

November 1984

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STUDIO SOUND

AND BROADCAST ENGINEERING



A LINK HOUSE PUBLICATION



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Soundcraft Automation system makes Series 2400 even more versatile.

Richard Elen of Studic Sound recently described the Series 2400 as "a very impressive console that is a pleasure to use."* Which is praise indeed.

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* Studio Sound – September 1983. Reprints available.

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REGULARS

- 5** **Editorial:** To improve control room acoustics some equipment can be annexed and remotely controlled, but this leaves us with the ever expanding console
- 30** **Diary:** Are you DEAF?... Woodgate consultancy...Forthcoming events... Address changes... Contracts... Agencies
- 32** **New products:** Audio + Design new products... Protech Audio amps... Denon CD test disc... Digital editing for F1 PCM and CPDM... Audio Engineering radio microphones... Applied Microsystems I-CON... Drawmer vacuum tube compressor... IAC two-in-one door
- 60** **Studiofile:** Surrey Sound Studios, Surrey... Windmill Lane Studios, Dublin
- 66** **Business:** Undercover... Working DSP... Canned response. By Barry Fox

SPECIAL FEATURES

- 46** **Mixing consoles:** As the choice of desks on the market widens Keith Spencer-Allen reports on the latest available models



- 70** **Ergonomic aspects of mixing console design:** With so many different requirements and innovations Gerard Paul Hodgkinson believes it may be time to study the console operator in greater depth

FEATURES

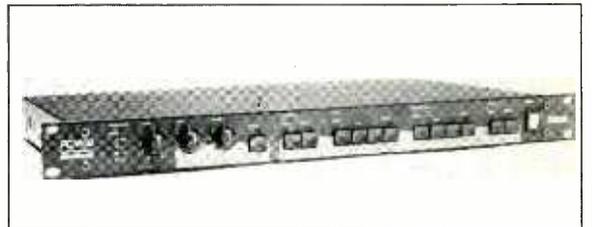
- 36** **TFA with Dylan at Wembley:** Richard Vickers and Paul Jackson were at Wembley Stadium in London recently during the Bob Dylan concerts to study the PA set up



- 54** **The E-V story:** The history of long standing microphone manufacturer Electro-Voice by Robert Bolles
- 76** **In perspective:** Experts and the Compact Disc by Martin Polon in the USA

REVIEWS

- 80** **Lexicon PCM 60:** A user report by Keith Spencer-Allen on a new digital reverb



- 82** **Mini reference monitors:** Following Hugh Ford's technical evaluation of seven pairs of mini monitors last month, we report on the findings of a listening panel
- 86** **Soundtracs CM4400:** The first of our technical mixer reviews by Hugh Ford

EDITORIAL

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A LINK HOUSE
PUBLICATION

Publisher and consultant to
APRS for Studio Sound's
Producer's Guide to APRS
Members 1984/85

November 1984 Number 11
Volume 26 ISSN 0133-5944

Graham Gouldman has recorded in the world's best studios.

(That's why he recorded his latest album at home)

Graham Gouldman, as a leading member of 10cc, has recorded in many world-famous studios, and certainly knows what makes a good recording, and also when he's achieved one. "But," he says, "I've always felt that the most creative recording environment is at home, in one's own space and in one's own time."

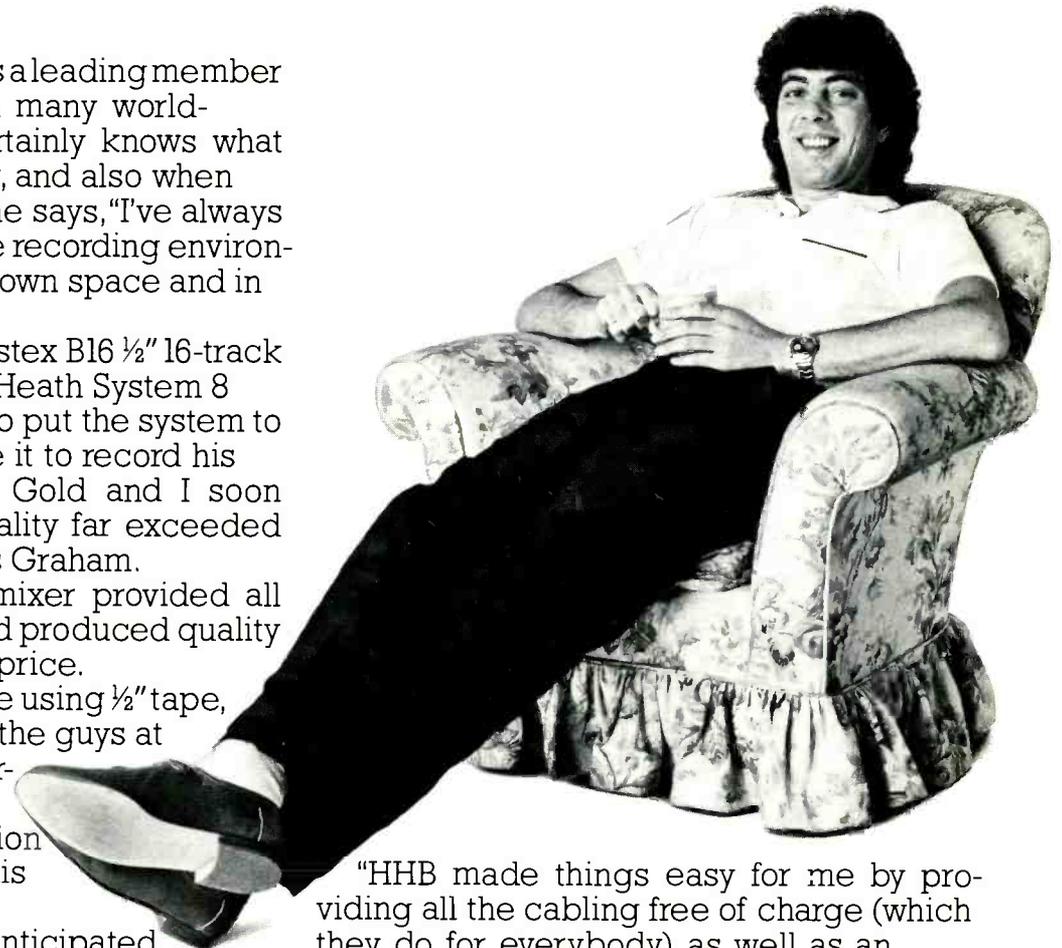
When he bought a Fostex B16 ½" 16-track recorder and an Allen & Heath System 8 16/16 mixer, he decided to put the system to the ultimate test and use it to record his current album. "Andrew Gold and I soon found that the sound quality far exceeded our wildest dreams," says Graham.

"The Allen & Heath mixer provided all the facilities I needed and produced quality to a standard beyond its price.

The Fostex B16, despite using ½" tape, was silent and accurate; the guys at Fostex really have mastered head technology, and the Dolby 'C' noise reduction really works a treat. All this for around £5000?!"

"For mixdown, we had anticipated having to transfer to 24-track—but when the time came, both Andrew and I agreed that the B16 sounded better.

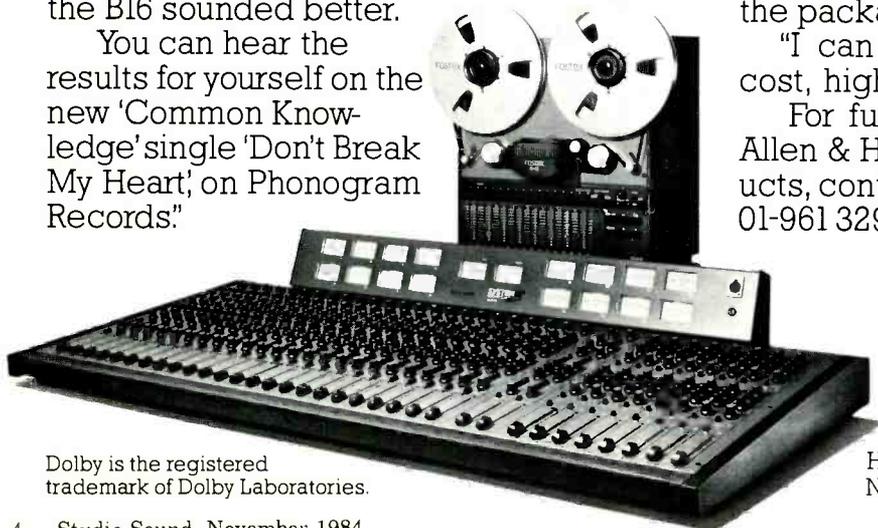
You can hear the results for yourself on the new 'Common Knowledge' single 'Don't Break My Heart,' on Phonogram Records."



"HHB made things easy for me by providing all the cabling free of charge (which they do for everybody), as well as an informative demonstration, sound advice and a reliable back-up service to complete the package."

"I can thoroughly recommend this low-cost, high-performance multitrack system."

For further details about Fostex and Allen & Heath, and all other recording products, contact Martin Westwood by phoning 01-961 3295.



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EDITORIAL

EDITORIAL

This month's comment from Keith Spencer-Allen

Little or large—the soft choice?

In recent conversations with a number of well known studio designers, the topic of equipment within the control room and its effect upon the room's acoustics has come to the fore. It is a problem that has grown in magnitude as, progressively, the other aspects of acoustic design have been brought under the designer's control. There are of course certain items that can be removed from the control room with no problems such as power supplies, computers, power amplifiers, etc, although this alone would have little effect other than removing fan noise. The current interest is in removing tape machines for both acoustic and noise reasons. The effects and signal processor racks have to stay but they are fairly easy to deal with acoustically. The biggest challenge is a large mixing console and outside a little creative crystal ball gazing there seems little immediate possibility of removing that.

During the mid '70s there was a 'groundswell' movement against the increasing size of mixing consoles. Up until the introduction of 24-track, the average mixing console had about 18 or 20 channels plus a few dedicated returns for the echo plates. Based on a 2 in channel width, with about 2 ft for the master section, group sends and monitor section there was little need for a console to exceed 6 ft in length. Twenty-four track increased the minimum channel size to 28. This increase led to the popularisation of the in-line concept for space saving reasons.

Apart from in-line concepts there were other designs, mainly from custom manufacturers where the ergonomic requirements were considered. This appears to have now been almost forgotten—when was the last time you saw a new wrap-a-round console or even a split L? For the most, I think it was partly that it was often impossible for the producer to sit near the engineer in such 'ergonomic designs' and partly the proliferation of automation systems that meant that *all* the channel faders did not have to be within reach *all* the time, that has led to their disappearance.

Any hope of a move towards compact consoles is I think now completely lost in the combined influences of synchronised multitracks and greater amounts of channel

signal processing. Increasing the size of the console to include 4- or 5-band parametric EQ on each channel and in some cases noise gate/compressor/limiter on each as well, does reduce the amount of such outboard gear that needs to be within console-bound reach and leaves the space for processors such as delay lines, flangers, etc. With the decreasing cost of chips suitable for delays, how long will it be before a delay line becomes standard per channel to allow effects and 'panning' within a stereo image using a method other than level? This will of course create even greater pressures to increase console size. I see the standard analogue audio console becoming even more of a mixer-with-integral-processing as this will actually become the most cost effective way of achieving the degree of processing being required. The only problem is that an increase in sophistication that leads to an increase in console size is bad news acoustically.

In the past 18 months there have been quite considerable developments within digital processing and control that allow assignability of facilities as they are needed (and hence a significant chance to reduce console size). To contain comparable facilities a standard analogue console channel would have to be 5 ft long with its own patchfield. There is something very aesthetically pleasing about a large console and I feel that until the advantages of reducing console size using some form of assignability become blatantly obvious, I don't believe that we will see any form of 'groundswell' opinion heading in that direction. It will have to be a case of show us the advantages and we will consider it.

So where does this leave us? We have a console that is increasing in size and becoming even more of a 'studio processing system' as more and more external functions are taken on board; we have the studio designer who is trying to remove the equipment from the control room as it reduces his possibilities of improving the acoustic; and finally no positive requirement from the equipment purchasers for a way out of this contradiction in any direction.

An acoustically soft console anyone?

STUDIO SOUND

AND BROADCAST ENGINEERING

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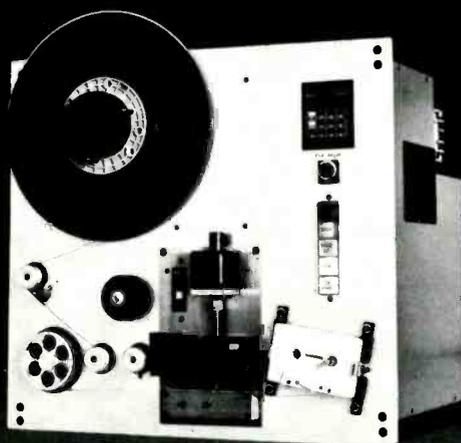
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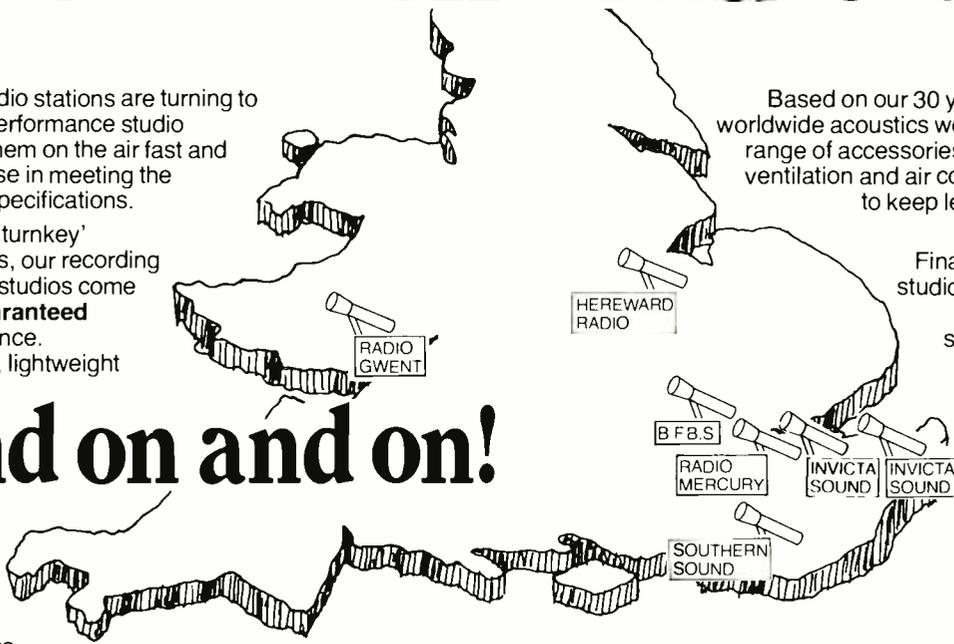
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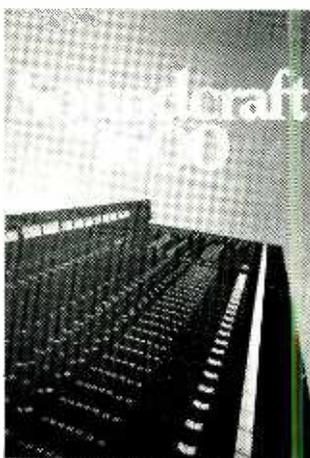
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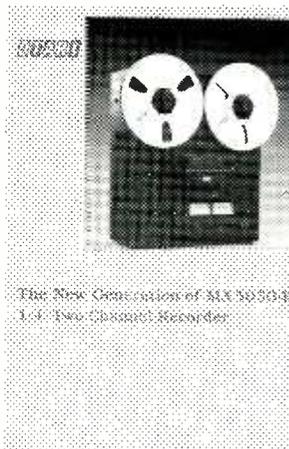
Various module options are readily available to customise the console to exact requirements. And finally the highly acclaimed 1600 Series, which cater for up to twenty four track.

In combination with Soundcraft recorders, we offer Producer packages. Matched

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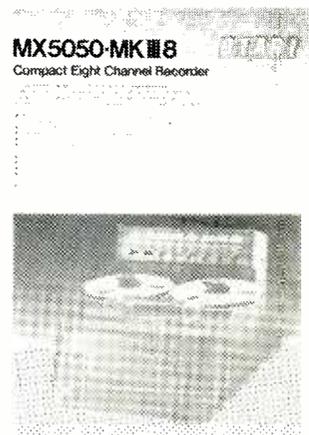
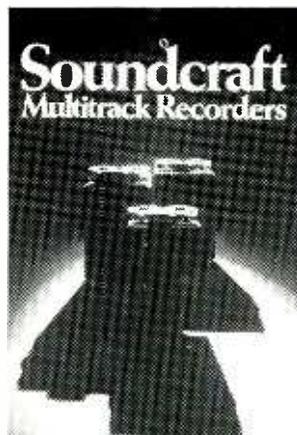
Both companies have recently upgraded the basic transport for their recorders, and it's worthwhile comparing bot specs and prices closely.



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TRAD

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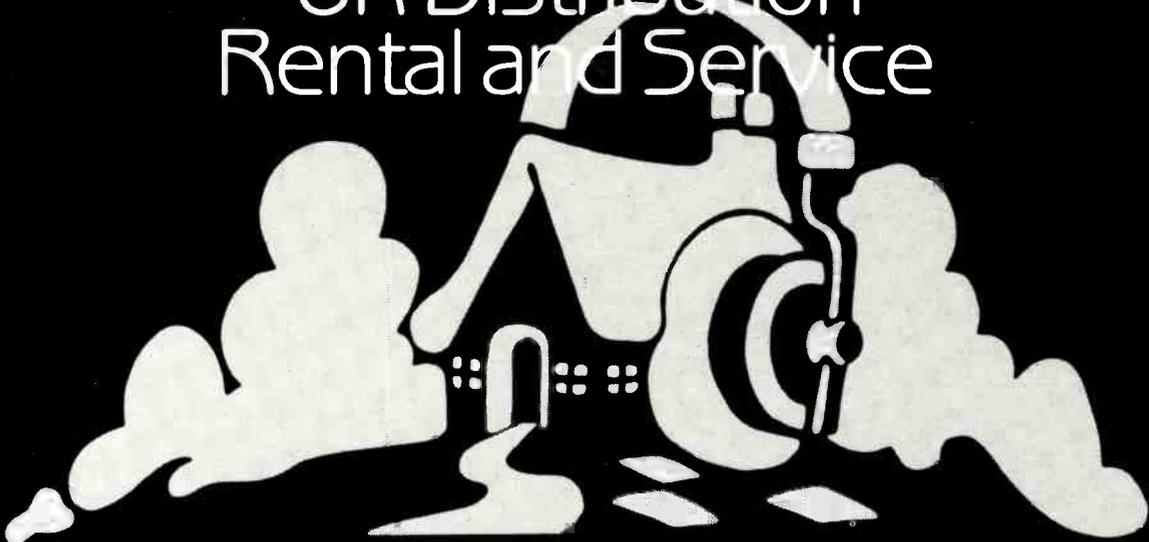
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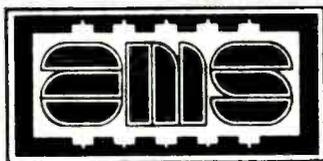
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- ★ Computer control mute input

The S30 Expander/Gate module sets a new standard in flexibility and quality. This module offers precise SLOPE control from 1:1 through the expander range (1:1.2 to 1:3) into the GATING range 1:4 (soft) to 1:20 (hard).

The RANGE control, whilst being manually set, will also vary automatically with the slope selected, according to the theoretical maximum for that RATIO. In the GATING modes a maximum of 60dB attenuation will be possible reducing to some 12dB on a slope of 1:1.2. The THRESHOLD can be varied from +12dBm down to -50dBm. In addition the SIDE-CHAIN can be pre-emphasised by up to 12dB in the HF or LF.

The ATTACK time has three switched positions giving 0.01ms(F), 5ms(M), and 40ms(S). The RELEASE time has a unique anti-log auto mode which speeds up as attenuation increases. The standard RELEASE ranges from 25ms to 4 seconds and incorporates hold facility which can be varied from out to 2 sec.

EXPANDER attenuation is indicated on a 60dB green bargraph with the first 10dB shown in single steps. The second ten segments working in 5dB steps.

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- ★ Ratios 1:1–20:1 (continuously variable)
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The S31 Compressor/Limiter is a dual function unity gain module which incorporates several new features.

A separate feed-back PEAK LIMITER can be moved by an indexed 20 position pot, over a range of 20dB from 0dBm to +20dBm. The Limiter has an auto attack and release function and operation is indicated by a single red led.

The feed forward compressor has linear RATIOS that can be continuously varied from 1:1 to 20:1. The THRESHOLD is an indexed 20 position pot and can be operated from +12dBm down to -50dBm (ideal for very soft slopes, 1:2.1 etc). RELEASE time can be switched to a LOG or LIN response. ATTACK time can be varied by a three position switch: (.03ms(F); 2.5ms(M); 25ms(S)).

MAKE-UP gain is a 20 position indexed pot which will compensate for gain reduction from unity to 30dB of gain. The SYSTEM can be switched IN or OUT as well as the side-chain (SC) being routed to an external equaliser. Gain reduction is indicated by a twenty segment orange led column with a range of indication from 0–60dB. Other features include a MASTER/SLAVE option which is switched on-board but with status indicated by front panel leds. This allows any one unit's MAKE-UP GAIN control to vary several units that are linked to it, thus simplifying stereo or four-channel operation. Control volt linkage for stereo operation is achieved by selecting STEREO link on the board.



These latest modules up date what was the first comprehensive modular signal processing system. SCAMP sets the standard that others emulate.

Other modules in the SCAMP range include: Gates, Compressors, Equalisers, Dynamic Noise Filters, Pan Effects, Auto Double Track and Time Shape modules, De-Esser, Distribution Amplifiers, Microphone Pre-Amp, Jack Bay, Power Supply and a VCA module.

Full details are available from your nearest SCAMP distributor.

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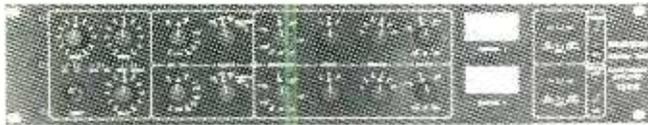


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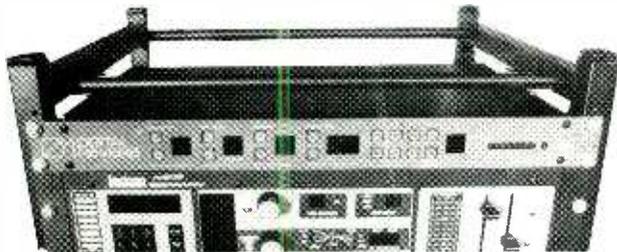
Top of our list of the latest rack technology is a compressor that uses valves

There is little doubt in the minds of many engineers that vacuum tubes possess a unique sound quality and there is technical evidence to support this belief. Such equipment is said to have a 'warmer' more 'alive' sound. The Drawmer 1960 is a dual compressor amplifier, using vacuum tubes in conjunction with semiconductors. Features include 'soft knee' characteristic, variable threshold and switchable attack release. Equalisation is provided.

Drawmer already lead in dynamic control with their conventional products, this new device is already in great demand. Full range available.

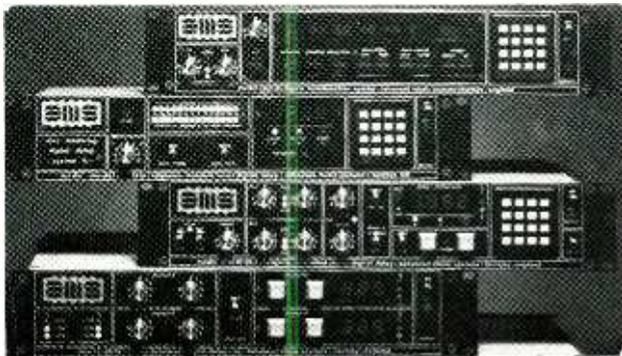


Reverb in a rack from MXR. The Ø1 digital reverb is still the price leader for stereo space without side effects. Programmable pre-delay, decay, and damping plus nine factory set simulations ranging from a tight plate sound to a large hall. About the only digital reverb at the moment on sensible delivery. All MXR studio products available. Normally from stock.



Short term digital recording is the most desirable effect in the studio today.

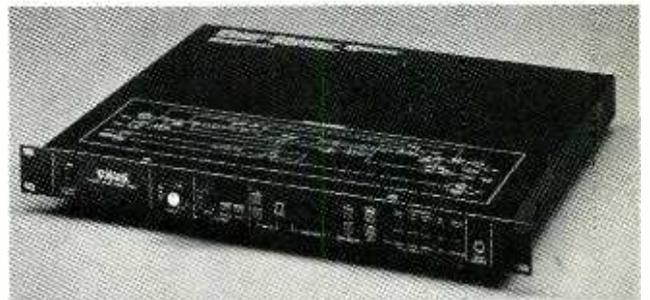
The AMS system is the most advanced product in the market featuring modular design, full loop editing and modulation for all the popular effects. We are South of England distributors for AMS. Call us for a demonstration of their studio reverb.



Stereo from Mono The effect is a generation beyond simple left/right, bass/treble splitting. True comb filtering with variable modulation and chorus effects bring stereo spread and sparkle to any source. An ingenious device from Studio Technologies in the States. Demo tape available on request.



Computer controlled delay MIDI is upon us, and this new Yamaha product shows just how far the music manufacturers have advanced. Fully programmable obviously, with up to a second delay at 18kHz bandwidth. Each of its 16 memory banks can be remotely selected from a MIDI keyboard or other MIDI equipment. Stocks expected in October.



Introducing Stargate Another addition to our very wide range of reverb supply. Wide range of programmable parameters with full simultaneous display of settings. (Engineers who are already familiar with plate or spring reverbs will find the Stargate especially easy to operate. Demo on request.



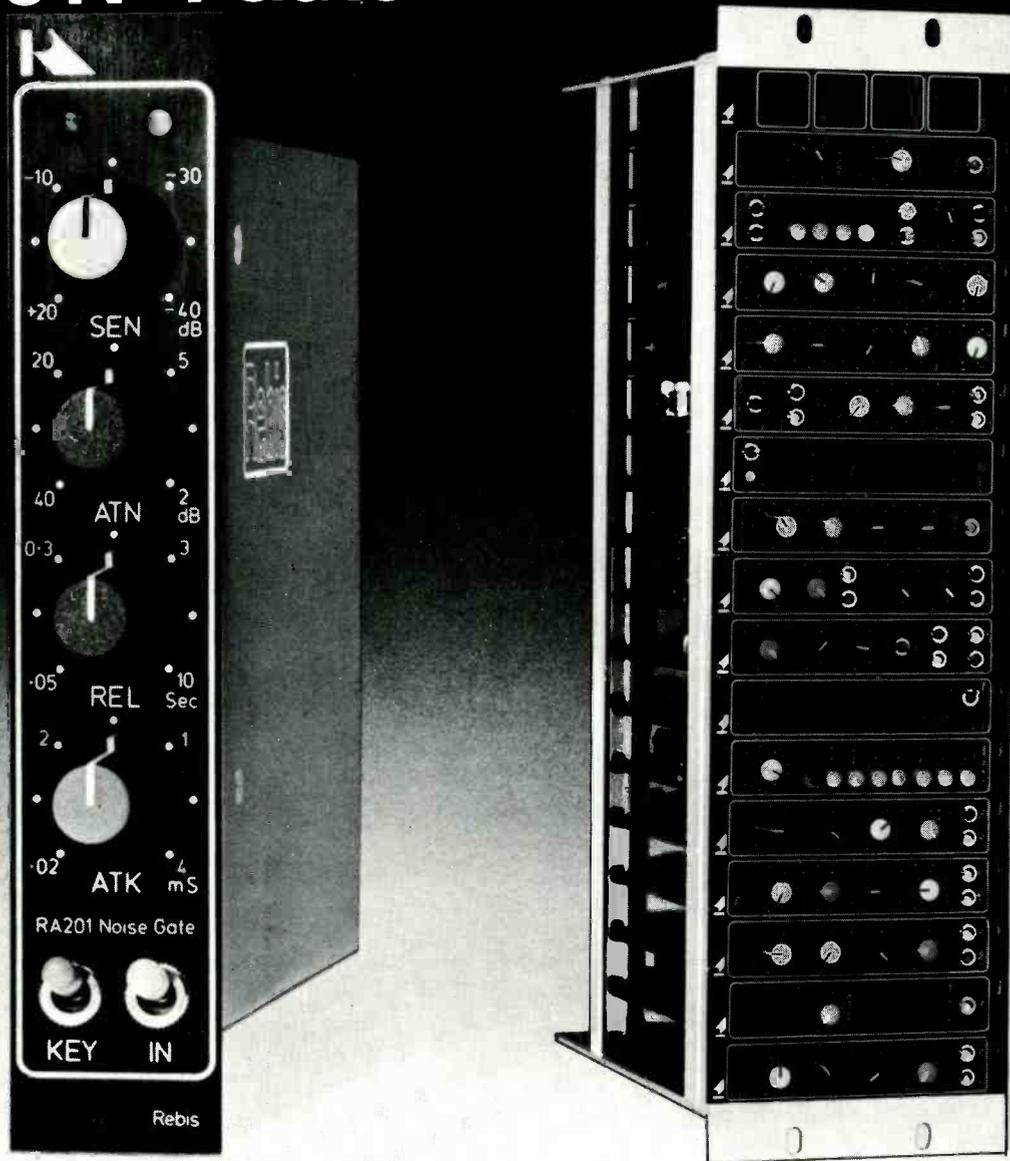
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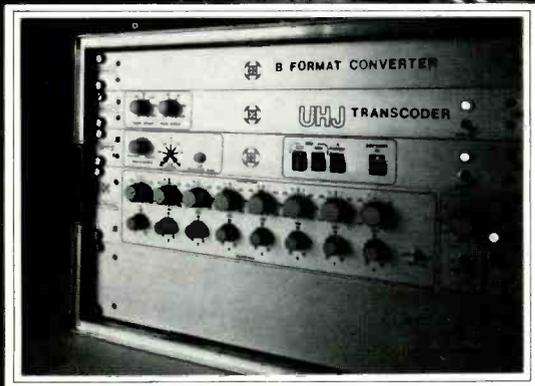
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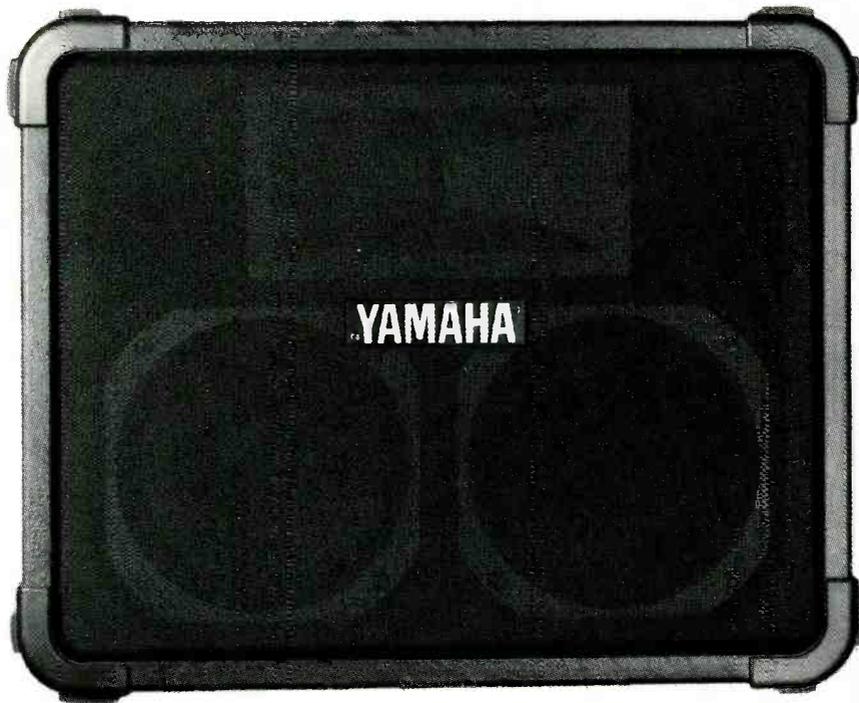
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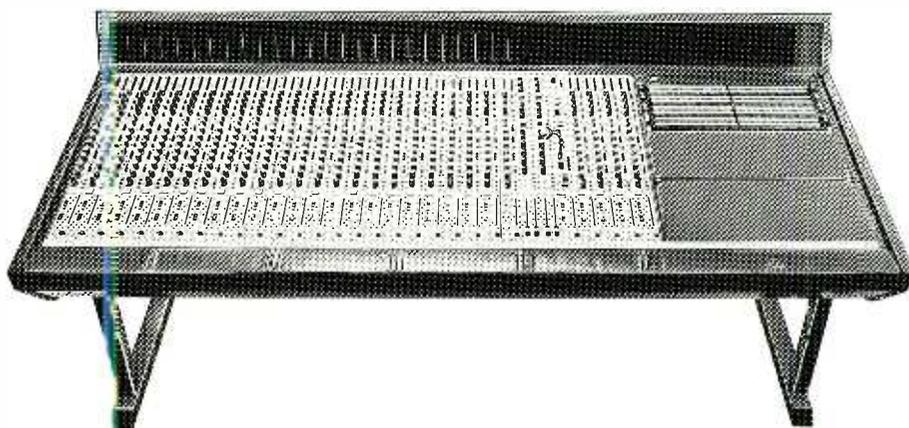
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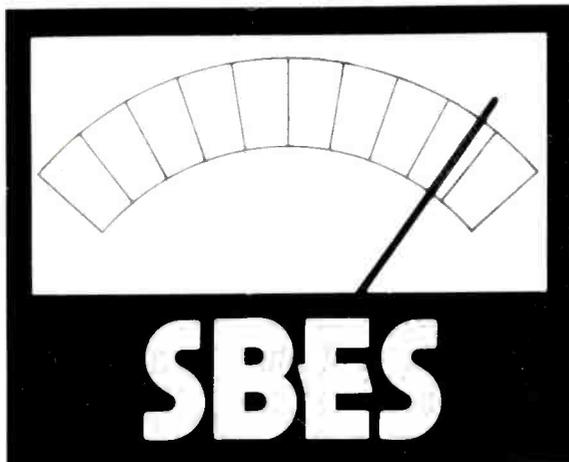
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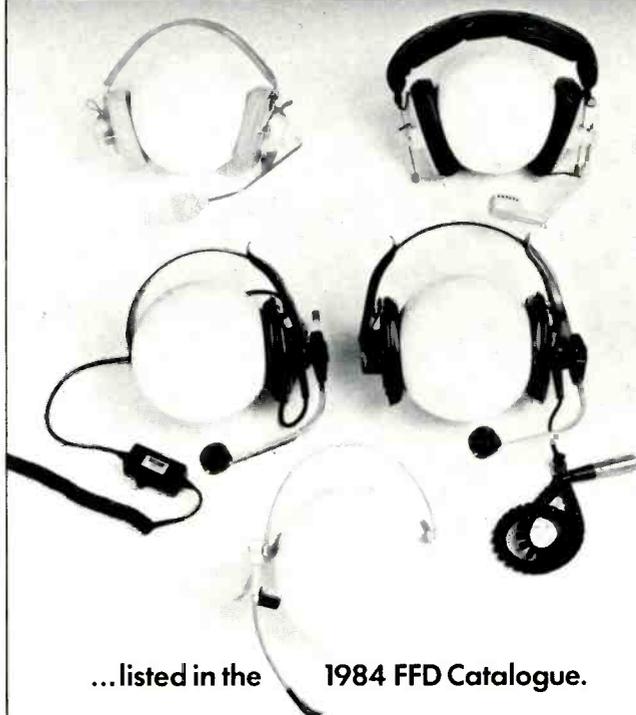
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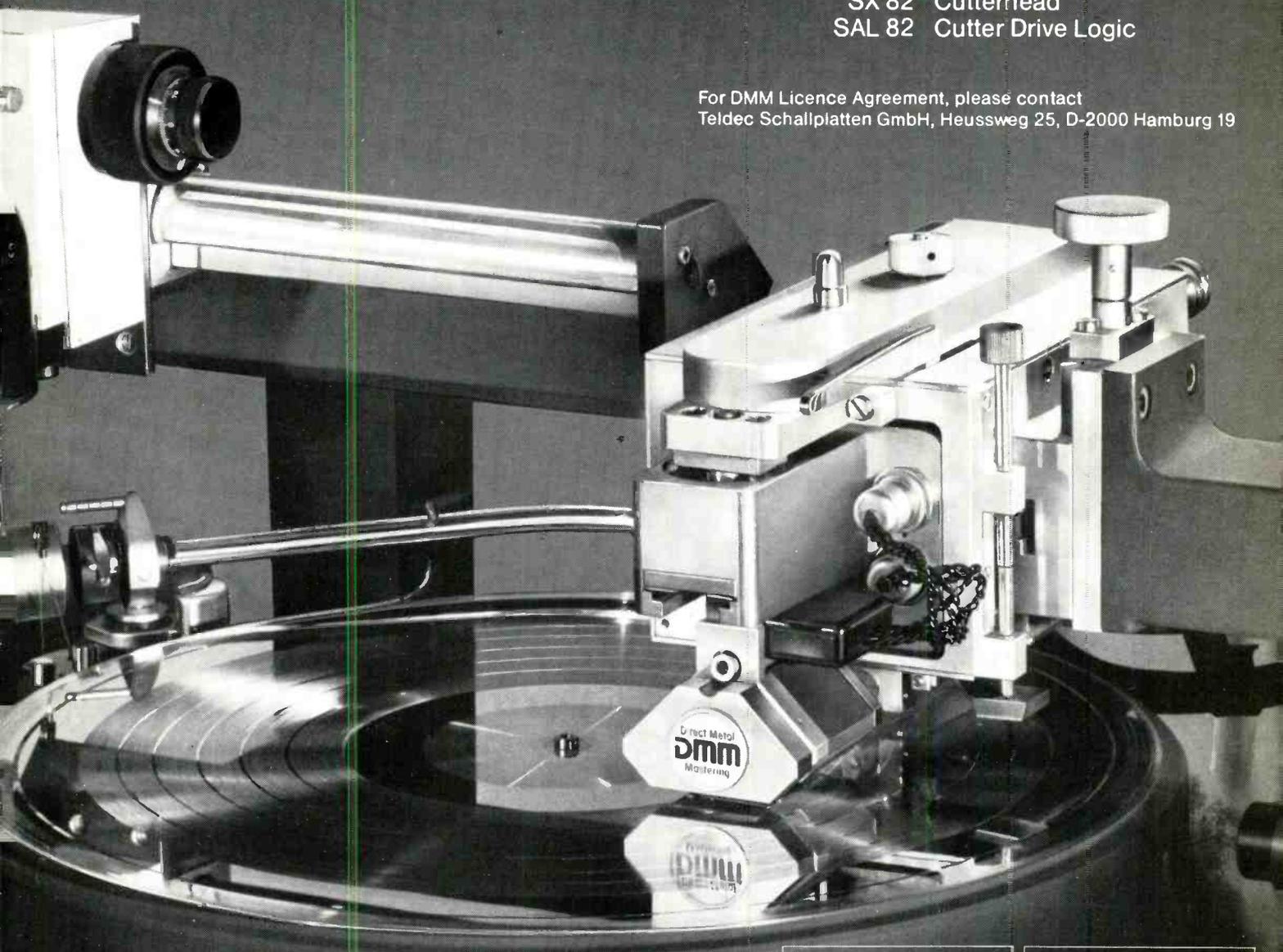
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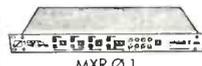
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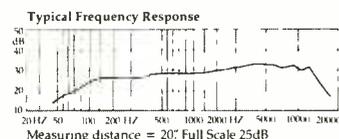
M-1 Miniature System

