TDS) as a measurement technique was first described by its originator Dick Heyser in 1967. This paper described a technique whereby accurate measurements could be made of devices and systems that possessed propogation or inherent time delay. Originally invented for the measurement of analogue tape machines, TDS is a time selective technique well suited to the measurement of the transfer function of transducers that have a defined input and output. TDS is one of a class of two port measurement systems, whereby the output of the analyser is sent to the device being tested, and the resultant output is analysed.

The commercial availability of a portable device capable of TDS measurements, the Tecron *TEF10*, enables many more of the characteristics that define a speaker's performance to be measured quickly and with great accuracy in otherwise reverberant spaces. Traditional measurement parameters can be defined such as the amplitude, phase and impulse response, in addition to the TDS specific measurements like the Energy Time Curve and the 3D redundant processing plots of time, energy and frequency.

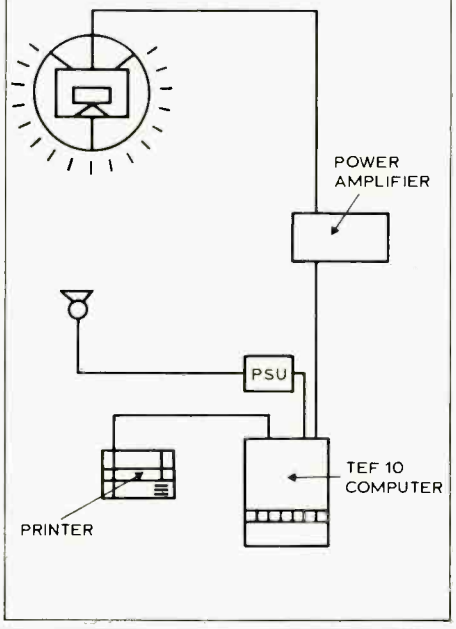
Time delay spectrometry being time selective can also allow the simulation of a true free-field environment. This means that data can be acquired under totally anechoic conditions.

It is not the function of this article to examine the measurement technique itself, since there is a considerable library of information on time delay spectrometry available. Of more interest is demonstration of typical TEF measurements and their formats in order to introduce the series of speaker reviews of professional monitor systems that we will be conducting through the coming months.

The one major disadvantage of the TDS system is the necessary complexity of the instrument and the degrees of freedom that this allows the operator. Many of the measurements may appear new, many familiar measurements may be presented in a different form. There was considerable concern that a series of speaker reviews using time delay spectrometry might present data that was unfamiliar enough as to cause difficulty in interpretation. This would of course unfairly penalise those manufacturers whose products were first in the series of reviews.

For this purpose a representative and anonymous speaker cabinet has been chosen in order to illustrate some of the techniques available and the format of data that the system is capable of generating.

FIG 1 TYPICAL SET UP FOR TEF MEASUREMENT



Room and measurement set-up

We do not require an anechoic chamber for these measurements. TDS has rendered the large, costly chamber obsolete. The discrimination of the TEF in both the time and frequency domains is such that measurements are possible in otherwise reverberant spaces of an accuracy that cannot be replicated in even very large anechoic chambers.

Fig 1 illustrates a typical set up for TEF measurement. The speaker stand can be rotated through 300° for polar response plots. We are using a space that measures 12 m×9.5 m×10 m. In this room, given a speaker to microphone distance of 1 metre, we can obtain a minimum time resolution of 20 ms. This translates in the frequency domain to a ripple error of ±0.48 dB at 50 Hz.

And now to trade-offs—time resolution is the reciprocal of frequency resolution or Tr=1/Fr.

Given a Tr of 20 ms, the max broadband frequency resolution will be 50 Hz. This now determines the bandwidth and sweep rate of the analyser given the relationships Fr=S/B and Tr=B/S.

This defines the accuracy available within the space in both time and frequency domains. It is necessary to also define the signal path to maintain consistancy from one system to another. Unless manufacturers provide an amplifier, or crossover and amplifier rack with their speaker systems as a preferential choice we will be using the same amplifier for all the speaker reviews. The amplifier is capable of delivering 1300 W into an 8 Ω load, run bridged. The system's gain is governed by a programmable voltage-controlled attenuator for protection.

It is obviously important to provide sufficient head-room electrically for there to be no influence on the performance of the speaker under test, yet taking care not to drive the speaker into non-linearity with the test output. Fortunately, the signal-to-noise capability of the TEF is outstanding under all ambient noise conditions encountered in the test room, and the only high level test ouputs to be used would be if we were conducting power compression tests—in other words the changes in a speaker's transfer function when thermally and mechanically stressed.

Without in any way wanting to be drawn into the arguments that still run through the hi-fi press regarding speaker cable and interconnects, it is worth noting the we will use a high quality and commercially available multi-strand speaker cable, and that the same set of interconnects will be used for all the review speakers.

The family of curves that we will be using repeatedly throughout the series of reviews can be summarised in **Fig 2,** drawn as for the perfect electroacoustic transducer. **Fig 2a** is energy as a

Speaker reviews are scheduled to appear in the new year and we are currently compiling a review list. ▷

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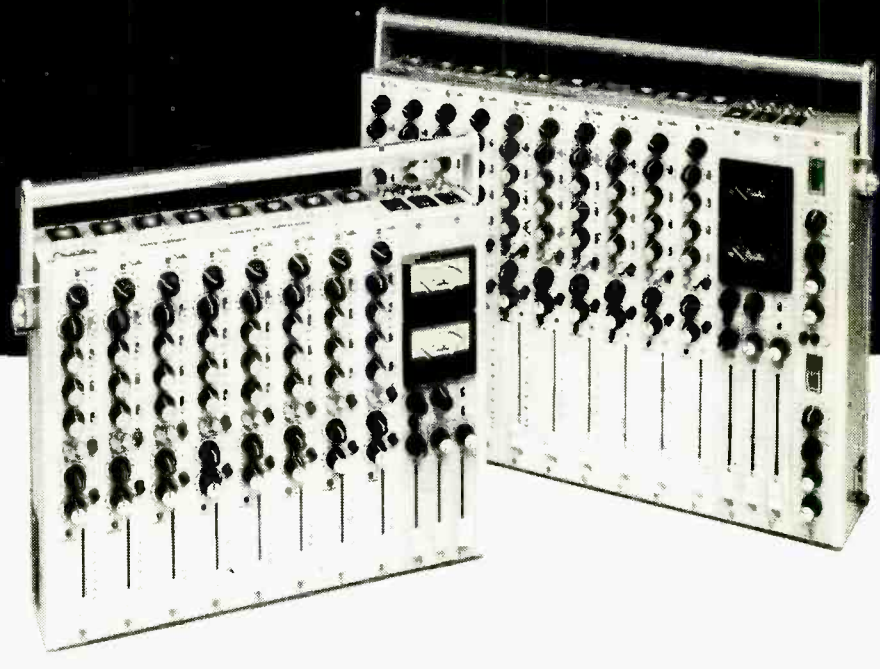

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function of time, **2b** is frequency as a function of time and **2c** and **2d** show the complex frequency response; phase and amplitude as a function of frequency.

Fig 3 shows the same family of curves, but illustrating the type of distortions that occur in reality. **Fig 3a** shows that the ETC now has finite width, and the jaggedness associated with reflections and resonances. **3b** illustrates smearing in the time domain, and **3c** and **3d** shows a non-linear amplitude and phase response, the phase curve no longer passing through the origin.

Fig 4 ties the various views of the complex signal into one diagram, trading off time and frequency resolution. This can be displayed in three formats: it is possible to look at the rising edge of the speaker system, the decay side of the curve, and directly down on top of the display.

System measurements in the real world

The system chosen to illustrate some of the TEF formats is a small high power three-way monitor. Each cabinet has a reflex loaded bass woofer, a direct radiating mid range, and a direct radiating tweeter. The mid and high frequency speakers are off-set

INTRODUCTION TO LOUDSPEAKER REVIEWS

asymmetrically on the speaker baffle. The object of this article, however, is not to conduct a review, but introduce a measurement technique, so we will not approach the speaker critically, just describe what is happening in each of the displays and how the results are achieved and analysed.

Space being at a premium, it will sometimes be necessary to restrict the number of plots that it is possible to reproduce, additionally some data can be better presented in a table. System sensitivity, specific frequencies, phase angles and harmonic distortion can all be presented in this way.

Fig 5 contains some of the basic information with regards to performance which we will refer to later.

The time domain

Fig 6 is the speaker ETC or 'when' the speaker and its components are in the time domain. This measurement is totally frequency blind. It is important to note that there are no reflections in this measurement. What you can see is the total amount of acoustic energy dissipated into the room by the speaker. The room is not contributing at all.

The vertical scale is divided into 6 dB slices, showing some potential 48 dB of dynamic range. The time resolution that we have chosen to use on the ETC is defined by the number of lines across the display, the sweep rate and the band of frequencies covered. These relationships are defined as: Tr=1/S.Ts and Tw=400.Tr and Ls=Tw/400 where Tr is the time resolution per line of the analyser, 10.9674 μs, Tw is the total time window of the analyser, given 400 lines per display, and is 3218 μs, and Ls is the line spacing of the display, which is 8.06427 μs.

This particular speaker is a three-way device. Note the cluster of arrivals: A is the tweeter; B is the mid range, and C is the woofer. Note that the three speakers are all separated in the time domain. It would be possible by introducing delays in the crossover to remove any inter-driver delay, and all you would be left with would be the different rates of rise and decay of the three drivers. The narrower the section of the ETC, the more broadband is the frequency

FIG 2 FAMILY OF CURVES IN USE

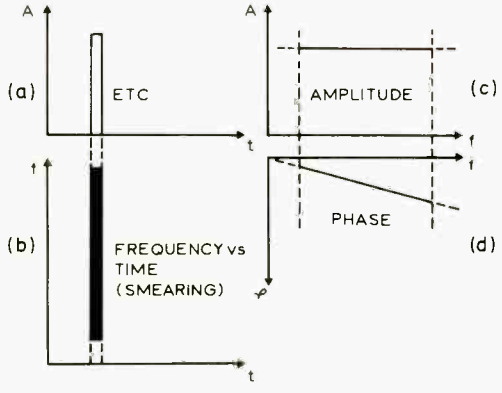


FIG 3 FAMILY OF CURVES ILLUSTRATING DISTORTION

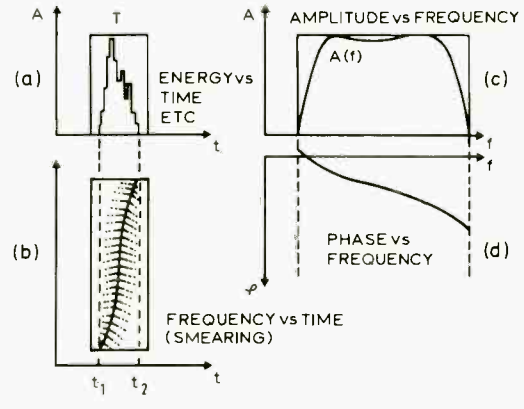
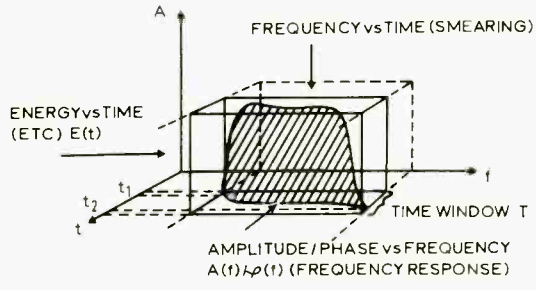


FIG 5 Distortion products referred to the fundamental, driven with a 50 W input

Frequency	2nd harmonic	3rd harmonic
20 Hz	−10 dB	−15 dB
50 Hz	−16 dB	−20 dB
100 Hz	−26 dB	−28 dB
1000 Hz	−37 dB	−45 dB
10,000 Hz	−42 dB	−32 dB
20,000 Hz	−35 dB	−39 dB