A whole new approach to microphony. The fingertip-sized condenser element combines ruler-flat response with ultra-high spl capability to handle the most difficult tasks. A wide range of optional accessories extend the M-1's versatility.



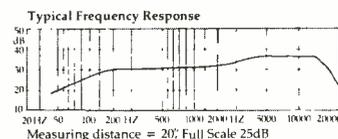
D-1 Dynamic Microphone

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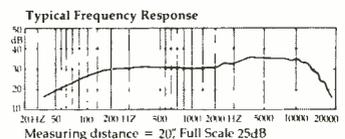
D-2 Dynamic Microphone

The satisfying heft of the D-2's satin gunmetal case and the smooth, seductive sound it lends to vocals place it a step above other dynamic mics. Its low harmonic distortion and high spl capability tell part of the story—but specs alone can't convey the D-2's natural, well-balanced, exceptionally musical sound quality.



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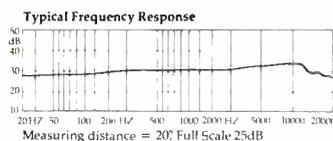


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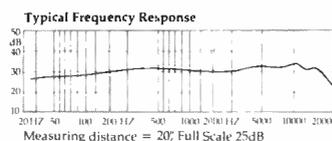
P-1 Condenser Microphone

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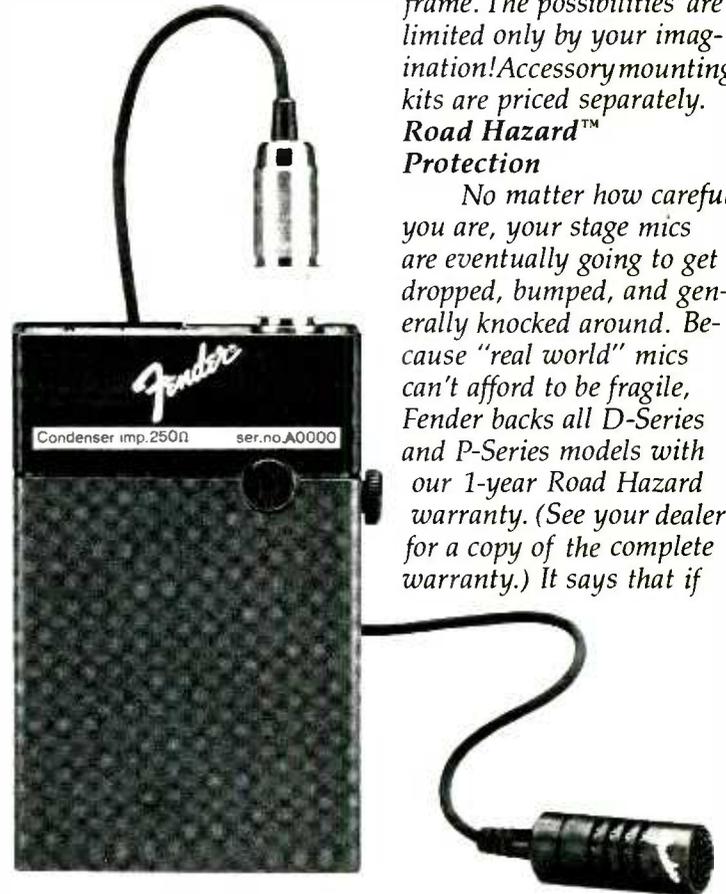
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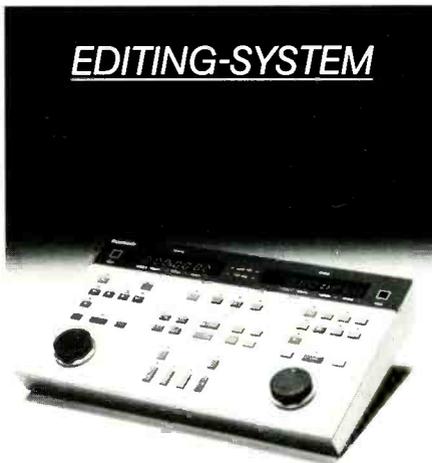


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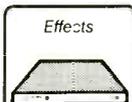
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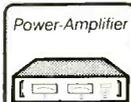
Effects



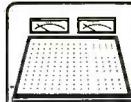
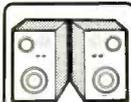
Digital-Processor



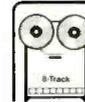
Digital Video-Recorder



Power-Amplifier



2 TR Master



8 Track



Multi Track



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01-267 4680

DIARY DIARY

Events, addresses, agencies

Are you DEAF?

Probably not, but you should be on December 21 at the London Hyde Park Hilton when the annual Distinguished Audio Engineers Federation (DEAF) Awards dinner is taking place.

This year there is a new team of organisers, taking over from Jackson Music's Malcolm Jackson, the man who has been the prime mover in setting up this hugely enjoyable and worthwhile event since its inception. The new team consists of Roger Cameron of Advision, Dave Harries of AIR London, Ken Townsend of Abbey Road and Brian Whittaker of FWO Bauch. As always the aim of the dinner is to make plenty of money for charities which

aid children with hearing problems.

Applications for tickets are now invited, as are silly nominations for awards and awardees. If you have any ideas, you should address them to Ken Townsend at Abbey Road. To give you inspiration, here are some past honours: Gritty Groove Award (Malcolm Davies, PRT, 1976); Brown Trousers Award (Roger Cameron, 1976); Hello Sport Award (Dave Hawkins, Eastlake, 1978); Last of the Lemmings Award (Barry Ainsworth, Mobile One, 1980); and the Pain in the Butt Award (Phil Guy, *Studio Sound*, 1982). The organisers will pick the best of the bunch (as long as they are assured of indemnity against libel actions!) for presentation on the big night.

There will also be the usual

range of highly desirable raffle prizes (including, it is rumoured, something not unrelated to Compact Discs).

Look out for the ticket application form in the December issue of *Studio Sound*, and if you can't wait until then, further information may be obtained from Ken Townsend at Abbey Road Studios, 3 Abbey Road, London NW8 9AY, UK.

Woodgate consultancy

J M Woodgate & Associates is a recently established electronics consultancy in design, standards and marketing. Equipped with computing and document processing facilities as well as an electronics laboratory and prototype construction facility

the company can offer specialist advice and services in many areas including consultation on British and International standards; marketing; applications; technical writing, translation of technical copy from European languages into English and prototype design and evaluation. J M Woodgate & Associates, 3 Bramfield Road East, Rayleigh, Essex SS6 8RG, UK. Tel: (0268) 747839.

Forthcoming events

- November 21 to 24 13th Tonmeisterstagung, Munich, West Germany
- November 29 Sound Broadcast Equipment Show, Birmingham, UK

Address changes

● Uher Sales & Services Ltd have moved out of London to Leighton Buzzard. The new premises incorporate a fully fitted showroom/demonstration room, and modern warehouse and distribution facilities. Uher Sales & Services Ltd, Unit Q1 (The Marley Estate), Cherrycourt Way, Leighton Buzzard, Beds LU7 8UH. Tel: (0525) 383277.

● Comfort Sound Recording Studio has relocated at 26 Soho St, Suite 390, Toronto, Ontario, Canada. The new facility was designed by Terry Medwedyk and covers an area of 2,000 ft². New facilities include an SMPTE videolock system which means that Comfort can now offer full audio post-production for video. They have also added a synthesiser suite. Tel: 593-7992.

● Midcom Inc of Dallas, Texas, have moved to their new headquarters in the Dallas Communications complex. The new 5,000 ft² premises brings the company nearer many of its clients and the extra space will enable them to embark on many new projects. Three Dallas Communications Complex, Suite 108, 6311 N O'Connor Road, Irving, TX 75039-3510. Tel: (214) 869-2144.

● Sandy Brown Associates

have relocated. The architects and acoustic consultants partnership is now at 1 Coleridge Gardens, London NW6 2QH, UK. Tel: 01-624 6033. Telex: 28356. The separate mechanical services unit is now at Haughdell House, Park Road, Banstead, Surrey SM7 3EL.

● Alphonat Elektroakustik, the West German manufacturer of Haufe transformers and the Alphonat range of products, has set up an office to market its products within the US pro-audio market. The full address is Alphonat, 506 Indian Creek Drive, Roanoke, Dallas, TX 76262. Tel: (817) 430-3351.

● The National Association of Music Merchants (NAMM) has relocated and since August 1, 1984, has been at 5140 Avenida Encinas, Carlsbad, CA 92008, USA. Tel: (619) 438-8001.

Contracts

● As part of an overall contract for the new dubbing suite at Television South West (TSW), FWO Bauch have supplied a Studer 900 mixing console. This is a specially developed 'hexmix' version of the 902/8/2 which has been fitted with a 24-track monitor mix in a very limited space. Other equipment supplied includes a Studer A80/VU multitrack, an A810 machine with timecode tracks, ITC cart

machines and EMT turntables.

● The Digital Entertainment Corporation has supplied a Mitsubishi X-800 32-track digital recorder to Burbank Studios for their scoring stage No 1; and an X-800 to United Western Studios, Los Angeles for use in their three studios as required although it will be mainly based in Studio 3.

● Theatre Projects Sales have announced the sale of a quantity of Court Acoustics GE60 graphic equalisers to the Italian broadcasting network RAI, and 19 to Clair Brothers for use on the Michael Jackson tour in addition to the 20 that were purchased last year. Theatre Projects have also recently supplied BGW power amplifiers to PRT and Lansdowne Studios, London. Viewplan have taken delivery of a further batch of BGWs for their hire department.

Agencies

● ACES have announced the appointment of two new dealers for the UK. They are Michael Stevens & Partners, The Homesdale Centre, 216-218 Homesdale Road, Bromley, Kent BR1 2QZ. Tel: 01-464 4157; and KG Music, 18-42 Charlotte Street, Wakefield, West Yorks. Tel: (0924) 371766.

Both dealers will be able to offer full sales and service for the full range of ACES

professional sound products including in-house studio facilities for the demonstration of equipment.

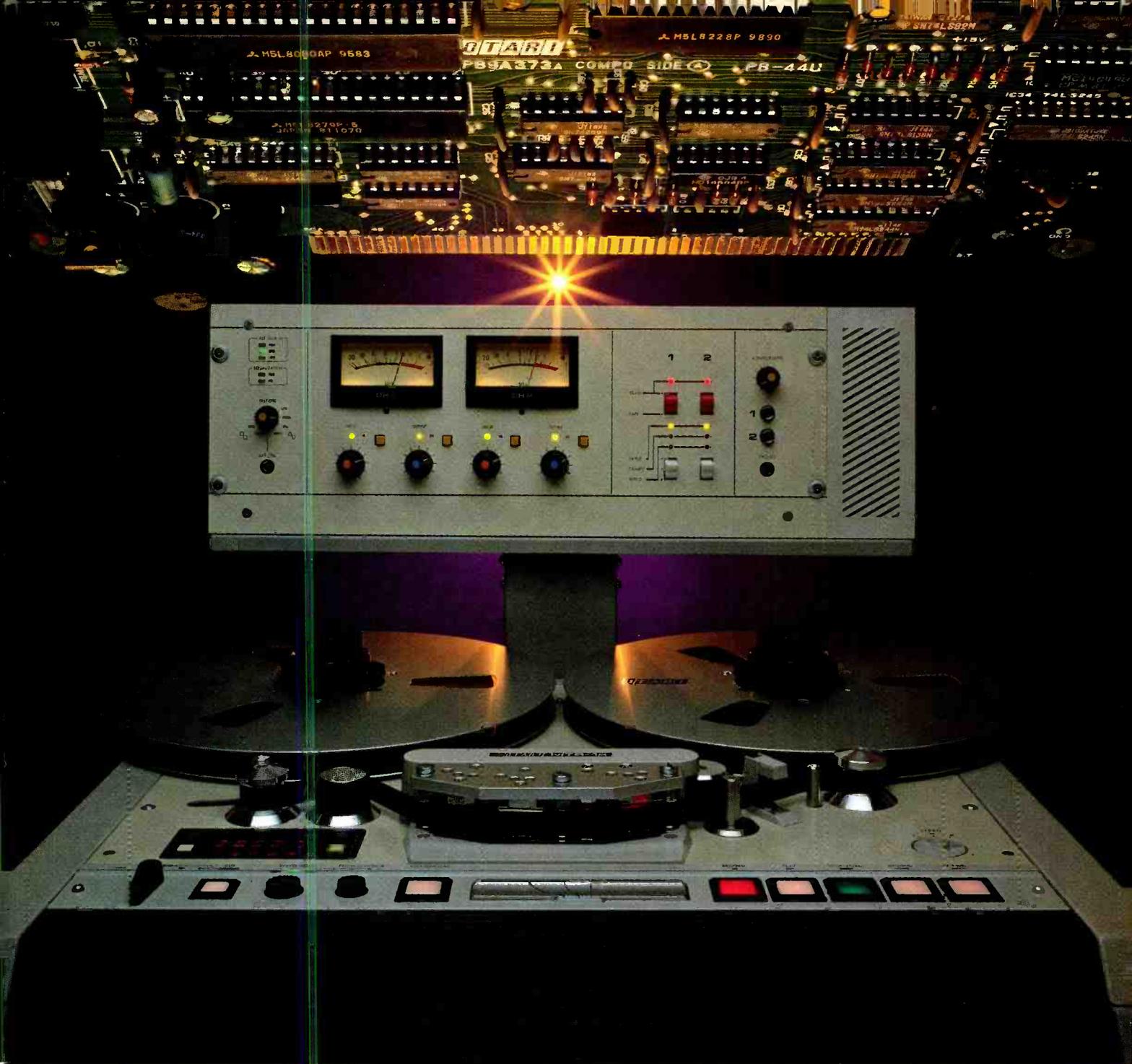
● Talk Studio, manufacturers of the DIGI-ATOM 4800 analogue-to-MIDI interface, have appointed the London Rock Shop as their UK distributor. The London Rock Shop is at 26 Chalk Farm Road, London NW1. Tel: 01-267 5381.

● Harrison Systems of Nashville have appointed Otaritec as their new dealer for Harrison products in Japan.

● Souriau, manufacturer of electrical connectors have appointed two new UK distributors: Trident Micro Systems of Redhill, and PSP of Middlesex.

● Sound Technology of California—manufacturers of Audio Test and measurement equipment—have appointed The Professional Recording Equipment Co as their UK and Eire distributors.

● Midcom Inc recently became a regional dealer for the Otari Corp. Midcom will now handle all sales and service for Otari's MTR-90 series of professional multitrack tape recorders. Midcom offers sales and service rental of over 65 lines of audio equipment. They also offer live sound support equipment, and their remote audio truck offers a 48-track facility (see Address Changes). □



THE OTARI MTR-12 SERIES

The Super-analogue Mastering Recorders

The fully microprocessor-controlled MTR-12 Master production recorders are now available in all professional 1/4" and 1/2" formats including the new 1/4" two-channel with time code SMPTE/EBU centre track configuration and Nagra* compatible mono and stereo Pilotone* versions.

Based upon the advanced design of the acclaimed MTR-10 recorders, the new MTR-12 Series feature expanded 12.5" reel capacity. Interface provision for time code based video editing systems, tape machine controllers or synchronizers have been augmented to now include an optional plug-in resolver module (Model EC-402) for film and video applications. In

addition, a DIN head version and 10 memory, full-function autolocator are available.

To receive comprehensive data and price details, or to arrange a demonstration, ring one of our authorised dealers now or contact us directly on 0735-822381.

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Tel: 0753-822381 Telex: 849453 OTARI G.

Authorized Dealers:

ITA 1, Felgate Mews, Studland Street,
Hammersmith, London W. 6. Tel: 01-748-9009 Telex: 21879
TURNKEY Brent View Road, London NW9 7EL
Tel: 01-202-4366 Telex: 25769

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Otari Singapore Pte., Ltd., 294-5370 Telex: R5 36935. Otari Electric Deutschland GmbH, Neuss, F.R. Germany 02101-274011 Telex: 41 8517691 OTEL D.

NEW PRODUCTS

NEW PRODUCTS

Equipment, modifications, options, software

Audio + Design new products

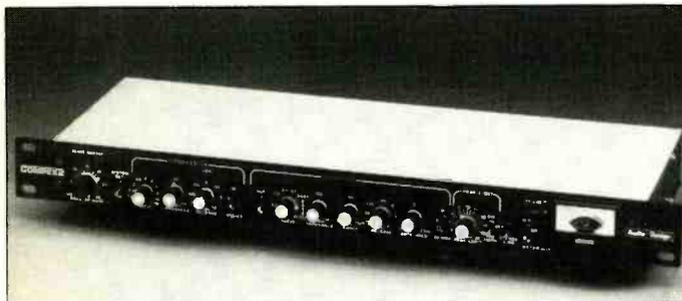
Audio + Design have recently introduced two new products. The first is the *AD-MIX* digital fader which consists of a rack mount processing unit with an optional plug in fader unit on a flying lead. Should there be a fader on a console capable of supplying 0 to 10 V, this can be used as an alternative input to the rack processor. Designed to work in conjunction with the A + D 1+2 modified version of the Sony 701 ES, the *AD-MIX* will allow level control of digitally encoded material so that fades and level correction can be provided without transfer to analogue 1610 format. Also it is possible to produce overdubbed recordings in the digital format by replaying a digital recording whose level is controlled by the *AD-MIX* while the new programme level is controlled by the 701 input attenuator or external input and recorded with the combined signal on to a second video recorder.

On the analogue side, there is now a new version of the *Compex* limiter known as the *Compex 2*. It offers separate

compression, expansion-gating and peak limiting as the original model but gives an extension of softer ratios and thresholds to -60 dB below normal operating levels. *Compex 2* is available as a single channel unit and the makeup-gain of both channels when linked for stereo being controlled from the master unit. The new design is also a unity gain system rather than the previous variable gain. Other new features include a choice of LOG or LIN compressor release times plus an AGC 'auto' release characteristic operating over a long period of time allowing gain to gradually increase during long low level passages. On the expander section, the ratio control extends from 1:1.2 to hard gating 1:20.

Audio + Design Calrec Ltd,
Unit 3 Horseshoe Park,
Pangbourne, Reading RG8
7JW, UK. Tel: 0734 861088.
Telex: 848722.

USA: Audio + Design Calrec
Inc, PO Box 786, Bremerton,
WA 98310. Tel: (206) 275
5009. Telex: 152426.



Compex 2

Denon CD test disc

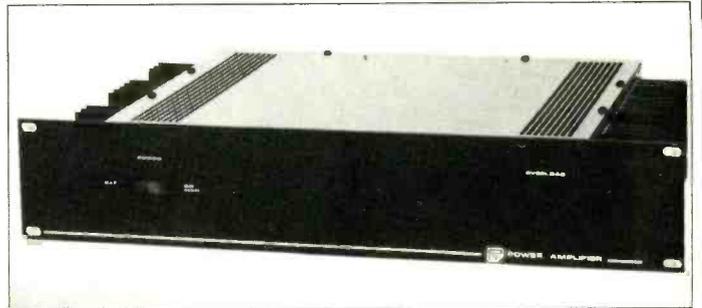
Denon have just released a CD test disc that will fulfil a very wide range of uses. Denon Audio Technical Disc C39.7147 is a mass produced disc at a cost not much greater than that of an average CD disc. Aside from the more consumer orientated items such as channel identification and 20 music tracks that allow various parameters to be checked by ear, there are 79 other tracks that contain a very wide range of test signals that are computer generated. It is suggested that a CD player with this disc is capable of replacing some items of test

equipment within the workshop although this is open to interpretation. The music references are from Denon digital recordings.

Nippon Columbia Co Ltd,
No 14-14, 4-Chome
Akasaka, Minatoku, Tokyo
107, Japan.

UK: Hayden Laboratories Ltd,
Hayden House, Chiltern Hill,
Chalfont St Peter, Bucks SL9
9UG. Tel: 0753 888447. Telex:
849469.

USA: Denon America Inc, 27
Law Drive, Fairfield, NJ
07006, USA. Tel: (201)
575-7810.



Protech Audio amps

Models 874 and 875 are two new power amplifiers from Protech Audio Corp. They deliver 60 W and 125 W respectively. Both units provide an 8 Ω and a 70.7 V transformer isolated output.

Rack mountable (19 in), manufacturer's specification

includes 30 Hz to 20 kHz ±1 dB frequency response and a 1.5% max @ full power distortion figure.

Protech Audio Corp,
Flowerfield Building 1, St
James, NY 11780, USA. Tel:
(516) 584-5855.

Digital editing for F1 PCM and CPDM

German audio specialist Peter Strueven has put together a system that will edit recordings made with dbx 700 (CPDM) and Sony F1/701 (PCM) processing using standard Panasonic VHS video recorders. The editing procedure is similar as for video, ie accuracy is within 1/25 PAL and 1/30 s on NTSC which is apparently sufficient for many applications. The system consists of one Panasonic AG-6200 VCR, one Panasonic NV-8500 VCR, one Panasonic editing computer AV-500; and for CPDM editing one dbx 700 Series processor or for PCM editing two Sony F1 or 701. The system will be available for sale at a price of under £7,000. Only one dbx 700 is necessary as they have found that CPDM is far more resistant to errors than PCM. The system can build up to include three independent computer controlled VCRs. The AG-200 is rack-mountable and can also be used as a mastering machine with one of the processors.

The two VCRs have to be modified to remove the video enhancement systems and to also alter the head switching. The tapes are stripped with timecode from the very beginning on the AG-6200 and this will be used during editing.

With PCM editing, the data stream to be edited will be

sent via 'copy out' to the NV-8500 which is capable of correcting half frames to odd/even/odd/even, etc, frames. The AV-500 enables any edit point to be found via the audio track running as slow as a frame a second. The NV-8500 can even be run in a reverse mode. The edit parts may be auditioned as often as desired and the trim function of the editor allows ±1/25 s steps. The error created at the edit point can be corrected by the copy function when preparing to the master tape.

With CPDM editing there are a number of advantages that can give more consistent results. As the dbx 700 is very resistant to errors the edit point does not apparently bother the 700. In a similar way to video CPDM can be edited head to head with the actual edit points found in the same way as for PCM editing via the audio tracks of the VCR. The 700 also has the ability to deliver a fairly good audio signal for the audio tracks of the VCRs so that the sound during the editing process is not as bad as it is usually known to be from 1/2 in VCRs.

Audio-Vertrieb Peter Strueven GmbH, Am Muehlenberg 26, D-2085 Quickborn, West Germany. Tel: 04106-6 9999. Telex: 2180633.

IMPORTANT ANNOUNCEMENT

Sony PCMF1/SLF1



Sony PCM701ES/SLC9



To clear any confusion or misunderstanding about the above Sony Digital recording products, please be advised:

1 The Sony PCMF1 is still in production in Japan, and is available from HHB. The Sony SLF1 video recorder has indeed ceased production, but HHB has managed to secure limited numbers of these desirable machines.

2 It should also be borne in mind that an alternative system exists for applications where portability is not essential. This system comprises the Sony PCM701ES processor - identical in function and compatibility to the PCMF1 - and SLC9 video recorder.

3 HHB are pleased to announce ex-stock availability of CLUE (Computer Logging Unit and Editor) which provides editing facilities for PCMF1 or PCM701ES/Betamax recording, as well as intelligent autolocation and logging.

Call now for more information about this exciting new product.



The No 1 name in Digital Audio.

HHB Hire and Sales, Unit F, New Crescent Works, Nicoll Road,
London NW10 9AX. Tel: 01-961 3295. Telex: 923393.

NEW PRODUCTS NEW PRODUCTS

Equipment, modifications, options, software

Audio Engineering radio microphones

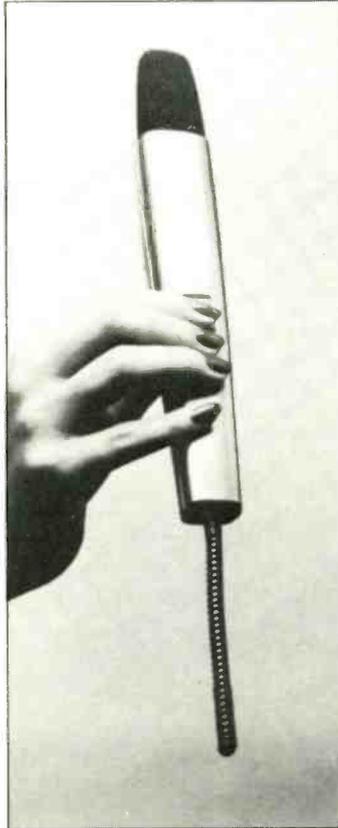
The *CNS Micron 500* series of professional radio mics feature a double ended system which first compresses the dynamic range and then expands it at the receiver section of the circuit.

Superseding the previous *Micron* range, the *500* series incorporates three models: the *501*, *502* and *503*. The *501* and *502* mics supersede the older *TX 101* and *102*. The *503* hand-held radio mic updates the earlier *TX 203* and omits the limiter and the possibility of recovery time problems.

The Modular Multichannel Diversity Receiving System *MDS2* is fully compatible with all parts or modules of the *500* series, and the Diversity Receiver Module *MDR 4* has been updated to *CNS Micron MDR 540*.

Audio Engineering Ltd, 33 Endell Street, London WC2H 9BA, UK. Tel: 01-836 9373.

USA: Micron Audio Products Ltd, 210 Westlake Drive, Valhalla, NY 10595. Tel: (914) 761-6520.



Applied Microsystems I-CON

I-CON is based on Applied Microsystem's earlier *CM50* autolocator, stretched sideways to provide either 16- or 24-track select keys and three or four additional function keys. Information is sent to the tape machine via a 9-core cable in high speed serial form to be decoded at the machine by a small circuit board provided with the *I-CON*. This cable is sufficient to carry all deck functions, channel select keys and all synchroniser functions including the timecode record and playback.

Later versions of the *CM50* and all *I-CONs* may be fitted

with a sync-pack. Factory tests have included locking an audio machine (Tascam *58* and Fostex *B16*) to a Sony U-matic, and also locking two audio machines together. It is also possible to lock the U-matic to the audio machine, although the autolocator section of the slave works best on the audio machine.

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

USA: Applied Microsystems, 8530, Wilshire Boulevard, Suite 309, Beverly Hills, CA 90211. Tel: (213) 854-5098.



Drawmer vacuum tube compressor

Drawmer have recently announced the *1960* vacuum tube compressor amplifier as an addition to their line of compressors and expanders. The *1960* is a 2-channel unit that uses valves (tubes) in addition to semi-conductor electronics. Each channel consists of a valve compressor and preamplifier which feeds into an electronically balanced output stage. The compression characteristic is 'soft knee' with variable threshold and switchable attack and release, and a make-up gain of up to 20 dB. The channel has a choice of input—either a balanced line level or mic level with variable gain from 0 to 60 dB with switchable phantom power on the mic input. There is a further front

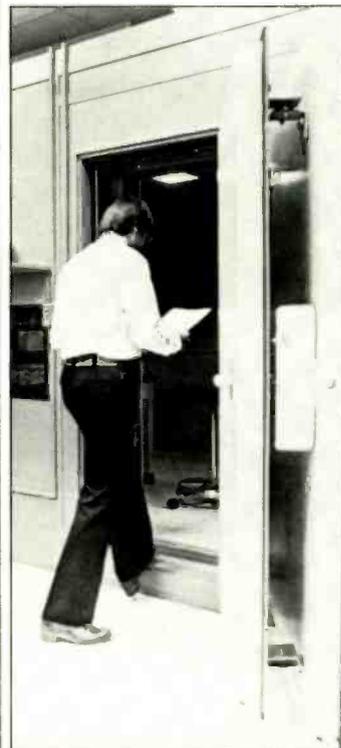
panel auxiliary input for direct instrument input and treble and bass EQ together with enough gain to achieve overload sustain effects.

There are a pair of insert points on each channel—the first pre-compression and the second allowing side chain EQ treatment with a selectable side chain monitor switch. Signal level or gain reduction is shown by a pair of VU meters and the two channels are stereo linkable.

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

USA: Harry Harris Sound Services, 7138 Santa Monica Blvd, Hollywood, CA 90046. Tel: (800) 637-5000.

IAC two-in-one door



Quadraseal acoustic door

Designed for test cells, broadcasting and recording studios and anechoic chambers, Industrial Acoustic Company's *Quadraseal* acoustic door aims for high transmission loss characteristics by a piggy-bank approach, combining two doors in one. It consists of 65 mm thick leaves separated by a 140 mm air space, with the inner leaf mounted to the outer by means of special vibration isolator brackets.

When installed, the outer leaf is hung from two cam lift hinges which lower the all steel door as it closes, to form a tight floor seal.

Industrial Acoustics Company, Walton House, Central Trading Estate, Staines, Middx, UK. Tel: 0784 56251.

USA: Industrial Acoustics Company, 1160 Commerce Avenue, Bronx, New York, NY 10462. Tel: (212) 931-8000.

USA: Industrial Acoustics Company, 10971 Garden Grove Boulevard, Garden Grove, CA 92643. Tel: (714) 636-5440.

Synconfidence.

Shopping for a desk these days can be a chancy business. Limited budgets all too often mean limited equipment, limited performance – and limited potential for future expansion. It's a story that many smaller studios know to their cost.

Enter the SYNCON Series B – a mixer of unrivalled flexibility. Designed by AHB to grow with your studio, but with a minimum upfront capital outlay.

The in-line modular concept means that you can start with a basic 16 track format and, without factory modification, expand to a 44 input,

fully automated console. For the 24 track user, the popular B36 (shown here) has 32 input/output modules, 24 track routing and 64 line inputs for remix.

The excellent design and superb sound-handling capabilities of the Series B puts it firmly in the Big League – but with a price tag that explodes the myth that a quality desk must necessarily set you back an arm and a leg!

We can confidently claim that the SYNCON Series B represents one of the best value-for-money deals in today's market.

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Orange, CT 0477
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Telex 643307

TFA WITH DYLAN AT WEMBLEY

S Therefore you looked at a different area of the music industry.

B Well you see we've never dealt with that kind of client, we NEVER have.

R I thought you used to do Ted Nugent and Aerosmith?

B Oh sorry yes—with the old 5-way which was essentially much the same as a Martin system really. In my time we haven't really done any of those acts. I picked up the tail end of them, the Ted Nugents of this world.

R When you first came to TFA, the 4-way Turbo was very much in presence, which was primarily a black box or rather a hidden system.

B That's exactly it, it was an anonymous system.

R Why was there a need to generate a new system in preference...

B Because it still was not terribly compact. In other words it still took up an awful lot of truck space, etc. And you have to come up with something new every now and then.

S How did you start off?

B Here's how it started. The first thing you've got to look at is will it go in a truck! So you then find out what the minimum truck width is, and you've got to base your cabinet on a design that will fit either two or three or four in the width of a truck; obviously the most compact way of doing it. So having done that you've got one dimension, and if you then use the Thiele-Small parameters for the design of a vented cabinet... I never overly much liked a horn cabinet. I don't think it's the best from a hi-fi point of view, ultimate cabinet because you're limited by the size of the horn. You can't make a good horn cabinet without using a monstrous horn—these are physical laws. You can mess about porting it and doing all kinds of bits and pieces but in essence it won't make a good horn unless it's big—the low frequency cut off relates totally to the mouth area.

R You were then looking at Thiele theory which advocates front loaded, vented speaker cabs.

B Yes, correct.

R Did this then lead you to looking more towards Electro-Voice because they were the main exponents of these theories?

B I went to E-V for several reasons: (A) it's been a very reliable product, over many years through experience. It's also a very very big company, there's a lot of back up there; (B) the people are in the forefront of Thiele-Small design and (C) they're a decent agency.

S Do you get a lot of help with E-V design?

B Always have done, even before Tony Oates (Shuttlesound); always got a lot of help from Larry Frandsen and his people.

S Once you'd decided you were going to build this system that fitted into a truck very well and it was to be a front loaded system...

B Well, because of the nature of the cabinet dimensions you're forced into a vented cabinet I think, to get decent bass response and efficiency. That... gives you the bass cabinet. So having arrived at the bass cabinet (and it turned out that that cabinet was 17 in deep), you've then got to look at some kind of upper frequency that is going to be no more than 17 in deep. You then look around at all the horns that are available and they're all that long (Bill spreads his arms)—about 3 ft. They're clearly not on, so something needs to be done in that area. The mid range isn't a problem, because a normal infinite baffle cabinet will do the trick.

R You originally went for two 3 x 12s and have now gone to 14 x 12s per stack.

B The 3 x 12 for some reason, although the books will tell you that if you

pack speakers together and stack them in vertical columns that they work best, doesn't always seem to be the case and the mid range tended to be honky.

R Too strong.

B Just seemed to be too powerful to complement the system. They seemed to be difficult to control although in theory it should have been the best arrangement.

S And with the 3 x 12 you also had a separate horn cab.

B Yes but all restricted to the 17 in.

R This was four tubes and E-V DH1506 full range dimension. Was the tube just stumbled upon during your research looking for a horn to fit in 17 in? I presume it appeared at just the right time?

B That's right.

R Did you have many problems with their usage as it was such a new idea at the time?

B Yes, there's a lot of problems with them, one of which is, it'll go something like 120° wide but only 20° in the vertical which means that if you're 20° out then you've missed the audience so it's quite critical in that area. So what we did was put two of them back to back, as it were, to try and widen that angle to 40°.

S Does that actually work?

B Yes it works. The other problem is, because they're inherently phase coherent (much more than a horn), the problem is, stacked side by side you're in real trouble because the phasing is very dramatic and so pronounced, because they're terribly accurate in the first place. When they go out of phase they really go out of phase at the point that they cross. So you do have to aim for a vertical column or else it becomes very very

critical.

R And so now to have four in a cabinet, two pairs that are...

B Two pairs that are back to back and above it another two pairs that are back to back.

S So that that way you get the vertical coverage.

B That's right. As you know to enlarge you can only stack vertically. It's all very well to say I'll just tilt this cabinet this way and that one that way but it just isn't as easy as that.

B The only drawback therefore with the tubes is this 120° dispersion which can run you into trouble if you're into venues where the vocal mic line may well be in front of the PA, actually a couple of feet in front of the PA system. At some shows that happens and feedback then becomes a little bit of a problem and very difficult to handle, which was when we developed the E-V 8HD horn type which tends to be much more powerful in the mid range, doesn't have the HF response of the tube, but is much more powerful in the mid range and it seems that a combination of the two types of cabinet seems to be absolutely perfect because it gives you that superb coverage on the HF but a much more accurate spread.

R So by using 8HD cabs, you can beam much more accurately where the sound is going, which enables you to use the tube cabs further away from the stage for overall spread.

B Yes and also if the tube cabs are giving you difficulties because of a particular situation you can just turn them down.

S So that one 'problem' the 120° dispersal actually made you develop the 8HD cabs.

B That's correct. Whilst most of the time 120° will give a full even coverage which is nice, occasionally you just run into difficulties with it.

R Did you find any problems with coupling the E-V DH1506 drivers with the tube?

B The tube benefits from having the diaphragm itself spaced away from the tube, as long as you don't go too far away (when it will start crippling the HF) it loads the diaphragm better. I couldn't say you can hear any real difference but it does load the diaphragm better. Your diaphragm, in theory, should last longer.

S What is HF reliability like? ▶



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TFA WITH DYLAN AT WEMBLEY

- B** They're really excellent. I think on the Dylan tour we blew three or four diaphragms at the most.
- R** And how many watts speaker power, how many C3 stacks, apart from the add on, did you have there?
- B** I think about 40-50 K of C3 and add on RSD.
- S** The semi-elliptical arrangement of the 8HD horns seems fairly unique—how did you decide upon this format?
- B** That's because I read an E-V paper on it. If you put several horns together, there's a correct way of doing this, generally like that (which Bill demonstrates) but whichever way you do it there are nodes in between the two (horns); there are phase cancellations, there's nothing that can be done about it. It's a fundamental law of science but E-V found that with an array that is concave there's really very little difference between the horns from a coverage view. But the little nodes become dramatically less in the elliptical mode. It gives much smoother response and overall, better coverage.
- R** Which is, in fact, the reverse of the way that horns are popularly stacked.
- B** That is correct, but again it was part of E-V's research and one of the reasons why I go for E-V, because they generate incredible amounts of this research literature if you've the time to read it all.
- S** Is it beneficial to hall coverage?
- B** Well it's (8HD) actually a dispersive horn, though it doesn't work the way you think it does. In fact if you look at the way it's used in the *Eliminator (1)* and it's actually the wrong way round, it's intended to be used in its vertical mode.
- R** So the discovery that two 3 x 12 per stack in the C3 produced too much honk, by reducing that to one 4 x 12 it gave you sufficient space to include the HF section in the cabinet and allowed you to arrive at two identically sized cabinets to continue through with your theories of truck spacing,

moveability and general aesthetic client benefit.

- B** Yes that's right.
- R** Was this a lucky coincidence or were you striving for more size compatibility and compactness?
- B** The three different cabinets was of course, a much more compact system, watt per cubic metre or whatever. Obviously because your 12s are densely packed. And so in a way the second box was slightly more space consuming but it didn't really matter.
- R** Made the whole system much better for flying, etc.
- S** What design work and testing did you do prior to manufacture?
- B** Well with the bass cabinet of course, E-V have design philosophy programmes now where you can pretty well accurately know what the speaker is going to do in such a box before you build it.
- S** So you've got your design programme and fed in the relevant data, did you make any other design alterations before you built it?
- B** No, because there's nothing really to do. It's such an elegant method of design that the design programme will handle any shape or size of box you like—if you want your box to be 5-sided it really doesn't make the slightest difference.
- S** With the 4 x 12 and horn box, was there any alteration to the 12 in section?
- B** No, because you're talking about an infinite baffle. There isn't anything much you can do, as the cabinet itself has no control over the loudspeakers. You're relying entirely on the loudspeaker itself to do its job so there's no real experimenting to be done

there. Of course, the high end's a different matter altogether.

- S** How did you arrive at the high end in its present position?
- B** You do really need to get the tubes in a vertical column and the only way you can do that is to have the HF end at one side of the cabinet and the mid at the other and when you stack them one on top of the other you get them to form columns.
- S** You could have done that with them centred which would give the same effect?
- B** No. The wavelength at 1 kHz of a 12 in speaker is about 12 in. So once you start moving them further apart you're into phasing problems at a very critical crossover region, so it's actually vital you don't split up the 12s.
- S** Did you put them into test chambers to see what was happening?
- B** Certainly did.
- S** And favourable results?
- B** Ah huh! The truth of the matter is you can't tell very much with test tones.
- S** So did you build a couple of stacks and try them out quietly?
- B** Initially we hired a band, who actually did it for free, to go down to the Rainbow and just set up one stack one side and compared it to a comparable stack of 5-way and one of TFA Turbo and it was all terribly, terribly impressive. Drums were very clear.
- One of the problems with a horn cabinet is that, say you've got something like a really deadened bass drum, it goes *bang*. In a horn cabinet there's a chamber in the back, the sound is actually bouncing around, hanging on in that chamber for a long time afterwards

and it gradually dies down and that's what causes your bass to turn woolly. And it's always resonating at one frequency and this won't show up in conventional pink noise tests, it won't show up as a boost, because it's not a peak of any kind, not louder than anything else, just that it hangs on a lot longer than anything else. You can only find it by pulse testing. And this is one of the problems with horn cabinets and with any other kind of cabinet, but it's not a problem that the vented cabinet has.

- S** Do you find by using this type of system in a normal hall venue that the sound is much smoother throughout the hall?
- B** On the bass end you can't control the bass; bass is essentially non directional and you can't really control it. So that end doesn't make any difference at all, as you get to the high frequency of course it's a different story.
- S** Do you find using the tubes in a hall improves ground level to balcony coverage because of its dispersion?
- B** Yes, it gives an excellent and uniform, I mean really uniform coverage for 120° so you don't have any kind of angling problem along that plane.
- R** I was impressed with the C3 at the Albert Hall when Elvis Costello was playing and I didn't think the PA was turned up until he spoke into the microphone and the PA was absolutely deafening.
- B** Well yes the tube's part of it. With a horn PA as you walk in you're going to hear nodes and real beaming hotspots and any time you walk into a hotspot usually the noise level will be much higher.
- S** Because the tube is very smooth all the way up.
- B** That's right. You tend to not hear a peak. All systems have noise, that's a fundamental law of physics but if there's a peak in the response somewhere in the high end then of course some element of that white noise is going to be most noticeable.
- S** You've built your own C3 active crossover, was there nothing suitable on the market?
- B** I wanted a crossover that could be used with any of our systems and when it came down to the final little bits and pieces there wasn't a commercial unit

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TFA WITH DYLAN AT WEMBLEY

which had everything on it that we wanted. We wanted for instance phase reversing switches on every band, etc. It was a way of getting exactly what we wanted.

- R** How did you overcome the problem of the mid boost in the *DH1506* at the start of its frequency range?
- B** It's not a mid boost, it's a 6 dB/octave roll off from 3 k which all drivers have it's just simply that E-V are the only ones that actually tell you or admit it and there are frequency correction networks in the cabinets to compensate for that. We did build it actively in the *C3* crossover at one time but I've knocked it out now, one reason was that it means that particular crossover card doesn't suit other applications such as the (TFA) Turbo for instance, having that boost there, it just works out better for the frequency compensation to be in the cab itself.
- S** You've continued use of the Quads, why?
- B** I've used them for years and years. They're very reliable, good smooth sound. If you've got something you're happy with there's no point in changing.
- S** And you're going over to the *MOSFET 1000*?
- B** If you go very very carefully through all the amplifiers available, for instance, the Crown (*DC300A*) has no meters,

obviously a major drawback, there's no way of telling if say a Crown goes DC and pops a speaker, you've no way of telling that.

All you can do with any amplifier is say (A) will this technically do what I want it to and (B) does it sound alright? If those two criteria are met and we did AB tests against the other amps we had, and of course it's got a much much higher rail voltage and so we now use limiters (a TFA mod to these amps) to keep it within power, to keep it from blowing speakers but the advantage that you have is that as higher powered speakers come along you can simply slip out the limiters and away you go.

- S** Yes I noticed at Dylan that the BGW meters were in the +dB area yet the MOSFETS were barely operating.
- B** It has a decent resolution meter on the output; had substantial output power; appeared to have the reliability (we couldn't blow it up); and the right connectors, size, the meters are re-calibrateable, so we can set them to any level that we want—has everything that we needed.
- S** With regards to the new wedges you've evolved, how did you arrive at their design?
- B** Again it was exactly the same as the *C3*. It's Thiele-Small vented theory. A problem with wedges is that they have to physically be small, so if you want to put bass down through it then an infinite baffle cabinet will be too small to reproduce the bass, you certainly can't have a horn

cabinet as there isn't the size available to you, for a decent bass response you're forced towards a vented cabinet and that single 15 in wedge is the best bass drum wedge that you'll come across. It's an excellent bass drum wedge, what a lot of people do is have different kinds of wedges for different applications, but in a rental company you really don't want to get involved with all of that.

- S** The *C3* half stack, was this designed in the same way?
- B** Again it was the same basic design, Thiele-Small formula for vented cabinets. We use them for drum fills, keyboard fills or side fills (for bands that don't like very big side fills).
- S** Are there any future improvements that you envisage?
- B** We're pretty happy with it now but obviously if something comes along then, well here's me. If you caught Neil Diamond recently, well, Stanley has got something, I haven't been able to suss it yet, some sort of artificial bass transducer which is not a speaker as such, some kind of solenoid thing which forces a cone backwards and forwards which he uses as a special effect; he just whacks it up at certain points and this huge rumbling, amazing bass appears. Any less work and I'd start working on my own powered speaker—if someone will give me a few grand. The history of this is one of the most interesting and also perhaps the saddest. Before the loudspeaker was invented, when there was only the old acoustic horn, someone

designed this thing, the name eludes me at the moment, *Inophone* or something like that. It had a little compressor which fed a tube up to a little comb valve which was directly connected to the stylus, so as the stylus modulated the little comb valve went like that (Kelsey demonstrates). If you think of a saxophone the way it works, it's just air rushing through a horn which is periodically slowed down and speeded up by the valves opening and shutting and this is what this little comb valve did. If you think about it, the loudness is controlled solely by how much air pressure you put behind the generator. This was apparently absolutely amazing for its day, when people switched them on, other people would rush out of their homes to see what was going on, all that kind of scene. And then Kellogg or whoever it was invented the loudspeaker and everybody became obsessed with the loudspeaker after that time and this little device was forgotten amongst the new technology which even for its day was pretty low tech. Then it got re-invented again in the 30s where it was used to screech at people from aeroplanes to broadcast adverts, it became such a menace, no-one could sleep at night because some aeroplane was screeching at them from out of the sky that it was banned within a few months and the whole thing was forgotten again and I think now is the time because technology has improved now, mechanical technology, the design of the comb valve could be vastly improved and so on. You could then make a PA system, bass end at least, I'm not sure how high up in frequency you could go but bass end at least, you could make a system that was large enough to do Hyde Park or the Isle of Wight and need be no bigger than a RCA W cabinet. It's nothing to do with its size, purely down to the amount of air pressure. I'd like to see something new done in loudspeakers. □

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As with any modern day concert rig, the monitoring position is really the nerve centre for the signal distribution system, where individual band members have immediate contact with soundcrew, where gigs are really 'won or lost' by the quality of a stage sound. Monitor engineers often find themselves controlling up to 16 different mixes at any one time—a demanding task, especially if time delay side fills etc are being employed.

Soundcraft desks were again featured, TFA using a *Series 4* 40/16 monitor desk with programmable muting and Santana a *Series III Electrotec* 40/16 monitor desk. Both sets of mixed outputs fed totally separate monitor systems, with TFA each wedge send was

Monitoring

treated by a Klark Teknik *DN27* ½-octave graphic equaliser with built in 2-way crossover, 18 dB/octave slope (a TFA mod)—for biamp operation. Side fill and drum fill sends were treated by Klark Teknik *DN27* ½-octave equalisers, before band separation by Yamaha *F1040* cascaded crossovers. Two types of wedges were employed either passive two *E120* with JBL *2441* drivers hung on cut down Vitavox horn with two JBL *075* tweeters passive, or biamped one *Electro-Voice 15L* with E-V *DH1506* driver hung on JBL *2307* flare with JBL *2308* lens. Drum fills are a scaled down version of the *C3*—two E-V *15L* (pointed), two E-V *12S* (infinite baffle) and

two E-V *DH1506* with tube. Side fills were one stack Court Acoustic Black Box system. In addition, Dylan used two Electrotec biamped drum fills as personal 'wedges' each containing one JBL 18 in speaker, one JBL *E120* 12 in speaker with JBL *2445* driver on a JBL constant directivity horn with two JBL bullet HF drivers. Biamped with crossover points active at 200 Hz and passive at 1.6 kHz and 5 kHz. Santana, like TFA, fed the mixed monitor outputs via Klark Teknik *DN27* graphics with built in 2-way crossover 18 dB/octave (another Electrotec mod) for biamp operation. Side fill feeds were sent to the TFA monitor desk while mixed wedge sends were sent additional TFA amps and wedges.

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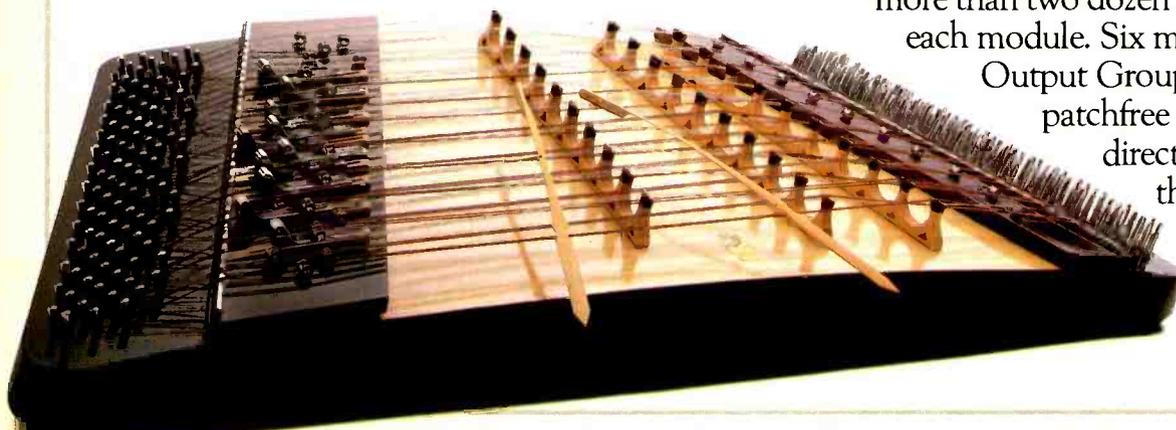
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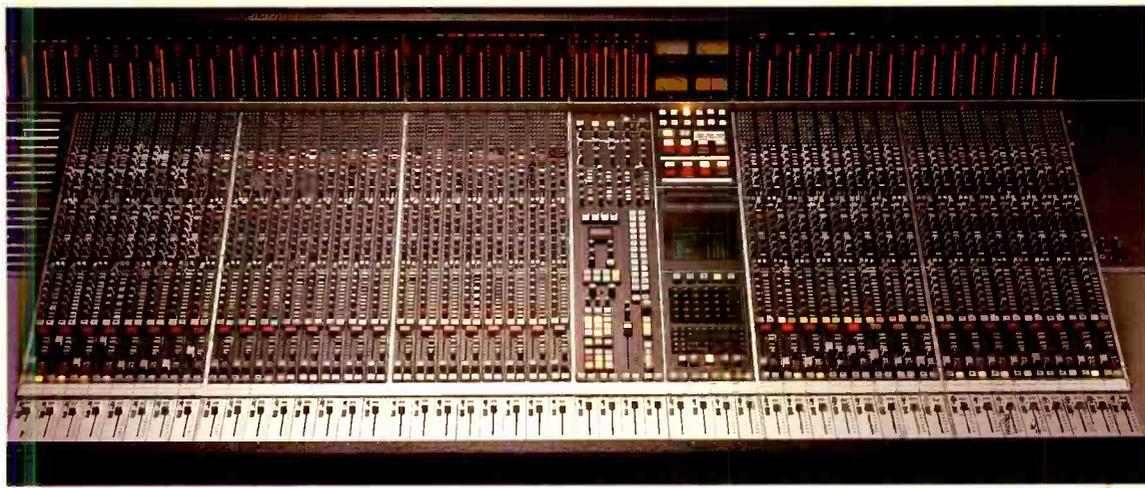
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MIXING CONSOLES

There are so many differing directions being taken by mixing console manufacturers at present that it is impossible to compile our customary general background feature. Instead, we are looking at some of the very new developments from a wide range of manufacturers whose latest products and design directions have not as yet received any coverage.

There is one observation, however, that is certainly well worthwhile making. About a year ago it would have been possible to complain that despite the fact that every other pro audio manufacturer seemed to be making consoles, whenever you wanted to buy a console within a particular price range, there only ever seemed to be a choice of two or three models. This was mainly true at the very top end and the equally competitive lower cost areas. A sign of the obviously increasingly healthy pro audio market must be that there are now more new mixing consoles available than at any time that I can remember and there seems to be greater choice at all levels.

● **Allen & Heath Brenell:** It is interesting to note that sometimes the popularity of a particular console can often far outlive its intended commercial life. AHB have had their share of such mixers with the highly ancient *Mini Mixer* and also the first of the low cost in-line consoles, the *Syncon A*. This is still apparently ordered although it has been many years since there was any attempt to market the console. The *Syncon B* is, of course, still fully current and a steady seller, particularly into Europe. The *System 8* has recently been updated to include phantom power, 100mm faders, EQ cut button and internal automatic routing of programme to channels. Of particular interest due to its routing system is the new *CMC* console covered in new products last month. This is possibly the lowest cost 16-track console to use microprocessor-controlled routing and could well be taken as a sign of how such systems are now very cost-effective. On the live sound side AHB have launched the *SRM 186* monitor mixer which incorporates its own internal mic splitter system.

● **Amek:** This company has become extremely dynamic in their R&D. There are apparently some interesting new developments on the way. The first step is the introduction of the *M3500* console, the first of which will be delivered before the end of 1984. It is configured as a 56/48 with complete 48-track routing and monitoring. Amek claim that the EQ will be the most comprehensive available from any manufacturer and that the console also

Keith Spencer-Allen reports on a selection of new products which have been launched during the year

has an extremely flexible internal routing system. The fader system is VCA-based with dedicated subgrouping and eight automation ready VCA-based effects returns. Perhaps the most innovative feature is that all the eight aux sends on the I/O modules may be instantly reset from an onboard memory, and the contents of this may be dumped and re-loaded from 'hard storage media'. This memory allows up to 16 different settings to be stored on a 56-input console and these can be changed during a mix. Amek are also offering the *M3500* with George Massenburg Laboratories moving fader automation system which uses Winchester disk storage with floppy disk back-up. The system is apparently Necam/SSL compatible. Although further details are at present not available, the console is described as being competitively priced.

Amek are also intending to introduce an instantly resettable 4-band parametric equaliser during 1985 and they claim that this should interface easily with most consoles on the market. To show how serious Amek are about these products, they have formed a new R&D company: Amek Digital Technology Ltd, so that these developments may be further developed and exploited.

● **Audix:** Although principally a manufacturer of broadcast consoles, the requirements of the broadcast studio and recording studio are not too dissimilar. It is therefore worth mentioning the *Assignable* console which uses digital techniques to control analogue processing circuits that are positioned remotely from the console thus allowing a console to be much smaller than facilities would suggest. The complete system is under microprocessor control with solid state memory facilities and the option to use floppy disk storage. The usual sets of duplicated channel controls have been replaced by a single set of controls that can be assigned to any channel, group or monitor. In typical use, the *Assignable* can memorise up to 20 'complete desk' set-ups any of which may be implemented at the touch of a button.

● **Calrec:** In a manner similar to Audix, Calrec have been manufacturing broadcast oriented consoles with automation and multitrack capabilities for many years. The introduction of the *UA8000* at the Paris AES was quite a

talking point. Although the console has really only been seen publicly in the form of front panel drawings they have sold three and delivered two of them already.

The facilities of the console are too comprehensive to cover properly here but the standard mainframe size is 48 channels although larger sizes are no problem. The channel section has a totally separate permanent line input independent of the monitor tape replay input and this allows handling of 96 inputs on a 48 frame. The input section always feeds the track matrix and the monitor section always feeds the main outputs. Each section has VCA control. The automation always acts on the monitor section VCA but can be written to from the large or small faders.

Other features worth mentioning are the Automatic Relative Q circuit used within the four band parametric EQ, where the Q of the circuit is increased with increasing amplitude. Each channel features a very comprehensive compressor/noise gate combination. For those of you with access to the exhibition guide for the APRS 84 exhibition, part of the front panel of the *UA8000* was featured on the cover.

Calrec are also developing a digitally controlled assignable mixing system known as *CCA1*. When this console will be ready is something that Calrec are not prepared to discuss at present although full outline details have been presented in an AES preprint (2074).

● **DDA:** Although they have only been manufacturing consoles for under two years, DDA have made quite a positive name for themselves. They have basically two ranges: the *M Series* with input sizes between eight and 32 channels into four. The meters are laid flat into the panel so that the console is easier to transport. The *S Series* is a similar console but with a meter bridge. Next comes the *D Series* which is intended to fulfil a wide range of requirements and so there are a number of module types and frame sizes available in order that the mixer may be configured for live use, recording use, theatre use, etc. It has eight buses.

A very recent addition is a little portable 4-channel mixer for remote use but with comprehensive channel facilities including switchable phantom powering 12/48 or 12 V A/B; 20 dB attenuator; phase invert; high pass filter; peak limiter; PFL etc.

● **D&R:** D&R Electronica are a Dutch company with a wide range of consoles. They have recently introduced the series *2000* which is a simplified version of the established *4000*. An in-line console, it has input channel frames of 10, 20 and

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MIXING CONSOLES

30 channels and as many effect returns as it has channels.

The series 8000 which is the largest D&R console for studio use has been updated so that it can be retrofitted with SCORE (Studio COmputer REMix), the D&R automation system. This console also has new mic preamps, new front panel layout and a new PCB layout for lower crosstalk.

● Electro-Voice: Although E-V are not particularly known for recording mixers the newly introduced *ELX-1* is a useful mini mixer providing four channels of mic/line mixing that can be used either on battery power for remote use or as a rack mount accessory unit within the

house mixing console. Both of these systems were the result of collaboration with Clair Brothers and Showco.

● MCI/Sony: There has been very little new from MCI/Sony on the analogue console front for some time, although this may not be the case by the time that this article is published.

● Neve: Although Neve and digital consoles seem to be synonymous in most people's minds, apparently last year was a record year for sales of analogue consoles. On the recording side, the most significant new product is the new *NECAM 96* automation system. The servo-driven faders are faster and the system has an intelligent roll-back feature. A colour VDU displays complete status information and lists of mixes, labels, mutes etc are readily available.

Up to 999 snap-shot static stores of faders and mutes, auto/manual cross fading, real-time *NECAM* fader and group muting, and up to 128 separate event switches make this system a

and fader modules with interchangeable VCAs. There are at present three EQ modules offering 4-band switchable, 4-band parametric or a 10-band graphic design. The mic inputs are available in seven different types all based around variations on transformer/non-transformer differences. The faders available are a linear audio fader, a VCA fader system with its own choice of VCAs or the new Digital Fader system. The Digital Fader is part of the *Westar* automation system that uses a hard disk storage system. There is not room here to look into this automation/fader system further but there are many possibilities that are in the process of development.

● Solid State Logic: SSL are a company who have a policy of bringing retrofittable additions to their product ranges rather than completely new models. The recent International Broadcasting Convention saw the introduction of the *5000 Series* for broadcast use. There have however been

D & R Electronica's 4000 series and (right) SSL 6000E—more and more non-signal processing aspects are being incorporated



studio. Both internal and external powering is acceptable with phantom powering provision and the complete unit occupies a single rack unit.

● Harrison: The most recent addition to the Harrison range was *The Raven*, a competitively priced type console available in a single mainframe size of 40 modules. There is a console expansion kit available for larger sizes. *The Raven* has many similarities to the *MR-4* in function and features. No internal patchbay is provided although there is provision for fitting one. Perhaps the most striking thing about the console is that it looks quite different to the standard Harrison-look.

There have also recently been two new live consoles—the *SM-5* stage monitor/theatre console and the *HM-5*

significant step forward over *NECAM II*.

The new additions to the console range are for post-production work—a 4-group version of the 542 range known as the 5455, and two new interfaces for the 542 series to allow interface with video editing systems.

● Quad-Eight/Westrex: The *Westar* is the most significant product from QEW in many years and should make quite an impact once it is in production. The styling of the unit that has been demonstrated at recent AES conventions is quite unusual and this has in some ways tended to detract attention from the facilities that it offers. It can be expanded up to 52 inputs with eight aux sends and 24/48-track interface. The *Westar* also has interchangeable equaliser modules, mic input modules

a number of new facilities that are now available for existing consoles. The *Synchroniser Controller* is an interface system between ATRs and VTRs and the studio synchroniser system allowing control from the SSL Primary Computer keyboard. The *SL 688V Stereo Mix Matrix* is for the 6000 and with its three separate stereo mix buses allows music, dialogue and effects stereo mixes. The third item is the *Programmable Equaliser* which may be retrofitted to any of the *E Series*. It has two independent 3-band parametric channels with variable Q. It also includes a programmable panpot for each channel. All movements are remembered as part of the dynamic mixing system and can be replayed and updated.