System sensitivity: 84.5 dB, for 1 W at 1 m
Nominal impedance: 8 Ω

FIG 4 THE COMPLEX SIGNAL



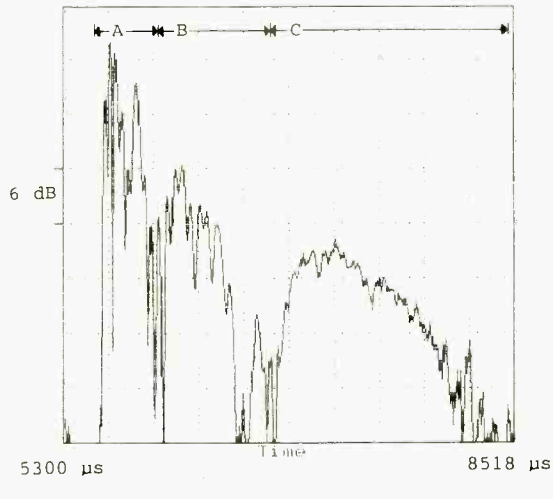


FIG 6 ETC
Vertical: 6 dB/div with base of display at 40.0 dB
0 dB is located at .00002 Pa
Horizontal: 5300 μs or 1.82268 m to
8518 μs or 2.92924 m
Scale: 3.0254E-01 m/in or 1.1911E-01 m/cm
879 μs/in or 346 μs/cm
Line spacing: 8.06427 μs or 2.77332E−3 m
Line width: 10.9674 μs or 3.77172E−3 m
Sweep rate: 15028.70 Hz/s
Sweep range: −31000.40 Hz to 31001.50 Hz
Window file name: A:HAMMING.W8T

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transform of that section, and the better defined is the time response. Notice the late arrival of the bass section, and, comparatively speaking, how long it takes to decay. Discrete peaks indicate the presence of reflections, and changes of slope are indicative of resonances. Where in the frequency domain they are situated will be determined from the amplitude response. In this particular cabinet the high frequency section leads the mid range by 435 μs and leads the bass section by 1081 μs.

Having decided 'when' in the time domain the speaker is, it is possible to remove the inherent delay between the acoustic centres of the units, and look at the amplitude response. It is becoming obvious that not only does each device occupy a different 'when' but that this varies with respect to frequency. Again, other views of this will be shown in the frequency domain by the phase and 3D plots.

The frequency domain

The curves we will show will use linear

INTRODUCTION TO LOUDSPEAKER REVIEWS

frequency scales not logarithmic, the amplitude response being overlaid with the modulus of impedance and the electrical phase of the speaker. The TEF itself is indifferent to the input it is presented with. By converting the output to a constant current source, and re-calibrating the input, it is possible to directly measure the modulus of impedance with respect to frequency, and the electrical phase with respect to frequency.

We require to present not only the amplitude response of the whole system but also the resistive and reactive load that the system presents to the outside world, as the frequency of the input to the cabinet is varied. Because of the wealth of information generated, the frequency band is split into three sections, 0-200 Hz, 200-2000 Hz and 2000-25,000 Hz.

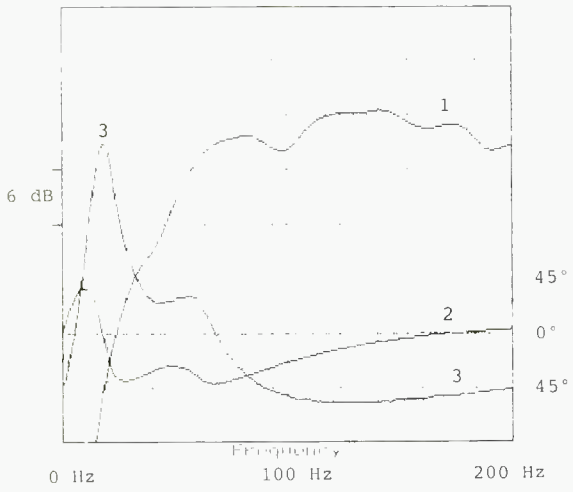
Fig 7 shows the low frequency response from DC to 200 Hz. Referenced to 100 Hz, the system is 3 dB down at 58 Hz. This is as we have said a free field measurement and therefore we must take into account that the system is radiating into 4π space. This means that the low frequency response would lift if the cabinet was flush mounted in a wall. The amplitude response is acceptably flat, the box resonance is at 56 Hz though suppressed but the speaker resonance is at 18 Hz. This is a little low, and the speaker could be stressed at high levels of low frequency input. Additionally, the phase angle is −41.97° at 68.6 Hz. This is highly reactive: in this case capacitive, and the amplifier will be required to deliver large amounts of current while being driven near the voltage limits of its rails. This speaker will certainly represent a difficult load at these frequencies and many amplifiers will have difficulty with current limiting.

The minimum impedance point is at 140.7 Hz, and is 6.41 Ω. This is entirely satisfactory for a nominally 8 Ω speaker system.

Fig 8 is the amplitude response from 200 Hz to 2 kHz. The response itself is acceptably flat and it is obvious that we pass the first crossover point marked by the ripple in the phase and impedance curves. In fact this is at 741 Hz. The speaker still represents a reactive load and the impedance is rising.

Fig 9 completes the response as far as 25 kHz. The response would again be good, were it not for a pronounced rise at 16.469 kHz. The 'Q' of this resonance is relatively high, and the result will affect harmonics and sibilants, making the cabinet sound aggressive, and perhaps harsh. The high frequency extension is good, the system being 3 dB down at 22 kHz. The load is now completely inductive with both the resistance and reactance becoming asymptotic. The ripples in the impedance and phase response are caused by the upper crossover point, which is set at 8.9 kHz.

By way of providing a more familiar



KEY
1 EFC (amplitude response)
2 Electrical phase
3 Modulus of impedance

FIG 7 EFC
Sweep rate: 19.73 Hz/s
Bandwidth: 4.4422E+00 Hz
Frequency resolution: 7.7418E+01 m and 4.442E+00 Hz

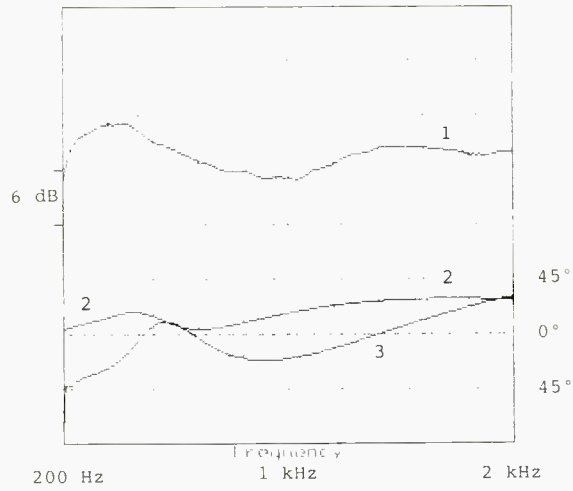


FIG 8 EFC
Sweep rate: 199.85 Hz/s
Bandwidth: 1.4137E+01 Hz
Frequency resolution: 2.4327E+01 m and 1.4137E+01 Hz

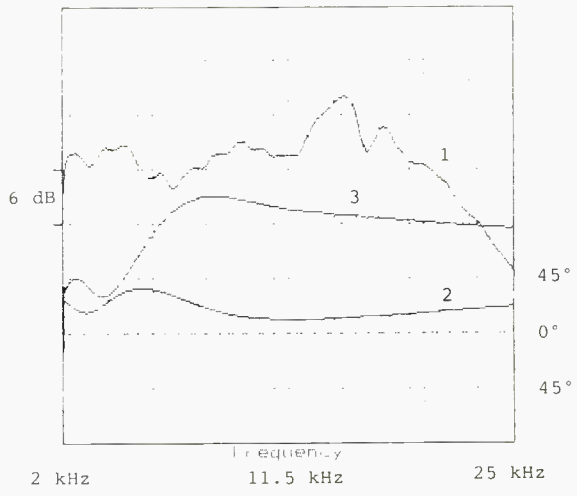


FIG 9 EFC
Sweep rate: 15028.70 Hz/s
Bandwidth: 1.2265E+02 Hz
Frequency resolution: 2.8066E+00 m and 1.2265E+02 Hz

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reference, and also to introduce the phase and distortion curves we have included two log frequency plots. Both have the same amplitude curve overlaid on them, **Fig 10** has the phase versus frequency curve, **Fig 11** has the second and third harmonics shown overlaid. It can be seen that below 6 kHz the phase curves wraps twice through 360°. This is because the relatively late arrival of the bass and mid range units, makes it impossible to remove the inherent delay between these devices and the microphone.

If we were interested in the detailed acoustic phase of each device within the system, it would be necessary to disable the other two, and measure them all singly, taking care to terminate the crossover in such a way as to provide a consistent load.

In order to provide clearer readings, some key distortion levels have been moved to the table in **Fig 5.** All professional systems should show very low distortion at 1 W inputs, so we have chosen to measure at 50 W input. This

INTRODUCTION TO LOUDSPEAKER REVIEWS

represents with this system, an acoustic output of 101 dB, relative to 20 μPa/m.

3D or time energy frequency plots

The typical 3D plot showing the rise and decay of a system is created by taking 32 sweeps and varying the offset delay for each sweep. These plots can be shown in any one of three ways; looking at the rising edge of the system, from T1 to T2, or by reversing the display, looking from T2 to T1, and thus displaying the decay side of the system. The third display is known as the Frequency Time Curve, FTC, and shows the 3D from on top of the display, looking down on the curve. All levels in the FTC are represented by contour lines, and we have chosen this display to illustrate the polar response of the cabinet. (See **Fig 4.**)

However firstly the response of the system as an electrical input arrives. In **Fig 12,** we can clearly see the three sections of the system, and their different arrival times. To clarify this the display has been divided into three. The tweeter arrives first then the mid range and then the bass; the frequency scale is still linear.

If we require greater low frequency resolution we would just sweep the area of specific interest. Of most interest here in the broadband sweep, is the resonance in the tweeter, now obviously prominent.

Fig 13 is the reverse of this display and the individual driver resonances are quite clear. Also obvious is the extra time necessary for the bass driver to settle.

Fig 14 is the FTC, looking down on the display. The time smear is clear, the rise and fall of the system proceeding from the bottom of the display to the top.