● Soundcraft: New products have been flowing out of Soundcraft at such a rate recently that it would seem that consoles would have to be slowed in development. This is far from the case with three new consoles being launched in the last year. The *SAC-2* marked a move into broadcast units and the *Series 600* was for low budget 8-bus recording with 16-track monitoring. The main console for recording was, however, the *TS24*. This is the first in-line console from Soundcraft and they have tried to design a system that is easier to operate than standard in-line consoles. They have introduced a new set of master conditions that allows the console to be configured by a single button. The new concept is one of mix and channel and

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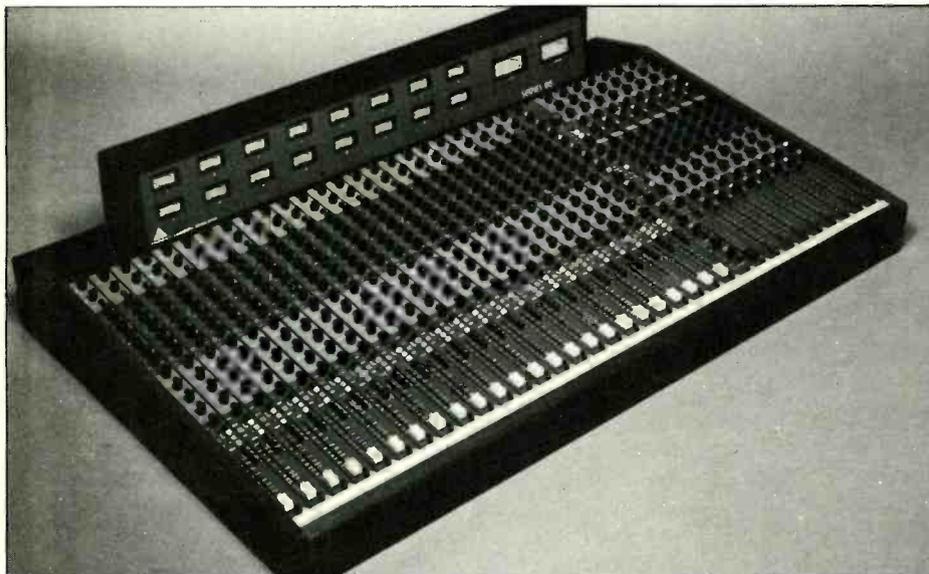
this will allow a simplified operation. In mixdown mode, the I/O modules can be used as two separate inputs thus doubling up on mix channels. Each channel has six aux sends, parametric EQ, balanced inputs and outputs with VU and peak metering.

● Soundtracs: Soundtracs now have a range of 22 different types of console. Their top of the range *CM4400* microprocessor-based console is reviewed in this issue and it is really developments related to this console that are perhaps the most newsworthy. There have, however, been a number of new mixing consoles introduced in the last few months. The *M Series* is a modular console for the 8-track studio, live use or the theatre. Each channel has four band

PA applications. The larger frame is wired for 16-bus use.

● Tascam: The new range of consoles is known as the *M-500* series. The *M-520* is a 20/8 configuration and the *M-512* is a 12/8. These consoles are compact designs with four aux sends, insert points on channels and groups, 3-band parametrics as well as direct outputs from each channel. The *M-520* is due to be reviewed shortly.

● Trident: Trident have recently introduced two new consoles. The *t.i.l.* is the first in-line console from Trident and has been designed to remove what Trident considered to be the confusing aspects of in-line use, ie that the aux sends move with the console status. The *t.i.l.* has the monitor section moved in-line with the input channels. The eight aux sends on the channels may then be individually routed to either input or monitor which removes a source of confusion. Also the EQ can be switched between the input and monitor or just the high and low ends or the two swept middle ranges as desired.



Series 65 16-channel desk from Trident

EQ, six aux sends, 8-bus and master routing. The mainframe is available as either 16, 24 or 32 input. There has been a new 24-8-16 added to the small recording mixer range.

Most recently they have announced a family of in-line consoles available in 18- or 26-channel versions. The mixers use some spin-off techniques from the company's microprocessor experience with the *CM4400* so that facilities such as solo-in-place, and a full range of master console modes are available from a single button. Each input has a sum mode that doubles the number of channels available for inputs. Using VCAs, any input channel can be configured as a sub-group.

● TAC: As a sister company to Amek, TAC have always handled the smaller mixers although the very successful *Matchless* in its largest mainframe is blurring this distinction. The *1682* system is being replaced by a new console known as the *Scorpion* which is based on the *Matchless* design but incorporates features from the *1682* series. Two frame sizes are available to give input sizes ranging from 16 to 32. Uses for the console are recording and

The *Series 80B* console has now been provided with 3-band EQ on the monitor and pushbutton routing to the remix bus. The number of channels on the console has had to be reduced by two to accommodate the additions although this should make little difference as the console has gained another 24 EQ'd inputs during mixdown.

The second new console is the *Series 65*. This is designed for the 4-, 8- and 16-track market with a maximum size of 40/8 with 16-track monitoring. The units have an interesting feature by the name of Output Assign. When recording with a console that has fewer bus outputs than tracks on the tape machine the engineer would normally have to repatch. The *Series 65* is fitted with 8- or 16-group output connectors and pushing the output assign will route from say track 1 on the eight bus unit to track 9, or track 2 to 10, etc. With this button pressed the monitoring is also switched. Other features of the console include eight aux sends, balanced transformerless inputs and outputs, 4-band EQ plus swept LF filter, four echo returns, in-place-solo and 3-band EQ on group or monitor. □

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THE E-V STORY

Robert Bolles charts the growth and evolution of Electro-Voice

For years, Al Kahn, founder and first president of Electro-Voice, called meetings of EV sales personnel to order by banging on the podium with an E-V model 664 microphone. He often stated—and would vigorously demonstrate—that the mic could be used to drive nails without affecting its performance as a microphone. As a result, *EV 600 Series* microphones were often referred to in the audio trade as ‘Buchanan Hammers’.

Buchanan, Michigan (population 5,142 as at 1981) is a lovely, quiet town, situated among gentle hills and peach orchards near the eastern shore of Lake Michigan. But here is where the history of Electro-Voice was written, and this small town was witness to some important milestones in microphone development. Electro-Voice today is still a vital element of this community and still attracts outstanding technical expertise to continue the tradition.

In 1920 Al Khan was a determined young man of fourteen, blessed with an intense curiosity, and an aptitude for radio. An account of his early life which appeared in the *Berrien County Record* (1955 edition), a Buchanan newspaper, stated: “‘Radio fever’ in the early 1920s was serious, and the neighbours felt sorry for the poor boy. He spent his days climbing around on roofs hanging up wires from lofty poles, and his nights in sleepless agony trying to pick

up long-distance reception on a regenerative receiver.” The neighbours could well have saved their sympathy for a more deserving soul, for Al Kahn soon found his talent and knowledge in demand, doing the frequent repairs required by radios of those days. Almost without effort, Al Kahn was in the radio repair business. And he liked it.

By 1927, Al Kahn and Lou Burroughs, a friend who shared Al’s fascination with radio, were doing business in their home town of South Bend, Indiana (close to the University of Notre Dame and just a few miles south of

Buchanan), under the name ‘Radio Engineers’. Their radio repair work had led them into the business of providing public address systems for temporary use by travelling carnivals, auto races, revival meetings, and other public events. Through this renting of PA systems they discovered growing demand for quality microphones. The delicate carbon instruments then available frequently malfunctioned, and could only be purchased as part of a system, not as separate components.

Radio Engineers

In the 1920s the microphone business was much different from today. In a sense, there was no microphone business. The original Bell and Edison patents had long since expired, but what interest there was in microphony lay in the telephone industry—and principally in the carbon microphone design of Edison. Western Electric was well satisfied with the profits generated in making microphones to satisfy the enormous demands of the rapidly expanding telephone system, and seemed unaware of the needs of the infant broadcast industry, or of any other small user. According to the *Berrien County Record* (1955), “The entire production was tied up by a giant monopoly and it was easier to sneak into the Sultan’s harem than acquire a microphone by any honorable means.”

In 1927 Kahn and Burroughs had established

Radio Engineers in the basement of the Century Tire and Rubber company in South Bend. At this site they first began producing microphones to use in their PA systems, and later to sell to people who couldn’t buy them any other way. Kahn: “Lou Burroughs and I began an association that has been devoted to problem-solving, filled with excitement and a great deal of fun.”

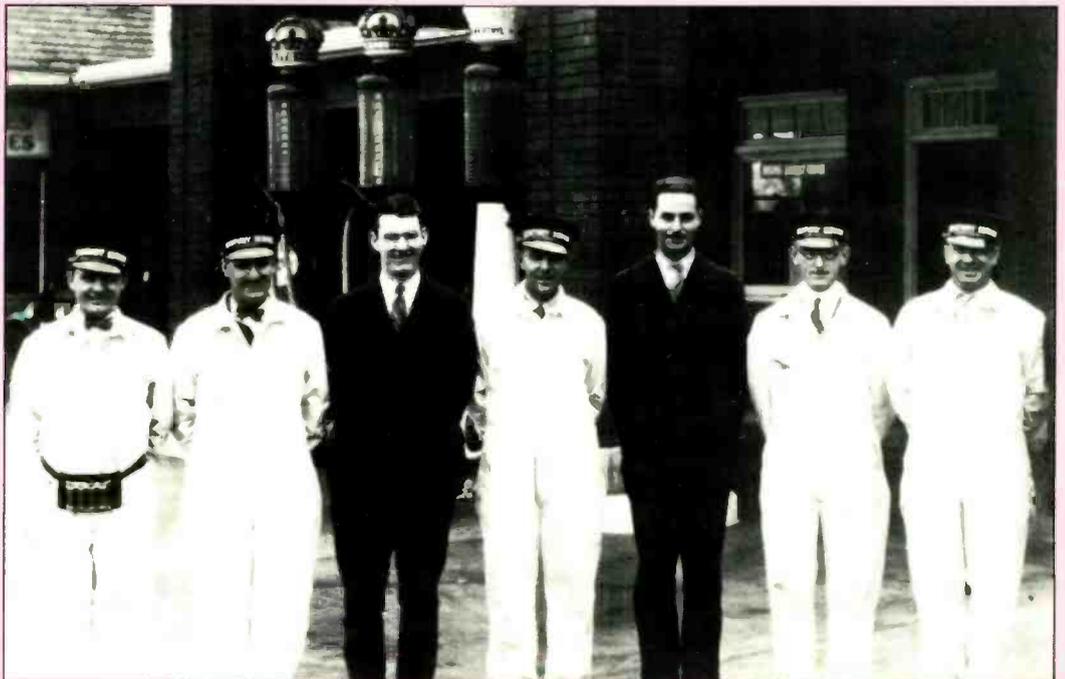
Electro-Voice—the first steps

During the early months of 1930 Knute Rockne, the legendary football coach of the University of Notre Dame, was recovering from an illness which made it difficult for him to supervise activities on the four practice fields just south of the university.

Kahn and Burroughs were asked to design a public address system to solve the problem. A tower was built overlooking all four fields and the talented duo designed a four-speaker system with a microphone and switching mechanism by which Rockne could bark training orders to each of the four squads. By some accounts Rockne referred to the system as his “electric voice,” and is credited with inspiring the name for the new company.

Incorporated on July 1, 1930, Electro-Voice was involved heavily in installation and rental of public address systems for churches and other public buildings. Politicians especially had become aware of the power of the microphone

Al Kahn (5th right) and Lou Burroughs (3rd right) outside Century Tire and Rubber where they had their first premises



to increase their reach, and demanded ever more powerful PA systems. Microphones were originally manufactured only for E-V's own use, but within a few years the balance had shifted and manufacturing microphones for sale to others had become the more important part of the business. Kahn: "The great depression was a wonderful time. You had to fight for everything you got. I can't think of a better time to have begun the company, because if you established the base during those years, you had a good start when the recovery came."

Humbucking coil

In 1934 E-V made a technological breakthrough that gave them a tremendous edge. While going through some old technical journals, Al Kahn had stumbled upon what he calls "an ancient watt meter—patented in 1892 or thereabouts" which had a balanced winding to cancel hum from the stray 60 Hz fields that the watt meter might pickup. As Kahn described it, "A little light bulb went off above my head, and I rushed back... got some tin snips, cut some laminations out, and I made a transformer and put it in and it worked!" Thus the humbucking coil was born, and solved a major problem for microphone users. According to an early E-V catalogue, the V-1 velocity mic "can be used within 18 inches of an AC line. No other velocity microphone in its price field has this feature at the present time." It was a major step forward for the industry, and for E-V.

Burroughs and Kahn

The T-45 lip mic was developed during World War II to increase intelligibility of battlefield radio transmissions



continued their efforts to improve both the product and the manufacturing techniques and in 1935 they developed a method for stretching dynamic mic diaphragms *before* assembly. The manufacturing economies which resulted caused a dramatic drop in E-V mic prices. Electro-Voice had shown that they were, seriously, in the business of manufacturing quality microphones.

By 1938, Kahn's company had produced several hand-held dynamic microphone designs. The Model 600 was described in E-V product literature as offering "Blast-proof high fidelity, close talking... ideal for sports announcing, mobile PA, aircraft, police and general PA and communication work."

Business grew steadily while Khan and Burroughs spent much of their time travelling—"converting people to our marvellous microphones throughout the country."

War years

By 1940 World War II had already begun in Europe, and the United States military was aware of its potential involvement in the conflict.

In 1940 radio communications in combat were estimated as being successful in less than 20% of all transmissions since the microphones then in use on the battlefield picked up battle noise as much as the human voice. What was needed was a noise-cancelling microphone that provided clear voice communications under the worst possible conditions.

Kahn and Burroughs again put their heads together and designed a mic which used a 180° phase shift to cancel

background noise. They engineered a lip microphone incorporating the new invention and tried to present it to the military. Kahn: "I tried to show it through regular channels at several different military bases and wasn't getting anywhere. But I had a friend, Web Soules, who was a signal officer at Fort Knox and he said, 'Why don't you come on down, we'll try it out!' Lou and I went down and put it into a tank. Now a tank's radio transmission and receiving range at that time was about eight miles. We extended it to twelve miles, because of cancelling the noise. Web was excited and he got a general to come. The general heard it and the general was excited. A few other (military) people came and heard the demonstration and they asked us to come back again. They had some observers there from the Marine Corps. They heard it and *they* were excited."

War production began soon after. (The military even offered to pay for development costs, which Kahn refused). Employment soared from a staff of six to a roster of 500 employees working around the clock. This mic became such a vital part of radio communications that Marine Corps officers later confided to Kahn that the landing at Guadalcanal was held up several weeks until the troops could be equipped with the mic in order to reduce casualties.

The demands on E-V were understandably enormous. Kahn recalls: "With everyone drafted it was a little rough. We had almost no one to work the third shift, so I took that, working from 11 pm to 7 am. I'd come back to the office to see what had happened and I'd stay all day. I'd sleep a couple of hours, come back and go to work again." Production peaked at 2,000 units a day, and total production came close to 1 million mics.

These E-V noise-cancelling microphones proved to be a most valuable contribution to the war effort, raising intelligibility of radio communications from 18% to 85%. At the close of the war, Lou Burroughs was awarded a special citation from the war department for the design and development of the T-45 lip microphone, which had been classed as a 'top secret' project during the war years.

Peacetime

During the war, the US military had encouraged suppliers to prepare for post-

war production, and E-V had accordingly planned ways to convert their knowledge and resources to peacetime use.

As commercial air service 'took off' after the war, E-V noise-cancelling mics were specified for use in all civilian commercial aircraft. This remains an important E-V market to this day as does off-road construction equipment, mining and railroad environments.

During the war, Electro-Voice had operated in several small buildings in South Bend, Indiana. But as post-war production needs expanded and changed. Kahn wanted to consolidate all operations in a single building. A suitable building in South Bend could not be found, so the present site in Buchanan, 20 miles to the north, was selected as the new home. At the time, the building seemed much too large for their needs, but it was soon filled to capacity and has been expanded steadily since then to its current size of 53,000 ft². Manufacturing facilities are also located in Newport Sevierville, Tennessee, and Redmond, Washington. All research and development activities are located in the Buchanan headquarters.

Acoustalloy for broadcast quality

Up to 1946 radio broadcasters had believed that only fragile ribbon microphones could deliver high quality sound pick-up. Early dynamic microphones were rugged and reliable, but were used mainly for public address systems because of the acoustic quality of the aluminium diaphragms. Lou Burroughs, working in the lab to develop a better diaphragm material, had turned to synthetic plastic, about which little was known at the time. Burroughs formulated a new film material which he dubbed *Acoustalloy*. Even under the worst of conditions *Acoustalloy* retained its shape, was much less easily damaged, and didn't have the inherent "tinny" sound of aluminium diaphragms. Most importantly, it greatly improved the quality of the sound.

E-V personnel also remember *Acoustalloy* as a combination of plastics and solvents that made a 'witches brew' of highly explosive methyls. A special room was set up to manufacture *Acoustalloy* safely and efficiently... and securely away from the eyes of the competition. Rather than disclose the nature of

THE E-V STORY

Acoustalloy in a patent, the formula was retained as a trade secret.

The marketing problem that now confronted Electro-Voice was to convince broadcasters that dynamic mics would truly deliver the quality of sound they needed. Kahn recalls that *Acoustalloy* was still experimental when the chief engineer at WBBM Radio in Chicago, who was desperate for microphones, since post-war production had not resumed, requested, "Whatever you can send."

"I remember apologising ahead of time," said Kahn, "because all we could offer were PA-quality mics. But Lou and I dropped his new *Acoustalloy* head into our 630 casing and shipped 12 of these to WBBM. They loved them! They took them on the road for remote broadcasts and soon engineers from smaller stations were convinced they needed our mics too."

Anechoic chamber

Al Kahn frequently found himself in conversation with physicists involved in acoustic research. After one such conversation about some new concepts in free-field testing, Kahn hurried back to Buchanan and sketched plans for what became the first anechoic chamber ever built outside a research laboratory. For E-V engineers, the chamber became an invaluable research and quality control tool.

Before its construction, free-field testing of microphones took place on a water tower atop the factory. Tests were run late at night when the birds were sound asleep and men had stopped their noisy hustle and bustle. Of course, as Kahn points out, such tests were at the mercy of wind, rain and passing trains. The anechoic chamber provided a welcome change from such unreliable circumstances. Today a much larger chamber at Buchanan is a fundamental resource for their engineers, while smaller versions serve production lines in all their factories.

According to Alan Watson,

chief engineer/microphones, "The anechoic chamber is still the very best means for testing free-field response. Other approaches—TDS and FFT—are all techniques to try and emulate the best characteristics of an anechoic chamber, but they don't actually do it. At best they can approach it, never equal or exceed it."

Holography

Electro-Voice pioneered the use of holographic interferometry to study the motion of microphone diaphragms. Enthused by the promise of laser technology, E-V asked researchers at the University of Michigan, a centre of holographic research, to investigate diaphragm behaviour.

In spite of some strange results having to do with the researchers' attempts to spray paint the diaphragm in order to avoid the problems of the diaphragm's transparency, E-V engineers were convinced of the value of this technique, and decided to bring the laser process in-house. They have used laser testing ever since, developing their own methods for solving the transparency problem. Since then, holographic interferometry has been an important tool in standardising manufacturing processes to ensure uniform performance of products. According to Watson, "Holographic analysis has provided insights into diaphragm motion that weren't known prior to the use of this technique."

Research on the road

Product development and improvement was greatly influenced by E-V's interaction with customers, from which they gained knowledge of needs in the marketplace. Over the years, Lou Burroughs travelled throughout the country offering sound advice on microphone usage to all who would listen. He had a gift for listening to and understanding the specific needs of anyone who used a microphone. His lectures were often referred to as 'Dr Burroughs Medicine Show', and, indeed, his ingenuity in diagnosing a problem could usually be depended upon to cure the affliction. Burroughs would return from his trips with the concerns, frustrations and dreams of microphone users foremost in his mind. Then he would go to work along with the engineering

staff on practical solutions to the problems he had identified. Burroughs would then return to his audiences, providing instruction without seeming to do so, packing information into informal talks.

A legendary E-V product which grew out of this process is the 643, a 6-foot-long monster mic for picking up distant sounds. Although the 643 is no longer manufactured, it is still being used at presidential press conferences, political conventions, athletic events and other situations where conventional microphones cannot handle the distance problem.

In 1954, E-V introduced and patented the *Variable-D* microphone. The *Variable-D* effectively eliminated proximity effect through a multiple port design at the rear of the diaphragm, which provided more uniform frequency response at all angles of incidence and a more natural sound at all miking distances. The *RE20*, a *Variable-D* design, is today one of the most well-known microphones in the

world for voice recording and reinforcement.

Award-winning mic

Electro-Voice is one of the very few manufacturers ever to receive the Motion Picture Industry's Academy Award (Oscar) for the development of a new microphone. The model 642 *Cardiline* mic received this prestigious citation in 1963. The award read, in part, "To Electro-Voice for a highly directional dynamic line microphone... capable of picking up sound in situations where a microphone cannot be placed close to the sound source and where unwanted sounds are to be discriminated against. For these purposes, this device is a valuable addition to the microphones available for motion picture recording."

During these years, significant American competition for Electro-Voice microphones was developing, but as Kahn points out, "It was an enjoyable situation."

Helen O'Connell, vocalist with the Jimmy Dorsey Orchestra in the 1940s, using the Cardyne cardioid dynamic mic



The 643 line mic for picking up distant sounds was used during Queen Elizabeth's visit to Stuttgart to 1965





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THE E-V STORY

Our competitors were businesslike and honourable. The focus of the competition was performance and technology, not price, and the benefits for the customer were always the bottom line over which we contended."

Other products, other times

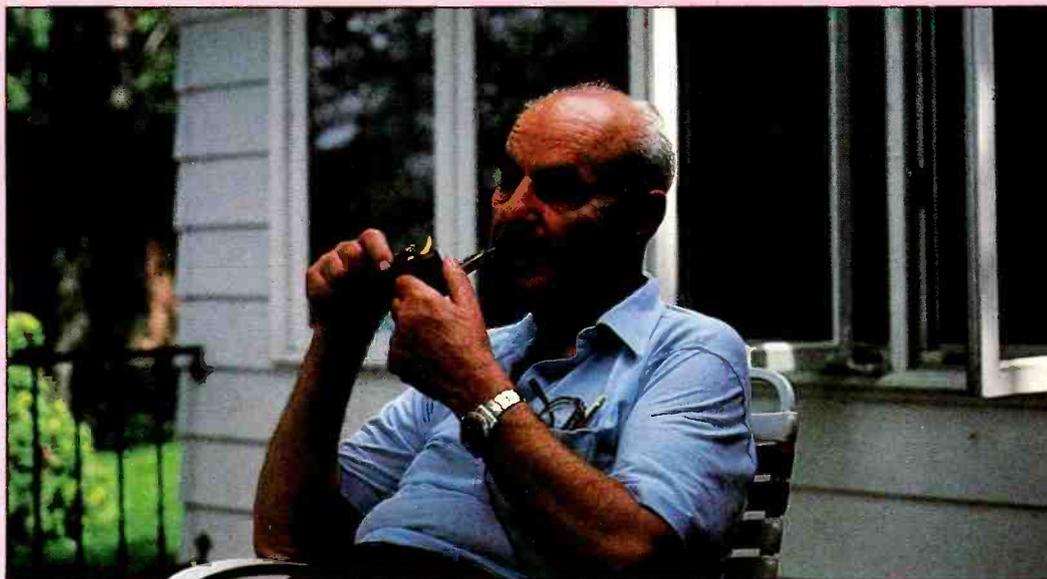
By the late 1940s Kahn had expanded the engineering staff of his microphone company to include personnel experienced in the design and manufacture of loudspeakers. Much of the early E-V work in loudspeakers involved high-quality systems for the home, such as the legendary *Patrician* series, and later, smaller-format bookshelf systems. EV's work on the adoption and refinement of the systematic low- and mid-frequency design theories of Australian researchers Neville Thiele and Dr Richard Small has produced some important results. E-V also developed the first loudspeaker with directional control of high frequencies referred to as 'constant directivity' and by 1980 had applied CD to complete loudspeaker systems. These and many consistent contributions have led to more than 160 patents in the area of speaker design for the company.

The E-V dedication to meeting people's needs led it into several related businesses such as television signal boosters, and E-V electronic organs brought sound to thousands of homes and churches throughout the US.

Electret development

Today, E-V is one of the leading producers of electret microphones. The road to that position was not easy or simple.

In the 1950s, Electro-Voice began experimenting with the electret concept. E-V engineers developed experimental transducers based on thin plastic films at a time when electret researchers were still working with thick wax blocks. During this period,



Al Kahn pictured at his summer home on Diamond Lake in Michigan

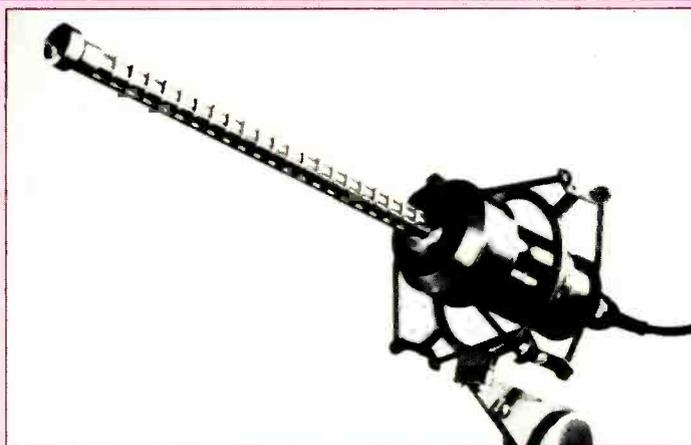
they produced a pilot run of a commercial electret microphone model. However, under conditions of high humidity, the electret charge would drop.

The programme was abandoned when it was determined that the available plastic films had inherent defects that made the construction of a reliable product virtually impossible.

In the next decade new plastic films had been developed, manufactured to quality standards unheard of in the 1950s, that made electrets commercially feasible.

A process was developed at E-V which allowed electret charging with no degradation of the plastic film. This process, which remains a trade secret, is used to produce high-quality electret transducers with exceptional stability. This electret technology allowed the degree of miniaturisation needed to make a new second-order gradient mic now in production for the military. The advanced noise-cancelling of this mic now provides intelligible communications in intensely noisy military environments such as helicopters and high-speed tanks. Much of the engineering at E-V has been aimed at making E-V microphones perform under conditions that were much less than ideal.

One rigorous test came with NASA's Skylab missions, when specially designed microphones and speakers were shot into space for use by astronauts during docking procedures. Even with a lost heat shield, the equipment functioned without fail throughout Skylab's six years in orbit. E-V mics also equipped the early Mercury and Gemini space missions. Presently, E-V has proposed a



The long range pick-up mic, model 642, won wide acceptance in the film industry and E-V won an Oscar in 1963 for its development

communication device for use in NASA training cells where astronauts prepare for Shuttle flights. Forced air is used to simulate weightlessness in the 'tank' creating a noisy environment and a perfect application for noise-cancelling expertise.

This involvement with military and space products has spin-offs that help produce rugged civilian products.

Continuing commitment

From its beginnings in a basement in South Bend, Indiana, many things have changed for E-V. In 1967, when Electro-Voice was acquired by Gulton Industries, gross annual sales had approached \$20,000,000, a far cry from the profit of \$15,000 earned in 1935.

But many things have remained the same. Reliability is still the highest priority. "It can look like it's been through the war... you can drop it on the floor, bend it, scratch it, but when you pick it up, it's going to work.

"Really, when you get right down to it, all we do in this world is solve problems. That's all you're doing regardless of what your profession is. And the better you solve a problem the more successful you are."

Those are recent words of Al Kahn, who is today a hale and hearty 78 years young. He lives on a mountain near Gatlinburg, Tennessee, from which he supervises the activities of Ten-Tec Corporation, a manufacturing business of ham radio equipment developed by Kahn to provide job and learning opportunities for disadvantaged residents of Tennessee, his adopted home.

Lou Burroughs is enjoying a quiet, well-deserved retirement in Arizona, where he reminisces about the many famous voices who were helped to national prominence through his efforts. Burroughs, known and respected throughout the audio industry, continues to be a teacher of microphone techniques for users around the world through his highly-regarded textbook *Microphones: Design and Application*. □

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I know I'm good at getting lost, but this was ridiculous. Having left home a good half hour early, and finding myself arriving an hour and half late was going to take some explaining—even to myself, and I was there.

"No, you came the wrong way," Mike Cobb, studio manager assured me. "We're really only 35 minutes away from London, and it's not difficult. Really."

Not to be consoled (pun unintentional), I busied myself with asking studiofile-type questions to occupy my distracted mind with more beautiful thoughts. Actually it was Derby day. I mean, on any normal day if you get lost you don't end up in 10 mile long queues of traffic do you?

Anyway, Surrey Sound studios was not what I had expected at all. I have always been under the impression that although the studio was consistently turning out hit records, the place itself was, well, a bit under developed. Now if this was true, the Surrey Sound of today has swung to completely the opposite end of the balance. Large, spacious, comfortable, professional, excellently equipped—these are the phrases which spring to mind as you survey the scene.

Producer and proprietor Nigel Gray, was seated inconspicuously behind the desk with his engineer Jim Ebdon looking like something out of one of those Zanussi advertisements they have on the television. Seriously though, the change is stunning. The rooms are both large with high ceilings and a lot of space.

Situated in an old Co-operative community hall above the Co-op Dairy, the studio's outer appearance is very unassuming. Surrey Sound started out in life towards the end of 1975 when Nigel Gray (and brother Chris) built a studio for his secondhand 4-track. Six months later Mike Cobb came along as a customer and became involved with the studio itself. At the end of 1976 they upgraded to 16-track, and at this time their work consisted mainly of demos.

The turning point really came in 1979 when Miles

Surrey Sound Studios, Surrey

Copeland went down to Leatherhead with three or four of his bands including Squeeze, the Police and Chelsea. Mike Cobb takes over the story: "Kevin Godley and Lol Creme started to come in around this time as well, mainly because they live locally, and they found that they liked the studio. It was whilst they were here that we upgraded to 24-track, with MCI throughout." Surrey Sound was obviously on the road to becoming established. "Roxanne was also a hit for the Police whilst they were here and their first album was a huge seller." Thus Nigel Gray was beginning to make waves on his own account as a producer. "All of a sudden the studio had quite a reputation and Nigel was established as a producer."

The Surrey Sound empire began to develop and grow. Sesame Songs was set up by Mike Cobb and in 1980 it developed into Surrey Sound records which was also run from the Leatherhead base. "The record label didn't have any hit records but we did get a lot of good deals. Eventually we ran out of finance and the company finished at the end of 1981."

In 1983 it was decided that the MCI equipment needed changing and the studio closed for refurbishing, re-emerging two months later totally transformed.

There are three companies operating at the moment: the studio itself, Nigel Gray Productions, and their own publishing/production

company. "It's a risky business," continues Mike. "The studio is the one aspect which does not depend on creativity or speculative work—anyone can come in and pay a fee. As long as the studio is working it should make a profit."

"The other two companies are entirely speculative products—a lot more risky. Being tied up with the studio eliminates the recording cost which is one of the major expenditures of a publishing/production company, and we do this by using 'dead' time. The studio should be working seven days a week on a commercial basis."

"We're in the album market—entirely mastering; we very seldom do demos. We're geared to doing masters with our equipment and our set up."

The studio is about 26 ft wide by 32 ft long and the ceiling is approximately 13 ft high. The walls are finished in pine with a stud and track sound proofing system behind. Two thirds of the floor is carpeted with an area at the back of the room left simply as polished wood. In one corner there is an isolation booth large enough to take a drum kit. These walls are finished with mirrors and tongue and groove, and access is via patio sliding doors from the studio.

The ceiling slopes on both sides, following the shape of the roof above it. The passage running down the side of the room is a fairly recent addition and its ceiling was causing problems by being

considerably lower than that of the studio. Fairly hefty soundproofing had to be incorporated.

The control room juts out into the recording area, effectively breaking up the front end wall. The control room has in fact been considerably enlarged and is now 26 ft at its widest point and 18 ft at its deepest. Mr Gray was specifically aiming at having as large a control room as possible as nowadays he prefers to record almost everything in here.

Mounted either side of the window are the Electro-Voice *Sentry III* monitors approximately 5 ft above the floor. The studio was using these monitors before the refurbishment and there was no question of changing them. Nigel feels they give a very good clean sound—they are completely unflattering. You can take the tapes home after a session and they will sound just as good there as they did in the studio.

In the alcoves underneath the monitors, the machines are housed: Otari *MTR 90* 24-track, ½ in stereo and ¼ in stereo machines, all of which Gray is reputed to have fallen in love with. Additional facilities include four of the Sony *TC-K81* cassette decks and a *PCM-FI* system.

The choice of desk involved a bit of heartache but their final choice was the Harrison *MR 4*. Surrey Sound was the first UK commercial studio to have this console installed and it has proved to be a wonderful asset. The only problem here was that it was planned to take delivery of the Audio Kinetics *MasterMix* computer at the same time but this finally arrived nearly a year later in May. Mini monitors mounted on the desk are Teac *XL-7s*.

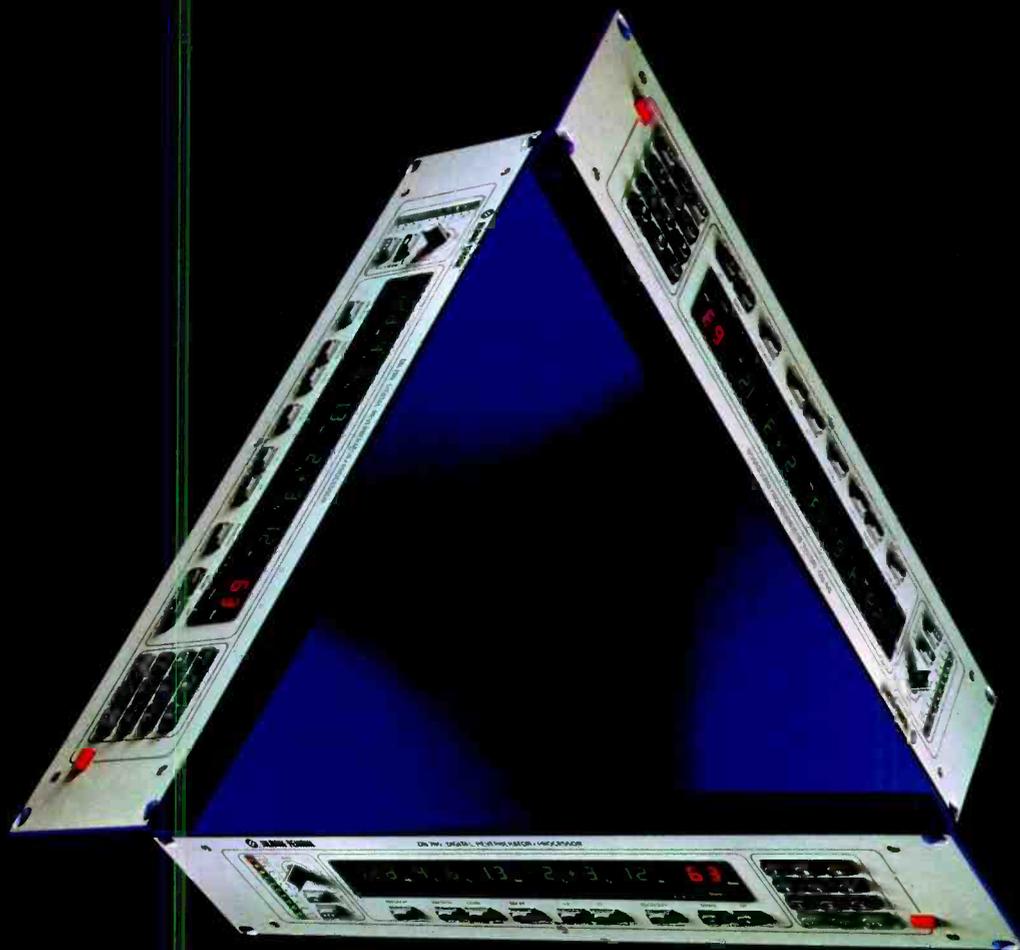
The control room ceiling is angled again with a timber frame and covered with Rockwool and pine. There is an area over the desk itself which is covered with the same material as that used over the monitors.

The outboard gear is fairly standard and comprehensive: dbx noise reduction, an AMS *DMX DDL*, two MXR 15-band graphics, an Orban de-esser, dbx 162 stereo compressor/limiter and a *Boom Box*; Rebis



A small universe

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parametric, Eventide H910 Harmonizer, Audio & Design Compex limiter and Express limiter. They also have a Scamp rack filled with noise gates, flanger, phaser, compressors and Autopan. Reverb is with an EMT plate.

The microphone collection (this sounds like a fashion show) includes Neumann U87s and 67s, Brüel & Kjaer, AKGs, Beyers and Electro-Voices.

There are also several instruments, mainly guitars lying around in various corners. But what about the piano? "The piano?" says Mike, "the piano is something that ought to be thrown out." But it's a Broadwood grand, I protesteth. "Yes, but it takes up so much room," as if they didn't have enough to spare, "and, well, there's a couple of

Surrey Sound (continued)

notes missing! It does record very well though when it's tuned and everything. But people don't tend to want to use a piano these days. Last year we had a band that literally came from all over the world to record their album here. They all arrived and started on the first session. The piano player stood up and said I'm sorry this piano is no good, so they all packed their bags and went home again!" Crazeee. What's wrong with hiring a piano? "That's exactly what I said, but they went. Strange."

In addition to the actual recording facilities, there is a kitchen where food is provided, including a full evening meal. Above this is the TV lounge. There is, as yet no

accommodation, although it is easy to fix clients up in local hotels. There are plans for the future conversion of one of the rooms into bedroom accommodation, but nothing very definite as yet. It isn't really a problem, as not that many people actually want to stay around the studio all the time anyway.

MC: "We are so close to London". I must confess at this point that I did miraculously manage to get home in 35 minutes! "We can compete very realistically with the London studios and we have done some very good work here. The studio reopened last July doing an album for American artist Helen Schneider; a single for the Lotus Eaters—that *First*

Picture of You which was nice; we did an album for Danse Society and a single. Since then we have been fully booked with Nigel's productions: Shadow Talk, Indians in Moscow, Wishbone Ash, and a single for Godley and Creme which was produced by Trevor Horn.

"Our major client is Nigel Gray producer and his production work because he likes to work here. He built it and did everything to it himself—he knows this place backwards and is therefore very happy here."

And so he should be. It looks good, sounds good, and the product that comes out speaks for itself. **Janet Angus**
Surrey Sound Studios,
70 Kingston Road,
Leatherhead, Surrey. Tel:
(0372) 379444.

Just a short walk from the centre of Dublin, near the quay where the Guinness tankers used to dock, is Windmill Lane. The name derives from a windmill that for many years ground tons of grain brought in by boats along the River Liffey. Beside the mill there stood a grain store with massive granite walls built to withstand the outward pressure of the grain as it settled.

The old windmill has gone and the Dublin docks have moved down river but the great granite grain store still stands and is now the home of Windmill Lane Studios. The top two floors of the three storey building house 16mm and 35mm film editing rooms, two broadcast standard video editing suites sharing five Ampex 1 in C-format and two Sony BVU high-band U-matic machines, plus a small video studio, Rank Cintel Mk IIIC Digiscan telecine, and a low-band U-matic off-line edit suite. The ground floor houses one of the company's two sound recording studios.

This combination of film, video and audio facilities in one building came about because some six years ago James Morris, a bass player who ran a film editing company with Russ Russell and Meiert Avis, suggested to Brian Masterson, a bass player who had become a recording engineer, that the four of them should set up in business

Windmill Lane Studios, Dublin

together. The plan was to expand the film editing, introduce video editing and offer first class recording studio facilities to attract Irish and international artists.

In the early 1970s Brian Masterson had cut his teeth on the Ampex MM 1000 series 8-track in Ireland's first multitrack studio which was owned by Eamonn Andrews.

Andrews was for many years Terry Wogan's predecessor as the all-purpose Irish front-man on British radio and television. As other multitrack studios began to open in Ireland, with ever increasing numbers of tracks, Brian Masterson began to feel the limitation of 8-track at the Eamonn Andrews Studio. He became a freelance engineer, gaining experience in Dublin and London. Then came the opportunity to form the present company.

It took some time to find the right sort of premises but as soon as Windmill Lane had been discovered the design and construction work began. The sound studio had to be able to cater for a wide range of musical styles as Brian explains:

"In Dublin you can't really afford to specialise in one type of music so the idea was to build a general purpose studio—if there is such a thing. I think we've just about succeeded in that. It's big enough (98 sq m); we've had a

45 piece orchestra, army brass bands, and various combinations of rock and classical sessions. It does seem to suit most people."

The studio certainly has a very pleasant atmosphere. The design by John Storyk of Sugarloaf View, New York, is both acoustically and visually attractive. The acoustic treatment on the main end wall is particularly interesting. It combines vertical slat resonators of unplanned white deal alternating with areas of brickwork using a mixture of protruding and recessed bricks, and a couple of strips of fine Irish wool carpet. The ceiling at that end of the studio has been extended through to the next floor to create an area ideal for woodwind, brass and strings. A number of Audio Kinetics acoustic screens tend to congregate here too.

There is the familiar range of mics: AKG D12, D222, C414, C33 (fixed cardioid version of the stereo C34) and C12A (tube); Calrec CM1050C; Electro-Voice RE20; Neumann KM84, U47, U87 and U67 (tube); Sony C55 vocal mic. Brian Masterson has been a firm fan of PZMs since they first appeared and has half-a-dozen of them.

The studio was originally provided with a Yamaha 7 ft 8 in grand piano but as part of a recent upgrading the

Yamaha was transferred to Studio 2 and replaced by a Steinway 9 ft concert grand.

A major part of the upgrading was the installation of a 40-input Solid State Logic SL4000E computer controlled desk. There is space for another eight channels which may be fitted if 32-track becomes the accepted digital format. The arrival of the desk involved Brian in a dawn trip to the docks.

"It's Value Added Tax at point of entry. I had to actually meet the boat at 7 o'clock in the morning with a bank draft for £50,000 which was the VAT on the mixing desk. We have two VAT rates here. We've got what is euphemistically called the 'low' rate. That's 23% on services and certain 'non-luxury' goods. The 'luxury' rate is 35% and that comes on things like toilets, wash hand basins, baths... The Government's definition of 'luxury' is not quite anybody else's definition.

"Obviously a mixing console is a luxury item so it's 35% and you have to pay that the moment the goods enter the country. You're supposed to get it back in your next VAT returns period but they always seem to find the paperwork has gone astray and we're waiting months and months and months for our money back. It was a sort of once off scheme to suddenly increase the Government's cash flow by

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bringing forward all their back revenue but the effect its had on small business has been absolutely disastrous. A lot of small businesses don't have that sort of cash flow possibility and they've just gone to the wall."

As the SSL desk was moved into the control room all the multitracks, reverb units, and other fan-cooled gear was moved out to join the SSL computer in the former isolation booth—now called the equipment room—where they can whirr away at one another in air-conditioned comfort (exactly 18°C) without intruding on the silence of the control room, but still visible through the double glazing. Mic lines have been installed to allow the sound lock to be used as an isolation booth.

The tape machines are an Otari *MTR-90 Mk II* 24-track with Dolby *SP24* and two Otari *MTR-10 ¼* in 2-tracks which share a pair of Dolby *A361s* plus a Sony *PCM-F1*.

A pair of Electro-Voice *Sentry 100A* monitor speakers with a source selector are provided in the equipment room for editing, etc. Tape machines can be isolated from the SSL desk when editing or running safety copies, to ensure that there is no danger of breakthrough.

Reverb is by EMT stereo plate, and Lexicon *224* and Sony *DRE-2000* digital reverb units. The outboard equipment bay in the control room includes AMS *DMX 15-80* delay/pitch changer and *DM 2-20* flanger/phaser; DeltaLab *DL2* delay; two Drawmer dual gates and a *DL221* dual compressor; Eventide *H949 Harmonizer*; Orban *516EC* 3-channel de-esser; Roland *SDD-320 Dimension D* signal enhancer; UREI *546* dual parametric EQ and two *1178* dual peak limiters; plus disk drives for the SSL desk and space for hired in gear.

The main monitors were upgraded two years ago to a design by Andy Munro of Turnkey Two using soft-domed mid-range and tweeter. They are tri-amped with BGW *750* for the bass, BGW *600* for the mid and Amcron *D-150* for the top end. Brian is delighted with them.

"I can't believe the difference, going over from horn-based systems, it's just

Windmill Lane (continued)



fantastic. Up to now the technology hasn't been there to get this power level out of mid-range and high-range drivers without resorting to horn-loading and things like that. Horn-loading definitely has its defects in terms of beaming and a sort of hardness to the sound. These are very easy to listen to, there's no fatigue, and they're liked by everybody who's used the place since we changed. I'm full of praise for Andy." The mini-monitors are a pair of Yamaha *NS10* speakers which Brian bought in Hong Kong two years ago when they were not available in Europe.

The Studio 1 suite is completed by a small cassette copying room with Sony *TC-FX66* machines—the ones with a real time counter and 'laser trimmed amorphous heads'—and an artists' rest room with video, kitchen, and the usual 'luxury' facilities.

"In all fairness it was definitely something above the standard at that time for Ireland. I suppose it was a calculated risk. I had a lot of faith in both the Irish side of the music business and getting the international work. We've had a good deal of success with attracting international acts in. Not from the States. That is something I'd like to do very much but it seems difficult to get American bands over to Europe in general. I don't think the English recording scene is exactly busy with American bands recording there either. They tend to stay in America and record in America. But I think Ireland has a special attraction for Americans. So many of them can trace their heritage to Ireland—not just

Ronald Reagan but lots of others."

U2 have recorded all their albums at Windmill Lane and, at the time of my visit, they were just completing the latest with producer Brian Eno. Other international artists who have used the studio include Status Quo, UB 40, Hot Chocolate, and Rick Wakeman. There are also the internationally successful traditionally based Irish bands like Clannad, Moving Hearts and The Chieftains who had previously recorded abroad.

The studio has not had to push really hard for international work because there is always plenty of work with Irish artists, less well known outside Ireland, recording both contemporary and traditional music.

This growing interest was one of the things that led to the opening of a second studio. The original idea was to build another studio close to the main building, but at the time a small studio near the centre of Dublin was up for sale. It had been built in a style very similar to Windmill Lane Studio 1 and no one else seemed to want to run it as a studio so the lease was bought up. Brian thought it would be wrong to let it revert to its former use, as a squash court, after all the work that had been put into it.

The former 16-track studio had been gutted and needed to be completely re-equipped and considerably refurbished before it opened in March 1983 as Windmill Lane Studio 2. The new installation included an Otari *MTR-90 Mk II* with 16-track and 24-track headblocks to complement the Otari multitrack at Studio 1.

"We made a decision not to make any compromises in the tape machine department because we foresaw a situation where clients from Studio 1 might like to avail themselves of overdubbing time in Studio 2. When you're overdubbing you don't need a huge studio or an amazing amount of outboard equipment but you do obviously need compatible tape machines.

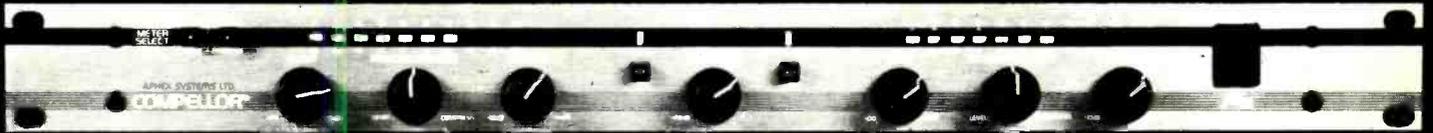
"Our philosophy at the beginning was to provide lower-budget facilities for the less wealthy musicians. A place where the new young bands—and the young engineers—could get started when other studios were closing all around. We offered a 16-track as well as a 24-track at low rates and it immediately filled up. But we found that over the year and a half since it opened client demand has had us updating and updating."

The process of updating has brought Studio 2 a collection of outboard equipment to rival Studio 1: AMS delay/pitch changer; Bel *BF-20* stereo flanger; dbx compressors; Drawmer noise gates and compressors; Roland *SDE-2000* digital delay; plus AMS *RMX 16* digital reverb and a couple of EMT plates. There is a similar selection of mics including the *PZMs* which particularly suit the 'stringy' sound of the bouzoukis and guitars in traditional music. Andy Munro has done some work on the Gauss main monitors and Brian has bought another pair of Yamaha *NS10* mini-monitors.

The final stage of the present update will be the installation of a new desk and the removal of all whirring machinery to an equipment room. The 56 sq m studio can comfortably accommodate 20 performers.

A business built on such foundations is unlikely to fail, but it is a tribute to Brian Masterson as managing director of Windmill Lane's sound studios that they have managed to expand and update at a time when other Dublin studios—Eamonn Andrews' 8-track studio and Philip Green's two 24-track Dublin Sound Studios—have closed down. **Tim Leigh Smith Windmill Lane Studios, 4 Windmill Lane, Dublin 2, Eire. Tel: 01 71344.** □

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BUSINESS BUSINESS



Barry Fox investigates the facts behind the industry news

Undercover

Big name pop groups now charge so much to play at a concert that concerts only make a profit if they are held in enormous halls or open arenas which can cope with an audience of many thousands. That in turn means that the group has to use a mammoth sound system which costs a fortune to hire and transport from hall to hall. So up goes the ticket price even further.

Every now and again a group gets tired of it all and does a 'secret' gig in a small club under a phoney name. The idea is to get back to the roots. Inevitably someone always spills the beans and the 'secret' gig is packed out after overnight queues halfway across town.

My teenage kids recently heard about a 'secret' gig by pop group the Police. They queued, paid £3 each to get into the club and £1.15 at the bar for a half of lager. The 'coppers' will be on at 10pm said the bouncer on the door with a nudge and a wink. The bouncer was right. The coppers did come on at 10. Five young trainee fuzz, all wearing silver glitter suits instead of their customary royal blue. They played a medley of hits from *Fame* and *Evita* with considerably more enthusiasm than ability.

What a nice little racket. Most of the audience were fuzz as well. So, who's going to start a riot?

Working DSP

Whatever happened to DSP? Tape One in Central London has quietly started to use a DSP mastering unit. Clearly there are all kinds of political reasons why everyone involved studiously avoids using the words 'console' and 'desk'. The Neve press release talks instead about a 'two channel unit for digital audio post production'. True, there is no control switching logic, just sound processing. But it's DSP. Tape One got it at cut price, for the simple reason they were prepared to play guinea-pig. It paid off. "We can't fault it," says Bill Foster "and we shall get our money back through being first in town. We didn't go into digital processing to further the art of digital science. We did it to make money by doing it properly."

So what does it do, and why? Let's try to fill in some of the gaps between the lines of the official Neve statement, carefully tailored not to offend the BBC or CTS by stealing their launch thunder, but keep faith in the DSP concept until the launches are ready to thunder.

When a digital master tape is prepared for CD or vinyl cutting, it will usually need at least some processing, for instance equalisation, filtering, limiting or compansion. If this is done in the

analogue domain some noise and distortion is bound to be added. The DSP simply does it in the digital domain. Emphasis is stripped off at the input, before processing. At the output, emphasis can be added, but digitally, and thus exactly to spec. There's a suspicion in some quarters that some Japanese CD plants are adding emphasis by temporarily shunting the digital signal back into the analogue domain. EQ in the digital domain is easier to control, with exact frequency readout. You select a mid band frequency of 50 Hz and you get exactly that. The limiter has a side chain with a delay of a few milliseconds. That way there is no overshoot on transients.

The result in theory, and according to Bill Foster in practice as well, is a cleaner top end. When a signal goes through Atilla (Why Atilla, it's not German? It looks like a cash till!), there's no phase error, or channel imbalance, on heavy EQ, which could upset vinyl cutting. "Get into digital at the earliest stage, and stay there," says Foster, "that way the signal stays pure. Of course on early tapes, like Beatles recordings where Lennon stood too close to the mic or Tamla mixes, there's distortion. But this way you hear the original distortion and no more. You hear what Smokey Robinson heard in the control room."

Canned response

If you are one of the countless millions who watched the nauseatingly anodyne interview between Michael Aspel and Prime Minister Thatcher on London Weekend Television earlier this year, you may have wondered how on earth the PM got such enthusiastic applause from a studio audience at a time when public opinion over the miners' strike was running so high. You may also have wondered why the applause sounded so manically hysterical. Also why was the audience never shown while Aspel talked to Thatcher?

If you are thinking the obvious, perish the thought. LWT swears blind that

there really was an audience applauding live. "We can categorically assure you of this," said LWT. The audience received their tickets weeks in advance, before anyone knew that Margaret Thatcher and Barry Manilow would be on the show. Fortunately for LWT, the kind of people who spend months on the waiting list for tickets to see the Michael Aspel TV show are not on the whole the kind of people who feel strongly about politics. Most of them come from womens' institutes and mothers' unions. LWT assures me that the manically rapturous applause and laughter at everything Thatcher said really did sound that way in the studio. If anything it was toned down. So here we have the supreme irony; a live audience that sounds more canned than a phoney laugh track.

Did you know how laugh tracks were born? John T Mullin of 3M was working on the 1947-48 winter season of Bing Crosby shows in Hollywood. They had started pre-taping the shows in 1947 with two German Magnetophons, which Mullin had commandeered in Europe while in the US Signal Corps, along with 50 rolls of BASF tape. In 1948 Ampex replaced the Magnetophons with the first Model 200s and 3M came up with a suitable tape. Mullin, writing in an American magazine years later, recalls how one night hillbilly comic Bob Burns threw in some farm stories which were not in the Crosby show script. Although by today's standards they were about as blue as the Aspel-Thatcher interview, in those puritanical times they had Philco, Crosby's sponsors, worried.

Mullin had to cut the jokes out before the broadcast. But they had got by far the best laughs out of the studio audience. Script writer Bill Morrow told Mullin to save the laughs. In a later week's show, the script was dull and the audience hardly tittered. So Mullin dubbed in the audience laughs from the Bob Burns jokes. You can't fool all the people all the time and listeners wrote in complaining about the phoney sound. Perhaps LWT can save their audience reaction to Margaret Thatcher, and keep it for a rainy day. □



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ERGONOMIC ASPECTS OF MIXING CONSOLE DESIGN

The field of sound engineering is characterised by increasingly complex and sophisticated electronic equipment. This is particularly true of sound mixing consoles as Swettenham has remarked in the context of the recording studio.¹ The increased operating demands placed on the sound engineer by these devices must be matched with his abilities, capacities and limitations if he is to perform his job with maximum effectiveness.

Since the invention of the first simple tools, the importance of human factors in the design of equipment has increasingly been recognised. Traditionally devices have evolved by a process of trial and error. However, with the relatively recent proliferation of complex technology has come the realisation that such an approach to the problems of functional effectiveness and human welfare is inadequate. Consider, for example, the design of a nuclear power station control room. How many displays can the operator handle at a given time? How much 'feel' should be built into the controls? At what height should the operator be positioned relative to his console? Should he sit or stand? For how long can he remain effective?

Ergonomics is the name given to this area of study. "The ultimate goal of the field is to help in the design of equipment, tasks, work places and work environments so that they best match worker abilities, capacities and limitations."² Ergonomics is not a separate and distinctive discipline; rather it represents an area of overlapping interest, drawing upon subject matter from fields as diverse as Anatomy, Toxicology, Applied Physiology, Industrial Design, Engineering, Psychology and Sociology. Central to its objective is the concept of man-machine systems.

Man-machine systems

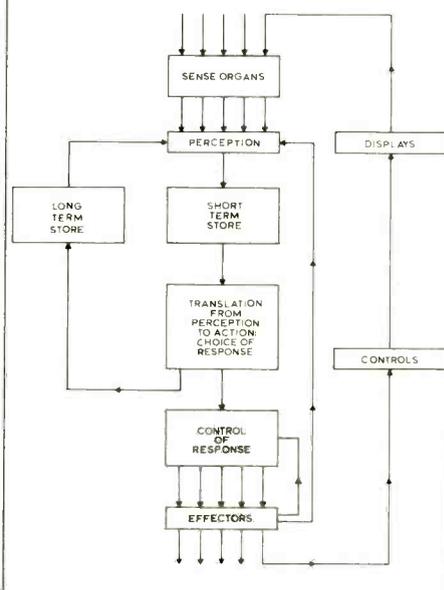
McCormick and Sanders³ define a man-machine system as: "... a combination of one or more human beings and one or more physical components to bring about, from given inputs, some desired output". Thus as Singleton⁴ observes, tanks in a battle are rendered more or less effective not by the efficiency of the tank per se, neither by its crew, but by the man-machine system. In a motor race at Le Mans, neither the drivers nor the cars determine the outcome. Rather it is an interaction of both as a man-machine system.

Similarly the quality of sound, whether in a recording, television, or radio studio, or at a live performance in a concert hall, will be determined by the combined

PART ONE

There are many sides to mixing console design that are derived from what has become the accepted norm. In this two-part article Gerard Paul Hodgkinson looks behind established principles and gives an overview of ergonomics—the problem of fitting the task to the man—as it relates to the design aspects of mixing consoles

FIG 1 Hypothetical block diagram of the human sensory-motor system. Only a few of the many feed-back loops which exist are shown. (Adaptation from Ref 35)



functioning of the sound engineer and the equipment he operates, as a man-machine system.⁵ Fig 1 illustrates the functions of the sound engineer as a component of a man-machine system.

Firstly information furnished by the displays of the mixing console is received by the sound engineer via his sense organs. Although there is a great deal of information continuously impinging on the sound engineer, only some of this is available for 'translation from perception into action'. Information is filtered, recognised, integrated, stored and sometimes lost as it passes through the 'perception' and 'short-term memory' parts of the human sensory-motor system. Finally the information is translated into a course of action which may, if necessary, result in the engineer activating the controls of the mixing console by means of his effector mechanisms.

The man-machine model outlined above can be regarded as a general model of skilled performance. It has implications for the design of any task.

Display design

Machine displays are a conventional point of entry into the man-machine cycle because they constitute the communication link from machine to man. A display consists of anything that conveys information to the operator about the state of the machine. Thus the setting positions of the mixing console control knobs, the PPM or VU meters and the characteristics of the sound coming from the PA system and/or studio monitors each act as a display to the sound engineer.

Singleton⁶ distinguishes between real displays where design involves enhancing data rather than generating them; and artificial displays which involve preliminary non-human sensing devices. The sound emitted from a PA system and/or studio monitor constitutes an instance of the former category, whereas mixing console PPM and VU displays are an instance of the latter. Both of these may be used by the sound engineer in ensuring that the system is not in a state of overload.

However, not all engineers pay attention to the meter displays. A considerable number rely solely on an auditory analysis of the sound. This is not surprising for as Singleton⁶ cautions: "... an artificial display is often a barrier between the operator and the real display. It is usually trusted less and reacted to less immediately for all sorts of reasons from lack of built-in urgency to lack of full indications of consequences." Thus it is desirable that

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PPM and VU displays be designed so as to convey information pertaining to the state of the system in a form conducive to rapid and accurate interpretation.

As Chapanis² has pointed out, a great deal of attention has been devoted to visual displays: "even a partial listing of the kinds of research done makes an impressive catalogue of applied visual problems". There has been more research into the human factors of meter design than any other type of indicator⁷ so the topics listed here are merely indicative of the range of available advice. Factors that need to be taken into consideration include: the size and number of scale divisions; scale base length; the arrangement of scale divisions; the direction of increase of value and the position of zero; the choice of scale maxima; the design of scale marks; the design of numerals; pointer design; the colour of the scale marks, the dial face and the bezel.

There are a variety of VU and PPM displays currently on the market. Meters, luminous bar graphs and LED columns are commonly employed. Empirical research is necessary in order to establish the relative merits of each of these types of display.

Design of controls

There is a considerable body of research showing that manipulation of the design parameters of controls can have a significant effect on the speed and accuracy with which the operator executes an appropriate response or chain of responses.⁸ Controls may be divided into two broad classes, namely: discrete action and continuously variable. Discrete adjustment controls (ie controls that snap into place) can be positioned with one gross movement; continuous adjustment controls require a slewing movement and a fine adjustment movement and thus more time and attention.⁸

Discrete action (detent) controls are to be preferred when a limited number of settings is required, or when precision requirements are such that a limited number of settings can represent the entire continuum.⁹ By far the most common forms of discrete action controls to be found on sound mixing consoles are rotary selector switches, pushbuttons and toggle switches. Less commonly found are detent thumbwheels.

Continuous adjustment controls should be selected when precise adjustments along a continuum are needed, or when a large number of settings (usually more than 24) is required. Faders and rotary control knobs are the most common forms of continuously variable controls, and indeed controls generally, employed by designers of sound mixing consoles. We shall consider the design parameters of each in turn.

There is a notable absence of any reference to faders in the literature. With regard to the optimum length of travel, this is a matter which must be determined empirically. As Moore¹⁰ has remarked: "Accuracy can often only be obtained by use of a control with a long range of travel whereas the adjustment time increases with range. The designer must select a range which enables sufficient accuracy of adjustment to be

ERGONOMIC ASPECTS Of MIXING CONSOLE DESIGN

attained within the time limits available to the operator. It must be remembered that whereas accuracy increases proportionally with range, speed does not, since starting and stopping movements are always present and are approximately constant. The speed of any action will additionally be related to the number of possible control states and to the uncertainty as to when the signal to carry out the action will be given".

A related factor to consider in determining the optimum design of faders for mixing consoles is the ratio of the distance of movement of this control relative to that of the moving element of its associated display, the PPM or VU meter. For position (zero order) controls such as faders on sound mixing consoles, the control-display ratio is the reciprocal of 'gain' or 'sensitivity', expressed in terms of the ratio between display and control movements. If a small control movement is associated with a large display 'deflection' this means that the operator has to deal with a highly sensitive system. If, on the other hand, a large control movement is required to produce a small movement on the corresponding display, the system is said to be highly insensitive. The optimum control-display ratio for a given system is a function of human motor activities necessary to position such continuous adjustment controls. Whenever a continuous adjustment control is used, the operator effectively performs two types of movement: (1) an initial ballistic movement by which he rapidly moves his control close to the final desired position; (2) fine-adjusting movements by which the operator places his control precisely in the final, desired position.

In general, the higher the control-display ratio (low-sensitivity), the greater will be the gross adjusting time because of the longer movements required. Conversely, the lower the control-display ratio (high-sensitivity), the greater will be the fine-adjusting time. Fine-adjusting time may be reduced either by increasing the control-display ratio, or by easing the tolerance requirements. The optimum control-display ratio is that which minimises the total time (gross plus fine-adjusting) required to make the desired control movement. It occurs at the point where the curves of these two functions intersect.¹¹

The control-display ratio would appear to be a critical factor in terms of operator performance. Indeed, a good control-display ratio has been shown to save from 0.5 to 5 s in positioning time when compared with a poor control-display ratio.^{11 12 13 14}

In view of this, it would seem that the concept of control-display ratio has important ergonomic implications for the design of sound mixing consoles. However, we must agree with Chapanis and Kinkade:⁸ "because of the many complexities involved, optimum C/D (control-display) values should be established empirically at least for those applications where time and precision are critical".

It is important that rotary control

knobs are not so small as to prevent it from being gripped and turned easily. On the other hand, panel space should not be wasted by using controls which are larger than those required for efficient operation. Bradley¹⁵ has argued convincingly that by using knobs of the smallest diameter for which operational time is minimal, both of these considerations will be served. In an experiment in which the subjects were required to make a series of standard control settings, he demonstrated that operation time will be minimised, regardless of the levels of frictional resistance employed, by using a knob diameter of 51 mm (2 in). A diameter as small as 25 mm (1 in) may be employed without greatly increasing operation time provided that only moderate levels of frictional resistance are present (ie when 50 to 100 in-g of torque are required to rotate the knob). However, between 38 mm (1½ in) and 13 mm (½ in) diameter, reach time increases with decreasing diameter. Bradley suggests that the slight but, nevertheless, real increase in reach time with decreasing diameter at diameters smaller than 38 mm (1½ in), indicates that reach time is a function of the size of the target which must be reached to and grasped.

A later study revealed that when the optimum combination of economy of panel space and minimisation of inadvertent operation is an important consideration, this will be approximated by spacing small-diameter 13 mm (½ in) knobs 25 mm (1 in) between edges.¹⁶ The implications of Bradley's findings for ergonomics in the design of sound mixing consoles are that knobs ranging from 38 mm (1½ in) to 51 mm (2 in) should be used in cases where economy of panel space is not such an important consideration. This applies to much of the ancillary equipment used by sound engineers (for example certain effects racks). It would appear that the optimum inter-peripheral spacing for knobs in this case is 51 mm (2 in). If, however, panel space is at a premium, as it is with the majority of sound mixing consoles, Bradley's¹⁶ recommendations should be applied.

However, Bradley's data must be interpreted with caution in the present context, since his studies were limited to the investigation of knob parameters using a vertical control panel, whereas sound mixing consoles employ control panels set at various angles between the horizontal and vertical planes. Furthermore, because of the large control spacing required in order to prevent the accidental operation of adjacent knobs, it seems unlikely that his recommendations could be implemented on any but the smallest of consoles.

Clearly this illustrates some of the difficulties faced by ergonomists attempting to make design recommendations on the basis of research findings derived in other contexts. However rigorous this secondary research may have been, it is no substitute for primary validation studies. Further research is badly needed in order to find a satisfactory control panel arrangement.