Finally, the polar response. To make the measurement, we no longer vary the time offset for each of the file sweeps, but just rotate the cabinet 10° between each sweep. In **Fig 15,** the centre, darker line shows the on-axis response, either side falling away at 10° per division. The higher frequencies not only fall away fastest as expected, but the dominant resonances linger. They will therefore be more noticeable off-axis. This is clearer in **Fig 16,** the FTC of the polar plot. It is also clear now that the cabinet itself is asymmetrical the left or lower side showing a marked improvement over the right hand side. The extra baffle area to the right of the drivers contributes to the suck-outs—these are due to diffraction from the edges and lips of the cabinet. To interpret this display, imagine that the speaker lies at the centre of the left hand vertical axis, and the direct response lies directly in front. Each contour represents a 3 dB fall in sound ▷

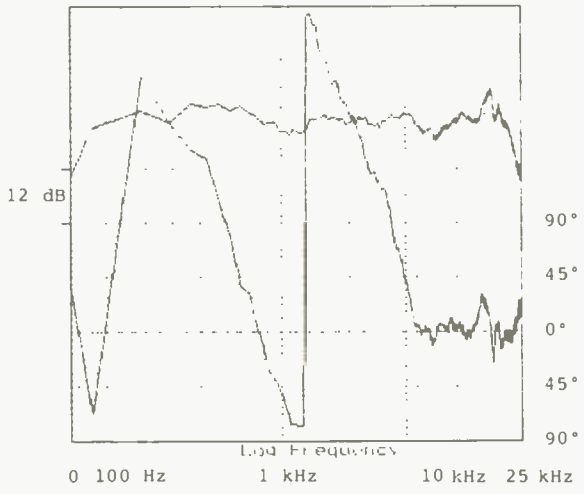

FIG 10 EFC AND PFC
Sweep rate: 1977.45 Hz/s
Bandwidth: 4.4000E+01 Hz
Frequency resolution: 7.6521E+00 m and 4.4942E+01 Hz

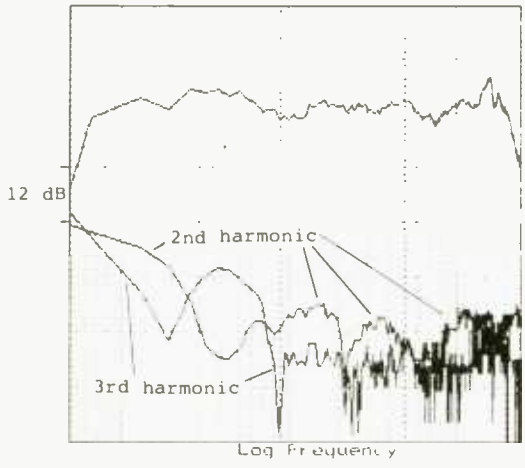

FIG 11 EFC
50 W input
Sweep rate: 15028.70 Hz/s
Bandwidth: 4.4000E+01 Hz
Frequency resolution: 10069E+00 m and 3.4156E+02 Hz

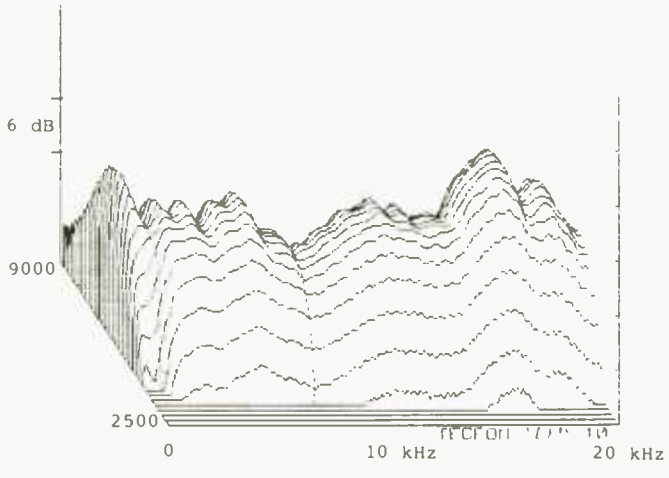

FIG 12 3D
Vertical: 6 dB/div with base of display at 76.0 dB
0 dB is located at .00002 Pa
Horizontal: 0.00 Hz to 19998.10 Hz
Scale: 5467.68 Hz/in or 2152.63 Hz/cm
Resolution: 5.4319E-01 m and 6.3146E+02 Hz
Time of test: 2500 μs 8.5750E−01 m (front) to
9000 μs 3.0870E+00 m (back)
210 μs/step or .0719193548387 m
Sweep rate and bandwidth: 10734.80 Hz s and 1.7000E+01 Hz

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pressure level as the cabinet is turned ±150°.

There are other measurement formats we will use where applicable. The 3D display can be loaded one curve at a time to illustrate, if necessary, power compression in its various forms. The shift in the phase response, or the movement of the impedance curve with respect to rising input power can be displayed graphically, as can the effect of long term temperature rise. Measurements of the system's headroom, and its capability of passing transients will be made where appropriate.

Measurements of the electrical performance of associated crossovers, circuitry and amplifiers will be made as necessary, as well as the overall performance of the system as a whole.

We believe that TDS analysis will continue to define the industry standard of measurement, particularly for electroacoustic transducers. Hopefully this series of articles will reveal many more aspects of speaker system performance that had previously perhaps been suspected rather than defined. You can consider any one measurement as looking through a reference window as the device under test. In these terms TEF analysis is like sitting in a greenhouse—there is glass in every direction. □

INTRODUCTION TO LOUDSPEAKER REVIEWS

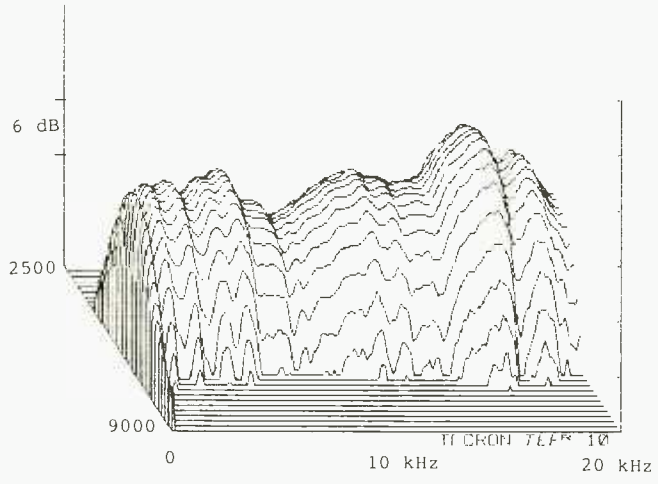

FIG 13 3D
Vertical: 6 dB/div with base of display at 76.0 dB
0 dB is located at .00002 Pa
Horizontal: 0.00 Hz to 19998.10 Hz
Scale: 5467.68 Hz/in or 2152.63 Hz/cm
Resolution: 5.4319E-01 m and 6.3146E+02 Hz
Time of test: 9000 μs 3.0870E+00 m (front) to
2500 μs 8.5750E−01 m (back)
210 μs/step or .0719193548387 m
Sweep rate and bandwidth: 10734.80 Hz/s and 1.7000E+01 Hz

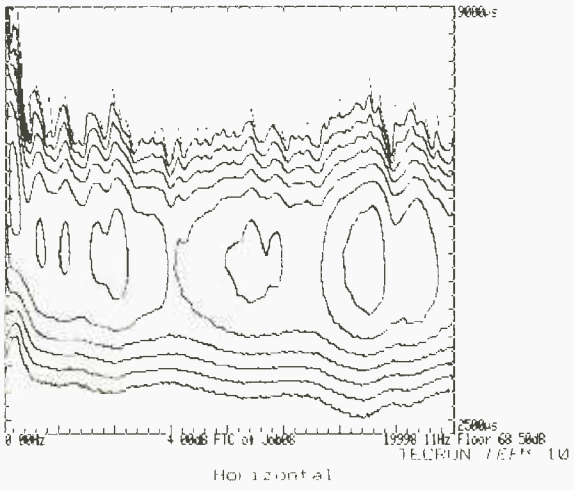

FIG 14 FTC
Frequency: 0.00 Hz to 19998.11 Hz
Scale: 5454.01 Hz/in and 2147.25 Hz/cm
499.95 Hz/tic and 2499.76 Hz/ticmajor
Vertical:
Time: 2500E−6 s or 0.8575 m (bottom)
Thru: 9000E−6 s or 3.0870 m (top)
Scale: 26E−6 s or 0.0090 m/raster
209E−6 s or 0.0719 m/tic
1846E−6 s or 0.6334 m/in
4690E−6 s or 1.6088 m/cm
Resolution: 5.4319E−01 m and 6.3146E+02 Hz
Sweep rate and bandwidth: 10734.76 Hz/s and 1.70000E+01 Hz

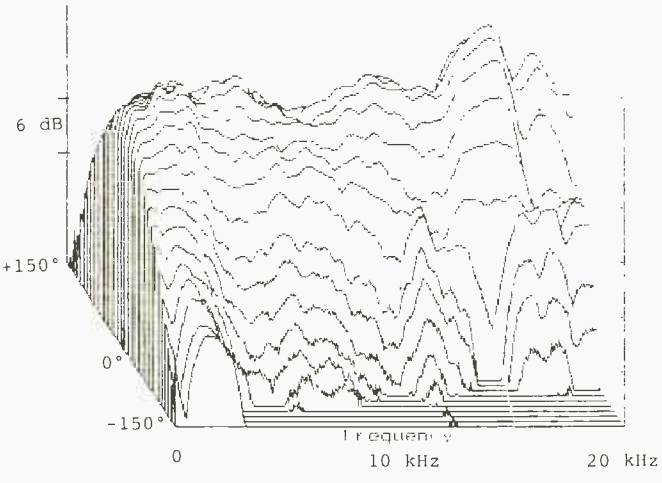

FIG 15 3D POLAR PLOT
Vertical: 6 dB/div with base of display at 82.0 dB
0 dB is located at .00002 Pa
Horizontal: auto 0.00 Hz to 19998.10 Hz
Scale: 5467.68 Hz/in or 2152.63 Hz/cm
Resolution: 5.9496E−01 m and 5.7803E+02 Hz
Time of test: 0 μs 0.0000E+00 m (front) to
0 μs 0.0000E+00 m (back)
0 μs/step or 0 m
Sweep rate and bandwidth: 15028.70 Hz/s and 2.6000E+01 Hz

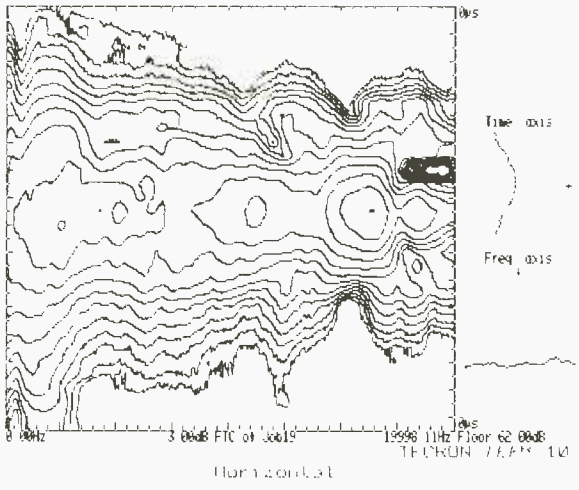

FIG 16 FTC POLAR PLOT
Frequency: 0.00 Hz to 19998.11 Hz
Scale: 5454.01 Hz/in and 2147.25 Hz/cm
499.95 Hz/tic and 2499.76 Hz/ticmajor
Vertical:
Time: 0E−6 s or 0.0000 m (bottom)
Thru: 0E−6 s or 0.0000 m (top)
Scale: 0E−6 s or 0.0000 m/raster
0E−6 s or 0.0000 m/tic
0E−6 s or 0.0000 m/in
0E−6 s or 0.0000 m/cm
Resolution: 5.9496E−01 m and 5.7803E+02 Hz
Sweep rate and bandwidth: 15028.66 Hz/s and 2.60000E+01 Hz

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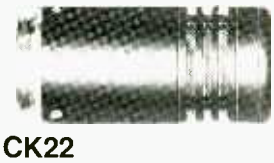
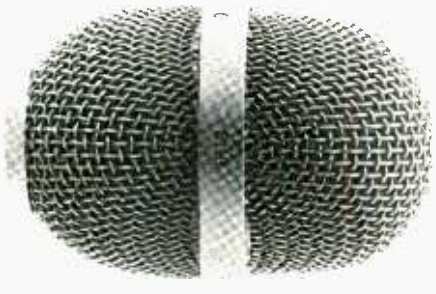
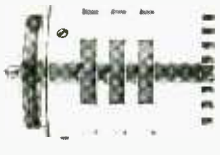


CK22

CK3

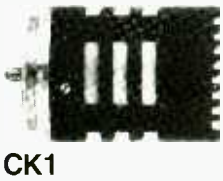


CK5



CK1S

CK4



CK1

CK8

CK9

ac

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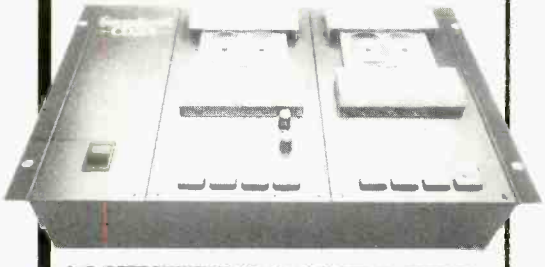


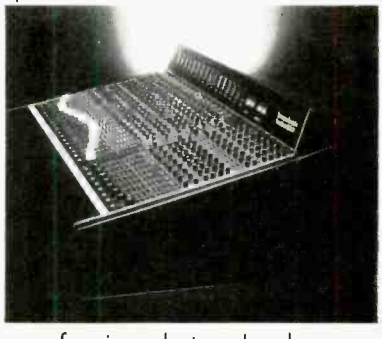
Soundcraft New 500 Series

Much more than a live console. The 500 Series has been designed for use as a live console as well as an 8-track multitrack console. It has a sophisticated balanced input with 4-band equalisation and 6 aux buses. There are 8 sub-groups and an 8-way monitor section which doubles as an effects return to group input when used in a live situation.