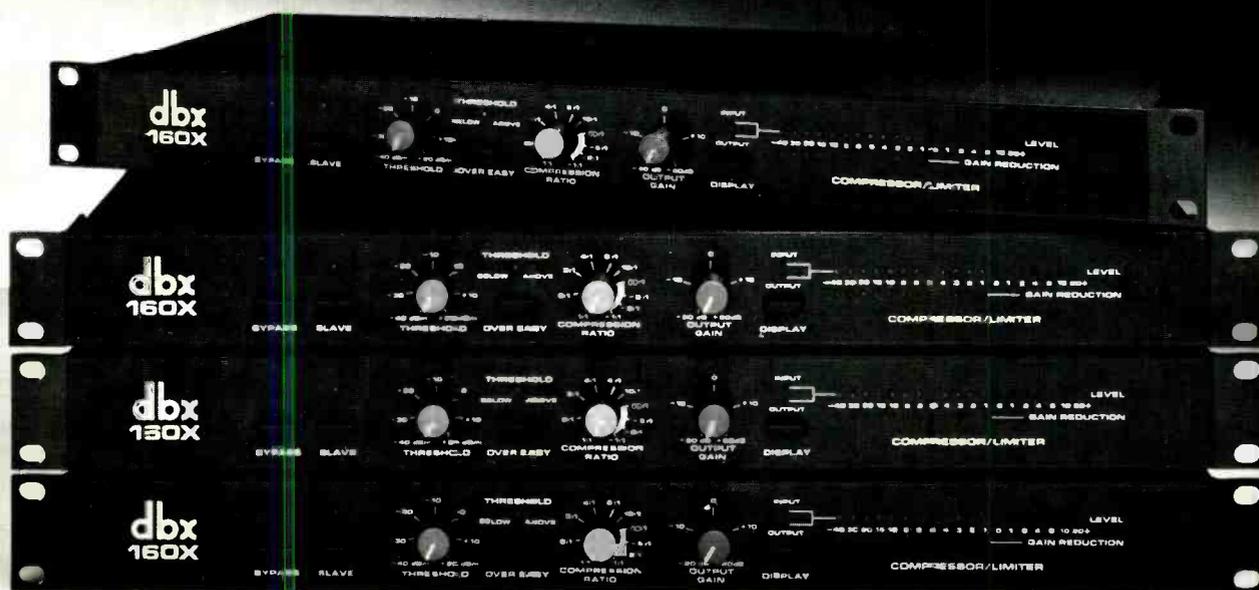
The suggestion of stacking or 'ganging' several control knobs along the dimension perpendicular to the

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instrument panel by means of concentric mounting, does not seem a feasible solution to the problem of panel space conservation as it relates to sound mixing consoles. This is because: "the large diameter differences that are necessary to prevent frequent front knob errors strongly suggest that when the avoidance of inadvertent operation of adjacent, non-detent controls is the critical consideration, panel space will seldom be saved by mounting knobs on concentric shafts".¹⁷ In any case as Swettenham¹ has remarked, where dual concentric knobs have been employed on mixing consoles, often the inner knob has borne only the roughest correlation to the scale markings.

Knobs may vary between 13 mm (½ in) and 76 mm (3 in) in height. However, the optimum thickness lies somewhere between 19 mm (¾ in) and 25 mm (1 in).¹⁸

Cylindrical knobs should normally have serrations around the edge in order to facilitate gripping.⁷ The display of control knob settings appears to be inadequate on the vast majority of mixing consoles. Indications of knob positions are usually given by means of a fine radial line which is engraved on the knob's surface. This gives rise to the possibility of parallax errors. Knobs with attached pointers or beaks afford a much clearer presentation of control setting provided that the markers are not so small that they lend themselves to errors arising from poor legibility. Knobs with longer beaks are clearly much better. The knob beaks should slope down and remain close to the control panel so as to minimise parallax.¹⁹

Another important factor associated with the display characteristics of knobs and indeed of controls generally, concerns the contrast of the components against the control panel. As Shackle notes, dark knobs on dark panels are obviously difficult to see whereas the use of grey or other lighter coloured knobs will afford a much greater contrast.

Other factors

Other factors that need to be taken into consideration in the design of sound mixing consoles include the coding characteristics of the controls and displays, control-display relationships, workspace and illumination.

The correct and rapid identification of

ERGONOMIC ASPECTS OF MIXING CONSOLE DESIGN

console controls and displays is critical to mixing performance since the failure to locate a given instrument swiftly and accurately can, and all too frequently does, have disastrous consequences.

The identification of controls and displays is essentially a coding problem. The vast majority of sound mixing consoles currently on the market employ a redundant combination of location, colour and labels as the means of coding the components. Such redundant schemes are recommended when maximum differentiation and identification are especially critical.⁸⁻³ However, there is widespread variation between consoles in terms of the implementation of these codes. Whilst the controls and displays on all mixing consoles are grouped according to function, this being in keeping with the functional principle,³⁻²⁰ the relative positions of functionally similar groups of controls often varies considerably between different models of console. Similarly, although the control knobs (discrete action and continuous adjustment) are colour coded, the assignment of specific colours to specific functions varies from console to console. This is poor because: "when individuals are likely to transfer from one model to another of the same general equipment type, the same system of coding should be used if at all possible. Otherwise, it is probable that marked 'habit interference' will result and that people will revert to their previously learned modes of response".³ In view of this there is clearly a need to standardise coding procedures throughout the industry.

The use of colour coding is not recommended under conditions of poor illumination.²¹⁻⁸⁻³ In view of the fact that the sound engineer is often expected to mix under conditions of extremely low illumination, it seems highly probable that colour is a less than efficient means of coding control knobs, despite its widespread use. Perhaps some form of monochromatic code would prove to be superior. Clearly there is a need to test this hypothesis empirically.

With regard to the labelling of console components it would appear that the optimum stroke-width-to-height ratio of alphanumeric characters lies somewhere

between 1:8 and 1:10 (white on black). Capital letters should have a width-height ratio of about 1:1, although this can be reduced to about 3:5 without serious loss in legibility. In the case of numerals the recommended width-height ratio is about 3:5.³

Capital letters are customarily used for lettering on most dials and for the engraving on most panels. However Shackle¹⁹ recommends the use of lower case type, when extremely rapid reading is required, on the grounds that this facilitates speed—chiefly because of the two extra orders of differentiation provided by the extension of the tops of some letters above and the tails of others below the general body of type.

Moore¹⁰ suggests the following: (1) the labels should be on or beside the controls and they should be consistently placed throughout the panel; (2) the labels should be brief, but only common abbreviations should be used; (3) a great deal of information may have to be included on the labels to specify what is being controlled, which one of a number, and how it is being controlled. The verbosity of individual labels may be reduced by careful grouping of controls and by the use of a multi-level labelling system; (4) common words should be used and technical words avoided unless understood by all operators; (5) abstract symbols should be avoided when they require special training. Common symbols may be used in a conventional manner (eg plus, minus, arrow); (6) lettering should be horizontal at all times; (7) non-functional labels (eg name plates) should be inconspicuous; (8) labels should not be placed on curved surfaces and if a moving part can be rotated to the upside down position, a second inverted label should be considered; (9) every console, rack, panel, functional group, control display, control and control position should be labelled with these labels graduated in size.

Labels should be placed above controls, so that they are always visible, and, since consistency in layout facilitates performance, labels should also be placed above their respective displays.²²

Adequate space and sufficient lighting are the main pre-requisites for label coding.¹⁰ The minimum of light required for reading is approximately 1 FC (10 lux)²² though far more light than this is necessary if the task is to be carried out efficiently.

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IN PERSPECTIVE

IN PERSPECTIVE

Comment from Martin Polon, our US columnist

Over drinks in the first class compartment of one of the transatlantic 747's that shuttle bleary-eyed business passengers from continent to continent, two consumer electronic manufacturing Vice Presidents sat discussing their respective marketplaces. Each one represented opposite sides of the world. One became soft-eyed and contemplative over drinks and launched into a soliloquy about the so-called experts in the consumer electronics industry. "They remind me of characters from Spielberg's movies. After the last round of trade shows, I caught up on films with my family and I was really struck by the similarities between cinema fantasy and 'experts'. The real experts are like ET; timeless and brilliant but having absolutely no skills of communication with the rest of us. The remainder of the self-appointed experts remind me of The Gremlins. Feed them (with money), or splash water (truth) on their pride, and they turn into deranged monsters."

These thoughts may have been just born of a tiring Friday afternoon, but many in the industry feel that experts have represented a real stumbling block to the success of the digital disc by confusing the mass market. Another perspective can be provided by the comments of a transatlantic advertising agency executive whose charge is the Compact Disc: "I'm not pretending to be completely expert myself on new technology, but we know that forwards motion in the audio industry from consumer to pro will live or die based on the success of Compact Disc or the lack of it. If we're wrong, our agency jobs are on the line as well. Not so for the audio 'experts' who usually hedge their bets to cover their mistakes. The public is upset by the confusing image projected by the digital record industry. 'Is it any good?', 'Is it really better than the old records', 'Doesn't it have digital distortion?', 'Aren't many of the discs digital remastering of analogue performances?' I feel the problem is that too many people are saying too much and completely confusing the consuming public; especially in

Experts and the Compact Disc

the States."

For the world audio industry, the biggest guessing game for the 1984 selling season is 'What happened to the home CD market?' The answer to that question could be worth millions to Japanese and European manufacturers and their US and UK marketing subsidiaries. Equally connected are recording studios, professional equipment makers and marketers, etc. who would benefit from the upgrading of studio chains that is expected to accompany increased digital activity. The dawning of 1983 saw extravagant predictions by the 'experts' of one million Compact Disc players in the home by the end of 1984, and projections ranging up to three million units worldwide by the end of 1985. The difficulty with these kinds of figures is that the interest of the non-audio business press is drawn to the technology of the Compact Disc. When the sales fall far short of the projections, the press and Wall Street analysts turn against the technology, as they did with the home computer. The public reads these pronouncements by yet another category of expert and the conundrum continues. Never mind the fact that worldwide sales of digital disc players could exceed a quarter of a million units by the end of 1984.

The audio consumer is probably the one element of the personal computer revolution that needs the tender ministrations of the 'experts' the least and receives the unwanted outpourings the most. One of the problems with the home audio equipment and record crash of the late 1970's was that the public was nearly convinced that conventional records were flawed at best and garbage at worst. The experts were laying the ground rules for digital audio by pointing out in print and elsewhere that conventional records were made from polluted vinyl with over-used stampers in foreshortened production cycles and then strangled with shrink wrap. Worse still,

record stores were reported to be buying their own plastic wrapping gear to resell returns. Rumours of years of flawed masters were embellished. Most of this was true, but needed to be presented to the public in context. Lo and behold, the appearance of the Compact Disc has been marked by experts decrying the 'obvious distortion' of 14/16-bit sampling, analogue to digital conversion, the use of analogue masters, flawed production of discs, etc. What can the public think?

Dealers harbour a different kind of 'expert' but one just as confusing to public confidence in the Compact Disc. That the 'suede-shoe' salesman has come to audio retailing is as much a measure of the industry's reaching maturity as anything else. It was inevitable that the same school of selling that has swept consumer goods and automobile retailing would reach the audio marketplace. These 'experts,' whether on Tottenham Court Road or on 45th street east of 6th avenue, have found a way to sell items they do not understand. They will never say 'I don't know' in response to a question. Additionally, digital audio disc players do not always deliver superior sound when paired with \$350 bargain audio systems. The idea that the esoteric or 'tweak' (tweaking the knobs) dealers would jump behind the digital disc has not been a universal reality. The major electronic manufacturers have recognised that the mass market for CD lies with the under \$500 price point and may well exist at the under \$300 segment of the marketplace. More slowly than in Europe and the UK, but just as inexorably the price for players in the United States is dropping below \$500. For many premium audio dealers, even with the inducement of selling a complete new 'digital ready' system, the lowering price points do not fit the image of 'esoteric audio'. Of course, premium units such as the Revox CD serve well for some dealers, but the analogue

is better argument has been fuelled in no small part by many high end audio dealers, as well as itinerant audio mass merchandisers.

The presence of more than three dozen magazines devoted in whole or in part to audio of all kinds, sizes, shapes and forms provides for yet another category of expert. Each magazine has numerous editors: labelled variously as assistant, associated, consulting, contributing, continuing, technical, technology, managing, in-chief, editorial directors, editorial consultants, editorial managers and equipment reviewers to name a few of the titles to grace a masthead. Now it is equally true that all of these 'experts' have to eat (present columnist included) and the publishing game mandates articles such as 'Do digital disks really sound better?' and 'What's really wrong with Compact Disc?' The same type of headlines have been used since the time of Julius Caesar to decry everything from the Roman empire to sex. Simple maths not requiring a computer, tells us that there must be at least 2,000 plus experts toiling to produce that pile of audio, audio-video, video, audio-trade, photographic, popular, science, regional and other magazines that have hauled Compact Discs back and forth before readers. These magazines have themselves been backbreakingly delivered by dedicated postal personnel to the portals of the tens of thousands of other audio 'experts' every month, who often parrot the printed 'gospel.' Never mind that many of these experts write for many of the same publications, so that certain names become written on our subconscious mind like some subliminal catalogue of 'acceptable' audio writers.

The consulting 'expert' has a different angle to play on. The audio consultant by definition is constantly selling opinion and services. According to one manufacturing executive who feels that consultants are a necessary evil, the bad ones "poison the water supply for everybody else."

The audio 'expert' relative is usually a brother-in-law or a cousin or, worst of all, the

IN PERSPECTIVE

IN PERSPECTIVE

precocious youngest son of your wife's baby sister. Although the Geneva Convention clearly bans such familial expertise under the topic of cruel and unusual punishment, the mere mention of the words digital audio are enough to start the noxious torrent. Unlike other home devices like washing machines or VCR's which merely elicit suggestions as to brands, the use of the letters CD calls forth a discussion that can continue for hours. One very jaded veteran of the recording studio wars in Hollywood enjoys replaying his adventures with his wife's relatives (one assumes out of earshot): "It always happens over the dinner table at some holiday. My brother-in-law and his wizard son launch into detailed discussions of the merits of the new A4 conversion for the \$100 player. What do I know; having only recorded the digital master that makes it all possible. Worst of all, when I innocently

mention after desert that the new B767 equipment offered by American Air is very impressive, my brother-in-law responds that he already knows having recently purchased the adapter for his CD player."

Perhaps the most vicious category of 'expert' is the reformed owner of one brand of Compact Disc player who has moved on to another machine. Like former fat people, alcoholics or non-believers who have found a new faith, those who switch CD players cling to the conviction that only they have found the true machine and all others are depraved non-believers. These self anointed 'experts' usually hang out in those audio stores carrying their former machine. That no sales person has summed up enough courage to cause bodily harm to these tormentors does not truly measure the impact of these converts to the 'new light'. They joyfully discourage the sales of their former unit by comparing it unmercifully

to their new CD player. The proceedings seem to be nothing so much as an effort to convince themselves that they have made the right decision; accomplished by dissuading others from buying their former brand of player. Armed only with the innuendos and half-truths of partial knowledge, these A to D chip reformers have replaced such slogans as 'alcohol makes you sterile' and 'if you don't find God, you'll burn forever' with rejoinders about 14/16 bit sampling speed, inaccessible A/D's and hidden sampling system bugs.

The purpose of all of this is not to suggest that every audio expert is flawed, or mistaken. The writer of this column fits several of the above categories perfectly, and assumes that his loyal readers could fit him into several more!

The point of this column is also not to suggest that if you were to lay all of the digital audio experts end-to-end at the

equator, they would stretch around the globe and many of them would still be all wet. Nor is there interest in pointing out that if you add up the numbers for all of the categories of expert you will find that the audio industry has been indulging in technological incest; listening and selling in large part to itself. Some of these points may be valid, but the bottom line is that the digital audio marketplace needs consumers at all levels, and we have never seen the audio consuming public more confused. It is time for the digital audio industry to swing clear of the full range of 'expert' spokespersons (which sounds like a bridge game tied to a wagon wheel), and to utilise an image building programme that provides for the flow of information needed by the news media and the consumer. There is a place for expertise in the audio arena, but it is to advise rather than to consent. □

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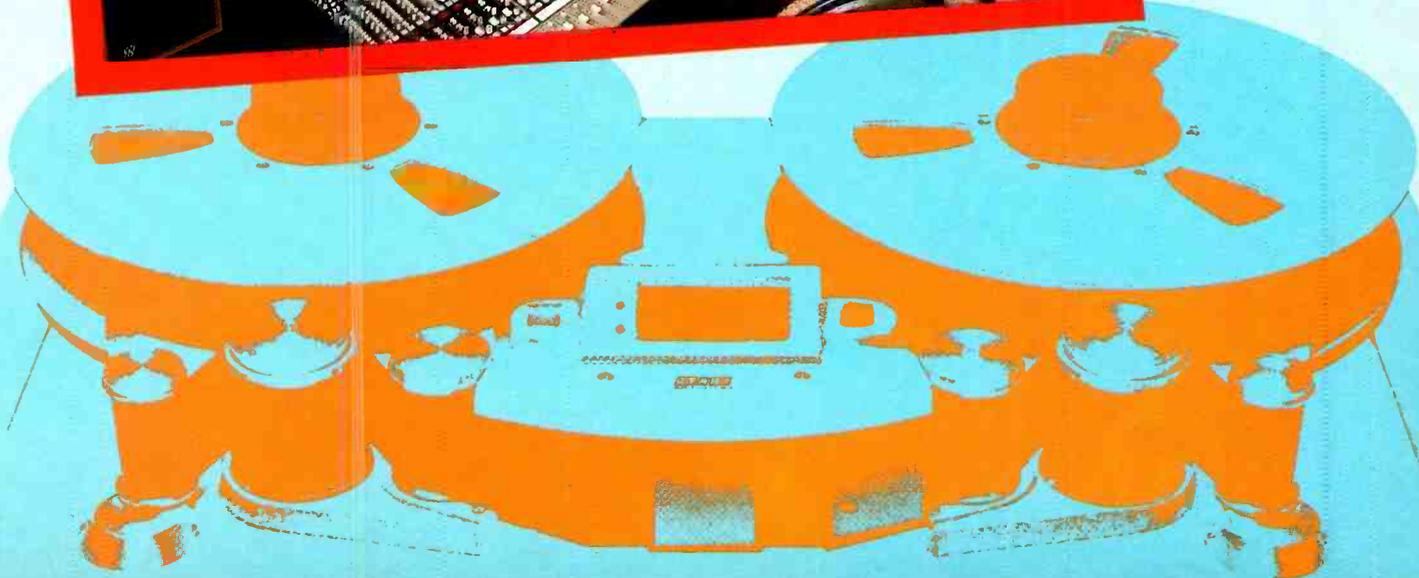
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REVIEW REVIEW

A user report by Keith Spencer-Allen



LEXICON PCM 60 DIGITAL REVERB

The *PCM 60* is a relatively low cost addition to the Lexicon digital reverb range and has been launched with very little publicity so far. In fact the first that we knew about this unit was when it was offered for review. Because of this and the pressure of demand to try the first few *PCM 60*s available, this review is based upon a shorter than normal evaluation period of just over one week. I don't, however, believe that there are many aspects of this unit that it has not been possible to check, as the basic facilities and controls are fairly simple.

In Lexicon's words the design brief for the *PCM 60* was for a high performance digital reverb possessing similar sonic qualities to their larger systems but with much reduced hardware costs in addition to being easy to operate. In many ways the aim could be considered as a digital equivalent of the role that a mechanical reverberation system used to have within the studio—ie stripped of all the sophisticated reverb functions that are an intricate part of the large systems.

Briefly, the unit has two main programs—Room and Plate—and the user can modify reverb characteristics in the areas of room size, reverb time, and bass and treble contours. It has a mono input with 'stereo' outputs.

The *PCM 60* is a standard 19 in rack mount unit of 1¾ in height and a depth of 11 in. With the exception of two level matching switches that will be covered later, all the control functions are on the front panel with all the input/output sockets at the rear.

The front panel is clearly laid out and most of the controls are self explanatory. The first item commencing on the right hand side is a five-segment LED display for the input signal. The LEDs are marked from -24 to 0 in 6 dB steps with the lower three being green, the -6 being amber and the 0 being red. Lexicon recommend optimum performance being achieved with the level set so that all the LEDs up to the red flash. I found that it was safe to operate within this area if you were working with a processed signal, ie one off tape or compressed. However, with a signal that still retains a number of

transients, I found it safer to back off a little and run at a lower level. This is not a criticism of the unit but more a question of coming to terms with the fact that the 0 dB headroom indicated on the LEDs does really mean that, with nothing in hand to cushion the incautious user. The meter is an instantaneous peak reading characteristic and would appear to be a reliable level indicator.

There then follow three rotary level controls for input level, output mix (between direct dry signal and reverb wet signal) and the output level. All the other controls on the front panel are switches and these are all good concave finger-sized switches that are light weight and pleasant to use with each switch having a coloured LED above it that indicates its selection. They are all latching types but under some of the grouped functions they are interlocked so that you can only select a single function at a time.

The first of the buttons is for the bypass mode. When selected, the input is connected, by the action of a relay to the outputs, bypassing all the level controls and processing electronics. The same input is of course presented at both outputs. This system would appear to bypass all the electronics when checking the schematic, however this is not the case as removal of power mutes the bypass path. There is additionally provision for remote control of the function from the rear panel. Lexicon recommend adjusting the *PCM 60* levels for unity gain through the unit with the output mix control set to dry signal.

As mentioned earlier, the *PCM 60* has two main programs—plate and room which may then be modified. The next pair of switches make that selection. The names are of course self evident with the plate program being similar to that reverb created by a mechanical echo plate and the room, the acoustic of a room surprisingly. Plate settings generally tend to sound far more even in response than real plates but it corresponds to what has become known as the 'plate sound' in digital reverb terms.

The next group of switches are labelled size and these are intended to modify the

apparent acoustic size of the plate or room program. There are four of these with the extreme left being labelled small and the extreme right being labelled large. They also introduce an amount of predelay that varies with the program and the size selected. In the room program setting these are 6, 9, 16 and 37 ms and in the plate program, 1, 2, 7 and 46 ms for the respective switches from small to large.

There then follow four switches for reverb time and these in a similar way to the size switches are labelled short to long. The actual reverb time that each of the switches represents varies on the selected program and the size switches selected. The extremes are 0.2 s with plate/small room/short reverb selected and up to 4.5 s with plate/large room/long reverb. The room reverb times fall inside of this with times 0.3 s and 3.8 s in the corresponding settings. (There is, however, a slight discrepancy in the preliminary manual about the upper reverb time for the plate setting so it may be 3.8 s instead of 4.5 s.)

The final pair of switches are labelled contour: one is marked treble and the other bass. The effect that these switches have is dependent on the program selected. With both switches out the response of the reverb is flat. The bass switch will increase the LF reverb time by 50% on frequencies below 800 Hz. The treble switch reduces HF reverb time above 800 Hz by 25% and then adds a gentle roll-off above 2 kHz to stimulate room absorption. I believe that this effect holds true for both main programs but the preliminary manual is a little confused with regard to the plate program. The effect certainly sounds similar.

Remaining on the front panel is the red rocker power switch which does not have any form of power-on indication but this is unnecessary as there are at least three other LEDs that will illuminate when the power is on.

The rear panel has a fixed mains cord and six jack sockets. There are one pair for effects send and return that send a feed from after the input level circuitry with a return straight to the input of the reverb processor. The bypass socket allows the use of an external footswitch.

REVIEW REVIEW

The main audio input is a stereo jack socket where the levels and input impedance are determined by a push button switch to the right of the input that is labelled -20 and +4 dB. In the +4 sensitivity mode the input will accept balanced line level signals while in the -20 mode it may be used for unbalanced high impedance inputs.

The output left and right sockets are similarly switchable for +4 and -20 operation. They are unbalanced outputs with 600 ohms input impedance.

Operation

At first the possibilities of the *PCM 60* appear rather limited. As soon as you realise that the size and reverb time all have a different effect dependent upon the program selected and the other settings made the possibilities become much wider. There are, in fact, something like 32 different reverb patterns available and these may be further modified by the contour settings so that the 32 can be multiplied by three variations. Yes, of course you are left with only two basic programs but in most cases it will be a plate or room type program that a larger reverb system will

be used for anyway.

Making comparisons of reverb quality is very difficult, particularly if the comparison has to be made from memory. The reverb character of the *PCM 60* appears to be very similar to that of the *Model 200* rather than say the *224X* which is not very surprising. The short programs are excellent with a high density of reflections and a very natural quality. The range of variations available was adequate for most general mixing needs. The sound quality of the longer reverb times was also good although there were slight traces of the 'digital reverb graininess' on the very long settings as the sound was decaying near its limits. At the kind of price that this unit is built to this is really not surprising.

Sometimes in the middle reverb time/room size ranges, the move up or down a switch seems to be a very large jump, although this must be a psychological type effect as the spacing quoted in the specification is fairly even.

The supplied manual contains a number of recommended settings and much care has been taken to introduce the concept of digital reverb to those unfamiliar with such systems. Also

interesting are the sections describing ideas for using a couple of *PCM 60s* with other delay line systems to produce effects that would have been unaffordable—unless you have two or three *224Xs* etc at your disposal.

The *PCM 60* actually contains no surprises. It really just follows on the tradition set by the other Lexicon delay lines in a simpler form. There have obviously been slight trade-offs on quality, although these are very small and inaudible in most situations.

The drawback to all singing and dancing digital reverbs has been that they are only capable of one reverb type at a time. Unless you can foresee the special reverbs you might need or have access to several systems this can pose a problem.

This is the area of application for units such as the *PCM 60*—to free the larger units from the menial reverb chores and let them do what they do best. If it is the *PCM 60* that you decide to use for basics, I don't think you will be able to tell which unit did what as soon as the details of the session are out of your mind. This unit is certainly another worthy addition to low cost digital reverb. □

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REVIEW REVIEW

Listening tests on speakers reviewed last month edited by Keith Spencer-Allen

MINI REFERENCE MONITORS SUBJECTIVE ASPECTS

Right from the very start of the planning of this review of mini reference monitors, certain decisions had to be made and acted upon. We were well aware of the subjective speaker evaluation test methods employed within certain sections of the consumer audio press including double blind statistical type techniques. We felt that such ideas were not really relevant within the professional audio field as we are often using a monitor as a production tool, ie perhaps only using one aspect of its performance at a time, and the total subjective output quality is often of little absolute meaning. Nowhere is this of course truer than with mini reference monitors where, if you ask half a dozen engineers why or how they use them, you will receive as many different answers. It is also a further point of debate whether such units should strive for a high quality (as much as their size permits); should they sound like your large monitors but with the extremes of response removed; should they be the 'mythical bad average' speaker; should they have the capability of being used for precise image positioning when panning for a stereo panorama during mixdown—quite simply what is their role? Without this answer readily available it was decided that our listening tests should involve experienced engineers and producers who are at home in a cross section of different musical styles although, obviously, in this particular case we are really only considering multitrack popular music.

Further decisions were made that were based upon our original philosophy that the purpose of speaker reviews is to pass on information so that any prospective purchaser may use them as additional information in making their choice. The technical aspects of this review will allow people to compare some of the physical response characteristics measured under identical conditions, without having to try and guess how the

Technical and physical reviews by Hugh Ford for all loudspeakers in this report were featured in the October issue. Our panel listened to their performance and we give their opinions.

various manufacturers had measured them. The role of the subjective aspect should be to pass on more information which may in some way be correlated with the technical measurements.

It was decided that there would be no attempt to form any preference order from the subjective tests but if one emerged, then that would only be by chance. The aim was to pass on subjective appraisals only.

The opinions collected below are summaries of the expressed opinions of five engineers, two of whom are also more generally record producers. Their experience with the industry varies from the minimum of eight years to nearly twenty. Auditioning of the seven pairs of speakers was all within a studio control room environment with a couple of hours for each of the panel to become familiar with the units individually on their own choice of material. A series of tests were then conducted with all the panel present.

The listening tests were in two parts. First there was a very wide selection of programme material of all types that would be auditioned on a reference monitor ie popular multitrack. The second section was trial balances made on large monitors within the control room and then referenced down to the units under test in addition to a balance

being prepared on the reference monitors (and maybe some EQ) and this then replayed on the large monitors. The differences were noted and commented on.

Other tests included moving around the normal listening positions to see how the tonal balance changed; high and low level playback; stereo image tests where signals were panned and programme material with very precise positioned images were replayed; and finally perhaps a general opinion of how the unit sounded.

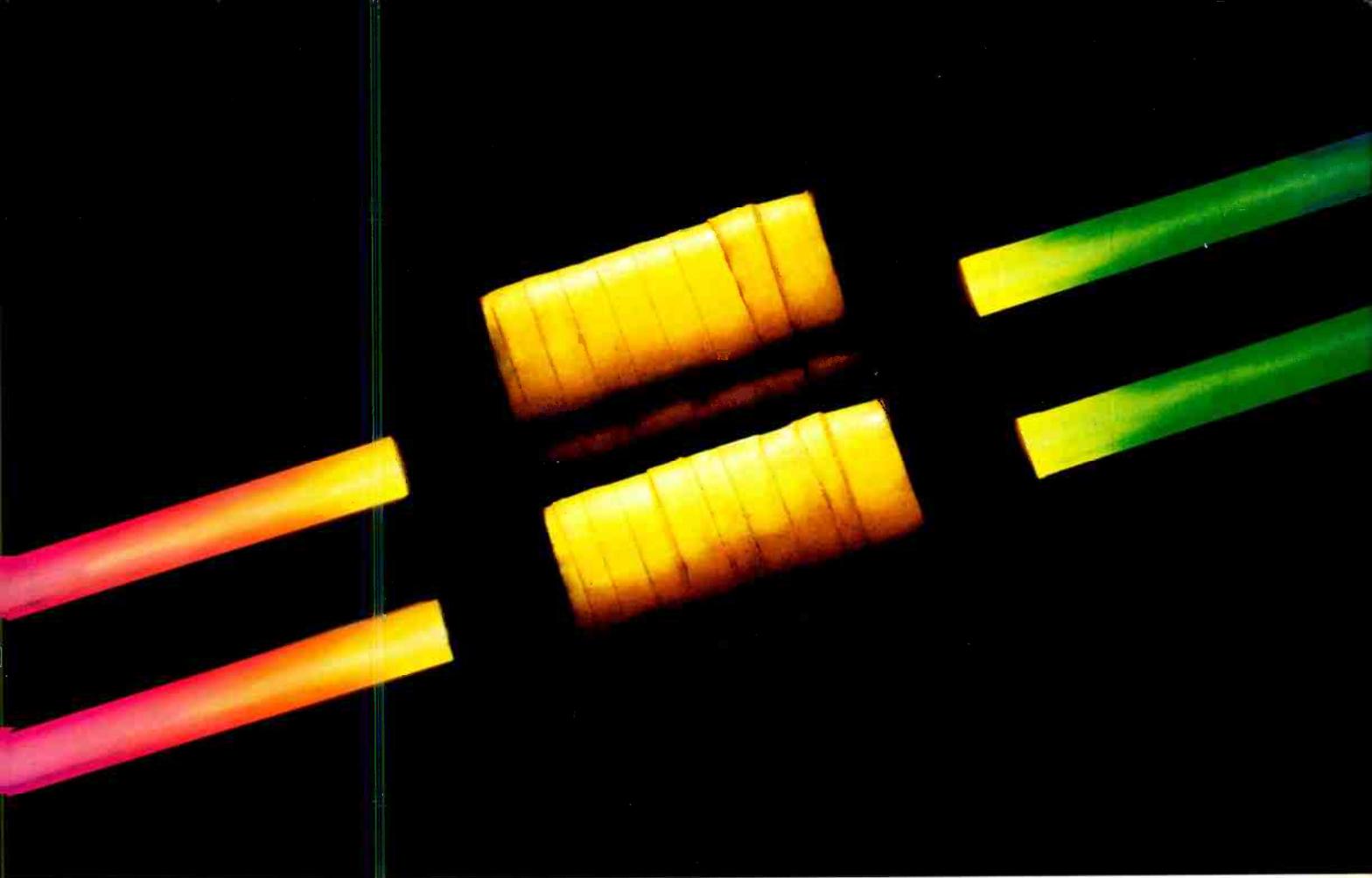
All the units were heard singly using a wooden stand that allowed the speakers to be simply placed upon the top edge of the console above the meter bridge. The speakers were in a standard mixing position ie about 3½ ft from the main monitoring position and focused to meet about 18 in behind the engineer's head. The order of testing was varied and we ran through the complete set three times. The results were then correlated.

Rather than detail the individual comments of the panel, these have been put together to form a general opinion. This was possible because the differences between these speakers are not very subtle and the listening experience often caused the same opinion to be formed by all the panel. Where differences of opinion were expressed they have been noted.

I hope that this aspect of the review is of some value and presents useful information. On low cost speakers such as these there is always the possibility that Hugh Ford may be right when he states that there may be more measurable difference between samples of the same speaker than different models—in which case we may have all wasted our time but I doubt that this is so true that all our results are invalid.

Auratone 5C Super Sound Cube

This speaker was included for control reasons. It is a kind of reference speaker



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REVIEW REVIEW

that now obliges most studios to have a pair somewhere. The sound is well known and, because of this, difficult to look at objectively. Two of the listening panel used 5Cs regularly and the other three didn't, although they had used them occasionally.

It was agreed that the sound is lacking in LF and HF at low volumes although it 'comes alive' as you increase the level. The depth of the sound, the image and the punchiness all improve as volume increases but there is a point where the quality disappears and the 5C just becomes loud.

There is a surprising amount of detail in the mid range so that it is quite possible to distinguish instruments in an approximately similar balance to the monitors but of course with the extremes removed.

Because of the familiarity of the panel with the 5Cs they found it hard to be more specific other than agreeing that for any kind of reference they found that there was a 'correct' level to use them at and levels far above and below produced results that were not thought so 'accurate'.

Toa RS-21M

Perhaps one of the drawbacks of testing in this way is that the eyes can lead the ears. This may explain why everybody expressed surprise when the RS-21M didn't sound exactly like the Auratone. It does sound slightly related though and most of the panel were using it to compare difference with.

First reaction on full range programme material was that it sounded far better than one would expect, with a reasonable amount of top end and a slightly deeper bass than speaker size would naturally dictate. The sound was described as pleasant as 'a listen' but there was felt to be less mid range detail and the programme had a 'smooth wash' over it. The centre image was also less solid although this was considered of secondary importance as unless the speaker positions were optimised as they were for the test, then there was unlikely to be any real image anyway except perhaps for the engineer.

As we progressed through a choice of programme material and then into the partial mixes, the comment was that the top end was becoming annoying and the brightness was 'getting in the way'.

As the volume level increased there was very little change in the tonal balance except a deepening in the bass response. In fact high and low level listening were very similar.

The panel were almost uniform in feeling that the Toa was a 'good listen' speaker (nearer small hi-fi than an Auratone) although they were less keen to use it for checking balances during a mix. In some cases it may be ideal if it is

for playback of programme material where sounding 'impressive' is an advantage.

AKG LSM 50

Another physically similar speaker possibly leading the ears—well maybe initially but it does sound quite different. At low levels it has a reasonable tonal balance on programme material with an acceptable low end although the HF sounds 'filtered'. This is not extreme but the comments from the panel on programme that they were familiar with, was the top end was not as they thought it should be.

On the more positive side, the sound was very precise and the LSM 50s were the only single-drive unit design to give any sort of image on programme that was not centre or hard left or right. The sound was thought to improve at higher volumes whilst the HF still had a strange character to it—less than smooth.

On the partial mix aspects of the test, they acquitted themselves well and the panel would have been quite happy to use them for level balancing. They would, however, have steered clear of any EQ judgements on what they heard. Unusually, the panel felt that there was a slight HF improvement when the grille was in position and so the tests were repeated but no feelings towards the speakers changed enough to alter the opinions already made. It was generally felt that the LSM 50s would be quite usable as mini reference monitors although their suitability would depend on the way that you wished to use them.

JBL LT-1

These were one of the larger speakers in the tests and consequently far more was expected of them. It was decided that the only way to mount them was with their stand and on their side with the HF unit being on the outside of the pair. Vertical mounting would have led to many problems and it was felt that being used close, the vertical distance between drivers would be too critical a concern in the listening position.

The sound was a very much bigger speaker type sound and distinctively—even at this size—JBL. There was real bass or rather relatively real bass present and the sound was altogether smoother, even at low levels. The detail was good and it was possible to detect the stereo ambience of a crossed stereo pair. The image was found to only move gently when turning the head to one side (unlike other speakers where the centre image was only true at the centre point) however the bass response dropped steeply when sitting out of the bass driver axis. This means that a producer might be slightly misled on a bass balance at low levels. This is to be offset

against the fact that at high levels the bass response was thought to be too forward and out of balance. These units seemed to prefer a higher power amplifier and were able to take a great deal of level without sounding strained.

The elevation angle of the bracket was found to be fairly critical to the image and some care had to be taken to make sure that both sides were exactly equal.

Generally it was felt that these were quite good for use as mini monitors although this may depend on your taste for the JBL sound. The only other reservation of the panel was their size which was thought big enough to have some effect on the sound that would be heard from the main monitors if they were perched on the top of the console as ours were.

Bose 101

This unit can be horizontally or vertically mounted. The manufacturers, however, appear to intend the speaker to be horizontally mounted. First impressions were of a larger speaker sound—or rather larger than the smaller ones here. It was found that the panel uniformly disliked the top end, using such terms as 'splashy' and 'dry'. On programme material the response seemed to fall off quite steeply at both ends although the treble did sound strange even at low levels. The situation was improved quite a lot when the grille panels were removed from both sides but still not to the satisfaction of the panel.

The sound was also described as distant, hard and with very little stereo image. At higher levels the sound became quite punchy although the treble situation was even less happy, with sibilance being added to vocals and cymbals splash 'wiping out' the top end. None of the panel were too happy about using these speakers whilst agreeing that operating the speakers in a vertical manner did improve the imaging and the perceived sound to a degree. Suggestions were made that these speakers would be far more suited to a very absorbent environment rather than sitting over a mixing console where the front panel splashback must be increasing the HF problem. Not necessarily a bad speaker but not suited for mini reference use.

Teac LS-X7

These speakers are a fairly small two driver unit. Firstly they were operated in a vertical position. Initial reaction was favourable all round the panel. They had a relative to size, good top end (if slightly on the bright side) and low end response. The overall tonal balance was good and the panel said that they recognised the balance of their own programme material. The image produced was described as fair.

At higher levels the sound had a tendency to become slightly boxy with the HF becoming splashy on cymbals. The top treble response tends to beam slightly in a way that might mean that the very top end would sound different to people sitting next to each other.

The overall response to this unit was favourable and two of the panel said that for the way they use mini monitors, they could quite happily consider working with this unit.

Placing the units on their side with the HF units outermost removed a lot of the HF beaming effect along the width of the desk although the vertical height of the speakers relative to the listener's ears was then critical. It was decided that on balance vertical mounting was preferable.

Visonik David 6000

This is a relatively compact unit with two drivers and, at the same time is fairly lightweight and doesn't feel as if it is full of concrete. Two of the panel were familiar with this speaker and one uses it as his reference.

At low levels the sound was surprisingly good—far more bass response than one would expect from such a unit. The detail in programme material was good, as was the stereo image. There was a tendency to think that the 6000 was dull sounding but this was only in comparison to the other units tested as when a bright instrument appeared in the mix, it sounded bright.

During balancing tests with partial mixes there was a comment that due to the bass response of the unit being greater than the average, it would take some relearning to check the drums against bass balance if you use your mini monitors in that way.

At high levels the sound was remarkably similar, with the unit taking a great deal of level without breaking up or even getting the overload light to flash. There was no treble break up at levels that would be common within the studio from small speakers.

There is no doubt that this unit is something special in the way of small reference monitors. It should in fairness be pointed out that it is also the most expensive unit tested here.

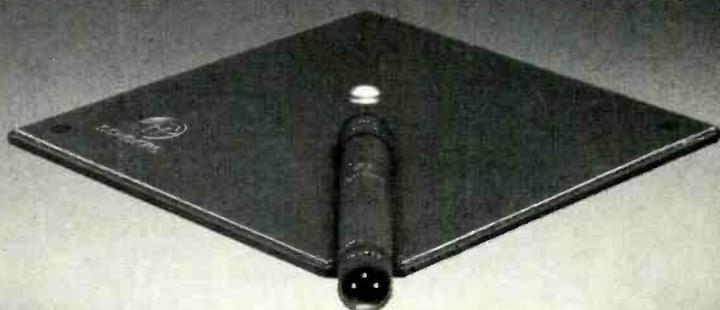
Conclusion

Although we stated that there would be no conclusion, some of the units have been found far better than others. For instance the *David 6000* is by far the most impressive in many ways but on the other hand it may be *too good*. As we stated earlier, mini reference monitors are used in a wide variety of ways and the speaker that you use reflects the way you work, which in turn alters what you ask of a monitor. □



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REVIEW REVIEW

Technical mixer review by Hugh Ford.



SOUNDTRACS CM4400

The Soundtracs CM4400 mixer system is a modular system which has a minimum configuration of 1/2/2 and a maximum of 32/12/2 with four different frame sizes being available covering 30, 40, 50 or 60 unit widths. In addition to the optional jackfield which occupies six unit widths, four other types of module are available. Each input module occupies a single unit width with the remaining

modules each occupying two unit widths.

The basis of the mixer is a fairly substantial alloy frame partitioned into ten single-unit width compartments with the interconnections between modules being by means of ribbon cables in a daisy chain format with the modules being secured at their tops and bottoms by means of Philips head screws.

A padded arm rest is fitted at the front of the desk with the sides being trimmed with wood ends. At the back the meter

bridge is fitted with illuminated VU meters. Powering is by a separate 19 in rack mounting power unit which connects to the desk via a 5 m length of cable fitted with good quality connectors.

Each input module has an XLR mic input socket to the rear with the line inputs, line outputs and insert points being available at the jackfield. Other connections to the outside world are normally via five 56-way locking connectors. One each of these covers sends and returns to 24 tracks of tape with a second pair accommodating 24 effects sends and returns. The fifth connector is the 'Master' for two stereo tape units, a stereo monitor amplifier feed and six mono auxiliary feeds. These facilities and others are available at the patchbay.

The final facility at the rear is an RS-232 interface connector for use with an external computer, this being used to display routing information in conjunction with the internal Z80 microprocessor which controls all bus routing and eliminates the conventional routing switches which take up so much space on input and group modules in normal mixers.

Input modules

Other than the ALPS fader at the bottom of the module all front panel controls are mounted directly on to a single good quality printed circuit board which is neatly laid out with clear component identifications to ease servicing. In addition all audio integrated circuits are socketed with a small 'piggy back' board which plugs into the main board doing the digital switching of the routing.

Connections to the buses are via

INPUT CHANNEL

Microphone input
(Electronically balanced)
Input impedance (with or without pad): 7 k Ω .
Maximum input: with pad +30 dBm, before clipping; without pad 0 dBm.
Pad attenuation: 30 dB.
Gain range: +20 dB to +60 dB.
Protection: RFI balanced PI filter network; safe for up to ± 50 V input.
Slew rate: 10 V/ μ s.
EIN ref 200 Ω , 20 kHz: -127.5 dBm.
Line input
(Electronically balanced)
Input impedance: 10 k Ω .
Maximum input: +30 dBm before clipping.
Trim range: -10 dB to +20 dB.
Protection: to withstand ± 50 V.
Slew rate: 10 V/ μ s.
Lowpass filter
Filter—Butterworth lowpass: -12 dB/octave.
Frequency: out 10 Hz, in 50 or 200 Hz, $\pm 5\%$.
Equalisation
Gain range: ± 15 dB on all four bands.
Break frequency: HF 12 kHz, M1 500 Hz to 10 kHz, M2 50 Hz to 1 kHz, LF 50 Hz.
Mid frequency filter Q: 1.5.
Outputs
Line and inject sends: (a) output impedance 50 Ω ; (b) maximum output +20 dBm.
Inject return electronically balanced: (a) input impedance 10 k Ω ; (b) maximum input +22 dBm.
Fader: (a) range +10 dB to infinity; (b) attenuation 90 dB.

MANUFACTURER'S SPECIFICATION

Mute attenuation: 90 dB.
General
Crosstalk between channels: 1 kHz 80 dB, 10 kHz 70 dB.
Mic-Line crosstalk: 1 kHz 85 dB, 10 kHz 80 dB.
SUB GROUP
Tape return
Input impedance balanced: 10 k Ω .
Maximum input before clipping: +22 dBm.
Aux return
Input impedance balanced: 10 k Ω .
Input gain trim range: -10 dBm to +20 dBm.
Maximum input before clipping: +30 dBm.
Inject points
Output impedance: 50 Ω .
Maximum output +20 dBm: +22 dBm into loads greater than 2 k Ω .
Input impedance balanced: 10 k Ω electronically balanced.
Maximum input level before clipping: +22 dBm.
Sub-group output
(Transformer balanced option)
Maximum output level: +22 dBm.
Frequency response: 25 Hz to 25 kHz, -2 dB.
Output impedance: 50 Ω .
Faders
Range: +10 dB to ∞ .
Meters (LED) option
30-element LED meters peak response

0 dB ref internally adjustable: -10 dB to +10 dBm.

MASTER MODULE

Auxiliary outputs
Maximum output level: +22 dBm unbalanced.
Output impedance: 50 Ω .
Master outputs
Specification as sub-groups outputs.
Oscillator
Range: 50 Hz to 10 kHz in two ranges.
Maximum output: +22 dBm.
Output impedance: 50 Ω .
Headphones
Output: 100 mW into 8 Ω or +22 dBm.
Monitor
Output: +20 dBm, +22 dBm into loads greater than 2 k Ω .
Talkback
Mic input socket low impedance.
Meters
As per sub-group.

GENERAL

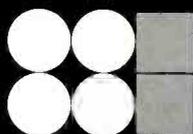
Distortion: IM and Harmonic less than 0.015%.
Mix noise: 28 inputs +16 tape returns mixed at unity gain; -78 dBm ref 20 kHz bandwidth. 0 dBm = 0.775 mV.
18 or 26 VU meter bridge set for +4 dBm but adjustable.
Other options: patch bay.
Manufacturer: Soundtracs Laboratories Ltd, 91 Ewell Road, Surbiton, Surrey KT6 6AH, UK.
USA: Soundtracs Inc, 262a Eastern Parkway, Farmingdale NY 11735.

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REVIEW REVIEW

insulation displacement connectors on the ribbon cable buses with a pin connector providing the audio inputs. The microphone input is balanced with switched 48 V phantom powering. This is followed by a 30 dB switched pad and a phase reverse switch before the input amplifier which has a gain potentiometer covering a 40 dB range.

A separate balanced input is used for the line input which has a screwdriver operated gain trim with a 35 dB range, both input amplifiers feeding the line/mic pushbutton switch which is, like the other switches, a Schadow switch.

Following down the front panel the input section is followed by two further switches which insert a highpass filter and select its frequency between 50 Hz and 200 Hz. There follows a 4-section equaliser which may be switched in/out. The 50 Hz highpass and 12 kHz lowpass sections have cut/boost potentiometers with a centre detent and a ± 15 dB range as with the mid-high and mid-low sections which have frequency potentiometers covering 500 Hz to 10 kHz and 50 Hz to 1 kHz respectively.

The insert send/return follows the equaliser section, the send being unbalanced and the return balanced. The latter is monitored for level with a 'peak' indicator and fed to the solo and mute buttons which have associated warning LEDs. This signal is fed to the channel fader and then on to the panpot and the auxiliary bus section. Auxiliary 1 is always pre-fade but may be switched pre- or post-equalisation, the latter being after the insert return. Auxiliary 2 is post-equalisation but may be switched pre- or post-fade. The two remaining auxiliary level potentiometers are similar and may be paired to auxiliary buses 3 and 4 or 5 and 6 there being six auxiliary buses available in addition to the solo bus, the left and right buses and the 12 sub group/master buses all 14 of which are fed by the computer controlled bus switching.

Group modules

Each group module is a double width module with two printed circuit boards similar in concept to the input modules. Each module has two identical channels each of which can handle two tape returns.

In the normal group mode of operation the group bus is buffered and fed unbalanced to the insert point from which it returns to a balanced input followed by the group fader which feeds the unbalanced group output. The group output is also fed to the solo switch, the VU meters and two level potentiometers which each in turn feed four auxiliary send potentiometers and a panpot.

Like the input modules the auxiliary sends feed auxiliary buses 1 and 2 with the two further potentiometers being switchable to feed buses 3 and 4 or 5 and

6. The sends to the latter can be switched pre/post fade with one panpot being dedicated to the left and right buses and the other assignable by the computer routing.

Either of the auxiliary sections may be switched to the associated tape return, one return having HF and LF equalisers with a ± 15 dB range about 10 kHz and 50 Hz respectively with both tape inputs having a screwdriver operated 35 dB gain trim.

In the tape mode the feeds to the group buses and the L/R buses are assigned by the computer with the auxiliary feeds and solo functions remaining hard wired.

Master module

Other than the faders the master module has five sections. The power section at the top of the module has six green LEDs to indicate the presence of the required power rails from the power unit. Below this is the monitor section which may be switched to monitor one of two pairs of L/R outputs, one of two pairs of stereo tape returns or the solo bus in mono.

Switching any module to solo illuminates a red LED on the master module and automatically switches monitoring to solo with pushbutton switches selecting A/B monitoring of either of the stereo tape returns. The monitored signals are permanently fed to the L/R VU meters before passing to the 15 dB 'Dim' switch and a mono/stereo button.

This is followed by two stereo ganged potentiometers which feed the L/R monitor outputs and the stereo headphone jack on the module.

Opposite the monitor and power supply sections is the auxiliary master section having a level potentiometer and an after fade listen/solo button for each of the six auxiliary buses.

Within the talkback section is an XLR socket for a dynamic talkback microphone and a talkback level potentiometer. Seven locking pushbuttons select the talkback destination between auxiliary buses 1, 2, 3 and 4, 5 and 6, the L/R buses, sub groups or the talkback output.

Actuation of the press to talk switch automatically dims the monitor and the headphone outputs.

The final section of the master module is the oscillator section which also contains two locking pushbuttons associated with the faders. One of these puts the two pairs of L/R faders in series to the master output B with the second button allowing monitoring or the A or B L/R outputs.

The oscillator itself has two potentiometers and four locking pushbuttons, one of which is an on/off button. One potentiometer sets the frequency between 50 Hz and 10 kHz in two ranges controlled by a pushbutton

giving a x10 multiplier on the calibrated frequency range from 50 Hz to 1 kHz.

The maximum oscillator output is +22 dBm controlled by the level potentiometer with the output being fed to an oscillator output in the patchbay, all auxiliary buses and/or sub groups.

Microprocessor routing control

As with any mixer there are sources and destinations for buses which are normally interconnected by matrices employing mechanical switches which are not the epitome of reliability. The advantages of replacing these by digitally controlled analogue switches are that reliability is increased.

Furthermore panel space may be saved and the complete system can be very much more flexible in operation. In this desk the control unit stores up to 30 complete set ups of the desk routing in addition to the current set up.

Not mentioned in the description of the individual modules was that each source module has a white momentary pushbutton with an adjacent red LED. Destination modules have a similar blue button also with a red LED.

Potential destinations are the group modules, each module being a stereo pair as in normal mixers, and the master module. Potential sources are the input modules and the pairs of tape returns in the group modules. All as in conventional mixers.

In the CM4400 the method of setting patches is extremely simple. First a destination button is pressed with its LED illuminating. The buttons on the desired sources are then pressed with their LEDs illuminating until the complete patch has been determined. This is set when the next desired source button is depressed and the routine continued until all desired patches have been set.

Once a complete patch is set the routing in the desk can be very simply inspected by pressing source or destination buttons. When a source button is pressed the LED on all its destinations are illuminated, and likewise, when a destination button is pressed the LEDs on all its sources are illuminated.

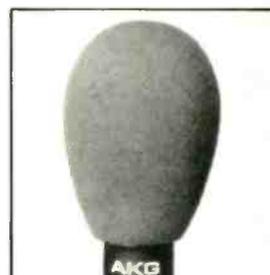
So much for a simple description of the modus operandi. The microprocessor section can store and recall 30 set ups with a battery backed memory which retains information for up to six months in the absence of power.

The control section has a keyboard with keys numbered from zero to nine, five further control keys and a 2-digit, 7-segment LED display. In addition there is a reset button with a LED that illuminates in case of microprocessor or operator error—pressing reset reverts to the power on state.

In case of serious control failure a

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Technical Data:

- Frequency range of amplifier: 5 to 30,000 Hz
- Bass-cut filter: 12 dB/octave at all settings
- Pre-attenuation 20 dB
- Recommended load impedance: ≥ 600 ohms
- Weighted noise level: $0.7 \mu V$ r.m.s. (acc. to IEC 179-A)
- Equivalent noise level: (measured with CK 1 capsule) 15 dB SPL (acc. to IEC 179-A)
- Hum sensitivity: $9 \mu V / 5 \mu T$ at 50 Hz
- Max. sound pressure level for 0.5% THD: 140 dB SPL (from 30 Hz to 20,000 Hz) 150 dB SPL (with 20 dB attenuation)
- Total dynamic range: 125 dB (A-weighted)
- Power requirement: 9 to 52 volts phantom powering acc. to DIN 45 596
- Current consumption: ≤ 1 mA
- Dimensions: 21×150 mm length (0.8 x 5.9 inch)
- Net weight: 135 g (4.8 oz).



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191 The Vale, London W3
Tel. 01-749 2042
Telex 28938

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191 THE VALE, LONDON W3

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REVIEW REVIEW

recessed slide switch provides an override function which bypasses the computer control and connects all sources to the master outputs—thus the desk remains in limited service without its brains.

The zero to nine buttons are used to select patches (memory locations of complete desk setups). A 'Lock' button with a warning LED inhibits determined button pushers from changing stored routing, it being necessary to press this button to make changes. If it is left activated without further action for two minutes the routing is again automatically locked out.

To recall patches the desired patch number is keyed in and 'Recall' depressed. Similarly patches are stored by pressing 'Store'. A further feature is that patches can be inspected without action by pressing 'Interrogate' or alternatively changed 'on the fly' with complete silence.

The final control button provides an in place solo function which inhibits all the other control functions when in action. After only a very short learning time this overall control system was found to be very easy and simple to use and to be far more versatile than conventional systems.

Patchbay

This consists of 40 miniature jackfields which are very well identified and divided into logical groups. So far as the input modules are concerned the line input, output and insert points are available with the groups having the insert point, output and two tape inputs.

Tape inputs and outputs for 24 tracks appear in the patchbay in parallel with the multiways at the rear as do the mix outputs, stereo tape connections etc. For test purposes the oscillator output is always available at the jackfields in addition to its switched capabilities.

Power supply

The rack mount power unit has the minimum of controls with an illuminated on/off rocker switch at the front and a multi-purpose IEC plug/tap changer/20mm fuseholder at the rear.

Whilst this covers the usual European and US line voltages the identification of the setting is none too clear! Within the unit the construction was very tidy with all major components being fitted with push connectors for ease of servicing.

Inputs and outputs

The microphone inputs offered an impedance of 4.4 k Ω balanced with the impedance remaining constant with the gain setting and with the insertion of the 30 dB pad. Common mode rejection was good but varied from channel to channel with typical results being shown in Fig 1.

The attenuation of the pads was precisely 30 dB with the maximum gain to the channel outputs being 70 dB reducing to approximately 33 dB at minimum microphone input gain. At maximum gain the input overload occurred at 12 mV increasing to 650 mV at minimum gain without the pad which increased these figures by 30 dB allowing inputs in excess of +22 dBm. Phantom

powering at a nominal 48 V measured at 45.5 V.

All high level inputs in the mixer including the line inputs, returns, tape inputs, etc. were identical so far as impedance and levels were concerned. The balanced input impedance was 9.7 k Ω with a maximum input capability of +30 dBm. Common mode rejection varied between inputs with typical

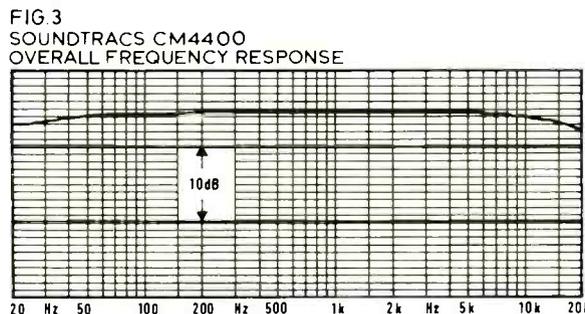
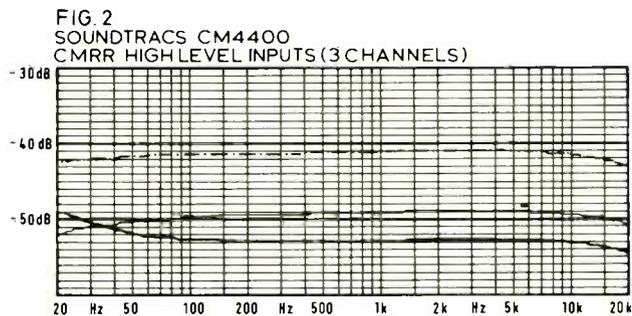
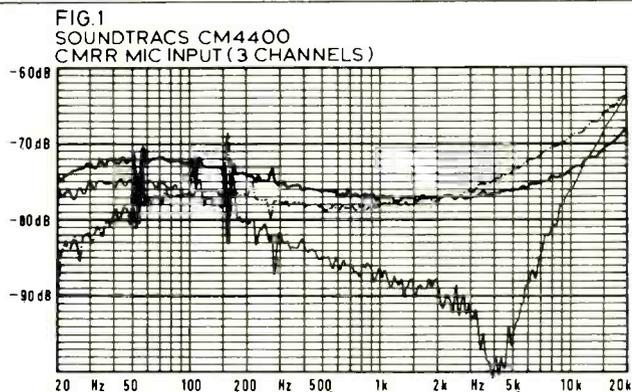
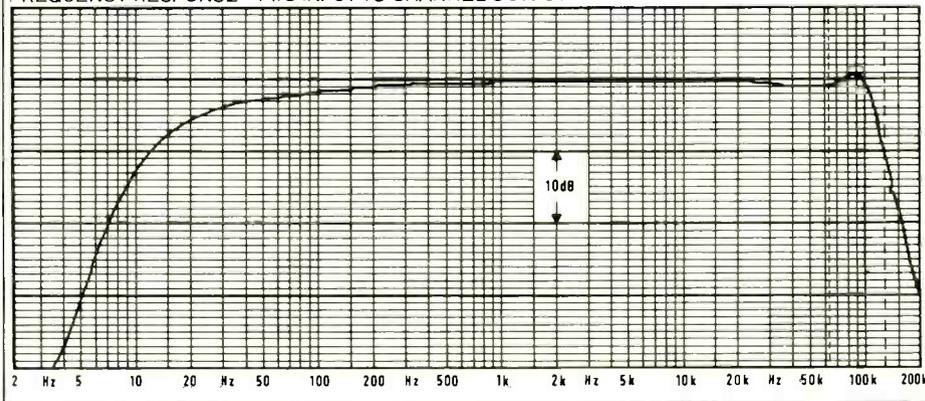


FIG. 4
SOUNDTRACS CM4400
FREQUENCY RESPONSE - MIC INPUT TO CHANNEL OUTPUT





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635A Dynamic Omnidirectional

The 635A is quite simply the most rugged, durable microphone Electro-Voice manufacture. A slow roll-off below 200 Hz (-8 dB at 50 Hz) with a broad rise of several dB from 2,000 - 12,000 Hz results in bright yet natural vocal quality without the low frequency noise pick-up problems that can plague microphones with flat low frequency response.

RE 20 Variable D Dynamic Cardioid

The sound of the RE 20 has made it one of the most coveted, unique microphones in the world, and it is still one of the few true multi-use studio microphones.

TOOLS OF THE TRADE

However, unlike many condenser microphones, the RE 20's dynamic element provides undistorted output at the high sound pressure levels found in up-close vocal and instrument miking (in excess of 160 dB), its Variable-D design frees it of any bass-boosting proximity effect.

RE 50 Shock-mounted Dynamic Omnidirectional

This mike was designed expressly for hand-held newsgathering work. It has the same tailored frequency response and high output level as the famous 635A. The RE 50's rubber shock-mount "mike-within-a-mike" design achieves a degree of shock isolation never before known in the industry. The construction is also highly resistant to damage from mechanical shock.



RE 50

RE 20

635 A

Many Electro-Voice professional product dealers can arrange hands-on trials at no cost to you. For further information please contact your E-V dealer or write to: Shuttlesound Ltd. Unit 15, Osiers Estate, Osiers Road, London SW18 1EJ. Telephone: 01-871 0966 Telex: 27670 Shutso G



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REVIEW REVIEW

FIG. 5
SOUNDTRACS CM4400
FREQUENCY RESPONSE - LINE INPUT TO CHANNEL OUTPUT

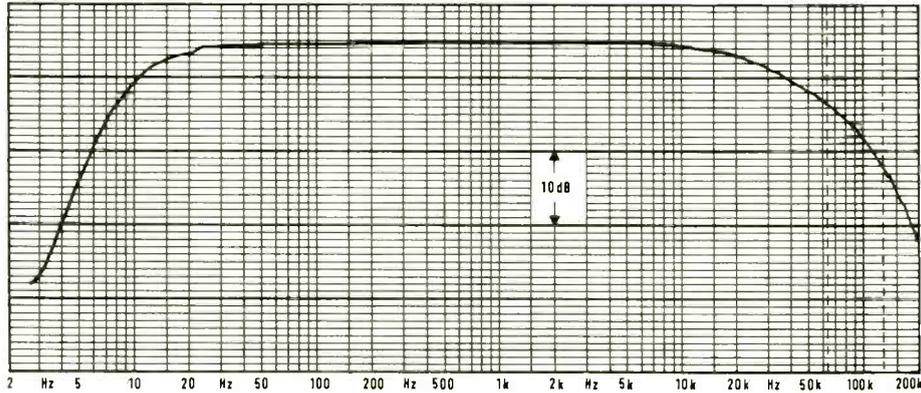


FIG. 6
SOUNDTRACS CM4400
HIGHPASS FILTERS

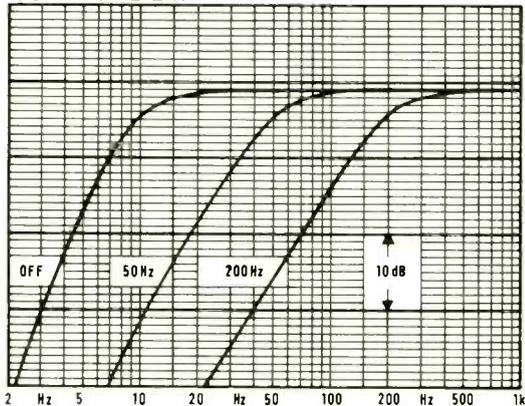


FIG. 7
SOUNDTRACS CM4400
HF EQUALISER

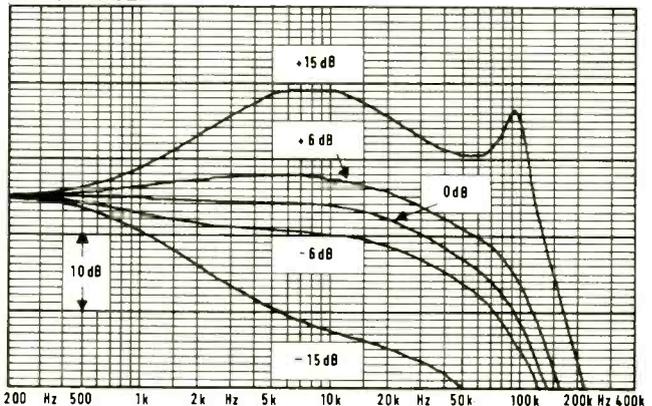
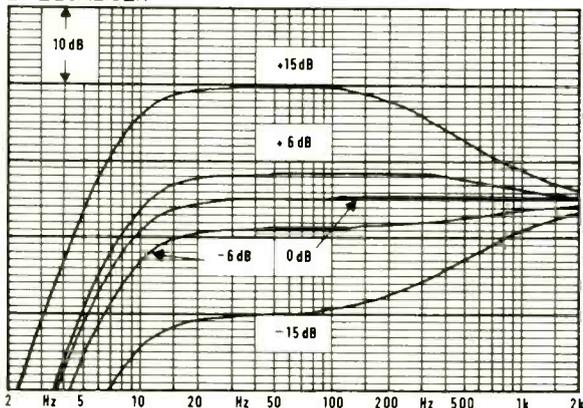


FIG. 8
SOUNDTRACS CM4400
LF EQUALISER



results for three inputs being shown in Fig 2.

In the case of the line input, the only one with variable gain by means of a slightly fiddly screwdriver operated control, the gain to the channel output could be varied from -0.5 dB to $+30$ dB with an input capability of $+1$ dBm at maximum gain increasing with decreasing gain.

The talkback microphone input, which is intended for dynamic microphones, had a gain range up to 44.5 dB with a satisfactory input voltage capability of

33 mV at maximum gain increasing to 330 mV at minimum gain.

All mixer outputs were identical in performance with an unbalanced output configuration having a 50Ω source impedance with a drive capability of $+22$ dBm into high impedances or $+21$ dBm loaded into 600Ω .

Frequency response

A typical overall frequency response of the mixer from a line input, through the input module and a group to the stereo

output is shown in Fig 3 where the limits are $+0$ dB, -2 dB from 20 Hz to 20 kHz reference 1 kHz.

So far as the input modules are concerned the performance of the microphone inputs was as Fig 4 irrespective of gain. A good feature of these inputs is the very rapid roll off at 100 kHz to avoid radio frequency interference problems.

Whilst such problems are less likely with the line inputs, they too are sensibly rolled off, as shown in Fig 5.

Highpass filtering in the input modules is at 12 dB/octave as seen in Fig 6 where the -3 dB point is at 10 Hz with the filters switched out and at 50 Hz or 200 Hz with the filters switched in.

The performance of the high and low frequency equalisers is shown in Figs 7 and 8 to be of the shelving type, the figures showing the maximum ± 15 dB settings and the calibrated ± 6 dB settings, the latter not being particularly accurate but giving a better control law than the calibrations at 3 dB intervals suggest. The equalisers in the group modules are similar except their frequencies are 50 Hz and 10 kHz.

I feel that the low frequency equaliser operates at rather too high a frequency but this may be compensated with the mid low equaliser which has a range as

The Stage System 200 is the finest compact portable sound system available. At Shuttle-sound we believe it is one of the best investments you can make in audio equipment. The Electro-Voice Stage System 200 takes small, portable, high power, state-of-the-art speaker design a bold new step forward.

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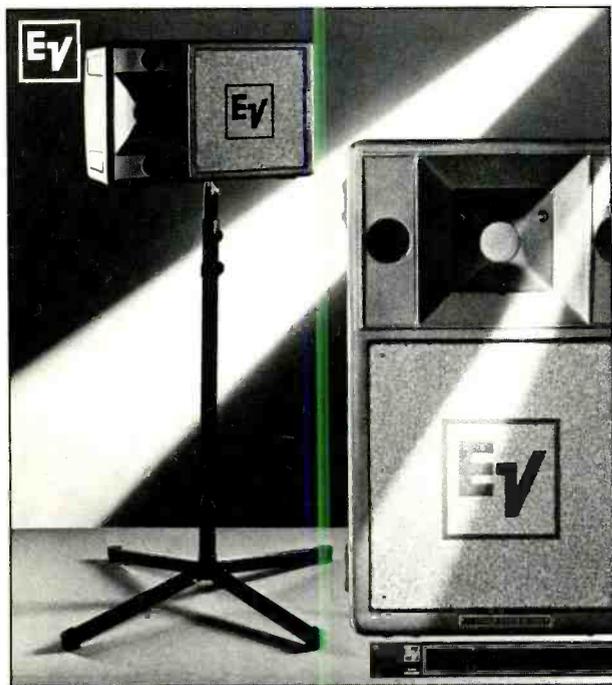
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The Stage System 200 has a unique feature allowing it to be used either with or without an external equaliser. The optional equaliser is a small box of electronics permitting the system to be used at a higher output level with a larger bandwidth giving more bass response, extending -3dB to 50 Hz.