Soundcraft 600 Series

A complete 16-track recording console with 8 sub-groups and 16 tape monitors and meters.

The 600 Series has been designed for use with professional or semi-



professional standard multitrack machines and attains the high standards you would expect to find on a console from Soundcraft.

Soundcraft Series 20 Stereo Machines

An exciting development from Soundcraft: a microprocessor controlled stereo machine built to professional standards. Available in ¼" or ½" format, the Series 20 has the ability to store a wide variety of line-up calibrations. Adjustments are via up/down controls, doing away with fiddly presets. Inputs and outputs are electronically balanced throughout; 14" reel capacity. A truly professional mastering machine. Options include centre timecode.

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BUSINESS BUSINESS

Barry Fox investigates the facts behind the industry news

E-mail advice

Quite a few engineers, working with studios, trucks and groups on the road, are already using electronic mail as a way of keeping in touch. For the benefit of those not yet switched on, think of electronic mail as the modern alternative to telex. It's *not* an alternative to paper and postage stamps for non-urgent communication. E-mail is expensive to send and read but where telex would be ideal, you can use a cheap portable computer, with modem and ordinary telephone line, instead of a clumsy, expensive, electromechanical terminal and dedicated line.

In theory it sounds all very easy. In practice there are quite a few snags. Root cause is that the computer industry knows all about bits and bytes but not about volts, amps and telephone technology. Not every audio engineer wants to be a computer buff.

One day electronic mail will be as easy to use as a typewriter. But so far, a confusion of standards, both computer and electrical, makes using E-mail like buying a typewriter as a bag of levers, springs, nuts and bolts. Here are a few tips, learned the hard way through using electronic mail in a few odd places.

Most micros will work as E-mail terminals. There are portables specially designed for the job. Some are far more sensibly designed than others. There is good reason why most people using electronic mail on the run are doing it with a Tandy (Radio Shack) *100*. Say what you like about Tandy the spec for the made-in-Japan model *100* was written by someone who really knew what people would need.

All the software you need for hooking into an E-mail system is there, burned into the chips. The simple wordprocessing program, also burned in, works hand in hand with the E-mail software. Compare this with the NEC portable, which comes out of the same Japanese factory but must surely have been spec'd by someone who never actually communicates by E-mail. You have to enter your own carriage returns when preparing messages to send; it's like using an old-fashioned typewriter. The Tandy asks what line length you want and then does it all for you.

On a telex link the signals are 80 V DC pulses, which is why dedicated lines are needed. For E-mail the pulses from the computer are used to modulate audio tones which then go down the line and are demodulated at the other end (hence MODulator DEModulator). The American Tandy *100* has a modem built in. Thanks to British bureaucracy, tied in with the clumsy transition period while British Telecom lost its monopoly, the British Tandy *100*s have no built in modulator so you need an add-on modem.

Note well that the modem standards used for Europe are not the same as for America: the tones are different. If you are using E-mail in America, you will need a local Bell standard modem; if you are using it in Europe you will need a local CCITT standard modem. There are dual standard modems but the neatest trick is to buy a Tandy *100* while you are in America. It can then be used without any additional modem for hooking into any American E-mail system. Back home in Europe, you just forget about the inbuilt modem and use an extra add-on unit that runs at the CCITT standard.

There are two types of modem, acoustic and hard-wire. An acoustic modem is like a mirror image telephone, with a microphone and loudspeaker to 'talk' to a telephone headset. The hard-wire type plugs direct into the telephone line, through a standard US or BT socket. Acoustic modems suffer from the obvious disadvantage that they pick up background noise which can corrupt the signal going down the line. There are times when it seems impossible to use a hard-wire modem: hotel telephones, for instance, are seldom on a plug and socket connection for the simple reason that guests unplug and steal. The trick here is simple when you know how.

The signal lead from a hard-wire modem, either external or built-in as in the Tandy and now some other portables, terminates in a standard multiway telephone plug. Only two of the many wires are 'hot'. Either break the lead or, better, plug it into a socket with flying leads. Tandy sell these. Now put crocodile clips on the end of the hot wires. Unscrew the mouthpiece of your hotel telephone and gently pull out the microphone. There are two terminals on the back. Clip on the crocs and you have direct injection into the telephone system. Dial in the usual way.

The only snag—any suggestions for cures gratefully received—is that some automatic hotel switchboards will mistake modem signals for fault tones, and shut down the line. The only safe answer is use of a telephone which doesn't go through an automatic switchboard.

Wherever possible try to use the PSS system (packet switch stream) which lets you send data at local call rates by satellite link back to London. It's cheaper and less prone to shut down than dialling a British E-mail number direct. Alternatively, if the country has a local E-mail system, you may be able to dial direct into that and from there interface with the British system. But here take a practical tip. Do all the necessary homework on telephone numbers and modem standards before you leave home.

It is usually difficult, if not impossible, to find the local PSS and E-mail system numbers from a foreign telephone directory. Sometimes the only number listed is an office which works 9-5 weekdays only. You will have to talk to them before you can get the number of the 24 hr service line. In Hong Kong, for instance, subscribers to the British Telecom Gold system can supposedly plug direct into the local China E-mail system which then talks with TG in London. Recently, I arrived in Hong Kong on a Friday night and left on Monday morning, during which time the E-mail system enquiry office was closed. I never did get the chance to plug in. So make sure that you have in advance all the code numbers and passwords necessary to get on to the PSS link and into your E-mail.

The situation in Japan is especially confusing. Despite the heavy American influence, the modem standard for their PSS links is European. This continually fools American visitors who arrive with portable equipment, like the Japanese-made Tandy, and find it will not work. But even with 'Eurogear' it's still not straightforward. In Osaka recently, I had a European standard modem but still couldn't use the PSS link (Venus) to get back into British E-mail. After talking to the phone company, I got the Venus office, who gave me a number. It worked on 1200 bit/s data rate. My portable modem, like most, works only on the 300 bit/s standard.

The really smart thing to do, before making a trip, is this. Check from Britain on the telephone, code and password numbers you will need in the foreign cities you are visiting. Then, dial long distance from London into the foreign number, eg dial Osaka 123456 from Tooting, and try from there to get back into the British E-mail system. It's seldom a first time hit but easy when you get the hang. Believe me, it's far easier to iron out the bugs from an office or home phone in Britain, than when you have just crawled hot, sweaty, tired and hungry into a tropical hotel room over a local holiday weekend in the middle of the night.

Supermarket sales for CD?

The CD price structure is now cracking. Pickwick, is offering 12 titles on CD for £6.99 each. They are all classical, and original digital recordings. The next batch will be popular re-issues, of artists like Jerry Lee Lewis, Mantovani and Johnny Cash.

The Pickwick discs are being pressed in France, by the joint venture between MPO and Mayking. At a pressing cost of around £2 a disc, Pickwick isn't getting fat on a £7 selling price. But it's a brave move which could bring CD to the supermarket.

As predicted Thorn-EMI is to start pressing CDs at its VHD videodisc pressing plant in Swindon. But PolyGram has put the trade price of CDs *up* from £5.75 to £6.25. Very strange.□

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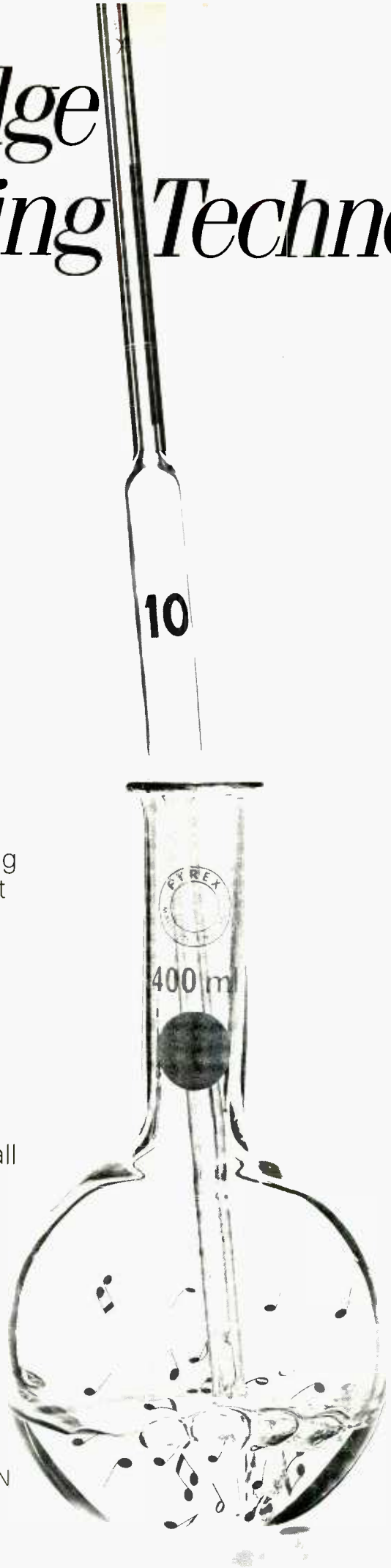
Leading Edge Sampling Technology?



The laboratory standard sampling equipment illustrated on the right will not give you 21 seconds of 20 KHz sampling on each stereo channel, full editing and triggering, plus delay, pitch transposition, sound shrinking and reverberation; all in stereo.

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LIVE AID

Further to last month's articles on the radio production and TV and telecommunications Richard Vickers reports on the PA system used at the Wembley concert in this two part feature

Throughout rock and roll's history there have been various gigs and events that have stood out above the rest as something a little 'special'. Each individual has his or her own special memories: Woodstock epitomised the start, followed by the Stones free concert in Hyde Park, the Isle of Wight Festivals—where more people turned up than at Woodstock—and much, much more.

Live Aid, however, involved not only the organisers and the audiences at Wembley and Philadelphia but the whole world was able to experience the world's premier rock acts and do something for the starving millions, outdistancing political forces worldwide.

The seed that was sown after Christmas 1984 developed from a live Wembley gig—with a BBC *In Concert* team there to record and later broadcast the show—to possibly the largest satellite link-up of all time.

As acts became aware of the importance of the event, more and more bands came forward to offer their services so split-second timing was essential just to get the large number of acts on and off the stage.

The majority of the bands had no sound check on the previous day. Ultravox—fourth on—was the first to get a monitor check which also (in the space of 10 minutes) had to double as the final set-up as backline was moved forward from the central stage revolve.

For the next four and half hours there were only 10 minute breaks between acts, until the London sets were interspersed with Philadelphia and breaks were extended to 20 minutes, allowing the crews a little relaxation and moving towards normal festival changeover times, with little room for error or any unexpected problems.

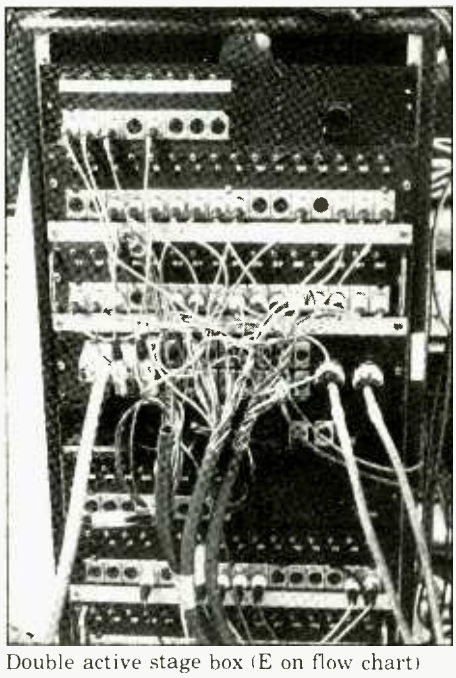
The mic patching system was centred on the revolving stage, which had been divided into three sections to allow the extremely tight changeover schedules.

This made it possible for one band to be playing, the previous act to remove their equipment and the next one to mic up (see **Fig 1**).

The backline satellite stage boxes (ABC) were run under the stage and up through the centre of the stage revolve.

To add to the stage manager's confusion the revolve's direction had to be reversed every three acts so that the multicores didn't become twisted. Even so, at one point one of the three lines did go down, necessitating a sharp switch-round with a spare.

Signals from these boxes plus the front-of-house vocal stage box (D) (as many dedicated lines as possible were kept constant during the show) were run to the double active stage box (E).



Double active stage box (E on flow chart)

In the Hill System the active stage box (F) contains the same front end as the front-of-house mixer, converting incoming signals to very low impedance, unbalanced line level signals which are then run (two signals to a screened pair) to the front-of-house mixers (OP).

Monitor mixer (GH) splits were accessed in the same manner, feeding the line inputs of the two desks. Each input on the active stage box had differential transformerless inputs with screwdriver slot gain control, 30 dB pad and overload peak indication (as the line level input is after the input channel pad mixers).

The line level feeds were then run via the FOH multicores (using BICC-Burdy connectors) out to the mixers and fantailed to the line level inputs.

For the BBC splits, the line level signals were run through stepdown balancing transformers to recreate low impedance balanced line mic levels for the OB vans.

Hill Audio's opinion is that the advantages of line level multi sends—eg less prone to RF pickup—far outweighed the disadvantages needing just one mulitcore in normal concert environments to carry mic signals. Any crosstalk, or so the theory goes, will be less than on stage spillage, the same going for stage return signals, a stereo bandpass to a pair, which are again run at line level.

The stage had been donated from the Bruce Springsteen gigs a few days earlier and, although easily big enough for that venue was extremely cramped for the conditions at the Live Aid concert.

In particular the monitor position was extremely tight necessitating the removal of some of the inner PA stack cabinets so the two monitor mixers could be fitted in. Similarly the backstage area had to be sectioned off and policed very heavily to make sure that all the equipment due to arrive and depart did just that.

Both FOH desks had identical effects racks, offering the choice of AMS *RMX16* reverb, Roland *SDE3000* delay, six Drawmer *DS201* noise gates, two Drawmer comp/limiters, A+D *Compex* limiters, Eventide *910* and *949 Harmonizers*, Roland *SRE555* chorus/echo and Lexicon *244* reverb.

The FOH desks were 32-input Hill *M* series *3*, used in conjunction with 12-channel 'stretch' boards, the first of which doubled as control board for switching between PA mixer 2 and PA mixer 1.

In addition feeds from the BBC and US broadcast signals were brought up here for use with the live videos from the States and as back-up to the live signals from the stage.

Full range sends from the control board were then returned via a Hill 3-way stereo crossover 12 dB/octave slope back to the monitor mix position at line level where they were split right and left and sent to the respective amplifier racks along cross-stage multicores, terminated with CPC bayonet connectors.

Ten-way 1.5 mm multicore cable, again terminated in CPC bayonet connectors, ▷

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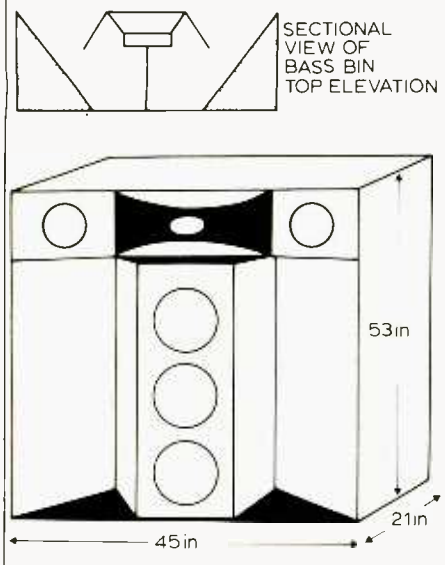
LIVE AID

Fig. 2



were run one per cabinet from each amplifier to each enclosure.

None of the speaker cabinets was crosslinked, a practice which in Hill's opinion reduces, unacceptably, the damping factor.

Hill flying system design

The Hill flying system is based upon the amalgamation of earlier, non-modular, Hill designs. Re-packaged into a single 4-way cabinet (3-way active, HF passive) the resulting enclosure 53 in high, 45 in wide, 21 in deep, has a speaker power handling of 1000 W and can safely be stacked eight or 10 high due to the cabinet strapping (via metal black bars running the length of the cabinets, secured with butterfly bolts on the rear of the boxes).

The bass section contains three ATC 12 in long coil bass speakers which act as both direct radiators for frequencies above 150 Hz and, in folded horn mode, for frequencies below 150 Hz.

It should be noted that the back of the enclosure is left completely open, which does induce peaks around 125 Hz (filtered out on the FOH graphics) and could lead to extraneous cone excursion (see **Fig 2**).

The bass end is crossed over at 350 Hz to a pair of specially modified Tannoy dual-concentrics (strengthened cones and surrounds). These are mounted left and right of the horn flare, in infinite baffle enclosures, handling frequencies up to 1.5 kHz. They are angled to the Emilar compression driver which is mounted on a short Renkus Heinz flare.

The Emilar handles frequencies from 1.5 kHz to 6 kHz and the passive networks in the cabinet bypass HF signals to the Tannoy tweeter units.

When stacking or flying side-by-side, an angle of 7° between cabinets is preferable to avoid inter-stack phasing problems.

At Wembley, 52 cabinets were employed each side—10 powered by Hill *TX1000* 3-channel amplifiers—the remainder by 22 Hill *DX3000* 2-channel amps. *TX1000*s were specifically built for use with this rig, though Hill are gradually converting to the *DX3000* (650 W into 8 Ω per channel).

To improve the quality of the sound, connections to the amplifiers were via a 10-core, 1.5 mm multi-way speaker cable with CPC bayonet connectors to gain a better damping factor, each of the 12 in bass speakers are powered from an individual pair of cores, whilst mid and treble use one pair each.

Monitor system

The desks employed were Hill *M* series *3* boards, 32 into 10 configuration, featuring 12-band input LEDs, 4-band EQ with two sweepable mids and 10 outputs. Line level inputs from the active stage boxes were again used.

The paralleled male and female *XLR*s (for mic signals) are of particular interest, allowing the board to become a central patching point in more orthodox systems.

Outputs from these desks were treated by a combination of Klark-Teknik *DN3030*, and White series *4000* ⅓-octave graphic equalisers which then drove Hill 3-way switchable crossovers (12 dB per octave slope), which in turn fed Hill *TX1000* amplifiers.

These drove the tri-amped wedges, which employed the same driver types as the main PA—two ATC 12 in long coils, Tannoy 10 in dual concentrics and Emilar, hung on Renkus-Heinz flares.

All the wedges were stationed in front of the stage revolve and were then moved into position between sets once the next act's equipment was moved to front stage.

Instead of the more commonly flown side fills, mobile *C3* FOH cabinets mounted on flight cases were more adaptable for multiple use as drum fills, side fills and so on.

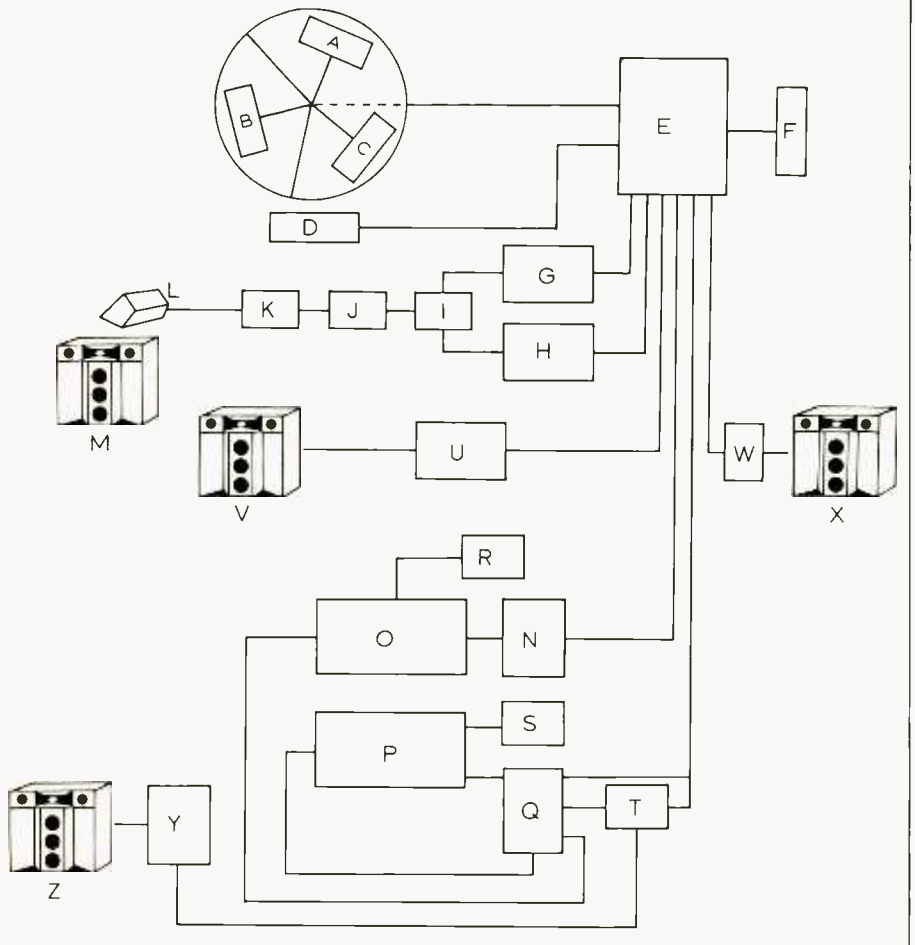
Approach, staging and microphone (LA3)

(MH=Malcolm Hill, MS=Mike Scarfe, RV=Richard Vickers)

MH: When we were first approached, only a few weeks before the event, all we were looking at was a show at Wembley with maybe 10 or 11 acts.

RV: In early June about the time of APRS, wasn't it?

Fig. 1



ABC	Revolve satellite stage boxes
D	Front vocal stage box
E	Double active stage box (mic sends—stage returns)
F	Step down transformer splits for BBC
G	Monitor mixer 1
H	Monitor mixer 2
I	Summing amp
J	Graphics & crossovers
K	Monitor amps
LM	Wedges & sidefills
N	PA2 stretch mixer
O	PA2 front of house mixer
P	PA1 front of house mixer
Q	PA1 stretch/control mixer
R	PA2 effects rack
S	PA1 effects rack
T	FOH graphics & crossover
U	Stage left amps
V	Stage left FOH speakers
W	Stage right amps
X	Stage right FOH speakers
Y	DDL & delay tower amps
Z	Delay tower speakers

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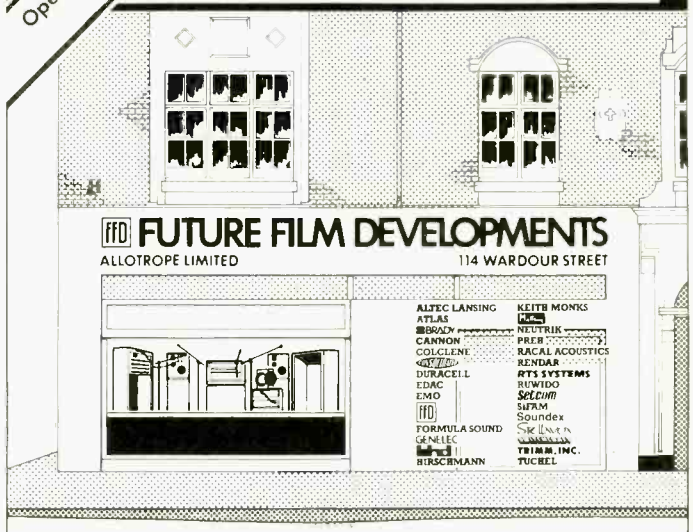

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LIVE AID

MH: That's right. The assumption was: a few bands but mainly personalities getting together—like Sting and Phil Collins ended up doing.