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FIG. 9
SOUNDTRACS CM4400
MID LF EQUALISER

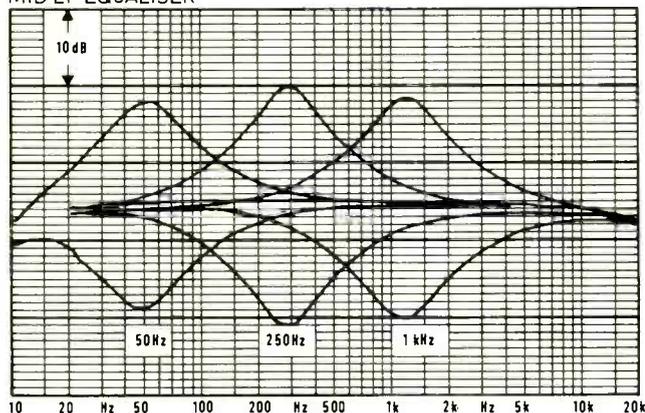


TABLE 1 Mic input noise
Band limited 22 Hz to 22 kHz RMS
A-weighted RMS
CCIR-weighted RMS
CCIR-weighted quasi-peak
CCIR-weighted ARM ref 2 kHz

-126.0 dBm
-128.5 dBm
-119.5 dBm
-115.5 dBm
-126.2 dBm

TABLE 2 Line and equaliser noise

	Line	Equaliser in
Band limited 22 Hz to 22 kHz	Max gain -95.5 dBm	Min gain -79.5 dBm
A-weighted RMS	-96.5 dBm	Min Gain -83.5 dBm
CCIR-weighted RMS	-86.0 dBm	-80.5 dBm
CCIR-weighted quasi-peak	-85.0 dBm	-78.0 dBm
CCIR-weighted ARM ref 2 kHz	-95.0 dBm	-74.0 dBm
		-69.5 dBm
		-84.0 dBm
		-80.0 dBm

FIG. 10
SOUNDTRACS CM4400
MID HF EQUALISER

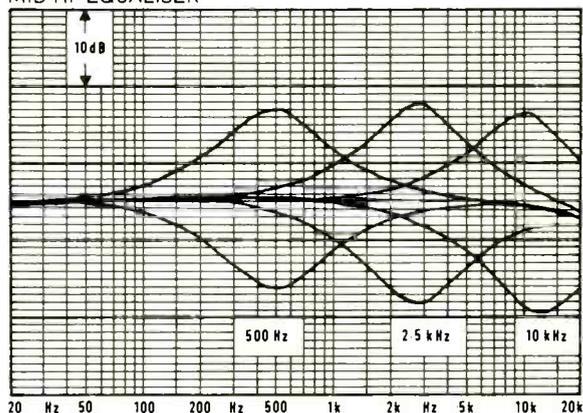
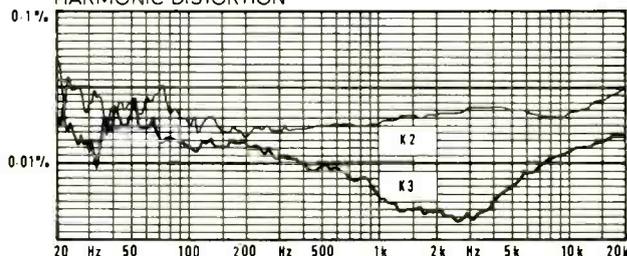


FIG. 11
SOUNDTRACS CM4400
HARMONIC DISTORTION



shown in Fig 9 or the mid high equaliser shown in Fig 10.

Noise

Noise referred to the microphone inputs terminated with 200 Ω was consistent from one channel to another and varied in proportion to the gain setting at the channel output. The results were good and the figures are shown in Table 1.

Measuring noise referred to the line inputs at the input channel output gave an approximately 20 dB variation with a 30 dB variation in gain as shown in Table 2 which also shows the effect of inserting the equalisers in their flat position. In other than flat positions the noise was as might be predicted.

Noise at either the master outputs or the group inputs was -83.5 dBm A-weighted with no input allocated increasing to -78 dBm A-weighted with any combination of four inputs at unit gain and pro rata for further inputs.

Distortion

Both harmonic distortion and intermodulation distortion to the CCIF twin tone method were measured for the line and microphone inputs to the input module output. Measurements were also made at various gains and levels from the inputs, through a group module to the master output.

At any level below a peak equivalent of +10 dBm output, intermodulation distortion at frequencies below 200 kHz

was less than 0.01%—a creditable achievement.

The worst case harmonic distortion measured is shown for the second and third harmonics in Fig 11 for the path through the complete mixer at unity gain and +10 dBm level. At lower levels there was a significant drop in both harmonics.

The application of squarewaves showed a complete lack of ringing or overshoot with the complete mixer path having a rise time of 0.8 μ s and a slew rate of 10 V/ μ s.

Crosstalk

Crosstalk across the channel mutes was 90 dB at 300 Hz rising at 6 dB/octave with the solo button offering an attenuation of 60 dB at 300 Hz also decreasing at 6 dB/octave.

Crosstalk between adjacent input modules was measured as 70 dB at 1 kHz increasing at 6 dB/octave with that across the mic/line switch being about 6 dB worse—a disagreement here with the manufacturer's specification, possibly resulting from the installation of the optional patchbay. It should however be noted that this performance was not very consistent from one channel to another.

Test oscillator and metering

The illuminated meters were properly scaled for VU meters and had the correct

rectifier characteristic. It was however found that the rise and fall times were very slightly on the slow side—not a matter for concern.

The test oscillator offered a maximum output of +18 dBm into 600 Ω or +21 dB, 7V into a high impedance with a flatness better than ± 0.1 dB over its full frequency range from 50 Hz to 10 kHz.

Frequency calibration was rather arbitrary but generally within 10% with the second and third harmonic distortion being 0.025 at 100 Hz, 0.02/<0.01% at 1 kHz and 0.05/0.02% at 10 kHz.

The variable output level control had approximately 1.5 dB steps from +21 dBm down to -10 dBm with the minimum usable output being -33 dBm; perhaps a non-detented output level control would have been better.

Summary

Mechanically the unit was well built without being excessively bulky and as daisy chain ribbon cable connections are used between modules this removes many mechanical problems.

The individual modules were particularly well made with servicing clearly having been a consideration in their design, the same applying to the power unit.

In terms of most performance parameters the complete unit is excellent and there is little adverse comment to be made, certainly nothing serious enough to include in this summary. \square

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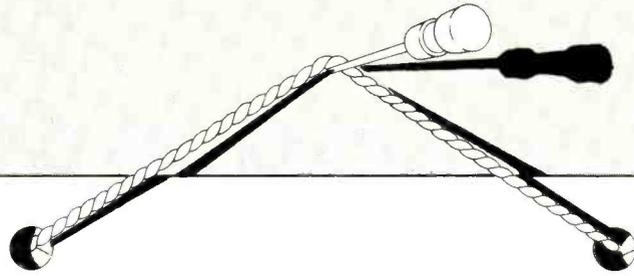


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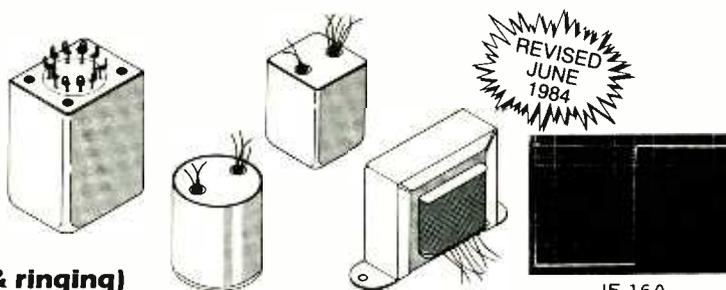
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INPUT TRANSFORMERS AND SPECIAL TYPES

Model	Application	Impedance Ratio Pri-Sec	Turns Ratio Pri-Sec	20 Hz Max. Input Level ¹	Typical THD Below Saturation (%) 20 Hz / 1 kHz	Frequency Response (dB ref. 1 kHz) 20 Hz / 20 kHz	Band-Width ² -3 dB @ (kHz)	20 kHz Phase Response (degrees)	Over-Shoot (%)	Noise Figure (dB)	Magnetic Shield ⁴ (dB)	Number of Faraday ⁵ Shields	Package ⁶	PRICES		
														1-19	100-249	1000

MICROPHONE INPUT

† JE-16-A JE-16-B	Mic in for 990 opamp	150-600	1:2	+8	0.036/0.003	-0.08 / -0.05	200	-8	<1	1.7	-30	1	A=1 B=2	64.21 68.86	42.89 45.99	29.60 31.74
† JE-13K7-A JE-13K7-B	Mic in for 990 or I.C.	150-3750	1:5	+8	0.036/0.003	-0.09 / -0.21	85	-19	<2	2.3	-30	1	A=1 B=2	64.21 68.86	42.89 45.99	29.60 31.74
JE-115K-E	Mic in for I.C. opamp	150-15K	1:10	-6	0.170/0.010	-0.50 / +0.10	115	-5	<7	1.5	-30	1	3	42.03	28.07	21.92

LINE INPUT

JE-11P-9	Line in	15K-15K	1:1	+26	0.025/0.003	-0.03 / -0.30	52	-28	<3		-30	1	1	103.47	69.13	47.69
JE-11P-1	Line in	15K-15K	1:1	+17	0.045/0.003	-0.03 / -0.25	85	-23	<1		-30	1	3	40.05	26.76	20.90
† JE-6110K-B JE-6110K-BB	Line in bridging	36K-2200 (10K-600)	4:1	+24	0.005/0.002	-0.02 / -0.09	125	-12	<1		-30	1	B=1 BB=2	62.86 71.52	42.01 47.79	30.83 32.97
* JE-10KB-C	Line in bridging	30K-1800 (10K-600)	4:1	+19	0.033/0.003	-0.11 / -0.08	160	-9	<2		-30	1	3	41.56	27.76	19.16
JE-11SSP-8M	Line in / repeat coil	600/150-600/150	1:1 split	+22	0.035/0.003	-0.03 / -0.00	120	-9	<3.5		-30	1	4	151.90	101.47	70.01
JE-11SSP-6M	Line in / repeat coil	600/150-600/150	1:1 split	+17	0.035/0.003	-0.25 / -0.00	160	-5	<3		-30	1	5	79.22	52.91	36.51

SPECIAL TYPES

† JE-MB-C	2-way ³ mic split	150-150	1:1	+1	0.050/0.003	-0.16 / -0.13	100	-12	<1		-30	2	3	34.60	23.13	18.06
† JE-MB-D	3-way ³ mic split	150-150-150	1:1:1	+2	0.044/0.003	-0.14 / -0.16	100	-12	<1		-30	3	3	60.09	40.15	31.35
JE-MB-E	4-way ³ mic split	150-150-150-150	1:1:1:1	+10	0.050/0.002	-0.10 / -1.00	40	-18	<1		-30	4	1	96.90	64.73	44.66
JE-DB-E	Direct box for guitar	20K-150	12:1	+19	0.096/0.005	-0.20 / -0.20	80	-18	<1		-30	2	6	43.57	29.11	22.73

1. (dBu) Max input level = 1% THD; dBu = dBv ref. 0.775 V

2. With recommended secondary termination

3. Specifications shown are for max. number of secondaries terminated in 1000 ohm (typical mic preamp)

4. Separate lead supplied for case and for each faraday shield

5. Except as noted, above transformers are cased in 80% nickel mu-metal cans with wire leads.

PACKAGE DIMENSIONS:

W	L	H
1 = 1 1/16" Diam.	1 1/16"	1 1/16"
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6 = 1 1/8" Diam.	1 1/16"	1 1/16"

NICKEL CORE OUTPUT TRANSFORMERS⁶

Model	Construction	Nominal Impedance Ratio Pri-Sec	Turns Ratio Pri-Sec	20 Hz Max. Output Level ⁷ (dBu)	20 Hz Max. Output Level ⁷ across (n) windings	600Ω Load Loss (dB)	DC Resistance per Winding	Typical THD Below Saturation (%) 20 Hz / 1 kHz	Frequency Response (dB ref. 1 kHz) 20 Hz / 20 kHz	Band-Width ² -3 dB @ (kHz)	20 kHz Phase Response (degrees)	Over-Shoot ⁸ (%)	Package ⁹	PRICES		
														1-19	100-249	1000
* JE-123-BMCF	Quadfilar 80% nickel	600-600 150-600	1:1 1:2	+28	2	-1.1	20Ω	0.002/0.002	-0.02 / -0.02	>450 160	-2.1 -4.1	<1	7	87.41	44.17	30.47
* JE-123-DMCF	Quadfilar 80% nickel	600-600 150-600	1:1 1:2	+21	2	-1.0	19Ω	0.004/0.002	-0.02 / -0.00	>450 230	-1.2 -2.5	<1	8	50.71	33.88	23.38
JE-123-BLCF	Quadfilar	600-600 150-600	1:1 1:2	+32	2	-1.1	20Ω	0.041/0.003	-0.02 / -0.01	>450 170	-1.9 -4.0	<1	7	61.30	35.79	24.70
* JE-123-DLCF	Quadfilar	600-600 150-600	1:1 1:2	+27	2	-1.0	19Ω	0.065/0.003	-0.02 / -0.01	>450 245	-1.2 -2.5	<1	8	39.61	26.45	19.42
JE-123-SLCF	Quadfilar	600-600 150-600	1:1 1:2	+23.5	2	-1.1	20Ω	0.088/0.003	-0.03 / -0.01	>450 245	-1.2 -2.8	<1	9	33.48	22.35	15.43
JE-112-LCF	Quadfilar	600-600 150-600	1:1 1:2	+20.4	2	-1.6	29Ω	0.114/0.003	-0.03 / -0.01	>450 205	-1.2 -3.2	<1	10	25.48	17.01	12.49
JE-123-ALCF	Quadfilar	66.7-600	1:3	+26.5	3	-1.3	8Ω	0.125/0.003	-0.04 / +0.06	190	-4.6	<6	8	42.14	28.15	19.42
JE-115-LCF	Bifilar w/ split pri.	600-600 150-600	1:1 1:2	+30	1 (sec)	-1.7	63Ω	0.058/0.002	-0.02 / +0.01 -0.02 / -0.05	>10MHz 155	+1.1 -4.1	<1	8	42.14	28.15	19.42

6. Multifilar construction has no faraday shield; cannot be used as input transformer. All specifications are for 0Ω source, 600Ω load.

7. Max output level = 1% THD; dBu = dBv ref. 0.775 V

8. Source amplifier -3 dB @ 100 kHz

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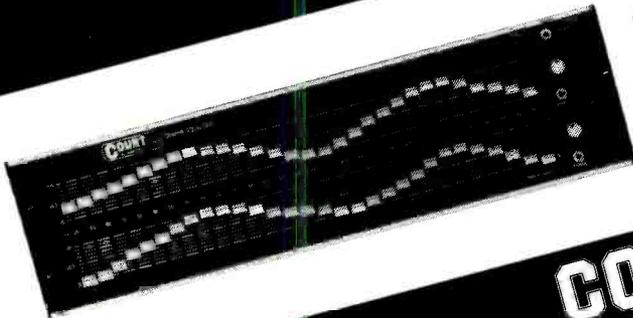
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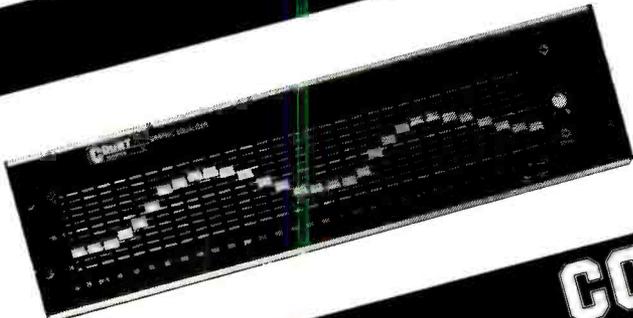
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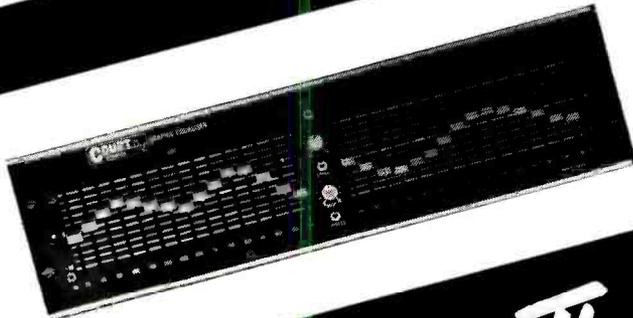
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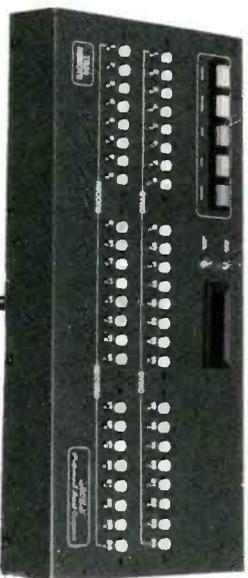
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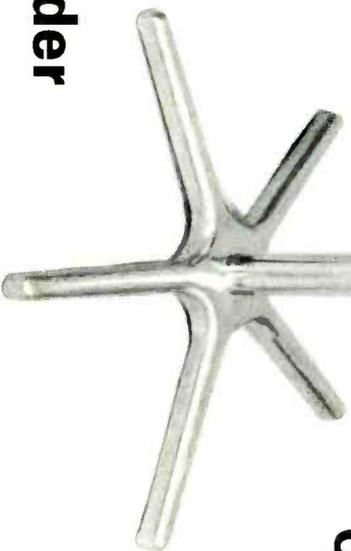


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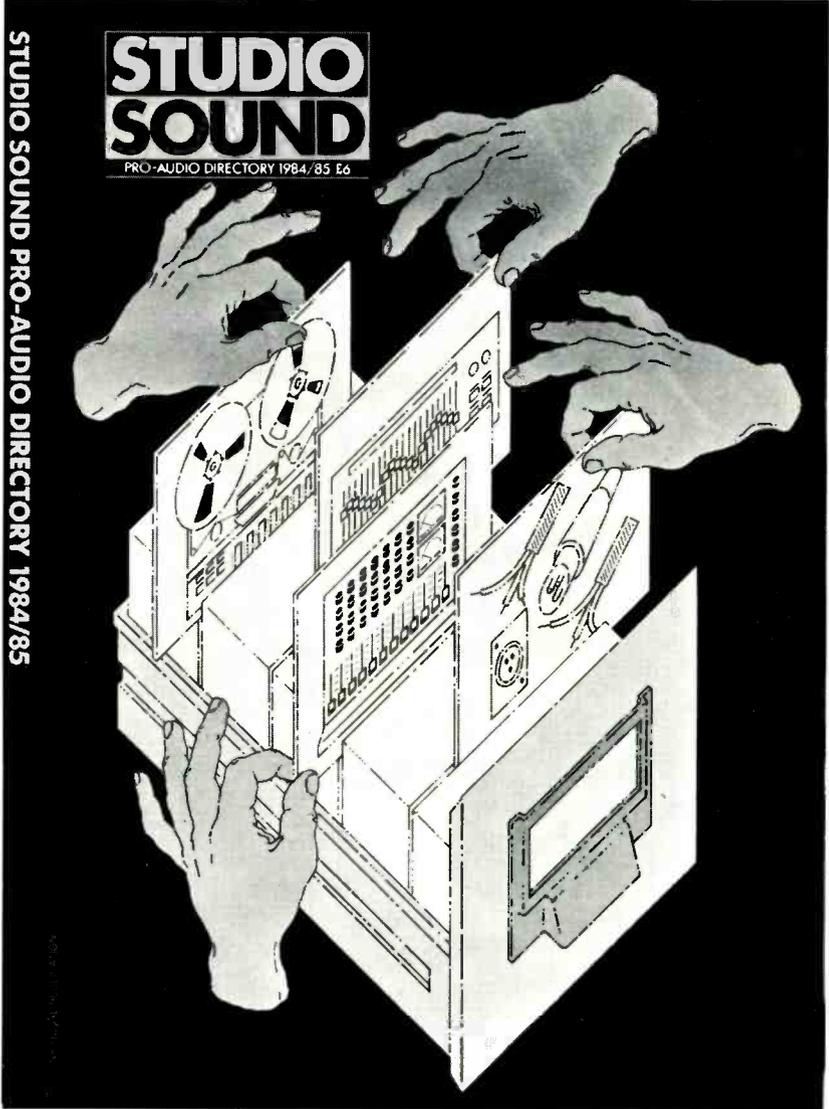
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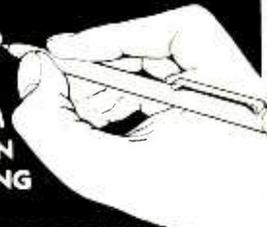
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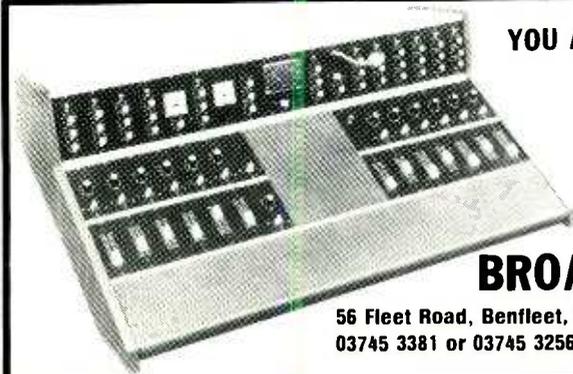
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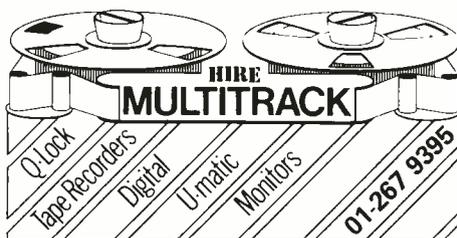
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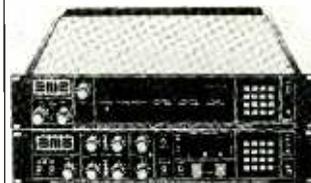
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"GOING TO PRESS" SEPTEMBER 1984

TAPE MACHINES

Tascam 85-16B New £7,995. Soundcraft SCM 762-24B with remote New £11,950. Fostex B16 New £POA. Tascam 58 New £2,450. Tascam 58 OB New £2,750. Tascam 48 OB balanced + 4db operation SMPTE compatible New £2,200. Soundcraft series 20 1/4" & 1/2" £POA. Tascam 38 New £1,495. Fostex A-8 & A-8 LR New £POA. Fostex A-8 s/h £895. Tascam 44 New (1st issue) inc DX44 noise reduction £995. Tascam 52 SMPTE switchable IEC/NAB £1,595. Teac 80-8 with DX8 £1,400. Tascam 32 £650. Teac A3440 2 years old £495. Revox PR99 Brand New £925. Revox PR-II £1,050. Revox B77 MKII special offer New £645. Revox PR99/II 18 months old immac £750. Teac X-1000M with dbx New £595.

MIXING CONSOLES

MCI 5000 32/34 Vu fully automated extra returns superb condition £25,000. Tascam Model 15B 24/8/16 New £3,750. TAC 16/8/2 as new £2,300. Dynamix 3000 series New £POA. Soundcraft 200 series 8-4-8 perfect £795. Soundtracs 16/8/16 New £POA. AHB System 8 1616 Ex-showroom £1,375. Special AHB System 8 164 £795. Last remaining AHB 16/4/2 £495. Studiomaster 16/8/2 Mint £975. Tascam Model 50 £1,495. Soundcraft Series 200.400.800, £POA. Tascam M30 £595. RAM RM10, RM16 now in stock from £550. Pro-Mark MX-3 £395.

STUDIO PACKAGES (fully inclusive of wiring loom)

Tascam 85-16B + Tascam Model 15B Brand New £11,700. Fostex B16 with AHB 1616 £4,135. Fostex B16 with AHB 2416 £4,500. Fostex B16 with Studiomaster 16.2 £3,975. Fostex B16 with Soundtracs 16.8:16 £4,895. Tascam 58 £3,750. Tascam 38 + AHB system 8 168 £2,695. Fostex A-8 + remote + RAM RM10 mixer £1,525. Tascam 48 OB + Tascam M50 £3,500.

REVERBERATION

AMS RMX-16 £4,680. Ursa-Major Stargate £1,995. MXR 01 £1,690. Yamaha R-1000 £430. EMT 240 Gold Foil remote £2,750. Klark Teknik DN50 £275. GBS III £195. Fostex 3180 £294. Tascam RS20B £295.

EQUALISATION

Formula Sound SE1 Room Eq £395. Audio & Design E900RS £295. Tascam PE40 £275. Ibanez GE3101 £195. Ibanez GE1502 £195.

TIME PROCESSORS

AMS DMX 1580S with 2 harm, D.G. 2 x 1.6 sec, L.E.S. from stock £5,320.00. Korg SDD 3000 £550. Bel BD80 from £600. Roland SDE 3000 £595. Ibanez DM2000 £345. Ibanez DM1100 £295. Ibanez DM500 £195. Ibanez HD 1000 (Harmoniser) £286. Boss DE 200 £245. Yamaha D1500 £436. Klark Teknik DN34 £295. Roland SDE-1000 £310. KORG SDD-1000 £295.

DYNAMIC CONTROL

Audio & Design Ex-press limiter £395. Drawmer DL221 Comp Lim £325. Drawmer DS201 Dual Gate £275. Drawmer DL231 Comp Lim Exp £450. Drawmer 1960 Valve Limiter £800. Fostex 3070 Comp Lim Exp Gate £206. Tascam GA4D. Quad Noise Gate (New Product) £275. Tascam DL20 Comp Lim (New Product) £250.

AMPLIFIERS

Arcron, Yamaha from stock £POA. HIT Northern Distributor full range from stock £P.O.A. Quad 303/405 Best Prices. Fostex 600, 300W + 300W £375. Special Purchase of Hill Amplifiers: DX100 - 100 W Mono £115. DX 140 2 x 85W £195. DX400 2 x 185W £350. DX700 2 x 300W £450. Studiomaster Mosfet 1000 £499. Mosfet 500 £395. Quad 405 SH £185.

MONITORS

JBL 4435 £2,395. JBL 4430 £1,895. JBL 4430 Ex-demo £1,695. JBL 4411 £795. JBL 4312 £650. JBL 4313 (L96) £525. JBL 4401 £295. JBL L15 £225. JBL J216 £95. Tannoy Super Reds X1000 £1,395. Tannoy SRM 15X £995. Tannoy SRM 12X £650. Tannoy Little Reds SRM 12B £550. Tannoy SRM 10B £495. Tannoy Broadcast BM.8 £315. Tannoy Kits £POA. Tannoy "Sync-source" Retro kit's £POA. Auratones £63.

HI-SPEED COPIERS

New Tascam T22640 Masters & Slaves now on demo, approximate price £700 Each.

MUSICAL INSTRUMENTS

Drum Computers: AHB "Impulse One" EMU Drumulator, 64 song £850. Hammond DPM 48 £595. Keyboards: Yamaha DX7 £1,100. Yamaha PF15 £795. Roland and Korg Keyboards £POA. New KORG digital Drum machines in stock £199. PLUS all the latest MIDI gear on demo/working in conjunction with the BBC-B Personal Computer - amazing £POA.

MICROPHONES

Neumann New & Second Hand £POA. PZM M.B. Stereo boundary mics, amazing value at £195. AKG, Shure, Beyer, EDC - Phone for brochures and best prices. Large Beyer type Boom Stands quantities from £21. S.O.T.A. Passive D.I. Boxes, £19.95. AKG C414EB, P48 £350.

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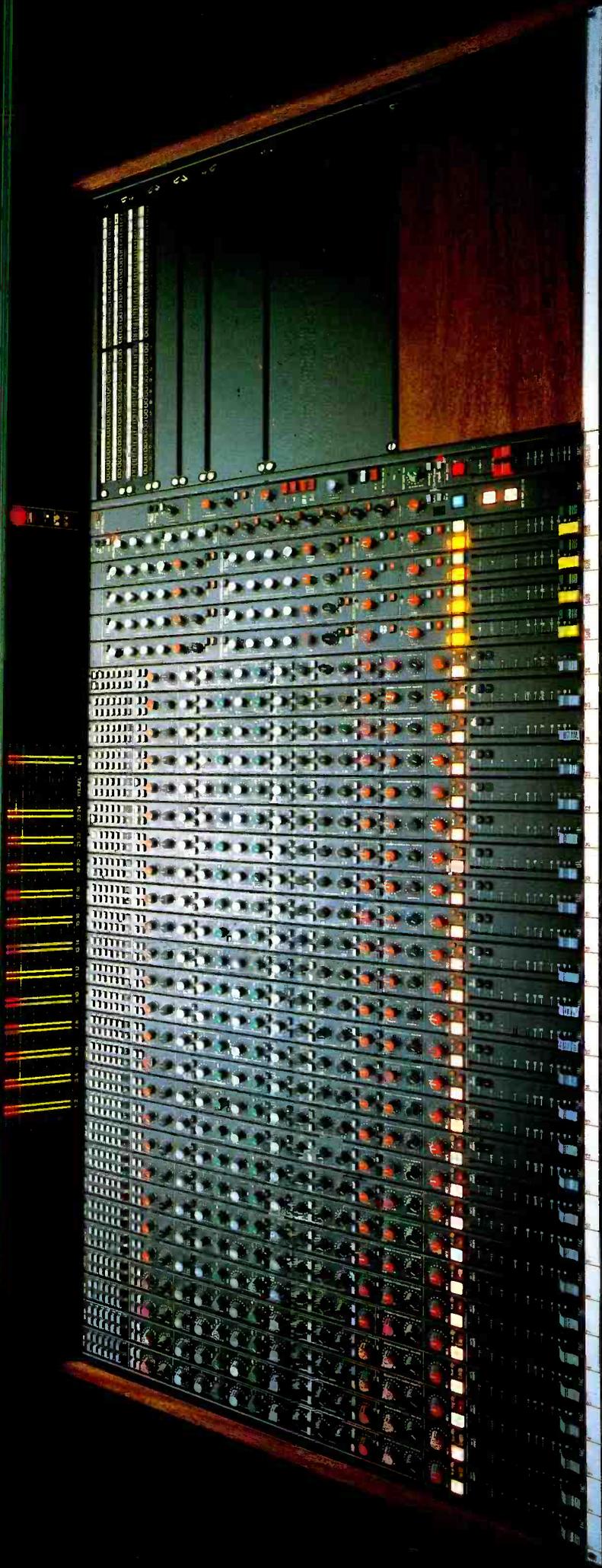
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INDEX TO ADVERTISERS

Aces (UK)	102
APRS	6
Advanced Music Systems	12
AKG	89
Allen & Heath/Brenell	35
Amek Ltd	51, IBC
Ampex (UK)	43
Aphex Systems Ltd	65
Applied Microsystems Ltd	103
Audio & Design (Recording) Ltd	12, 16, 98
Audio Kinetics	39
Audio Ltd	20
Audio Service Co.	24, 110
B&W Loudspeakers	103
Cable Technology	50
Capitol Magnetic Products	49
CBS Fender	26, 27
Connectronics	98
Don Larking Audio	68, 69
Eardley Electronics	77
EMT-Franz	6
Feldon Audio	97
Future Film Developments Ltd	20, 91
FWO Bauch Ltd	23, 25, OBC
Hardware House	10
Harrison	OBC
Harrison Information Technology	96
HHB Hire & Sales	4, 33
Hill Audio Ltd	57
ITA	15, 17, 19, 21
Industrial Acoustics Co Ltd	8
J.B.L.	83
Jensen Transformers	100
John Hornby Skewes & Co. Ltd	24
Kemble/Yamaha	18
Klark Teknik Research Ltd	61
Leeholme Audio Services	98
Michael Stevens & Partners	95
Mosses & Mitchell	91
Music Labs Hire Ltd	29
Neumann	23
Neve	59
Optex	24
Otari	31, 78, 79
Pangbourne Musical Distributor	8
Peter Struven	28
Point Promotions	20
Quad Eight	71
Rebis Audio	14
SRT	99
Scenic Sounds	73, 87
Schalltechnik Dr Schoeps	85
Shuttlesound	91, 93
Simmons Electronics	93
Solid State Logic	44, 45
Solid State Micro for Music	95
Sony Broadcast Ltd	41, 67
Soundcraft Electronics Ltd	IFC, 47
Soundout Laboratories	75
Sowter Ltd, E.A.	29
Studer	25
Studio Spares	22
Surrey Electronics	48, 66
Syco Systems Ltd	52, 53
Technical Projects	81
Theatre Projects Services Ltd	101
Tickle Them Ivories	29
TOA Electric Co Ltd	16
Trad Sales & Services	10
Trident Audio Developments Ltd	63
Turnkey	7, 9, 11, 13

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