As the thing escalated all the big names who'd been a bit 'maybe-maybe not' saw how big it was going to be, and rang back and said 'certainly we'll do it'; and Bob said, 'Fine, great'. Every day we were getting more people added right up to the last minute. At the end of the day you'd think you'd caught up with things but next morning it had escalated again!

We were down to 10 minute changeovers and they were trying to have people perform in the changeovers—we had great difficulty in explaining that you can't have a changeover and then put someone on to do a slot. So we went on with crazy things like the Boomtown Rats and Adam Ant sharing the stage, trying to cater for both as if they were one band; so Adam could only play one song which wasn't his fault at all.

RV: When it was first announced I wondered whether I'd do it, if I had a PA company. I must say my answer would've probably been no, because if anybody was going to get flak, it'd be the PA company.

MH: If we'd have known at the time what it would be like, I'm not sure what we'd have said—I know I'd have put in a lot of conditions, with hindsight.

It all changed when TV got involved. Originally BBC radio were going to record it, but when BBC TV came in and went bananas over it, it became an international event with satellites and everything.

So the priorities changed from those of a rock gig to those of a TV show—that was the biggest problem. If we'd known that in advance, we wouldn't have had the problems we did.

The situation was basically impossible but we achieved a good standard as far as the punters were concerned. The BBC were in a much worse position than us: their hardware had to be pre-planned and if anything changed it threw them out.

They were attempting an instant mixdown to 21 tracks, so when a band came up and said 'we've got an extra guitarist' and we'd use a spare channel, the BBC couldn't—they were going 'this is my keyboard subgroup and you can't put a guitarist in there'. They had two OB vans with an SSL in each, and although I'm not too sure of the details, it was difficult for them to move anything around.

MS: With 21 tracks it didn't really matter how many channels we used, it was only 21 tracks that the BBC had available.

MH: By the time BBC TV came in, everyone knew how big it would be, so they brought their top camera crews and everyone agreed the visuals were excellent. BBC TV took a mono mix from the radio sound, which was approached in a standard way by a standard *In Concert* team.

So a couple of weeks after we'd agreed we'd do it, I was working with the BBC to the effect that we'd have two sets of backline on a revolving stage.

The way things were going, though, I realised the only way we'd be able to do it was with two completely separate systems so that one could be line checking while the other was performing.

So we had to put a lot of pressure on the BBC—we said 'look, we're going to use two desks and there's no way you'll manage with one', and they kept saying 'get them all to use one drum kit!'

The BBC were very negative about it; in the end I said 'if you don't have two systems like us you won't stand a chance' because we were by now up to 20 complete bands with full line-ups, very particular requirements, and 10 minute changeovers.

RV: How did the two-mixer system work for you with the three-sectioned stage—did this mean boxes had to be moved?

MH: No. We had three sets of stage boxes and three sets of multicore—multicores 1, 2 and 3—and control systems A and B. We started off with A1, B2, 3 went to A, 2 went to B and it worked smoothly like that through the day, although there was a complication. I wanted to go to three systems, one for each stage but we didn't really have room for two monitor desks, let alone three. In the end we had to share the BBC camera's space.

RV: You were actually physically changing sub-snakes?

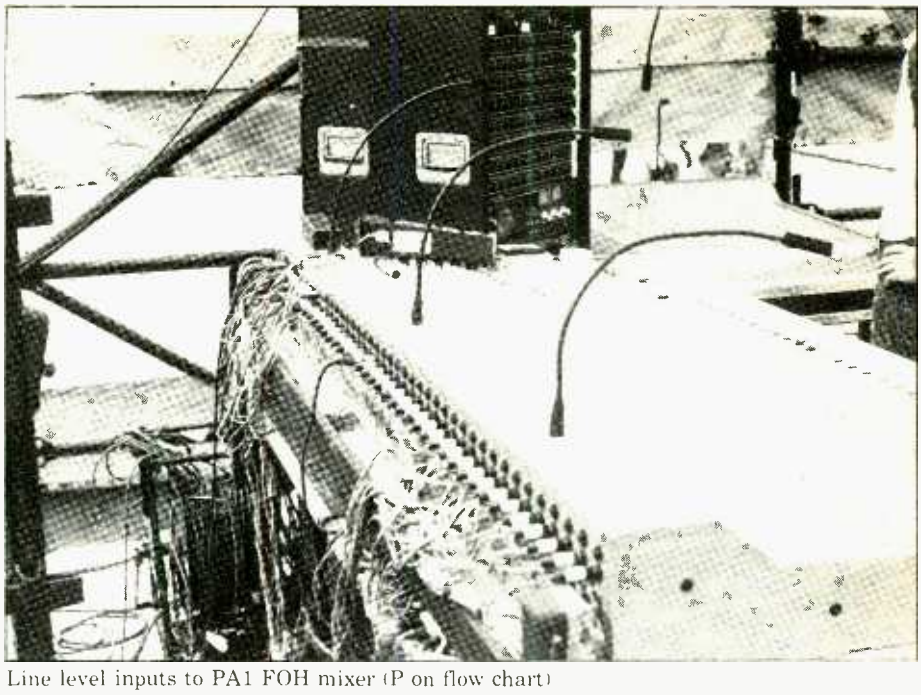
MH: Yes but that was all, and not between sets because after the line check nothing was changed. That's why we went to two systems, so that rather than change multicores just before a set and reset the desks we had the monitor mixer set up and the mics plugged in and all we did was to mechanically rotate the stage.

RV: I heard the budget was £300,000 while for JFK it was $2.5M.

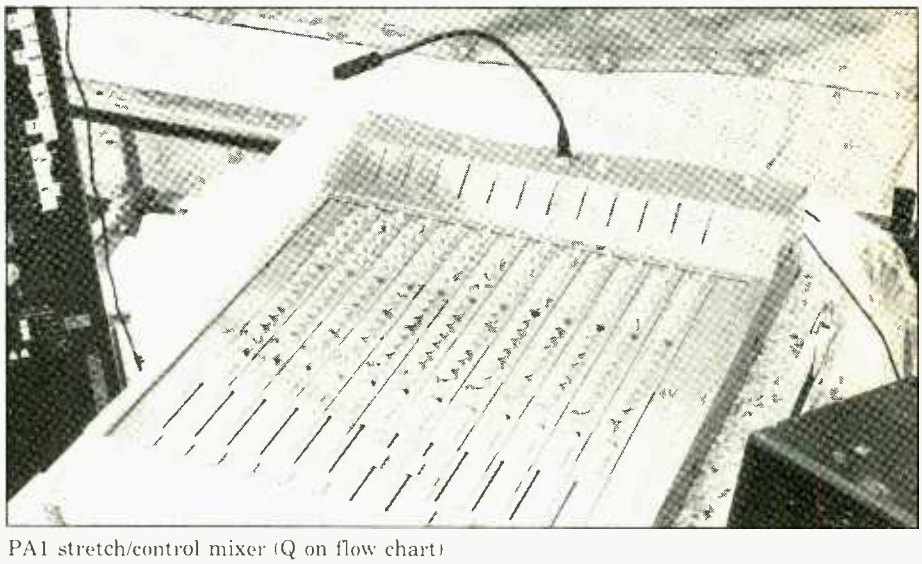
MH: Wembley actually cost under £200,000 to produce. The initial Philadelphia budget I believe was under $2 M and I think they got it down to $1 M, because they got people cheaper. People were under pressure but it was done on a commercial basis and if they had a requirement, they threw money at it.

RV: And because of that every requirement got sorted, probably for the betterment of everything?

MH: Yes, and though they had less time ▷



Line level inputs to PA1 FOH mixer (P on flow chart)



PA1 stretch/control mixer (Q on flow chart)

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LIVE AID

to put it together, when they planned it they were dealing with the event as it actually was.

RV: Plus they could hire specialist crew for any areas they were uncertain about.

MH: Their big advantage was being able to build their own stage with a lot of space, whereas we had to have this ridiculous split stage because we didn't have backstage room for rolling risers. In the States they had rolling risers and the revolving stage split into two, which leaves you with a decent area. When you have a triangular area you can put backline in but they haven't room to perform.

RV: I was surprised that although it was split into three, there was still so much room.

MH: I thought it would be impossible but although people had to cut down their backlines, it worked out. In the States they put the bands and the monitors on the revolve whereas our bands would rotate into position and then instead of just a quick monitor check they had to spend all that time moving keyboards off the revolve, re-adjusting monitors and things like that.

MS: We'd inherited Bruce Springsteen's stage which was a lot smaller than we'd thought about. He had a sunken monitor desk position in the stage, so we had to put the desks in where the PA was supposed to be and cut down the PA to fit in the monitors.

RV: They had a double line of monitors in the States.

MS: One lot came round on the revolve and one was static up front.

MH: If you had some backing singers you could get their monitors sorted out backstage and then revolve into view. We had to arrange them after they were in view and for certain bands that caused major problems—they started before we were ready.

RV: Did you have problems with stage management not catering for your needs?

MH: Well, we finished on time because everyone had to agree to start on time, not because everyone was ready. Everyone had their sets down to 17 minutes, and it got to the point where the BBC said, 'help, we haven't got Bryan Ferry's vocal', yet Bryan walks out on stage and had to spend half the set singing down two mics, one for the BBC and one for us.

MS: If we'd had five more minutes the BBC might have sorted that out and he wouldn't have had to do two thirds of his set needlessly holding two mics.

MH: There were so many departments that the stage manager had to clear, if he got the go-ahead from two lots of people he was off—he told me he said to Ferry 'the BBC haven't got your vocal mic but if we wait a few minutes you might have to shorten your set'.

MS: For someone who's sat behind a mixing desk for many years, it was unbelievable—neither the monitor guy nor the out front mixer had any control over anything; plus we had a ligger problem, not as bad as in the States, but for certain acts there were an awful lot of people all over the monitor desks and in front of them so we couldn't see what was going on.

MH: By the time Elton John came on we couldn't move—we couldn't even get on to the stage, let alone do anything because by that time all the bands had come out to watch. It was insane—and you couldn't shout at anyone because everybody had given their services for free.

MS: It was like a machine you had no control over. Bands simply went on because they had to be on time.

RV: How much did that contribute to Bob Geldof's mic not working?

MH: Not Geldof...but Elton John and McCartney, definitely. McCartney was on before anyone was ready; they slid him through without even any lights on. So instead of the two minute interval, someone said 'that's funny—I can hear a piano going somewhere, who's playing?' One by one—the BBC were last—everyone woke up to the fact that Paul McCartney was playing!

RV: It sounded as if the vocals were coming out of the monitors.

MH: That's right. The BBC were getting it from our monitors through a mic that was set-up for something else.

Sound, delay and paint—problems

MH: There was another problem. We were ready to sound check on Thursday, when we discovered the Wembley house power was 'absolutely nowhere'—there was so much voltage on the neutral line that we just couldn't use it.

So we organised a generator, which took four hours to turn up and when we ran it up we found it had never been properly adjusted and it was giving 260 V on each phase, which would leave us with no surge protection. This was 8 pm; we got hold of the guy who could strip it down and so we lost another couple of hours, getting it right. I spent two hours up to my armpits in diesel oil.

We got it right by 9.55 pm, and had five minutes to push the PA up before we got pounced on so as not to annoy the neighbours—about 30 s of sound check in total on the Thursday.

MS: Then we turned up at 8 am on Friday morning to give it a good sound check—and the generator was gone!

MH: Because our generator was intended as the spare for the lights another one had been brought in and they'd moved ours. By the time they'd brought in the other one and reconnected ours, three hours had gone. We thought we'd be able to catch up and get everything sorted out but we weren't back on stream until 11 am.

MS: By that time, we were into sound-checking the bands, so we never had time to sound-check the PA—just indirectly, through the bands' sound-checks. Fortunately, it was all happening.

MH: The promoter is the person with the authority to change things which he won't do until he can see the problem for himself. So it was always 'there's no need, don't bother' and then, later, 'there's a hole two thirds of the way back'. So when the promoters turned up and asked us how we were doing, we said: 'fine, but we really need a delay tower'. They said 'great', went away, saw the GLC and suddenly we had one, something we weren't supposed to have had. So we rushed up the gear and set it up that night.

Then we were suddenly told we had an 8 pm curfew instead of 10 pm as on Thursday, so we lost the two hours that we thought we'd be able to make up for ▷

Overall frequency response at mixing position	Too much B	LM	HM 6	HF 5	Too little B 3	LM	HM	HF

	More than enough	Sufficient	Not enough
Power rating available:	4	6	1
Volume level allowed:		5	6

	Excellent	Good	OK	Fair	Bad	Awful
Microphone choice:	1	9	1			
Effects choice:	1	8	2			
Desk facilities:	1	2	3	3	2	
Desk EQ:	1	3		5	2	
Desk ease of use:	1		2	5	2	

Arena coverage	Excellent	Good	OK	Fair	Bad	Awful
Mixing position:	1	1	2			
Side stand:		1	2	7	1	
Back stand:	1	1	2	2	5	
Midfield:		1	2	3	5	
Backfield:	1	1		1	8	

	Very helpful	Helpful	Workman-like	Disdainful	Abusive
Help from stagecrew:	3	8			

	Very good	Good	OK	Bad	Awful
Smoothness of changeover:		2	5	2	1

The above table of results represents the opinions of 11 engineers who completed a questionnaire.

In fairness to those who answered the questions, no names are being quoted but it does give an indication of other professionals' opinions.

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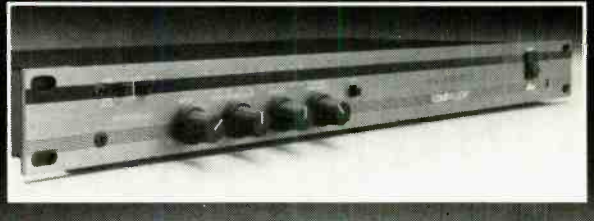

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the generator delay of the morning.

Then we came in early on Saturday to give it a good sound check, and get the delay tower set up properly.

RV: It didn't seem to function very well: it was very quiet and there was some buzzing.

MH: It was very much a last minute thing but we felt better having it than not at all even though it couldn't be set up as we'd wanted it to be.

The delay tower should have been four times the size and had it been that size the criticism of the sound in the second half of the field would have been greatly minimised.

RV: How did you work out the delay timing?

MS: By listening to the snare drum—it's the easiest to pick up—and holding a finger on the control until it sounded right.

MH: I worked it out approximately, then on the actual programme material I listened to hear whether it was too far in front or behind.

MS: Yes, we only had time to get it in sync.

RV: What was used for the delay?

MS: A Klark-Teknik *DN700*.

MH: Another big problem was that Morris Jones and Harvey Goldsmith, the two promoters, had been very involved with putting on U2 at Milton Keynes and Bruce Springsteen at Wembley, so nobody could give Live Aid any serious thought until the week of the event.

So the problems were power, curfews, the sudden approval of a delay tower—I'm not knocking it because it was better than nothing—and the 100 dB Leq. The drapes were the last straw.

MS: We'd been screaming at them for two days to find out what kind of drapes the PA screens were to be made of.

The drapes didn't go up until after we'd finished the sound checks. With that thick, emulsion paint. . . The actual material of the drapes was fine but instead of the normal spraying of artwork they just sloshed on white emulsion.

RV: I watched them doing it out on the pitch.

MH: So on the day, we were pushing the levels 8 dB higher although the mid and bass were lower because of the 100 dB Leq, we were driving the top end flat out. That's something we've never had to do before on our rigs, driving into clip to get the sound through a wall of paint.

MS: If you look at it, the artwork is in the area where you need the top end, in the middle of the stack in the middle of the paint.

RV: So wherever there was bold artwork it was solid paint.

MH: When we drive a large system we have three independent outputs with each side stack split left, middle and right, so we were able to drive the middle block's top end harder than the outer—but even so, projecting through a film of emulsion can't have helped.

The day before, everyone said 'fantastic!'—Paul McCartney's sound guy checked from all around the place and said, 'you've got a fantastic system here; it's clear as a bell everywhere'. And then we get a drape full of emulsion paint and 100 dB Leq. By this time I'd worked for about 72 hours without sleep and I couldn't give it 10 seconds' thought. Over Friday night I'd had to re-write the mic lists which the BBC were screaming for because some people had been so late bringing in their requirements. So personally I was in no fit state when Mike said 'these blokes should be. . .', and I said 'if they're doing it, they're doing it, and there's nothing we can do about it'.

MS: When an event gets to that stage, it's an immovable object and you have neither the time, the energy nor the authority to get something sorted out.

If we'd had that six hours, we could have found the relevant people to sort out the problems. When I saw them painting I realised what was going on and made a point of going to the person responsible who said, bascially, 'the visuals are important for TV and you'll have to deal with it'. I went higher, and they said they'd thin the paint out, which I knew wouldn't make any difference.

MH: Our problem was that we were a number into the show before anyone noticed that the paint was doing anything—and by then it was too late. Although the sound didn't have the top end we'd have wanted, it wasn't a disaster; if it had been, we'd have dropped the drapes. As far as the actual PA equipment was concerned we had one side of one amplifier not working, and one mic dead. Otherwise everything worked perfectly.

The GLC, Brent Council and sound level control

During the evening before, when the PA was finally run up (power had not been available the previous day until 8 pm) there was undoubtedly a feeling of great confidence within the PA company that the system would be more than sufficient for the gig.

However, early on Saturday morning the powers that monitor our health made their presence felt with the installation of a chart recorder monitoring the sound levels throughout the day.

Initially Brent Council decided that after the Springsteen gigs (where, due to recorded levels of 118 dB they'd served writs on both the mixing engineers and the promoters) that for Live Aid the sound pressure level (SPL) must be severely curtailed for the benefit of the 72,000 crowd.

Their initial demand was for a maximum sound pressure level of 96 dB at the mixing booth—about the level of a bus driving past. Luckily, the GLC were a little more understanding and imposed a level of 100 dB at the console (their guidelines advise a level of 96 dB Leq at 50 m from source over four hours continuous music; and 93 dB Leq for eight hours).

Having spoken at length to Mr J Griffiths at the GLC it was undoubtedly not their intention to ruin the day by imposing inadequate sound level controls. He pointed out that he was happy with 100 dB Leq continuously at the mixer position, although the actual level (one band excepted) was kept to 97.5 dB Leq.

Bearing in mind that 3 dB is the equivalent of a doubling in power, there is no reason why the volume should not have been increased sufficiently so that when the audience started clapping with their favourite act they could still have heard them.

When asked how sound companies should overcome the problem of midfield and backfield dead spots he enthusiastically endorsed the use of delay towers.

He was surprised that more companies did not employ them and that sound companies and promoters did not contact the GLC in advance of such concerts to achieve the best compromise possible for sound levels against crowd coverage.

As already mentioned Hill Audio did add a small delay tower to the mix position but were unable to use it to its full potential, although they'd advocated more extensive use of delay towers during earlier negotiations with the promoters.

Full marks must be awarded to Hill Audio for their brave decision to do the gig. Faced with the choice, how would you react knowing that if the sound was perfect and no mistakes were made the most praise possible would be: 'Well, at least the PA worked'; if, however anything went wrong the PA company would catch all the flak?

In Philadelphia, although the artists gave their services for nothing, Clair Brothers PA, the lighting company and staging and video companies were paid. The US budget was around $2M; the UK budget was set at £300,000 and actually came in at around £100,000.

It's very hard to yell at someone when their services are for free.

At the same time, why weren't the GLC contacted earlier; why was there no liaison between the PA company and the people producing the PA screens (which were painted with white emulsion—surely one of the best reflectors of sound)?

Proper live checks should have accounted for Geldof's and McCartney's mics not working; more positive stage management under the direction of the PA company could well have led to these problems being overcome a lot faster than they actually were.

Whose fault was it that two 200-A trips went out in a Wembley AC substation at the start of The Who's set, taking with them the TV and video power; and why was there no greater backup? Why was the SPL unnecessarily held back 3 dB which would have given that much more dynamic range to the sound?

It was a day of great expectations: even the Prince and Princess of Wales decided it should be supported by their personal presence, and in the main those hopes were met or exceeded. That this event should have happened at all is a quite remarkable achievement by all involved.

The number of mistakes was remarkably small when one considers how many things could have gone disastrously wrong.

Perhaps the best description of the day was a message taped to a splitter box which read: "To aunty—feed the world". Well done to all.□

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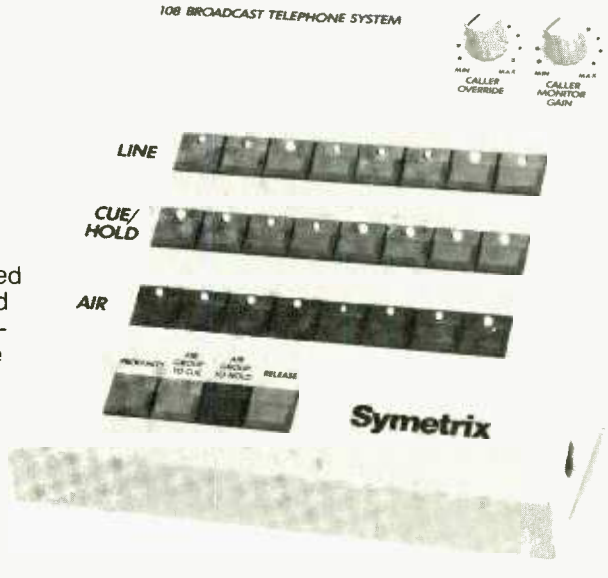

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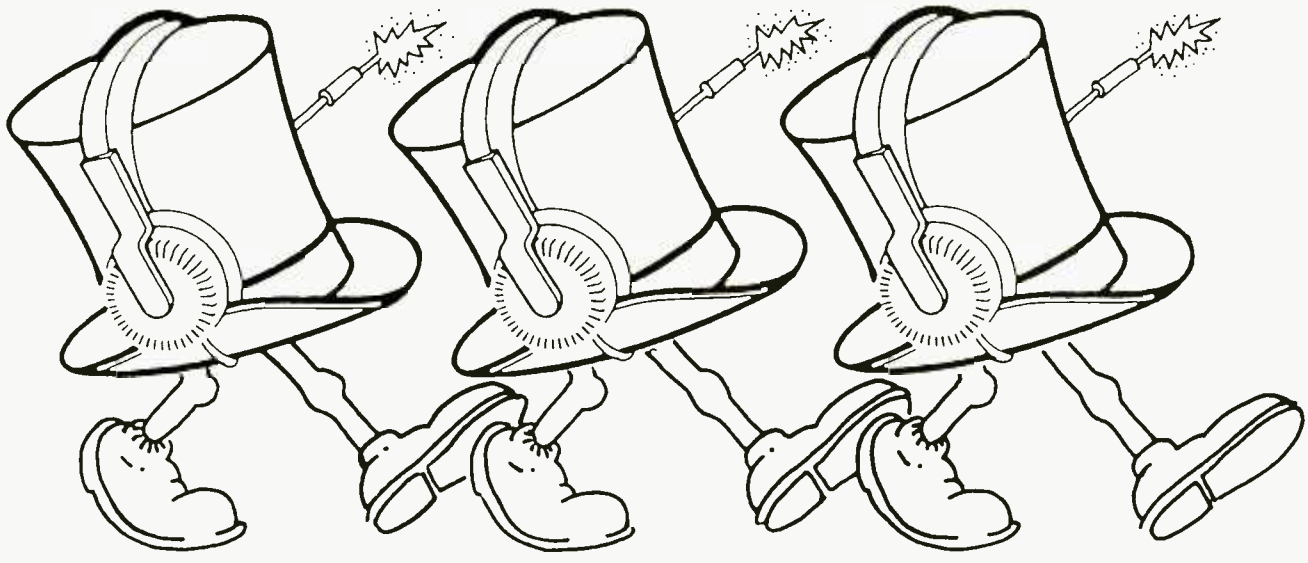

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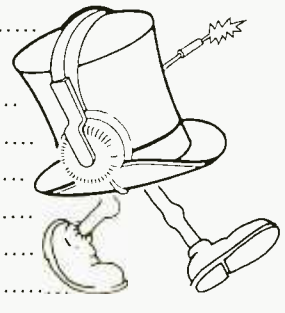

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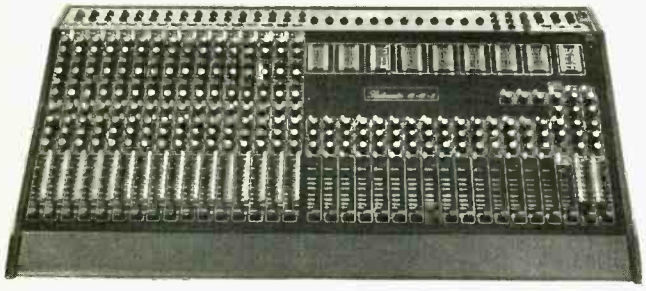
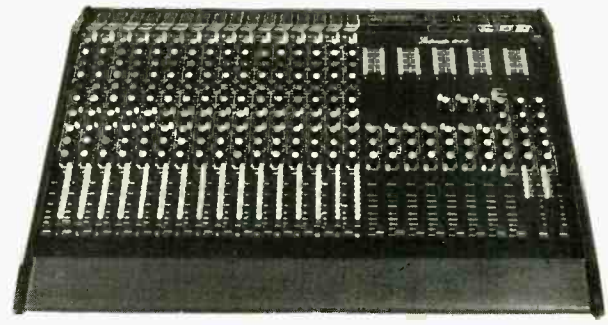
16-16-2



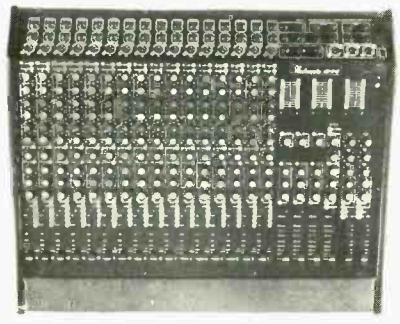
The 16/16/2 is designed to complement budget 16-track recorders. It features its own external P.S.U. which can supply even a fully expanded 16/16/2 (a 32/16/2!). All mic. channels have 48V Phantom Power, parametric E.Q. network, and 3 auxiliary sends. Full 16 channel monitoring is included in the 16/16/2 package. 12 segment 2 colour bargraphs are fitted to the 16 sub-mix stages and the master output which is also fitted with 3 band E.Q. As well as optional expander modules for the mic. channels, a double patch bay is available.

16-8-2



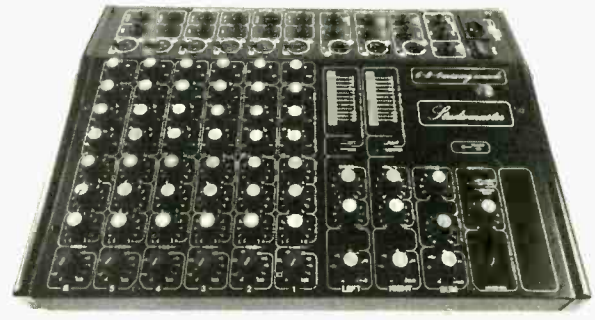
The 16/8/2 is compatible with 8-track recorders and has all the versatility of the 16/16/2, like optional expander modules for the mic. channels (an extra 16 mic. channels may be fitted without altering the unit's P.S.U.) and a double patch bay. Mic. channels feature 48V Phantom Power, parametric E.Q. network, 3 auxiliary sends and 90mm faders. Full monitor and foldback systems are included. Master outputs have 3-band E.Q. and 2 colour 12 segment bargraphs. These bargraphs are also fitted to the 8 sub-mix stages. Applications for the 16/8/2 include small 8-track studio mixing and live sound reinforcement.

16-4-2



The 16/4/2 is the mixer that the 16/8/2 and 16/16/2 developed from and consequently contains all their superb features. It is expandable to 32/4/2 on its existing P.S.U. and a patch bay is also available. Mic. channels have parametric E.Q. network, 48V Phantom Power, 3 auxiliary sends and 90mm faders. Full monitor and foldback systems, 3-band E.Q. on the master outputs and 2 colour 12 segment bargraphs are all supplied on the 16/4/2. Usec of this mixer include live sound reinforcement and for use with 4 track recorders in small studios.

6-2-1



The STUDIOMASTER 6-2-1 mixing console offers features and performance normally obtainable from mixers costing twice the price. Mic. channels feature three band e.q., effects and monitor sends as well as the usual gain and pan controls. 2 colour, 12 segment bargraphs allow monitoring of channels, auxiliaries and both stereo and mono sum outputs. This outstanding specification makes the 6-2-1 ideal for sub-mixing, P.A. and recording.

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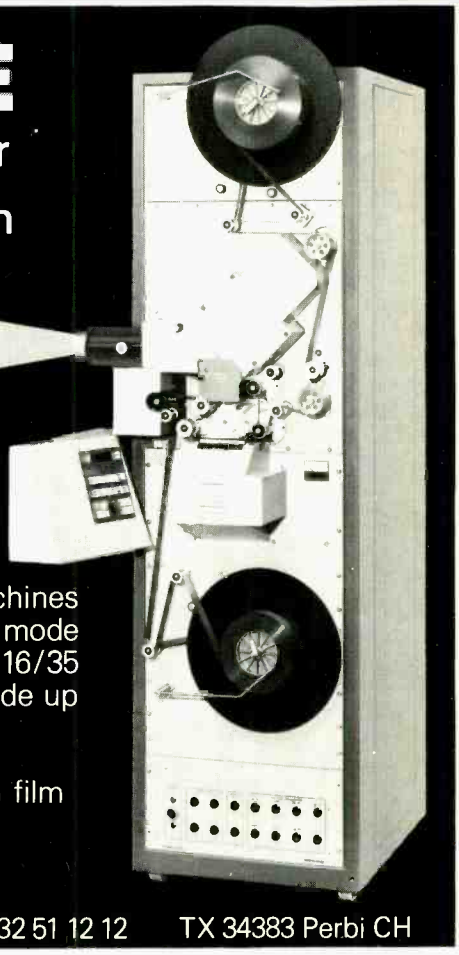

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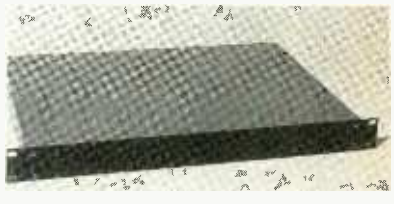

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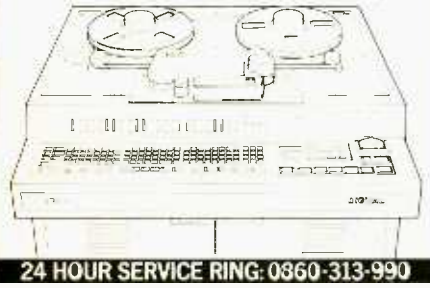

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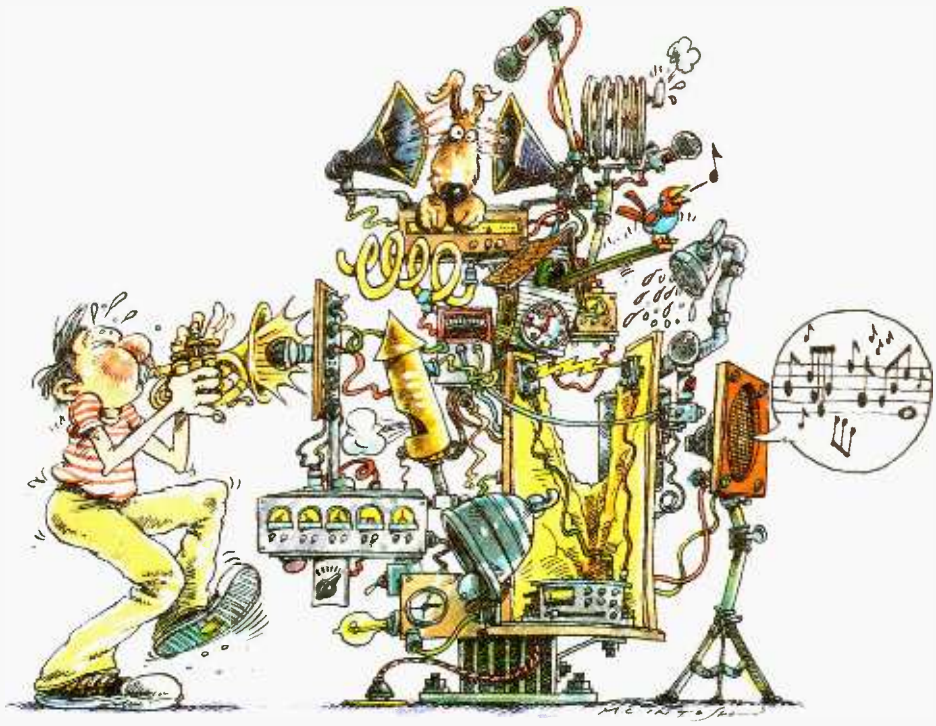

HARRY, THERE *HAS* TO BE AN EASIER WAY.

MEMO:

Listen, Harry, I *know* you keep saying we need "creative sound processing" to stay competitive. I *loved* the way you hung the mikes inside a 24-gallon aquarium for the Fred's Fish Food jingle (too bad Fred's singing goldfish dropped dead, though). And your reverse hyperspatial time-delay effects for the "H.G. Wells Concerto" were *incredibly brilliant*. Real award-winning stuff.

But I gotta tell you: these complicated setups of yours are driving me crazy. First I spend *all day* rigging equipment. Then I go *all night* de-bugging the effects so they sound right.

Harry, there just *has* to be an easier way to produce interesting acoustic environments.

And I think I found it: Ursa Major's new *StarGate 626*. The 626 puts just about every effect we need—digital reverb, delays, and special effects—inside *one box* with *one* set of controls. The reverb programs all sound *absolutely professional* (this is an Ursa Major unit, after all)—but the 626 goes way beyond straight reverb. There's mono and stereo delay lines, for example, an effect called "reverse reverb," a stereoized dual echo, and the brightest plate simulation I've ever heard. Plus a lot more—16 pre-tuned "rooms" in all, with 256 possible *variations* on each effect.

Anyway, Harry, I want you to cancel everything on your calendar tomorrow morning. I'm taking you to hear a *live demo* of the 626. Don't forget the checkbook, either. We *need* this thing—and the sooner the better.

Regards,

Ozzie

THE STARGATE 626

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